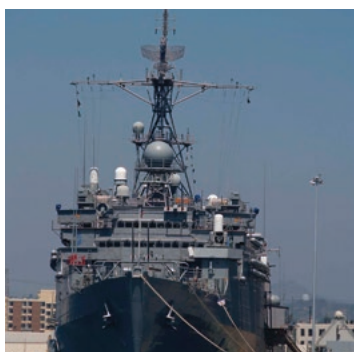




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Republic/Manatrol

Hydraulic and Pneumatic Control Valves

Catalog MSG14-3000/US

April 2019



ENGINEERING YOUR SUCCESS.

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SAFETY GUIDE

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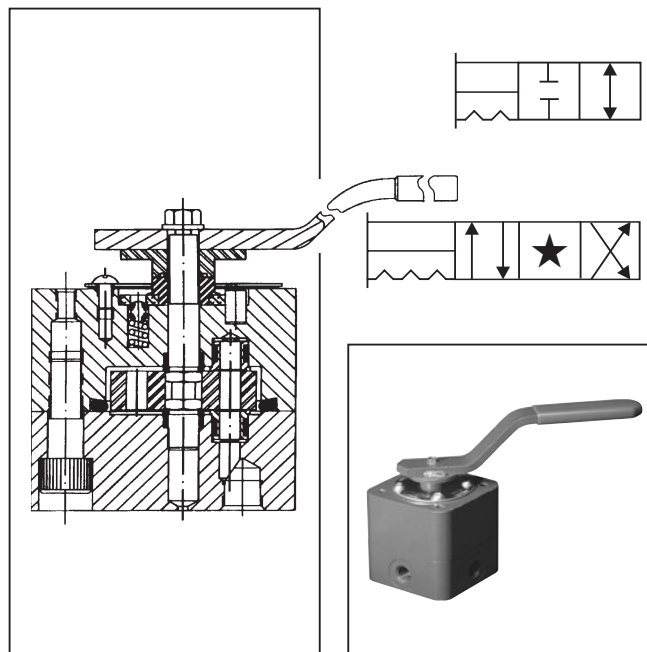
A

General Description

Series 8000E valves are 2, 3 and 4-way manual selector valves with near zero leakage characteristics and are rated to 207 Bar (3000 PSI) for liquids and 138 Bar (2000 PSI) for air. The valve design requires low actuation torque and can be used in applications where loads must be held for long periods and under difficult conditions.

Features

- Shear-type positive seal
- Zero leakage (1 drop per min. per pressure port)
- High contamination tolerance
- Long life due to wiping action of seals and disk
- Low turning torque
- Panel mounting is standard



Specifications

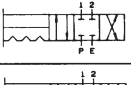
Service Applications	Lubricated air, hydraulic oil, and water. For case pressure or exhaust port pressure applications above 17.3 Bar (250 PSI), consult factory.	Material	Body & Cap: Steel Disk: Stainless steel type 440 Shaft: Stainless steel type 416 Seals: Stainless steel type 440 Spring Seals: Stainless steel O-rings: Synthetic rubber compatible with media Back-up rings: PTFE Handle: Steel Finish: Paint
Maximum Operating Pressure	Working: Liquids - 207 Bar (3000 PSI) Air - 138 Bar (2000 PSI) Proof: Liquids - 310.5 Bar (4500 PSI) Air - 207 Bar (3000 PSI) Burst: 517.5 Bar (7500 PSI)	Operating Temperature	-40°C to +121°C (-40°F to +250°F) Higher on special order
Porting	Bottom or side NPT: Pipe threads Sizes 1/4", 1/2" & 1" IST: Internal straight threads per AND10050 Sizes: 6, 10, & 16		Note: Steel bodies and caps for water or air service are electroless nickel plated. Water service valves are equipped with grease fittings and require periodic lubrication with a waterproof grease.
Mounting	Subplate - Sizes 6, 10 & 16		

Valve Size				Weight Lbs.	CV Factor P. to A. or P. to B.	Flow Passage Diameter	Handle Pull – Lbs.			
Subplate	SAE	Tube	Pipe				8000E		R8000E	
				Steel	8000E	8000E	Air	Oil	Air	Oil
Size 6	#6	6	1/4	5-1/2	1.0	.250 In.	10	9	15	14
Size 10	#10	10	1/2	10	2.8	.437 In.	15	13	21	18
Size 16	#16	16	1	22	8.5	.750 In.	18	15	30	25

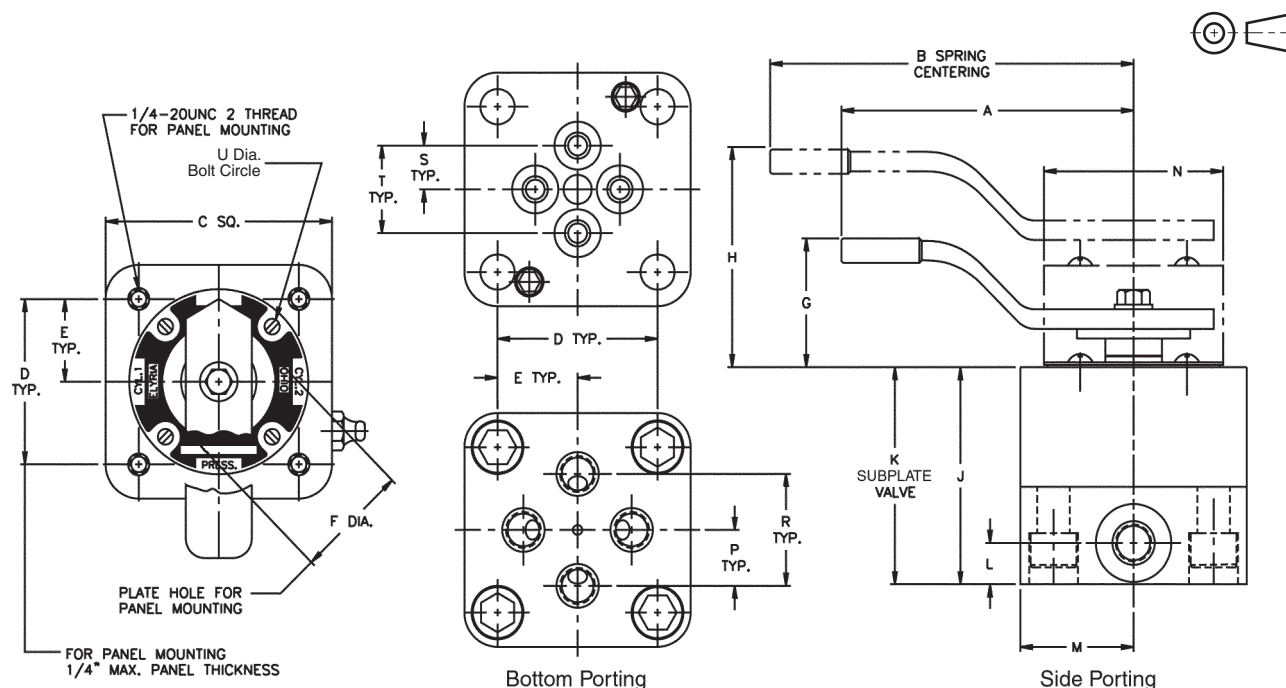
WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

A1_Cat3000.indd, ddp, 04/19

Ordering Information

80	5	1	E	-	1/4	H	S	2	
Prefix for Special Feature	3000 PSI Series	Flow Pattern	Type of Porting	Design Series	Size	Service Media	Materials	O-Ring Code	Suffix Options
See Option Page for Complete List	4 4-Way Closed Center  5 4-Way Tandem Center 	1 Side Ported 2 Bottom Ported 3 Subplate Mounted			1/4 NPT 1/2 NPT 6 IST 10 IST 16 IST 6 Subplate 10 Subplate 16 Subplate	H Hydraulic Oil W Water	S Steel	2 Nitrile 28 Fluorocarbon Others Available Per. Request	See Option Page for Complete List

Dimensions



Valve Size				All Dimensions are in Inches																	Subplate Mounted		
Sub-Plate	SAE	Tube	Pipe	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	M't'g. Bolt	Torq.
Size 6	#6	6	1/4	6	8	3	2 ¹ / ₈	1 ¹ / ₁₆	1	2 ¹ / ₈	2 ²¹ / ₃₂	2 ²⁷ / ₃₂	2 ²¹ / ₆₄	¹⁷ / ₃₂	1 ¹ / ₂	2 ³ / ₈	²³ / ₃₂	1 ⁷ / ₁₆	⁹ / ₁₆	1 ¹ / ₈	2	7/16 - 20NF 2 x 2 1/2 Lg.	700 In. – Lbs.
Size 10	#10	10	1/2	7	10	3 ¹ / ₂	2 ¹ / ₂	1 ¹ / ₄	1	2 ³ / ₈	3 ⁷ / ₆₄	3 ³⁷ / ₆₄	2 ⁵⁵ / ₆₄	⁴⁹ / ₆₄	1 ³ / ₄	2 ¹⁵ / ₁₆	³¹ / ₃₂	1 ¹⁵ / ₁₆	¹³ / ₁₆	1 ⁵ / ₈	2 ¹ / ₂	7/16 - 20NF 2 x 3 Lg.	700 In. – Lbs.
Size 16	#16	16	1	10	12	4 ¹ / ₂	3 ³ / ₁₆	1 ¹⁹ / ₃₂	1 ³ / ₈	2 ¹⁵ / ₁₆	3 ³ / ₈	4 ²³ / ₃₂	3 ⁴⁵ / ₆₄	1	2 ¹ / ₄	3 ¹¹ / ₁₆	1 ³ / ₈	2 ³ / ₄	1 ¹¹ / ₆₄	2 ¹¹ / ₃₂	3 ³ / ₁₆	1/2 - 20NF 2 x 4 Lg.	1,370 In. – Lbs.

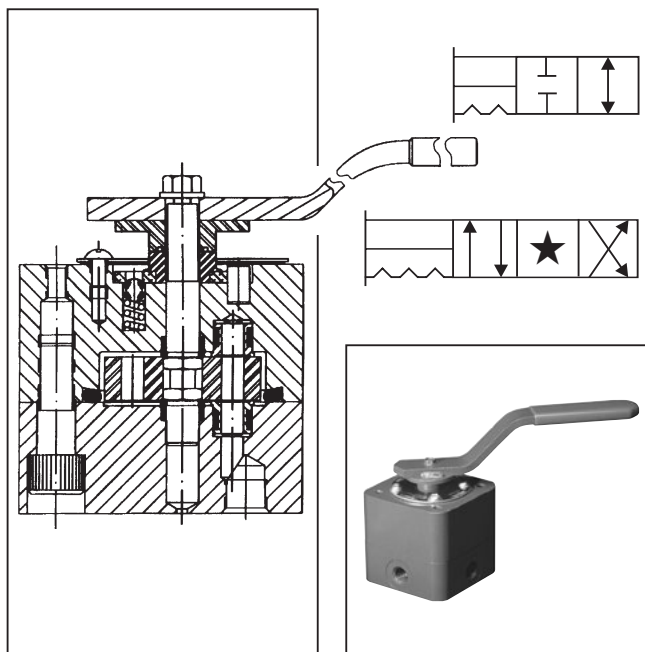
A

General Description

Series 8100E valves are 2, 3 and 4-way manual selector valves with near zero leakage characteristics and are rated to 414 Bar (6000 PSI) for liquids and 276 Bar (4000 PSI) for air. The valve design requires low actuation torque and can be used in applications where loads must be held for long periods and under difficult conditions.

Features

- Shear-type positive seal
- Zero leakage (1 drop per min. per pressure port)
- High contamination tolerance
- Long life due to wiping action of seals and disk
- Low turning torque
- Panel mounting is standard



Specifications

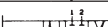
Service Applications	Lubricated air, hydraulic oil, and water. For case pressure or exhaust port pressure applications above 17.3 Bar (250 PSI), consult factory.	Material	Body & Cap: Steel Disk: Stainless steel type 440 Shaft: Stainless steel type 416 Seals: Stainless steel type 440 Spring Seals: Stainless steel O-rings: Synthetic rubber compatible with media Back-up rings: PTFE Handle: Steel Finish: Paint
Maximum Operating Pressure	Working: Liquids - 414 Bar (6000 PSI) Air - 276 Bar (4000 PSI) Proof: Liquids - 621 Bar (9000 PSI) Air - 621 Bar (9000 PSI) Burst: 1035 Bar (15,000 PSI)	Operating Temperature	-40°C to +121°C (-40°F to +250°F) Higher on special order
Porting	Bottom or side NPT: Pipe threads Sizes 1/4", 1/2" & 1" IST: Internal straight threads per AND10050 Sizes: 6, 10, & 16		Note: Steel bodies and caps for water or air service are electroless nickel plated. Water service valves are equipped with grease fittings and require periodic lubrication with a waterproof grease.
Mounting	Subplate - Size 6		

Valve Size				Weight Lbs.	CV Factor P. to A. or P. to B.	Flow Passage Diameter	Handle Pull – Lbs.			
							8100E		R8100E	
Subplate	SAE	Tube	Pipe	Steel	8100E	8100E	Air	Oil	Air	Oil
Size 6	#6	6	1/4	5-1/2	1.0	.250 In.	18	15	17	16

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

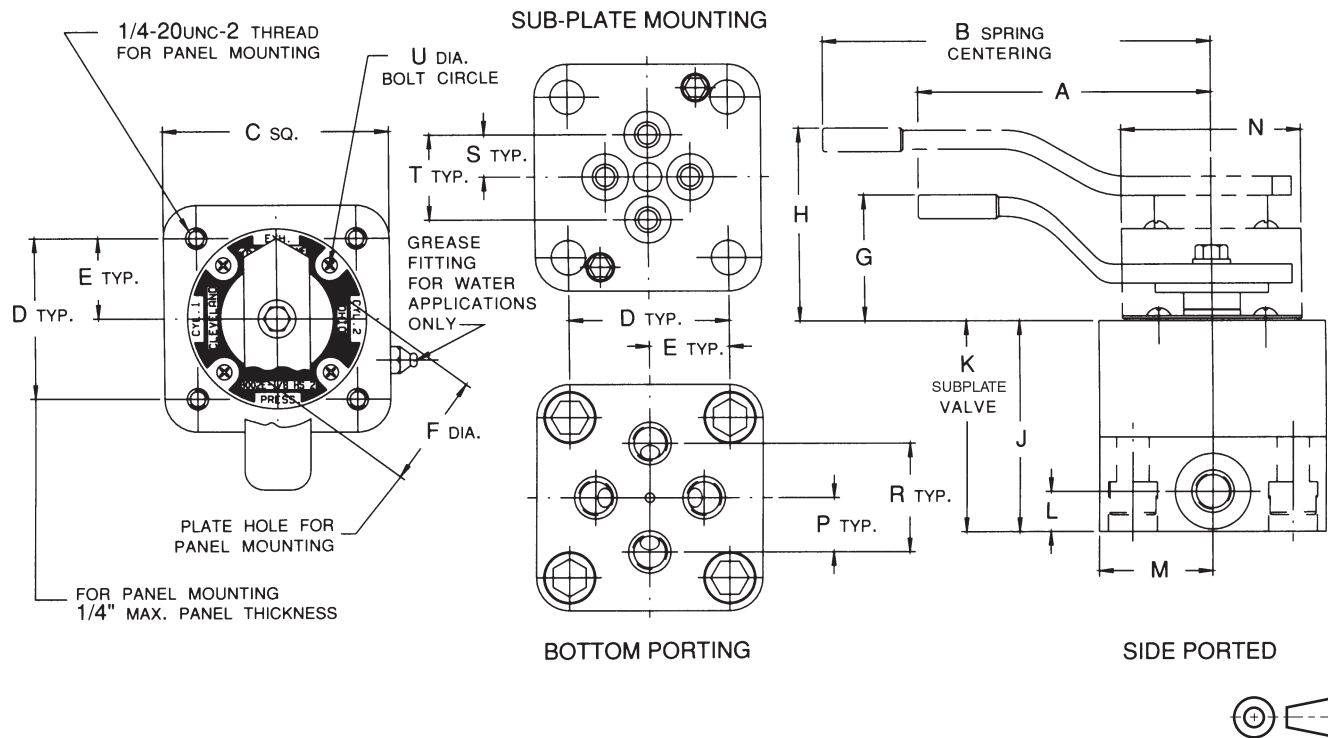
A1_Cat3000.indd, ddp, 04/19

Ordering Information

81		5	1	E - 1/4		H	S	2	
Prefix for Special Feature	6000 PSI Series	Flow Pattern	Type of Porting	Design Series	Size	Service Media	Materials	O-Ring Code	Suffix Options
See Option Page for Complete List	4 4-Way Closed Center		1 Side Ported 2 Bottom Ported 3 Subplate Mounted		1/4 NPT 3/8 NPT 6 Subplate	H Hydraulic Oil W Water	S Steel	2 Nitrile 28 Fluorocarbon	See Option Page for Complete List



Dimensions



Valve Size				All Dimensions are in Inches																	Subplate Mounted		
Sub-Plate	SAE	Tube	Pipe	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	Mt'g. Bolt	Torq.
Size 6	#6	6	1/4	6	8	3	2 ¹ / ₈	1 ¹ / ₁₆	1	2 ¹ / ₈	2 ²¹ / ₃₂	2 ²⁷ / ₃₂	2 ²¹ / ₆₄	¹⁷ / ₃₂	1 ¹ / ₂	2 ³ / ₈	²³ / ₃₂	1 ⁷ / ₁₆	⁹ / ₁₆	1 ¹ / ₈	2	7/16 - 20NF 2 x 2 ¹ / ₂ Lg.	865 In. – Lbs.



A

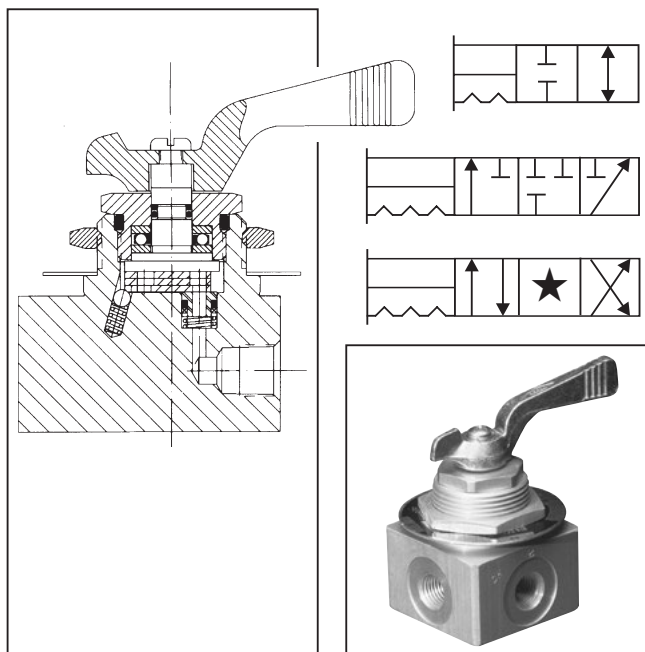
General Description

Series 8400E valves are 2, 3 and 4 way miniature selector valves with near zero leakage characteristics and are rated to 207 Bar (3000 PSI) for liquids and 138 Bar (2000 PSI) for air. The valve design requires low actuation torque and can be used for handling small amounts of fluid at high pressure and when space is at a premium.

Features

- Shear-type positive seal
- Zero leakage (1 drop per min. per pressure port)
- High contamination tolerance
- Long life due to wiping action of seals and disk
- Low turning torque
- Panel mounting is standard

Specifications



Service Applications	Lubricated air, hydraulic oil, and water. For case pressure or exhaust port pressure applications above 17.3 Bar (250 PSI), consult factory.	Material	Body & Cap: Steel Disk: Stainless steel type 440 Shaft: Stainless steel type 303 Seals: Stainless steel type 440 O-rings: Synthetic rubber compatible with media Back-up rings: PTFE Handle: Steel, aluminum & plastic Finish: Paint or anodize Stop pin: Steel Note: Steel bodies and caps for water or air service are electroless nickel plated. Water service valves are equipped with grease fittings and require periodic lubrication with a waterproof grease.
Maximum Operating Pressure	Working: Liquids - 207 Bar (3000 PSI) Air - 138 Bar (2000 PSI) Proof: Liquids - 310.5 Bar (4500 PSI) Air - 207 Bar (3000 PSI) Burst: 517.5 Bar (7500 PSI)	Operating Temperature	-40°C to +121°C (-40°F to +250°F) Higher on special order
Porting	NPT: Pipe threads, bottom or side Sizes 1/8" & 1/4" IST: Internal straight threads per AND10050, side only Sizes 4 & 6 SAE: Straight threads, side only Sizes #4 & #6		
Mounting	Subplate - Size 6		

Valve Size				Weight Lbs.		CV Factor P. to A. or P. to B.	Flow Passage Diameter	Handle Pull – Lbs.			
								8400E		R8400E	
Subplate	SAE	Tube	Pipe	Steel	Alum.	8400E	8400E	Air	Oil	Air	Oil
Size 6	#4	4	1/8	1.8	3/4	.26	.125 In.	10	12	8	8
	#6	6	1/4	1.8	3/4	.29	.125 In.	10	12	8	8

D03 Subplate Mounted with Standard Port Connections				
Part #	Port #1	Port #2	Port #3	Port #4
8413E	Exhaust	Pressure	–	–
8423E	Cylinder	Pressure	Cylinder	–
8443E	Pressure	Cylinder	Exhaust	Cylinder
8453E	Pressure	Cylinder	Exhaust	Cylinder
8473E*	Pressure	Cylinder	Exhaust	Cylinder

Port Connections					Port Connections				
Part #	Port #1	Port #2	Port #3	Port #4	Part #	Port #1	Port #2	Port #3	Port #4
8411E	Pressure	Exhaust	–	–	8451E	Exhaust	Cylinder	Pressure	Cylinder
8412E					8452E				
8421E	Pressure	Cylinder	Exhaust	–	8471E*	Exhaust	Cylinder	Pressure	Cylinder
8422E					8472E*				
8441E	Exhaust	Cylinder	Pressure	Cylinder	8481E	Exhaust	Cylinder	Pressure	Cylinder
8442E					8482E				

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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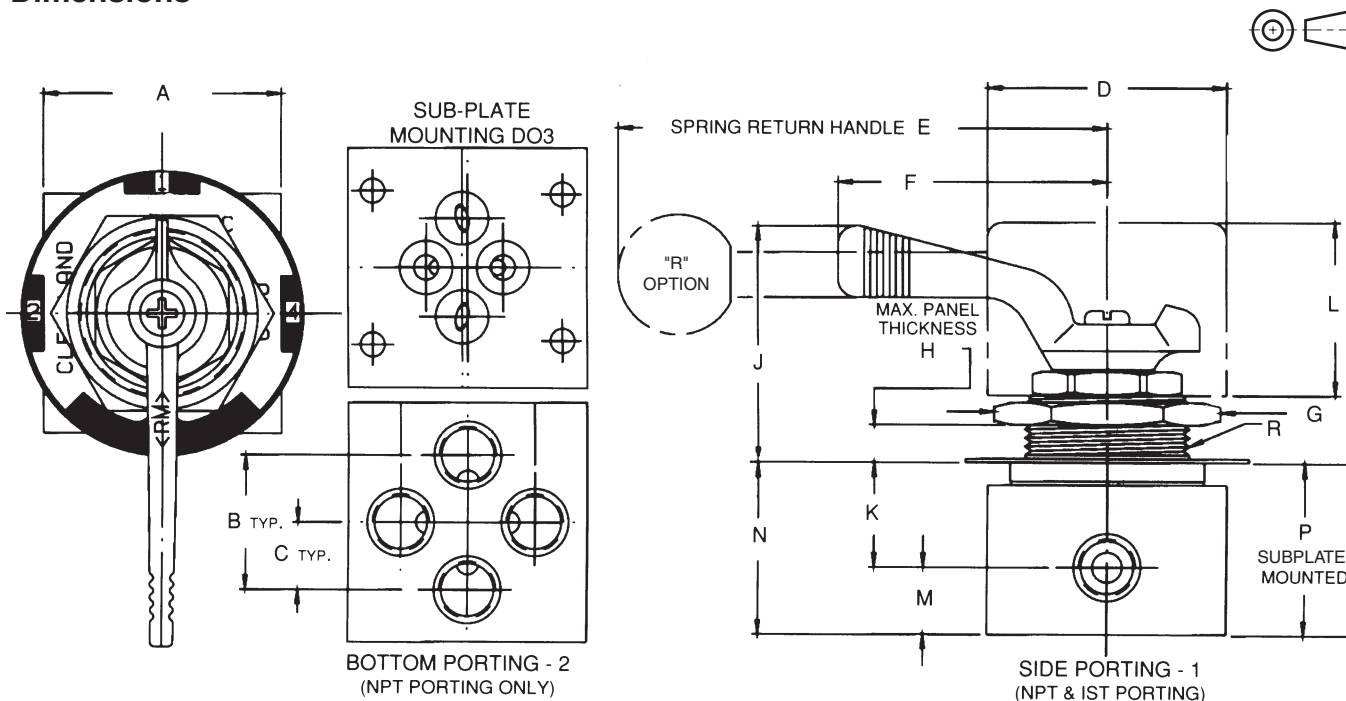
Ordering Information

84	1	1	E	- 1/8	D	2	P		
Prefix for Special Feature	Mini Lo-Torq Series	Flow Pattern	Type of Porting	Design Series	Size	Materials	O-Ring Code	Panel Mounting	Suffix Options
See Option Page for Complete List	1 2-Way Shut-Off		1 Side Ported		1/8 NPT	D Aluminum Alloy	2 Nitrile		See Option Page for Complete List
	2 3-Way		2 Bottom Ported		1/4 NPT		28 Fluorocarbon		
	4 4-Way Closed Center		3 Subplate Mounted		4				
	5 4-Way Tandem Center			6					
	7* 4-Way Manipulator Closed Center			6 Subplate					
NOTES: * 1. P/N 8473E connects pressure ports to cylinder ports in the center position when mounted on a									

NOTES:

- *1. P/N 8473E connects pressure ports to cylinder ports in the center position when mounted on a standard DO3 Subplate.
2. Other port connections that may be used by the customer are his options.

Dimensions



Valve Size				All Dimensions are in Inches																
Sub-Plate	SAE	Tube	Pipe	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R		
	# 4	4	1/8	2	1 ¹ / ₈	⁹ / ₁₆	2	4 ¹³ / ₁₆	2 ¹ / ₄	1 ⁵ / ₈	⁵ / ₁₆	1 ¹⁵ / ₁₆	⁷ / ₈	1 ⁷ / ₁₆	⁹ / ₁₆	1 ⁷ / ₁₆	1 ¹ / ₈	1 ³ / ₈	- 14 Thread	
Size 6	# 6	6	1/4	2	1 ¹ / ₈	⁹ / ₁₆	2	4 ¹³ / ₁₆	2 ¹ / ₄	1 ⁵ / ₈	⁵ / ₁₆	1 ¹⁵ / ₁₆	⁷ / ₈	1 ⁷ / ₁₆	⁹ / ₁₆	1 ⁷ / ₁₆	1 ¹ / ₈	1 ³ / ₈	- 14 Thread	

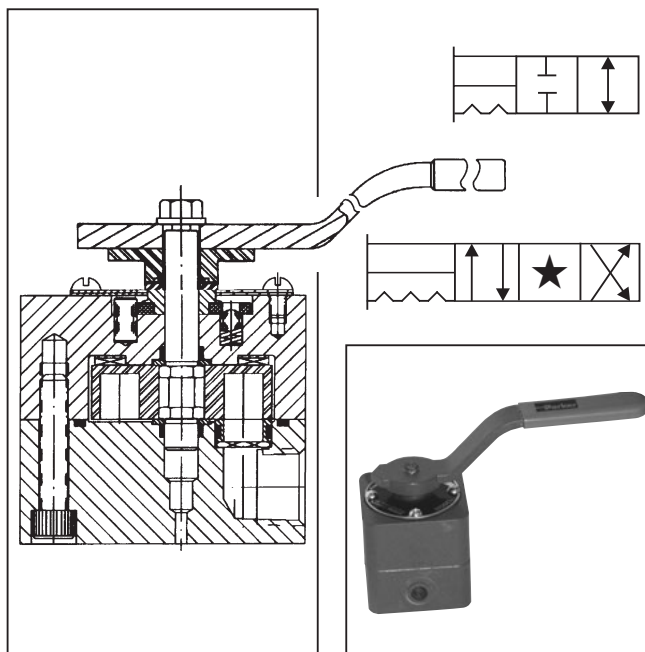
A

General Description

Series 8500 valves are 2, 3 and 4-way manual selector valves with near zero leakage characteristics and are rated to 207 Bar (3000 PSI). The valve design requires low actuation torque and can be used in air, oil and water applications.

Features

- Shear-type positive seal
- Zero leakage (1 drop per min. per pressure port)
- High contamination tolerance
- Long life due to wiping action of seals and disk
- Low turning torque
- Panel mounting is standard



Specifications

Service Applications	Lubricated air, hydraulic oil, and water. For case pressure or exhaust port pressure applications above 17.3 Bar (250 PSI), consult factory.	Mounting	Subplate - Sizes 10 & 16
Maximum Operating Pressure	Working: 207 Bar (3000 PSI) Proof: 310.5 Bar (4500 PSI) Burst: 517.5 Bar (7500 PSI)	Material	Body & Cap: Aluminum alloy anodized Disk: Stainless steel type 440 Shaft: Stainless steel type 416 Seals: Stainless steel type 440 O-rings: Synthetic rubber compatible with media Spring seals: Stainless steel Back-up rings: PTFE Handle: Steel, aluminum & plastic Finish: Paint
Porting	Bottom or side NPT: Pipe threads Sizes 1/8", 1/4", 3/8", 1/2", 3/4" & 1" IST: Internal straight threads per AND10050 Sizes 4, 6, 8, 10, 12 & 16 SAE: Straight threads Sizes #4, #6, #8, #10, #12 & #16	Operating Temperature	-40°C to +121°C (-40°F to +250°F) Higher on special order

Valve Size				Weight Lbs.	CV Factor P. to A. or P. to B.	Flow Passage Diameter	Handle Pull – Lbs.			
Subplate	IST	Tube	Pipe				8500E		R8500E	
				Steel	8500E	8500E	Air	Oil	Air	Oil
—	#6	6	1/4	2.5	1.7	.437 In.	13	15	11	17
Size 16	#16	16	1	13	8.5	.750 In.	15	18	26	30

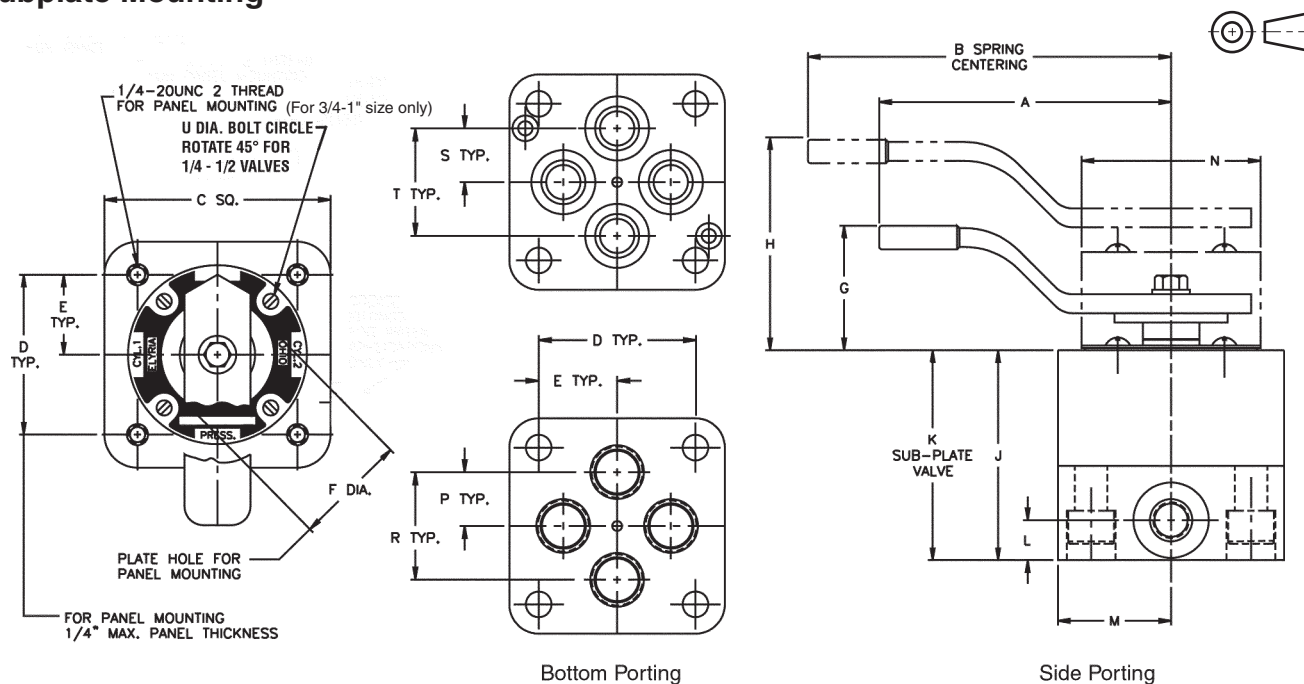
WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

A1_Cat3000.indd, ddp, 04/19

Ordering Information

Prefix for Special Feature	85 3000 PSI Series	5 Flow Pattern	1 Type of Porting	F Design Series	- 1/4 Size	H Service Media	D Materials	2 O-Ring Code	Suffix Options
See Option Page for Complete List	4 4-Way Closed Center 5 4-Way Tandem Center 7 4-Way Manipulator Closed Center		1 Side Ported		1/4 NPT 1/2 NPT 1 NPT 16 IST 16 Subplate	A Lubricated Air H Hydraulic Oil W Water	D Aluminum	2 Nitrile 28 Fluorocarbon	See Option Page for Complete List

Dimensions Subplate Mounting



Valve Size				All Dimensions are in Inches																	Subplate Mounted		
Sub-Plate	SAE	Tube	Pipe	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	Mt'g. Bolt	Torq.
—	#6	6	1/4	6	6	2 ³ / ₄	2	1	1 ²¹ / ₃₂	1 ³¹ / ₃₂	2 ²⁵ / ₃₂	2 ¹³ / ₁₆	2 ¹ / ₃₂	⁵ / ₈	1 ³ / ₈	2 ³ / ₈	²³ / ₃₂	1 ⁷ / ₁₆	¹¹ / ₁₆	1 ³ / ₈	2 ¹ / ₈	5/16 - 24NF x 2	250 In. – Lbs.
Size 16	#16	16	1	10	12	4 ¹ / ₂	3 ³ / ₁₆	1 ¹⁹ / ₃₂	1 ³ / ₈	2 ¹⁵ / ₁₆	3 ³ / ₈	4 ²³ / ₃₂	3 ⁴⁵ / ₆₄	1	2 ¹ / ₄	3 ¹¹ / ₁₆	1 ³ / ₈	2 ³ / ₄	1 ¹¹ / ₆₄	2 ¹¹ / ₃₂	3 ³ / ₁₆	1/2 - 20 x 4 Lg.	1,370 In. – Lbs.

A

Special Feature Letter		Location	8000 - 8100			8400	8500	
			$\frac{1}{8} - \frac{1}{2}$	$\frac{3}{4} - 1$	$\frac{1}{4} - \frac{1}{2}$	$\frac{1}{8} - \frac{1}{4}$	$\frac{1}{8} - \frac{1}{2}$	$\frac{3}{4} - 1$
F	-Fourth Seal	P	A	A	A	N/A	A	A
FR	-Fourth Seal & Spring Return	P	A	A	A	N/A	A	A
R	-Spring Return	P	A	A	A	A	A	A
CR	-Normally Closed Spring Return	P	A	A	A	N/A	A	A
H	-Less Handle	S	A	A	A	A	A	A
P	-Locking Kit	S	A	A	N/A	N/A	N/A	A
L	-No Left Handle Position	S	A	A	A	N/A	A	A
R	-No Right Handle Position	S	A	A	A	N/A	A	A
M	-No Center Detent	S	A	A	A	A	A	A

P=Prefix S=Suffix A=Available N/A=Not Available

Combined Options Not Available

- Options M, L & R available individually only.
- Options FR limits maximum pressure on valve to 1500 PSI.

Manifold Mounted Exectrol Directional Control Valves

Series 21353, 21356 Solenoid Operated, 2-Way B2



General Description

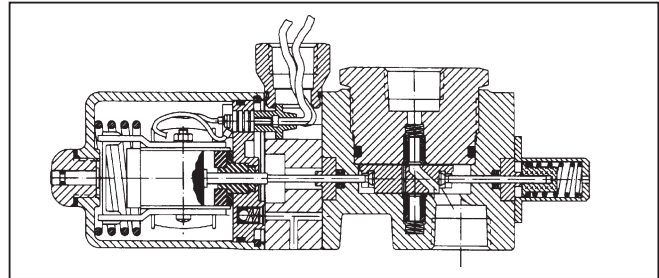
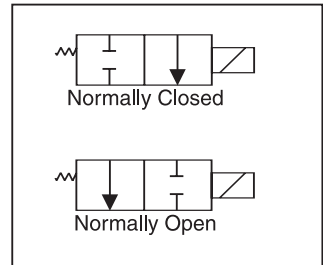
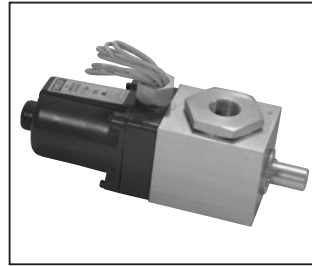
Series 21353 and 21356 Exectrol directional control valves are solenoid operated and can serve as a dump valve or a shut-off valve depending upon the configuration ordered. The valves handle grease and oil interchangeably without modification. The valves have a high tolerance to media contamination.

Features

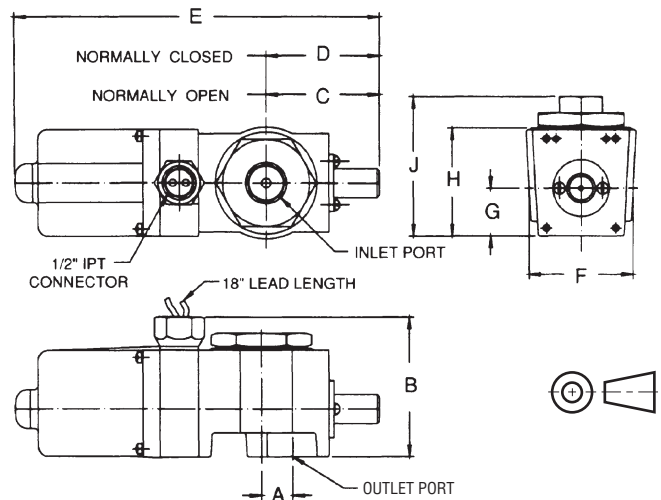
- Designed to handle grease and oil in centralized lubricating systems
- Self cleaning and dirt resistant
- Shear-type positive seal
- Recommended for “venting” an R6701 relief valve as a high pressure shut-off or dump valve

Specifications

Service App.	Lubricating grease or oil.	
Maximum Operating Pressure	Working: 310.5 Bar (4500 PSI) Proof: 465.8 Bar (6750 PSI) Burst: 776.3 Bar (11,250 PSI)	
Sizes	NPT 3/8", 3/4"	
Orifice Dia.	3/16"	
Ports	NPT Pipe Threads	
CV Factor	0.7	
Internal Leakage	1 DPM maximum per pressurized port	
Mounting	In-line. (ports offset)	
Material	Body, Cap, Solenoid Housing & Cap: Aluminum alloy, anodized Slide, Seals: Stainless steel, type 440 Springs: Stainless steel O-rings: Synthetic rubber Back-up Rings: PTFE	
Operating Temperature	-40°C to +107°C (-40°F to +225°F) (with Code 02 O-rings)	

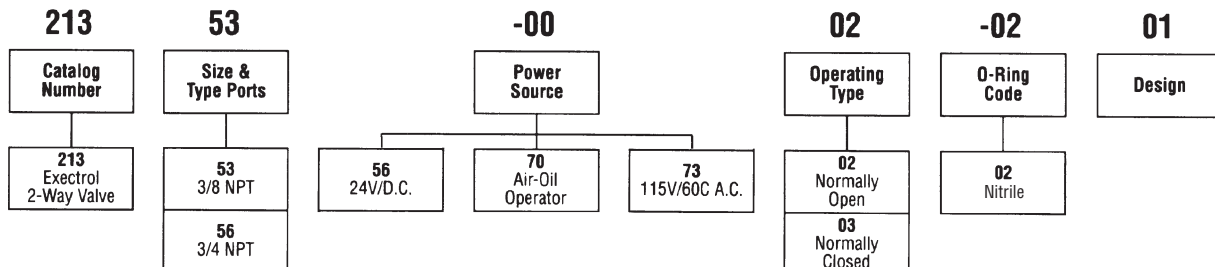


Dimensions



Power Source	All Dimensions are in Inches								
	A	B	C	D	E	F	G	H	J
A.C. Solenoid	$\frac{13}{16}$	$3 \frac{1}{2}$	$3 \frac{1}{16}$	$2 \frac{15}{16}$	$9 \frac{7}{16}$	$2 \frac{29}{32}$	$1 \frac{15}{64}$	$2 \frac{51}{64}$	$3 \frac{3}{16}$
D.C. Solenoid	$\frac{13}{16}$	$3 \frac{1}{2}$	$3 \frac{1}{16}$	$2 \frac{15}{16}$	11	$2 \frac{29}{32}$	$1 \frac{15}{64}$	$2 \frac{51}{64}$	$3 \frac{3}{16}$
Air - Oil Operator	$\frac{13}{16}$	$3 \frac{1}{2}$	$3 \frac{1}{16}$	$2 \frac{15}{16}$	$8 \frac{13}{16}$	$2 \frac{29}{32}$	$1 \frac{15}{64}$	$2 \frac{51}{64}$	$3 \frac{3}{16}$

Ordering Information



WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

B1_Cat3000.indd, ddp, 04/19

In-Line Mounted Check Valves

Series AVF	Adjustable Velocity Fuse (Hydraulic)	C2 - C4
Series AVF (Brass)	Adjustable Velocity Fuse (Pneumatic)	C5 - C6
Series LT and LTF	Line Check and Throttle.....	C7 - C9
Series CLS	In-line Check.....	C10 - C11
Series VLS.....	Fixed Velocity Fuse.....	C12 - C13
Series 450	High Pressure.....	C14 - C15
Series 480	Soft-seat	C16 - C17
Series 580 and 593	Swing.....	C18 - C19
Series CS	Subplate Mounted	C20 - C23



General Description

Series AVF (Hydraulic) adjustable velocity fuses are designed to provide automatic hydraulic line rupture shut-off, as well as the ability to isolate a problem circuit on parallel circuit applications. Use of the fuses limits oil spillage and potential component damage. The fuses feature an adjustable flow for easy set-up and operation. A set screw in the body is provided to “lock in” the selected flow.

C

Features

- Provides automatic line rupture shut-off
- Isolates problem circuit on parallel circuit applications
- Limits oil spillage and potential component damage
- Adjustable closing flow — simple readjustment

Specifications

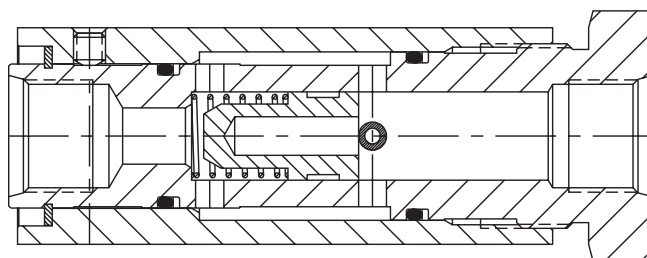
Service Application	Hydraulic	
Maximum Operating Pressure	340 Bar (5000 PSI)	
Material	Body, Sleeve, Poppet, Roll Pin	Steel
	Spring	Stainless Steel
	O-ring	Fluorocarbon
	Back-up Ring	PTFE
	Finish	Zinc Plated
Operating Temperature	-27°C to +177°C (-20°F to +350°F)	
Mounting	Any	

Ordering Information

Nominal Size	Port Type	
	NPT P/N	SAE P/N
1/4"	AVF-1/4-S28	AVF-106-S28
3/8"	AVF-3/8-S28	AVF-108-S28
1/2"	AVF-1/2-S28	AVF-110-S28
3/4"	AVF-3/4-S28	AVF-112-S28
1"	AVF-1-S28	AVF-116-S28
1-1/2"	AVF-1 1/2-S28	—



Construction View



Performance Data

Valve Size	Closing Flow Adjustment Range	
	Minimum	Maximum
1/4"	1.9 LPM (1/2 GPM)	15 LPM (4 GPM)
3/8"	3.8 LPM (1 GPM)	30 LPM (8 GPM)
1/2"	5.7 LPM (1-1/2 GPM)	45 LPM (12 GPM)
3/4"	7.6 LPM (2 GPM)	68 LPM (18 GPM)
1"	11 LPM (3 GPM)	102 LPM (27 GPM)
1-1/2"	23 LPM (6 GPM)	227 LPM (60 GPM)

Pressure drop at maximum rated flow is less than 100 PSID on all sizes.

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

C1_Cat3000.indd, ddp, 04/19

Operation

Series AVF adjustable velocity fuse is a normally open, in-line valve. Under normal conditions, a spring holds the fuse poppet off its seat.

Flow Path

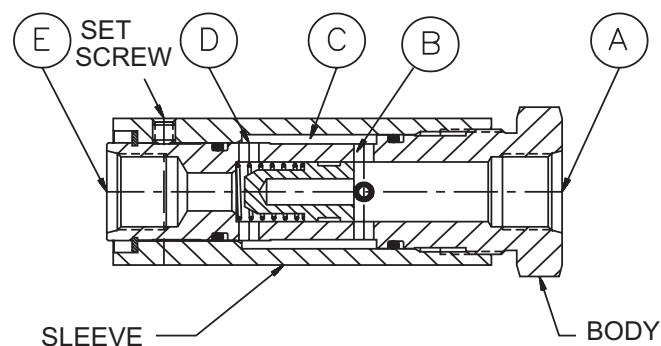
Flow enters the fuse at the flanged inlet port (A). Before reaching the poppet, a series of radial holes (B) in the body directs flow from the body core into an annular cavity (C) between the body and the adjusting sleeve. Flow is directed axially between the body and sleeve until it reaches another series of radial holes (D) at the poppet seat. Flow is then directed back into the body core through the seat and out the fuse outlet port (E).

Making Adjustments

External adjustments of the sleeve reduce the “free” area of the radial holes (D). This reduction in area creates an increase in flow velocity, resulting in a higher pressure drop. When the pressure drop exceeds the spring force holding the poppet open, the inlet pressure will force the poppet against its seat, effectively closing the fuse.

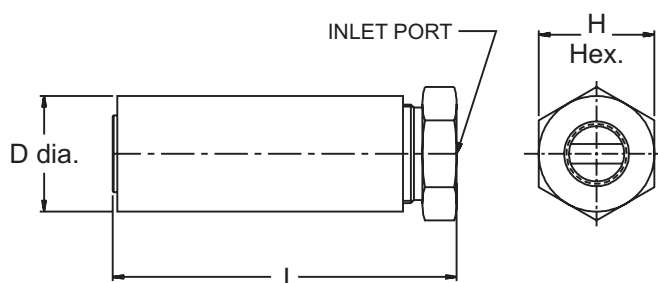
Line Rupture Shut-Off

The sleeve can be adjusted such that, at normal flows, the fuse will remain open but increased flow rates (such as caused by downstream line rupture) will result in a rapid closing of the fuse. The fuse will remain closed until the inlet pressure is eliminated or the downstream pressure is equalized with the inlet.



Dimensions

Inch equivalents for millimeter dimensions are shown in (**)



Nominal Size	L mm - (in)	D mm - (in)	H mm - (in)	Weight kg - (lbs.)
1/4"	90 (3.56)	29 (1.13)	29 (1.13)	0.36 (0.8)
3/8"	108 (4.25)	33 (1.31)	33 (1.31)	0.54 (1.2)
1/2"	128 (5.02)	43 (1.69)	43 (1.69)	1.1 (2.4)
3/4"	143 (5.62)	51 (2.0)	51 (2.0)	1.7 (3.8)
1"	168 (6.62)	61 (2.38)	61 (2.38)	2.8 (6.1)
1-1/2"	221 (8.69)	76 (3.0)	76 (3.0)	5.3 (11.6)

Conventional Fuse

- Closing flow must be calculated
- Calculation error results in unusable valve
- System changes make valve unusable
- “Matched” fuses are very expensive
- Special order to meet requirements

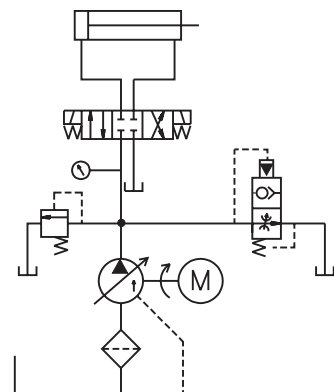
AVF Series Adjustable Velocity Fuse

- No calculations required
- Correct size always supplied
- Simple re-adjustment
- Minor adjustment only
- Stocked by pipe size

C

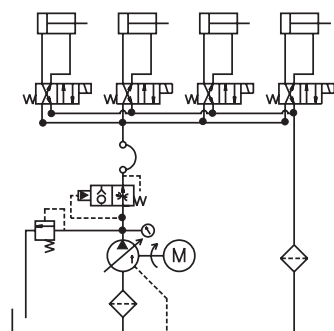
Pump/System Air Bleed

When starting a pump under load, the blocked port resists flow, and more torque is required from the prime mover. This condition may cause an electric motor to draw higher “pull-up current,” or may cause a combustion engine powered pump to stall. The velocity fuse is normally open and when tied into the tank, it will provide an open, load free path to tank when the pump first starts. As the pump nears operating speed, the resulting flow will cause the fuse to close, directing all flow into the primary circuit.



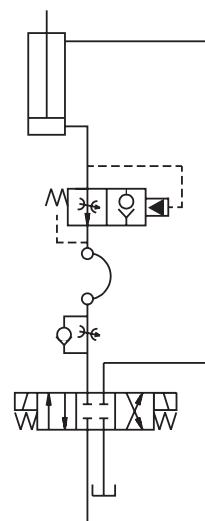
Main Pressure Line from Pump to Manifold

A line rupture in a central power unit would allow fluid to be pumped out through the broken line. The loss of oil can be expensive to clean up, dispose of, and replace; plus it must be done in accordance with EPA regulations. Ruptured lines may cause physical damage or the release of oil into a flammable area. A velocity fuse closes down flow when failure of a line occurs and eliminates these problems.



Cylinder/Actuator Shut-Off

A line rupture that occurs when a cylinder is supporting a load allows the load to fall unrestricted. A velocity fuse installed at the cylinder port will shut off flow and prevent the load from falling in the event of a hose or tubing failure.



General Description

Series AVF (Pneumatic) adjustable velocity fuses are designed to provide automatic air line shut-off if a line should rupture or break. The use of fuses limits the possibility of personal injury or damage to equipment from whipping hoses. The fuses are field adjustable for easy setup and operation. A set screw in the body allows the selected setting to be locked.

Features

- Provides automatic line rupture shut-off
- Limits runaway conditions
- Eliminates hose whip
- Air or water compatible

Benefits

- Eliminates "line whip." No injury or damage possible.
- Limits runaway conditions. Load will stay in place after break.
- Precise sizing not required. Each valve has an adjustable flow range.
- Simple readjustments. Turn barrel to reset.
- Setting may be locked
- Four sizes available
- Resets quickly after line repair. Pressurize downstream line.

Specifications

Service Application	Pneumatic
Maximum Operating Pressure	136 Bar (2000 PSI)
Material	Body, Sleeve, Brass Poppet, Roll Pin Stainless Steel O-ring Nitrile Back-up Ring PTFE
Operating Temperature	-27°C to +177°C (-20°F to +350°F)
Mounting	Any
Sizes	1/4", 1/2" and 3/4" NPT

Ordering Information

Series AVF Air Service	
Valve Size	Part Number
1/4" NPT	AVF-1/4-B2
1/2" NPT	AVF-1/2-B2
3/4" NPT	AVF-3/4-B2

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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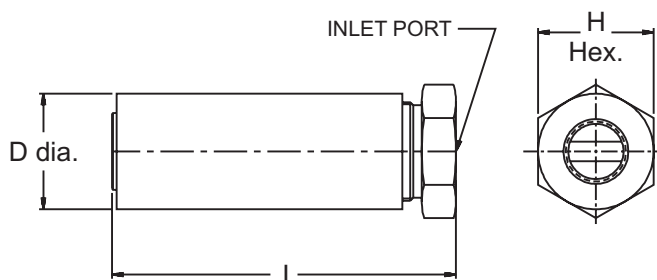


Performance Data

Valve Size	Series AVF Air Service Closing Flow Adjustment Range	
	Minimum	Maximum
1/4" NPT	4 SCFM	35 SCFM
1/2" NPT	6 SCFM	60 SCFM
3/4" NPT	10 SCFM	90 SCFM

Dimensions

Inch equivalents for millimeter dimensions are shown in (**)



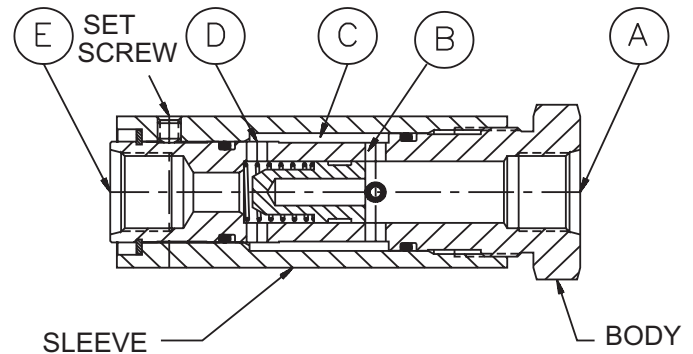
Nom. Size	L mm (Inches)	D mm (Inches)	H mm (Inches)	Weight kg (lbs.)
1/4"	90 (3.56)	29 (1.13)	29 (1.13)	0.36 (0.80)
1/2"	128 (5.02)	43 (1.69)	43 (1.69)	1.10 (2.40)
3/4"	143 (5.62)	51 (2.00)	51 (2.00)	1.70 (3.80)

Operation

Series AVF adjustable velocity fuse is a normally open, in-line valve. Under normal conditions, a spring holds the fuse poppet off its seat.

Flow Path

Flow enters the fuse at the flanged inlet port (A). Before reaching the poppet, a series of radial holes (B) in the body directs flow from the body core into an annular cavity (C) between the body and the adjusting sleeve. Flow is directed axially between the body and sleeve until it reaches another series of radial holes (D) at the poppet seat. Flow is then directed back into the body core through the seat and out the fuse outlet port (E).



Making Adjustments

External adjustments of the sleeve reduce the “free” area of the radial holes (D). This reduction in area creates an increase in flow velocity, resulting in a higher pressure drop. When the pressure drop exceeds the spring force holding the poppet open, the inlet pressure will force the poppet against its seat, effectively closing the fuse.

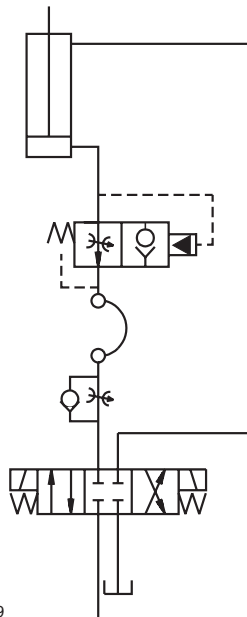
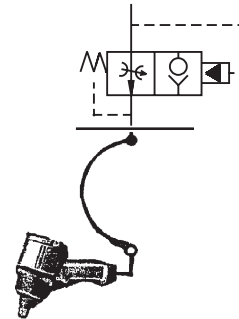
Line Rupture Shut-Off

The sleeve can be adjusted such that, at normal flows, the fuse will remain open but increased flow rates (such as caused by downstream line rupture) will result in a rapid closing of the fuse. The fuse will remain closed until the inlet pressure is eliminated or the downstream pressure is equalized with the inlet.

Applications

Air Line Drop

A broken air hose may cause a violent whipping action that could cause injury to employees or damage to equipment. A velocity fuse will provide an automatic shut-off of air in case of a broken hose and eliminate this problem.



Cylinder / Actuator Shut-Off

A line rupture that occurs when a cylinder is supporting a load allows the load to fall unrestricted. A velocity fuse installed at the cylinder port will shut off flow and prevent the load from falling in the event of a hose or tube failure.

General Description

Series LT and LTF check valves will operate satisfactorily when installed in any position. These valves may be used as line check valves, permitting full flow of hydraulic oil in one direction only or they may be used as restrictors.

An assortment of restrictors are available. When installed, the valve becomes a line throttle valve permitting free flow of hydraulic oil in one direction and a restricted flow in the opposite direction.

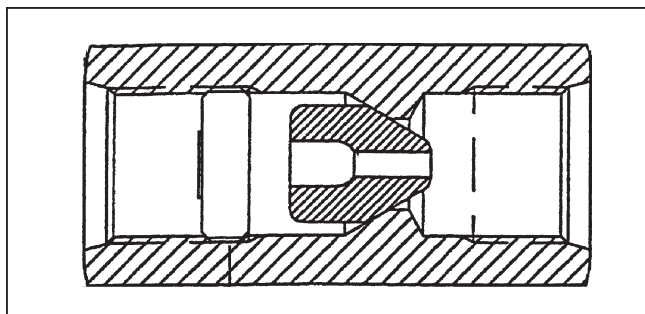
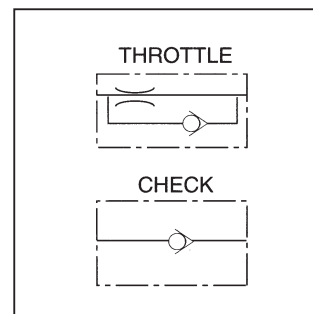
An array of color-coded poppets allows easy and quick identification.

Features

- Accurate control of double-acting cylinder by having both sides of the piston pressurized
- For improving control of the lowering stroke of a cylinder
- For preventing cavitation of a cylinder or motor having an inertia load
- For metering oil flow to a hydraulic motor for proper motor speed
- For improving control of the extend stroke of a hydraulic cylinder
- Unidirectional

Specifications

Maximum Operating Pressure	207 Bar (3000 PSI)	
Materials	Body:	Steel/Zinc-plated
	Poppet:	Nylon
	Retainer:	416 Stainless Steel
Operating Temperature	-30°C to +100°C (-22°F to +212°F)	



WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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Ordering Information



Series



Port Size



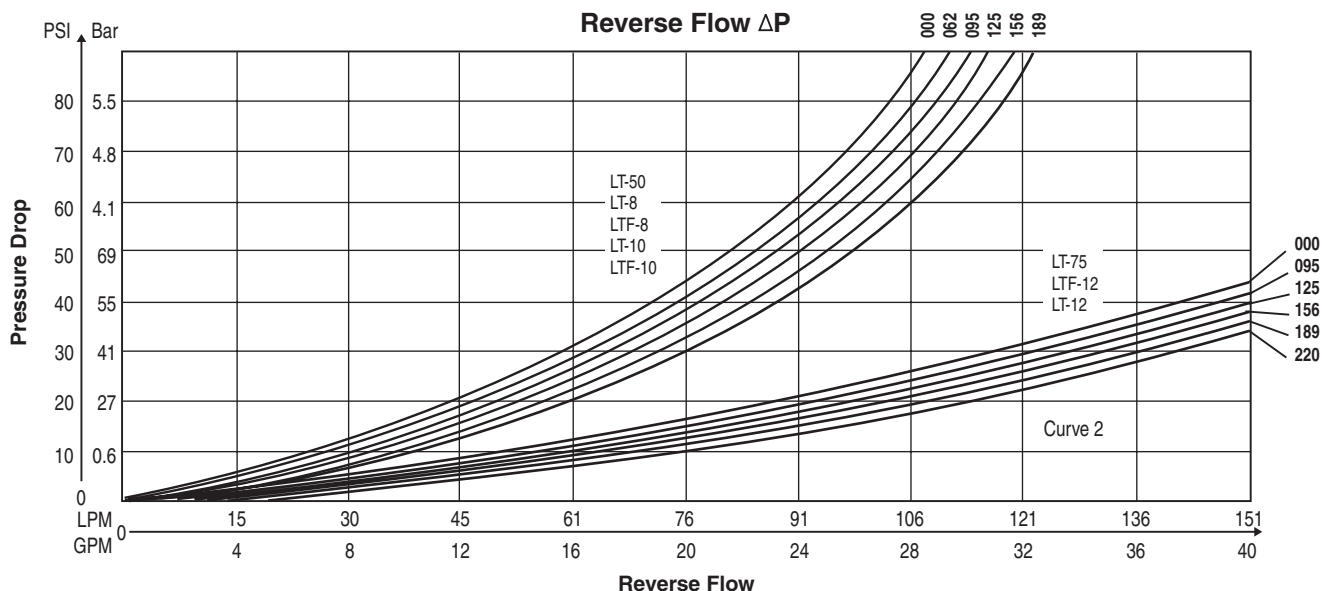
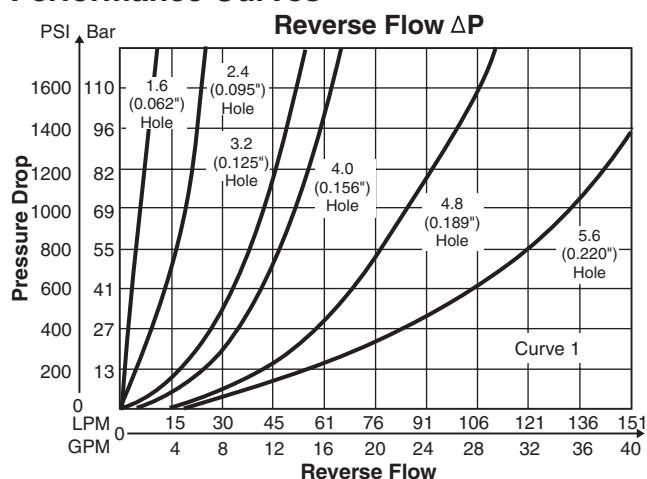
Throttle and Check Poppets

Code	Series
LT	Male-Female Ports
LTF	Female-Female Ports

Code	Size
8	3/4" – 16 UNF-2
10	7/8" – 14 UNF-2
12	1 1/16" – 12 UNF-2
50	1/2" – 14 NPT (LT Only)
75	3/4" – 14 NPT (LT Only)

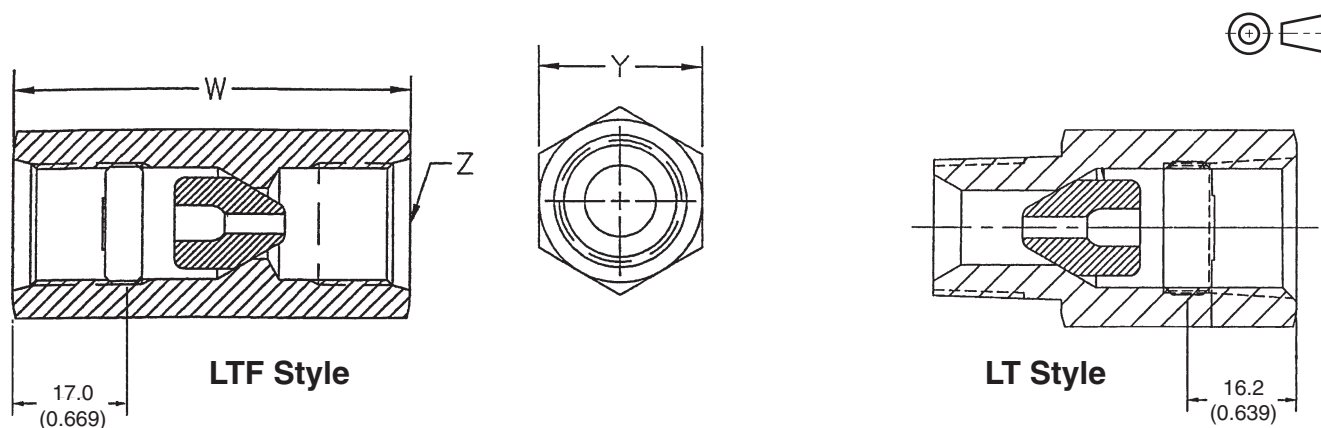
Poppet Order Symbol	Diameter of Hole in Poppet		Poppet Color
For Part Numbers LT-8, LT-10, LT-50, LTF-8, LTF-10			
4	1.19	(.947)	Brown
6	1.57	(.062)	Purple
8	1.98	(.078)	Pink
9	2.41	(.095)	Red
11	2.77	(.109)	Beige
12	3.18	(.125)	Yellow
15	3.96	(.156)	Lt. Green
18	4.80	(.189)	Black
25	6.40	(.252)	Dk. Green
0	Check (No Hole)		Beige
For Part Numbers LT-12, LT-75, LTF-12			
180	4.80	(.189)	Black
210	5.59	(.220)	Orange
250	6.40	(.252)	Lt. Blue
00	Check (No Hole)		White

Performance Curves



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Inch equivalents for millimeter dimensions are shown in (**)



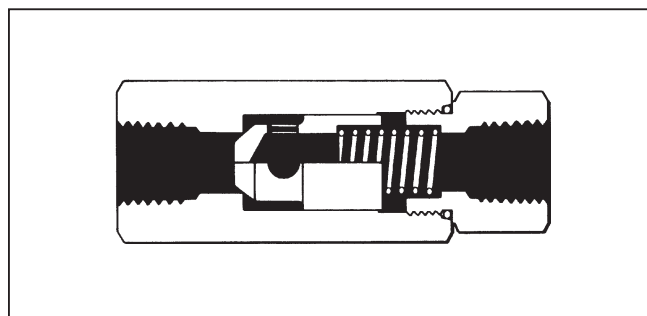
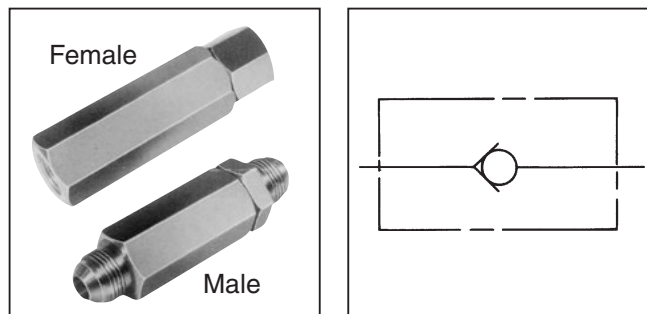
Model Number	W Length	Y Hex Size	Z Thread (Both Ends)
LT-50	54.1 (2.13)	25.4 (1.00)	1/2" – 14 NPT
LT-8	54.1 (2.13)	25.4 (1.00)	SAE 8 (3/4" – 16 UNF)
LT-10	58.7 (2.31)	28.7 (1.13)	SAE 10 (7/8" – 14 UNF)
LT-12	77.7 (3.06)	35.1 (1.38)	SAE 12 (1 1/16" – 12 UN)
LT-75	73.2 (2.88)	35.1 (1.38)	3/4" – 14 NPT
LTF-8	62.0 (2.44)	25.4 (1.00)	SAE 8 (3/4" – 16 UNF)
LTF-10	68.3 (2.69)	28.7 (1.13)	SAE 10 (7/8" – 14 UNF)
LTF-12	82.6 (3.25)	35.1 (1.38)	SAE 12 (1 1/16" – 12 UN)

General Description

Series CLS inline check valves are designed to provide free flow in one direction and a positive check in the opposite direction. They are available with a variety of port types and sizes and may be mounted in any position.

Specifications

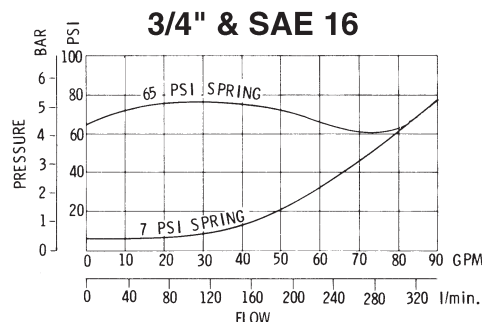
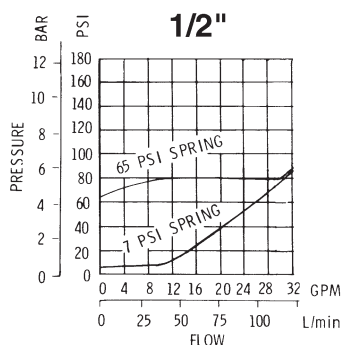
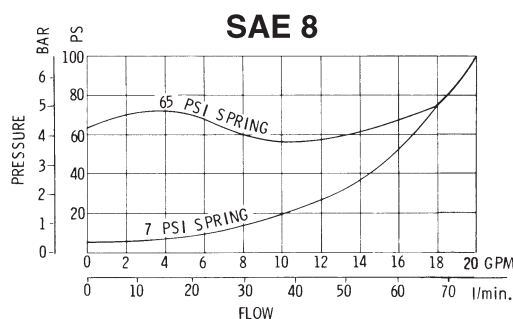
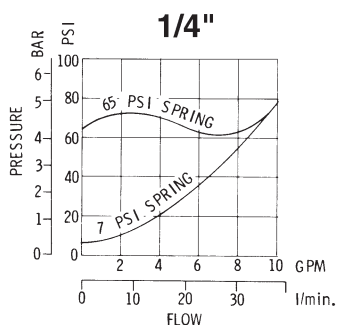
Maximum Operating Pressure	207 Bar (3000 PSI)
Flow Rating	Consult pressure drop data
Fluid Recommended	Premium grade hydraulic fluid with viscosity of 10cSt (60 SUS) to 216 cSt (1000 SUS) at operating temperature.
Operating Temperature	Under normal conditions of continuous operation, fluid temperature should not exceed -82°C (180° F). In no instance should the temperature exceed 93°C (200°F).
Material	All steel
Mounting	Not restricted



Features

- Up to 3000 PSI (207 Bar)
- 1/4", 1/2", 3/4" NPTF
- #8, #12, #16 SAE

Performance Curves



WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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Ordering Information

CLS

Check Valve

Port Size

Code	Size
25	1/4" NPTF
50	1/2" NPT
75	3/4" NPT
08	SAE 8
12	SAE 12
16	SAE 16

Port Type

Code	Type
1	NPT
2	SAE

Spring Rate

Code	Size
7	7 PSI
45	45 PSI
65	65 PSI

Type

Code	Type
M	Male
F	Female

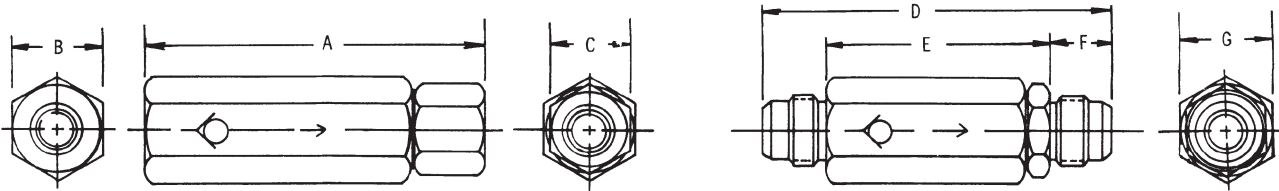
NOTE: NPT ports not available on Male type valves.

Weight (approx.)

1/4"	0.23 kg	(0.50 lbs.)
1/2"	0.45 kg	(1.00 lbs.)
3/4"	1.30 kg	(2.88 lbs.)
SAE 8	0.45 kg	(1.00 lbs.)
SAE 12	1.27 kg	(2.80 lbs.)
SAE 16	1.36 kg	(3.00 lbs.)

Dimensions

Millimeter equivalents for inch dimensions are shown in (**)



VALVE SIZE NPT & FEMALE SAE	A	B	C
1/4"	3.30 (83.8)	0.88 (22.3)	0.75 (19.1)
SAE 8	3.66 (92.9)	1.00 (25.4)	0.88 (22.3)
1/2" & SAE 10	4.50 (114.3)	1.38 (35.0)	1.25 (31.7)
3/4" & SAE 12	5.22 (132.6)	1.75 (44.4)	1.50 (38.1)

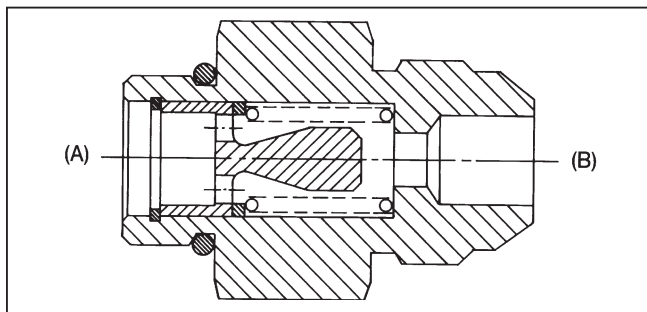
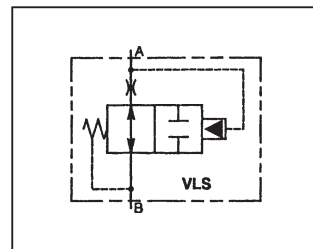
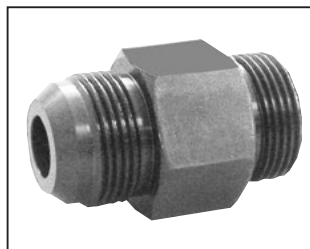
VALVE SIZE MALE TUBE	D	E	F	G
SAE 12	5.30 (134.6)	3.58 (90.9)	0.86 (21.8)	1.75 (44.4)
SAE 16	5.36 (136.1)	3.54 (89.9)	0.91 (23.1)	1.75 (44.4)



General Description

Series VLS velocity check valves protect your hydraulic system in the event of line rupture. These valves return to the open position once the pressure is equalized.

Series VLS valve is a flow sensing, hydraulic check. Flow will pass through the check until the designated closing flow is reached. Then the check will close, stopping further flow.



C

Features

- Up to 207 Bar (3,000 PSI),
0.01 to 23.8 LPM (0.5 to 90 GPM)

Specifications

Max. Operating Pressure	207 Bar (3000 PSI)	Operating Temperature	Under normal conditions of continuous operation, fluid temperature should not exceed -82°C (180° F). In no instance should the temperature exceed 93°C (200°F).
Normal Closing Flow	To be based on a nominal 3.5 Bar (50 PSI) with 150 SUS oil	Torque Req'd for Installation	See chart
Leakage After Closing	10 DPM maximum	Material	All steel
Reverse Flow	Not to exceed 150% of specified closing flow	Seals	Nitrile standard. For other seal compounds, consult factory
Fluid Recommended	Premium grade hydraulic fluid with viscosity of 10cSt (60 SUS) to 216 cSt (1000 SUS) at operating temperature.	Mounting	Not restricted

Ordering Information

VLS

Velocity Fuse

Inlet Porting

M

Male Thread

Port Type

Outlet Porting

M

Male Thread

Port Type

Fusing Flow

Code	Size
50	1/2" NPTF
06	SAE -6
08	SAE -8
10	SAE -10
12	SAE -12

Code	Type
1	NPTF
2	SAE

Code	Size
50	1/2" NPTF
06	SAE -6
08	SAE -8
10	SAE -10
12	SAE -12

Code	Type
1	NPTF
2	SAE
3	JIC
4	ORS

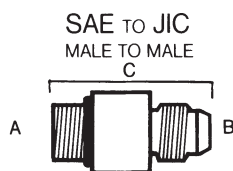
Code	Flow*
0.8	3.0 LPM (0.8 GPM)
1.5	5.7 LPM (1.5 GPM)
2.0	7.6 LPM (2.0 GPM)
3.0	11.4 LPM (3.0 GPM)
6.0	22.7 LPM (6.0 GPM)
7.0	26.5 LPM (7.0 GPM)
10	37.9 LPM (10 GPM)
22	83.3 LPM (22 GPM)

VLS Flow Chart	
Max Flow	Models
26.5 LPM (7 GPM)	06M2-06M3
37.9 LPM (10 GPM)	08M2-08M3 10M2-08M4
45.4 LPM (12 GPM)	10M2-10M3
56.8 LPM (15 GPM)	50M1-50M1
90.8 LPM (24 GPM)	12M2-12M3

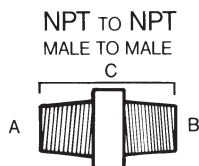
WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

C1_Cat3000.indd, ddp, 04/19

Inch equivalents for millimeter dimensions are shown in (**)



A (In.)	B (In.)	C		Hex		Part Number	Recommended Installation Torque* (In Lb. Ft.)	
		(In.)	(mm)	(In.)	(mm)		In Aluminum	In Steel
3/8	3/8	1.30	(33.0)	11/16	(17.5)	VLS-06M2-06M3-**	85-100	13-16
1/2	1/2	2.25	(57.2)	7/8	(22.2)	VLS-08M2-08M3-**	15-20	25-33
5/8	5/8	2.06	(52.3)	1	(25.4)	VLS-10M2-10M3-**	25-30	42-50
3/4	3/4	1.97	(50.0)	1 1/4	(31.8)	VLS-12M2-12M3-**	35-40	55-65



A (In.)	B (In.)	C		Hex		Part Number	Recommended Installation Torque* (In Lb. Ft.)	
		(In.)	(mm)	(In.)	(mm)		In Aluminum	In Steel
1/2	1/2	1.90	(48.4)	7/8	(22.2)	VLS-50M1-50M1-**	55-60	85-90



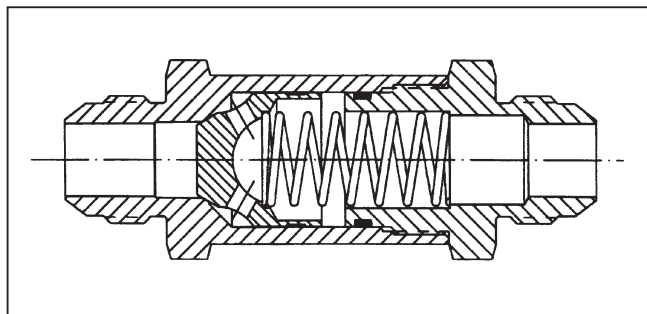
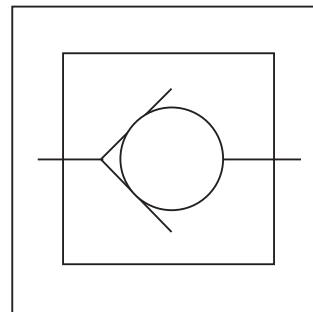
A (In.)	B (In.)	C		Hex		Part Number	Recommended Installation Torque* (In Lb. Ft.)	
		(In.)	(mm)	(In.)	(mm)		In Aluminum	In Steel
3/8	3/8	1.25	(31.8)	3/4	(19.1)	VLS-06M2-06M4-**	85-100	13-16
5/8	1/2	2.10	(53.3)	1	(25.4)	VLS-10M2-08M4-**	25-30	42-50

General Description

Series 450 high pressure check valves permit free flow in one direction, and shut off in the reverse direction with an extremely low internal leakage. These valves are ruggedly built for systems with high shock and high velocity, and will close smoothly.

Features

- High-pressure check valves
- Poppet 440 stainless steel
- For high-shock service



Specifications

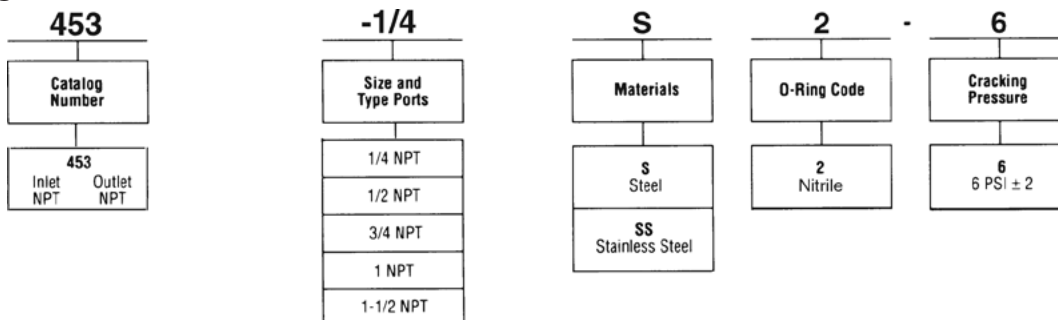
Service App.	Hydraulic	Mounting	In-line
Maximum Operating Pressure	Working: Steel and Stainless Steel 345 Bar (5000 PSI) Proof: Steel and Stainless Steel 517.5 Bar (7500 PSI)	Ports	NPT: Pipe threads FLD: Flared tube connection SAE 30° MS33656 FLS: Flareless tube connection MS33514 IST: Internal straight threads per MS33649
Nominal Cracking Pressure	0.4 Bar (6 PSI), ± 0.14 Bar (2 PSI), or 4.5 Bar (65 PSI), ± 0.4 Bar (6 PSI) Below 0.4 Bar (6 PSI), ±33% 0.4 - 1.4 Bar (6 - 20 PSI), ± 0.14 Bar (2 PSI) Above 1.4 Bar (20 PSI) ±10% Other settings available to order	Material	Body & Cap: Aluminum alloy, steel or 303 Stainless steel Poppet: Hardened 440 Stainless Steel Spring: 302 Stainless Steel Finish: Aluminum alloy, anodized; steel, cadmium plated; stainless steel O-ring: Synthetic rubber. Aluminum and stainless steel valves, sizes 4 - 16, when furnished to MS28765, MS28771, MS28890 and MS28892 only, O-rings are Code 27 (MIL-P-25732) Back-up Rings: PTFE
Operating Temperature	-40°C to +121°C (-40°F to +250°F) Higher on special order		
Internal Leakage	1 drop in 2 minutes		
Sizes	NPT: 1/8", 1/4", 3/8", 1/2", 3/4", 1", 1 1/4", 1 1/2", 2" FLD, FLS: 4", 6", 8", 10", 12", 16", 20", 24", 32"		

Size	Weights, Maximum (Approx.)	CV Factors
1/8	0.06 kg (0.13 lbs.)	0.84
1/4	0.12 kg (0.25 lbs.)	1.6
3/8	0.23 kg (0.5 lbs.)	2.7
1/2	0.28 kg (0.63 lbs.)	4.2
3/4	0.57 kg (1.25 lbs.)	6.5
1	0.85 kg (1.88 lbs.)	10
1 1/4	2.3 kg (5.0 lbs)	18
1 1/2	2.3 kg (5.0 lbs)	23

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

C1_Cat3000.indd, ddp, 04/19

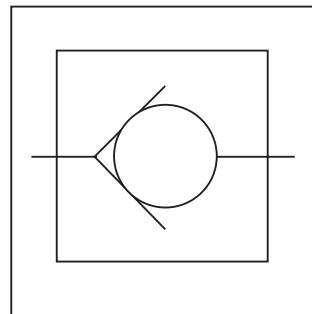
Ordering Information



Valve Size	All Dimensions in Inches	
Pipe	B	Flats F
1/4	2 11/16	13/16
3/8	3 3/8	1 1/16
1/2	3 23/32	1 1/8
3/4	4 5/64	1 7/16
1	4 7/8	1 11/16
1 1/4	6	2 1/4
1 1/2	6 3/16	2 1/2
2	7	3

General Description

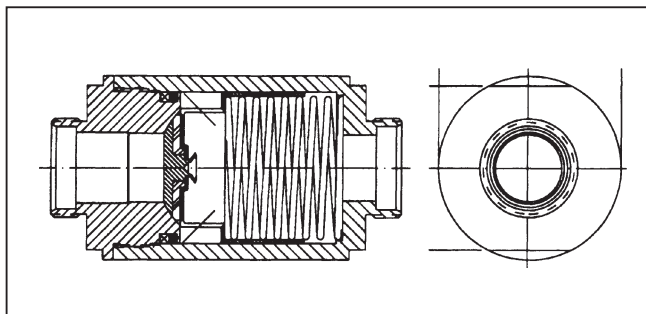
Series 480 free flow check valves permit free flow in one direction, and shut off in the reverse direction. Series 480 check valves can handle high velocity and will provide low pressure drop and zero leakage.



C

Features

- Resilient molded seal is permanently locked to poppet which ensures zero leakage in high velocity applications



Specifications

Service App.	Pneumatic or Hydraulic	Mounting	In-line
Maximum Operating Pressure	Working: 207 Bar (3000 PSI) Proof: 345 Bar (4500 PSI) Burst: 517.5 Bar (7500 PSI)	Ports	NPT: Pipe threads FLD: Flared tube connection SAE 30° MS33656 (AND10056) FLS: Flareless tube connection MS33514 IST: Internal straight threads (tube connection) O-ring seals.
Nominal Cracking Pressure	0.14 Bar (2 PSI), ± 0.07 Bar (1 PSI) Other settings available to order	Material	Body & Cap: Brass, Aluminum alloy, or 303 Stainless steel Poppet Body: 304 Stainless steel Poppet Nose: 303 Stainless steel Spring: AMS5688 Stainless Steel O-ring: Synthetic rubber. Molded Seal: Synthetic rubber Back-up Ring: PTFE
Operating Temperature	-54°C to +93°C (-65°F to +200°F) Higher temperature limits available		
Internal Leakage	Zero		
Sizes	IPT, EPT: 1/4", 3/8", 1/2", 3/4", 1" ISD, FLD, FLS: 4", 6", 8",		

Valve Size		Weights (Lbs. Approx.)			CV Factors
		Brass	Aluminum Alloy	Stainless Steel	Coefficient of Flow
Tube	Pipe				
4		.12	.06	.12	.75
6	1/4	.37	.12	.37	1.5
8	3/8	.62	.25	.62	4
	1/2	1.25	.5	1.25	6
	3/4	1.62	.75	1.62	7.5
	1	2.5	1.0	2.5	13

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

C1_Cat3000.indd, ddp, 04/19

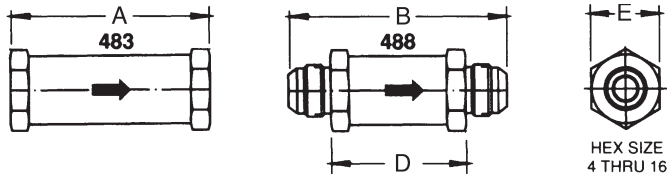
Ordering Information

483	-1/2	B	1	-2										
Catalog Number	Size and Type Ports	Materials	O-Ring Code	Cracking Pressure										
483 Inlet NPT Outlet NPT 488 Inlet FLD Outlet FLD	<table><tr><td>4 IST or FLD or FLS</td><td></td></tr><tr><td>6 IST or FLD or FLS</td><td>1/4 NPT</td></tr><tr><td>8 IST or FLD or FLS</td><td>3/8 NPT</td></tr><tr><td rowspan="3"></td><td>1/2 NPT</td></tr><tr><td>3/4 NPT</td></tr><tr><td>1 NPT</td></tr></table>	4 IST or FLD or FLS		6 IST or FLD or FLS	1/4 NPT	8 IST or FLD or FLS	3/8 NPT		1/2 NPT	3/4 NPT	1 NPT	483, 488 B Brass 488 D Aluminum Alloy 483 SS Stainless Steel	1 Nitrile 2 (Commercial) Nitrile	2 2 PSI ± 1 Others Available Consult Factory
4 IST or FLD or FLS														
6 IST or FLD or FLS	1/4 NPT													
8 IST or FLD or FLS	3/8 NPT													
	1/2 NPT													
	3/4 NPT													
	1 NPT													



Dimensions

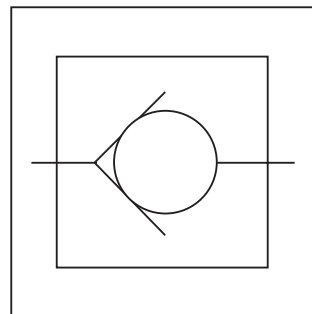
Inch equivalents for millimeter dimensions are shown in (**)



Valve Size		All Dimensions in Inches			
Tube	Pipe	A	B	D	Flats C
4		1 11/16	2 5/8	1 17/32	3/4
6	1/4	2 1/4	2 31/32	1 55/64	1
8	3/8	2 7/16	3 13/32	2 3/32	1 1/4
	1/2	2 15/16	3 31/32	2 29/64	1 1/2
	3/4	3 3/8	4 7/16	2 45/64	1 3/4
	1	3 25/32	4 15/16	3 7/64	2

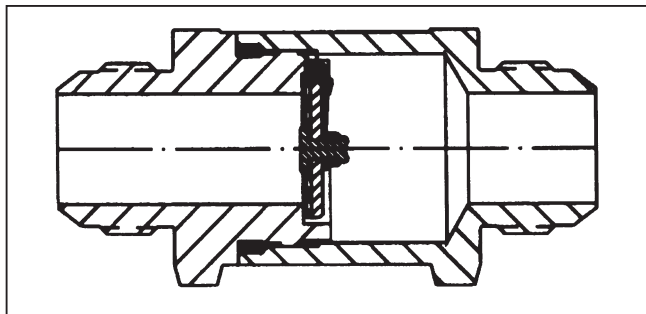
General Description

Series 580 and 593 swing check valves permit free flow in one direction, and shut off in the reverse direction with an extremely low internal leakage. Series 580 and 593 check valves will provide low pressure drop.



Features

- Zero leakage (less than 1 drop per minute)
- Full flow with low opening pressure
- Improved hinge controls
- Mounts in any position
- MS valves meet the following specifications:
MS28882A or B, MS28884A or B (see chart)



Specifications

Service App.	Hydraulic or Pneumatic	Ports	NPT: Pipe threads
Maximum Operating Pressure	Working: Sizes 4 to 16 - 24.2 Bar (350 PSI) Sizes 20 to 32 - 20.7 Bar (300 PSI) Cracking: 8", 0.02 Bar (0.29 PSI) water max.		FLD: Flared tube connection SAE 37° MS33656 (AND10056)
Operating Temperature	Code 1 -55°C to +71°C (-67°F to +160°F)		IST: Internal straight threads
Internal Leakage	Zero	Material	Body & Cap: Aluminum alloy, anodized
Sizes	NPT: 1/4", 3/8", 1/2", 3/4", 1", 1 1/4", 1 1/2" IST, FLD: 4", 6", 8", 10", 12", 16"		Internal Parts: Aluminum alloy, anodized, and Stainless steel
Mounting	In-line, mounts in any position		Molded Seal: Synthetic rubber
			O-ring: Synthetic rubber

Valve Size		Weight	CV Factor		
Tube	Pipe		583 Series	588 Series	593 Series
4		2 Oz.	2.5	1.5	1.5
6	1/4	2 Oz.	4.6	3.8	3.8
8	3/8	3 Oz.	7.3	7.1	7.1
10	1/2	3 Oz.	12.0	11.8	11.8
12	3/4	6 Oz.	17.7	17.1	17.1
16	1	8 Oz.	36	35.3	35.3
	1-1/4	14 Oz.	52	58.8	58.8
	1-1/2	1.3 Lbs.	84	82.3	82.3

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

C1_Cat3000.indd, ddp, 04/19

Ordering Information

583		
Catalog Number		
583	Inlet NPT	Outlet NPT
588	Inlet FLD	Outlet FLD
593	Inlet IST	Outlet IST

-1/8	
Size and Type Ports	
	1/4 NPT
	3/8 NPT
8 IST or FLD	1/2 NPT
	3/4 NPT
12 IST or FLD	1 NPT
16 IST or FLD	1-1/4 NPT
	1-1/2 NPT

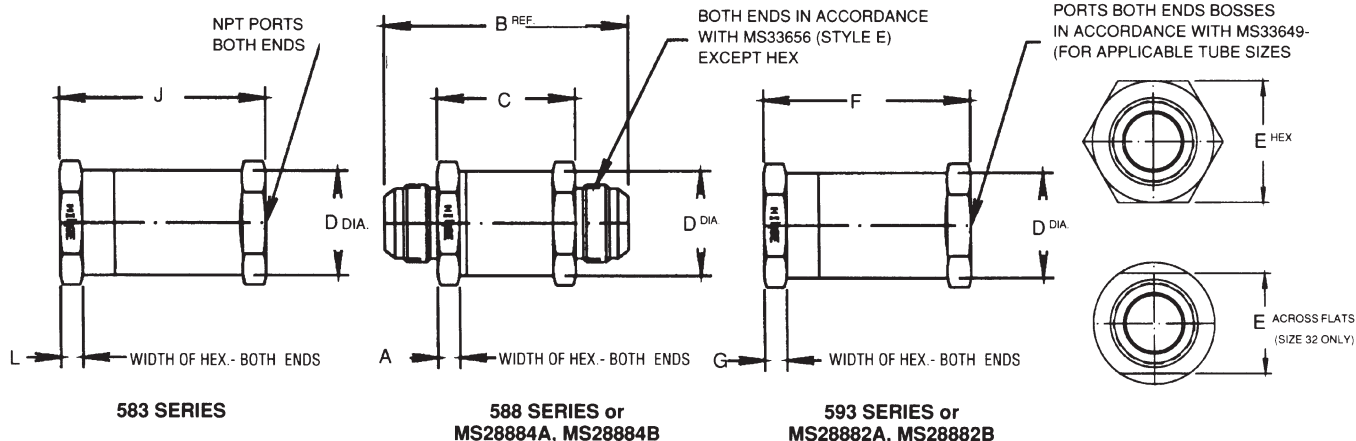
D
Materials
D
Aluminum Alloy

1
O-Ring Code
1
Nitrile
63
Fluorosilicone Others Available

Type Port		MS Number Ref. Only
Inlet	Outlet	
FLD	FLD	MS28884A - 4D1 MS28884A - 6D1 MS28884A - 8D1 MS28884A - 10D1 MS28884A - 12D1 MS28884A - 16D1 MS28884A - 20D1 MS28884A - 24D1 MS28884A - 32D1
IST	IST	MS28882A - 4D1 MS28882A - 6D1 MS28882A - 8D1 MS28882A - 10D1 MS28882A - 12D1 MS28882A - 16D1 MS28882A - 20D1 MS28882A - 24D1 MS28882A - 32D1

Dimensions

Shown in inches



Valve Size		All Dimensions in Inches										
Tube	Pipe	A Min.	B	C ± .031	D	E	F ± .031	G Min.	H Max.	J ± .031	K Min.	L Min.
—	1/4	.125	2.675	1.563	1.032	1.066 / 1.057	2.031	.250	3/4	1.906	.250	1/4
8	3/8		2.988	1.674	1.157	1.190 / 1.181	2.344			2.031		
—	1/2	—	—	—	1.220	1.253 / 1.244	—	—		2.625		5/16
12	3/4	.250	3.791	2.063	1.470	1.503 / 1.494	3.500	.375		3.000	.375	1/4
16	1		4.197	2.375	1.782	1.820 / 1.796	3.594			3.532		
—	1 1/4	.312	4.604	2.688	2.470	2.508 / 2.484	4.062	.500		4.140		3/8
—	1 1/2	.375	5.229	3.063	2.720	2.758 / 2.734	4.625					

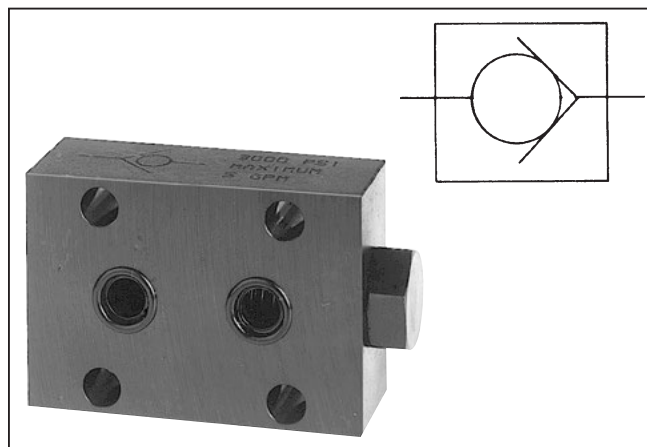
General Description

Series CS check valves permit free flow in one direction, and total shut-off automatically in the reverse direction.

Poppet checks, not ball checks, are standard on all Series CS check valves. Poppets eliminate chatter and minimize wear.

Features

- Stainless steel poppets standard
- Triangular retainers guide the poppets and hold the spring firmly in place, even under high velocity and shock



Specifications

Maximum Operating Pressure	210 Bar (3000 PSI)
Nominal Cracking Pressure	0.3 Bar (5 PSI) Other cracking pressures may be available on request.
Standard Options	1.3 Bar (20 PSI) 4.5 Bar (65 PSI)
Poppet Style	Solid metal poppet, Stainless steel

Quick Reference Data Chart

Model Number	Port Size	Rate LPM (GPM)	Free Flow C_v GPM	Orifice area, in ²	ΔP at Max. Flow Bar (PSI)
CS600	3/8	30 (8)	2.27	0.099	0.8 (11)
CS800	1/2	45 (15)	5.11	0.224	0.6 (8)
CS1200	3/4	100 (25)	7.95	0.348	0.9 (13)
CS1600	1	150 (40)	10.35	0.453	0.9 (13)

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

C1_Cat3000.indd, ddp, 04/19

Ordering Information

CS Check Valve Subplate Mounted CS Subplate Mounted	Size <table border="1" style="margin: 0 auto; border-collapse: collapse; font-size: x-small;"> <tr><td style="width: 40px; text-align: center;">600</td><td style="width: 40px; text-align: center;">3/8"</td></tr> <tr><td style="text-align: center;">800</td><td style="text-align: center;">1/2"</td></tr> <tr><td style="text-align: center;">1200</td><td style="text-align: center;">3/4"</td></tr> <tr><td style="text-align: center;">1600</td><td style="text-align: center;">1"</td></tr> </table>	600	3/8"	800	1/2"	1200	3/4"	1600	1"	S Material S Steel	Cracking Pressure <table border="1" style="margin: 0 auto; border-collapse: collapse; font-size: x-small;"> <tr><td style="width: 40px; text-align: center;">Omit</td><td style="width: 40px; text-align: center;">5 PSI Standard</td></tr> <tr><td style="text-align: center;">20</td><td style="text-align: center;">20 PSI</td></tr> <tr><td style="text-align: center;">65</td><td style="text-align: center;">65 PSI</td></tr> <tr><td style="text-align: center;">80*</td><td style="text-align: center;">80 PSI</td></tr> </table>	Omit	5 PSI Standard	20	20 PSI	65	65 PSI	80*	80 PSI	Seal Material <table border="1" style="margin: 0 auto; border-collapse: collapse; font-size: x-small;"> <tr><td style="width: 40px; text-align: center;">Omit</td><td style="width: 40px; text-align: center;">Nitrile</td></tr> <tr><td style="text-align: center;">V</td><td style="text-align: center;">Fluorocarbon</td></tr> </table>	Omit	Nitrile	V	Fluorocarbon
600	3/8"																							
800	1/2"																							
1200	3/4"																							
1600	1"																							
Omit	5 PSI Standard																							
20	20 PSI																							
65	65 PSI																							
80*	80 PSI																							
Omit	Nitrile																							
V	Fluorocarbon																							

Other cracking pressures may be available on request.

*80 PSI cracking pressure available on 1200 size and smaller.

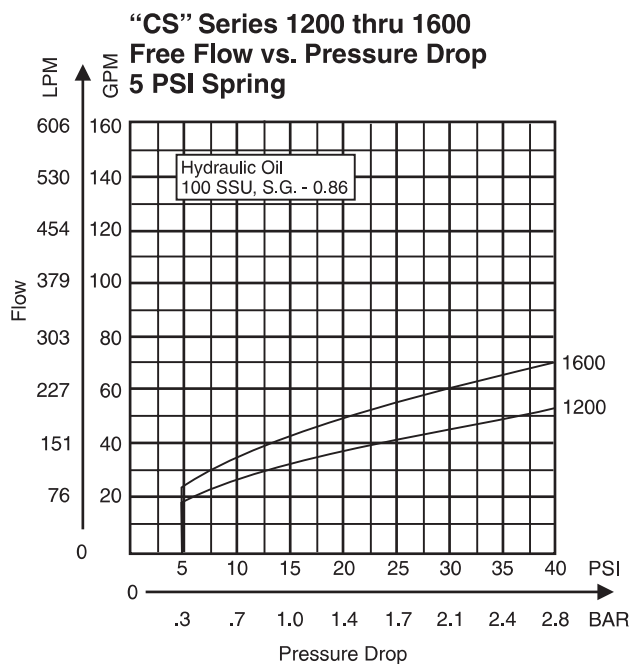
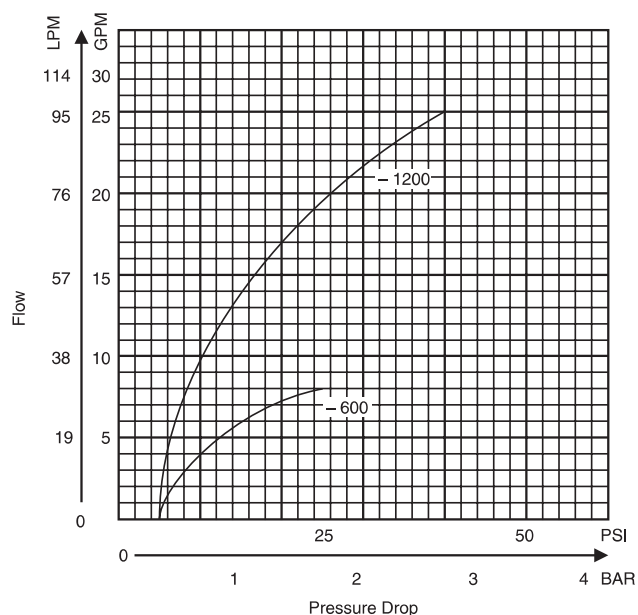
Bolt Kits

To order bolt kits, specify bolt kit number

Valve	Bolt Kit	Bolt Specification*	Bolt Torque
CS600S	BK02	1/4-20 x 1-1/2"	13 Ft.-Lbs.
CS800S	BK04	1/4-20 x 1-3/4"	13 Ft.-Lbs.
CS1200S	BK08	5/16-18 x 2-1/4"	27 Ft.-Lbs.
CS1600S	BK10	5/16-18 x 2-1/2"	27 Ft.-Lbs.

* Use SAE Grade 8 or better

Performance Curves

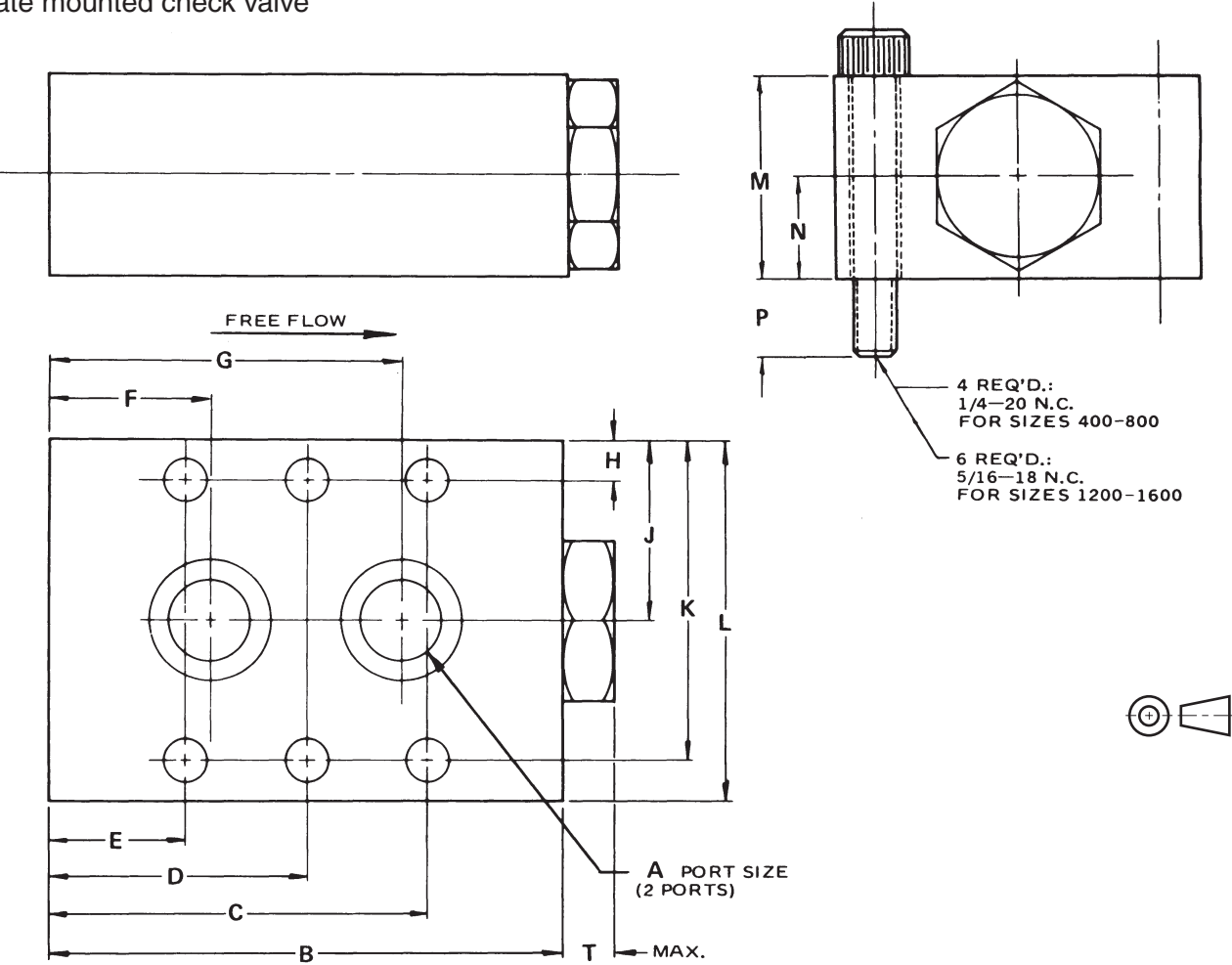


Millimeter equivalents for inch dimensions are shown in (**)

Models CS400S through CS1600S

Subplate mounted check valve

C

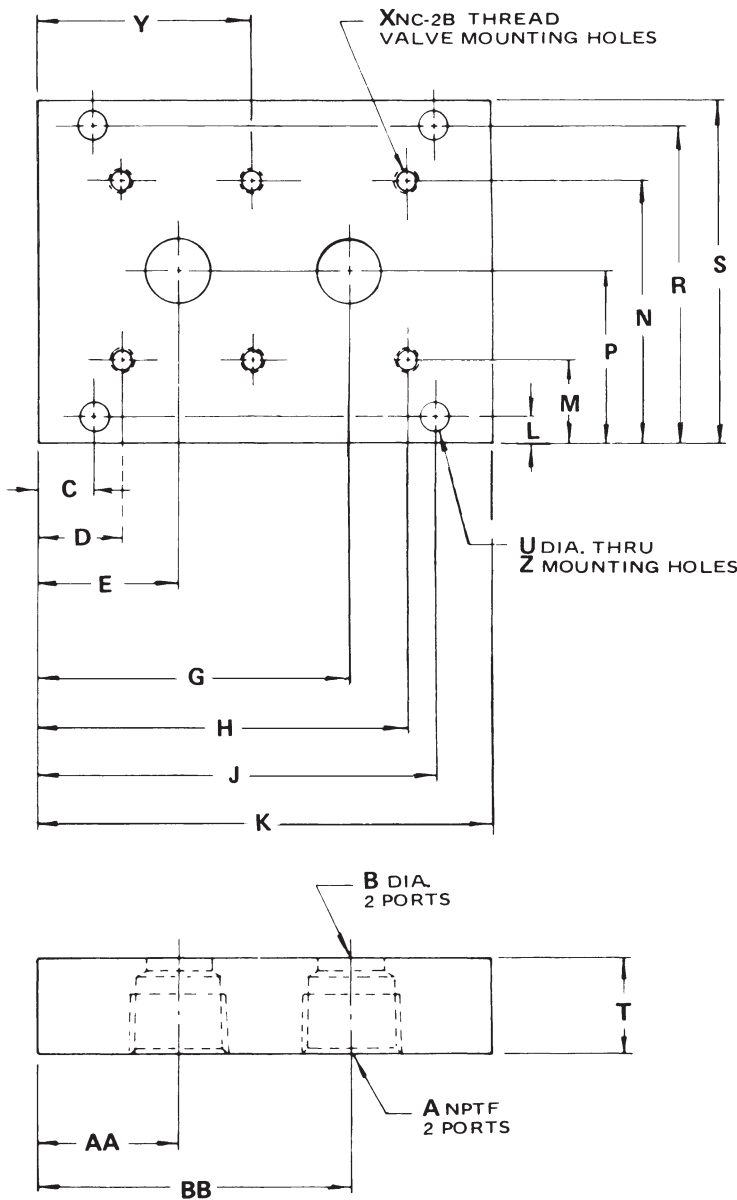


Valve Model	Dimensions in Inches (mm)															Wt. Lbs. (kg)
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	T	
CS600S	0.40 (10.2)	2.75 (51.6)	2.03 (69.9)	—	0.71 (18.0)	0.87 (22.1)	1.87 (47.5)	0.25 (6.4)	1.00 (25.4)	1.75 (44.5)	2.00 (50.8)	1.00 (25.4)	0.50 (12.7)	0.51 (13.0)	0.32 (8.1)	1.6 (0.7)
CS800S	0.47 (11.9)	3.18 (80.7)	2.34 (59.4)	—	0.84 (21.3)	1.00 (25.4)	2.19 (55.6)	0.25 (6.4)	1.12 (28.4)	2.00 (50.8)	2.25 (57.2)	1.25 (31.8)	0.62 (15.7)	0.52 (13.2)	0.32 (8.1)	2.3 (1.0)
CS1200S	0.68 (17.3)	4.09 (103.9)	3.54 (89.9)	2.04 (51.8)	0.54 (13.7)	0.99 (25.1)	3.12 (79.2)	0.31 (7.9)	1.37 (34.8)	2.43 (61.7)	2.75 (69.9)	1.75 (44.5)	0.87 (22.1)	0.57 (14.5)	0.42 (10.7)	5.1 (2.3)
CS1600S	0.87 (22.1)	5.00 (127.0)	4.37 (111.0)	2.50 (63.5)	0.62 (15.7)	1.37 (34.8)	3.62 (91.9)	0.31 (7.9)	1.50 (38.1)	2.68 (68.1)	3.00 (76.2)	2.00 (50.8)	1.00 (25.4)	0.57 (14.5)	0.42 (10.7)	7.6 (3.5)

Millimeter equivalents for inch dimensions are shown in (**)

Subplate

Reference Data Only
(Subplates are not available)



	Valve Numbers			
	CS 600	CS 800	CS 1200	CS 1600
A	3/8"	1/2"	3/4"	1"
B	0.406 (10.3)	0.469 (11.9)	0.656 (16.7)	0.875 (22.2)
C	0.375 (9.5)	0.500 (12.7)	0.344 (8.7)	1.500 (38.1)
D	0.843 (21.4)	0.875 (22.2)	0.750 (19.1)	1.125 (28.6)
E	1.000 (25.4)	1.031 (26.2)	1.188 (30.2)	1.875 (47.6)
G	2.000 (50.8)	2.219 (56.4)	3.328 (84.5)	4.125 (104.8)
H	2.156 (54.8)	2.375 (60.3)	3.750 (95.3)	4.875 (123.8)
J	2.625 (66.7)	2.750 (69.9)	4.156 (105.6)	4.500 (114.3)
K	3.00 (76.2)	3.250 (82.6)	4.500 (114.3)	6.000 (152.4)
L	0.250 (6.4)	0.438 (11.1)	0.344 (8.7)	0.343 (8.7)
M	0.750 (19.1)	1.125 (28.6)	1.062 (27.0)	1.062 (27.0)
N	2.250 (57.2)	2.875 (73.0)	3.188 (81.0)	3.438 (87.3)
P	1.500 (38.1)	2.000 (50.8)	2.125 (54.0)	2.250 (57.2)
R	2.750 (69.9)	3.562 (90.5)	3.906 (99.2)	4.156 (105.6)
S	3.000 (76.2)	4.000 (101.6)	4.250 (108.0)	4.500 (114.3)
T	1.125 (28.6)	1.125 (28.6)	1.125 (28.6)	1.250 (31.8)
U	0.281 (7.1)	0.359 (9.1)	0.422 (10.7)	0.422 (10.7)
X	1/4-20	1/4-20	5/16-18	5/16-18
Y	—	—	2.250 (57.2)	3.000 (76.2)
Z	4 Holes	4 Holes	6 Holes	6 Holes
AA	1.000 (25.4)	1.031 (26.2)	1.188 (30.2)	1.875 (47.6)
BB	2.000 (50.8)	2.219 (56.4)	3.328 (84.5)	4.125 (104.8)



C

In-Line Mounted Flow Control Valves

Series 133, 135, 143 Needle D2 - D3

Series FS.....Flow Control D4 - D8

Series PC*MS Pressure Compensated.....D9 - D12

Series TPC Temperature & Pressure Compensated D13 - D16

Series MVI.....Cartridge-type Needle D17 - D19

Series D Cam-Operated, 2-Way.....D20 - D33

Series NS Needle D34 - D37

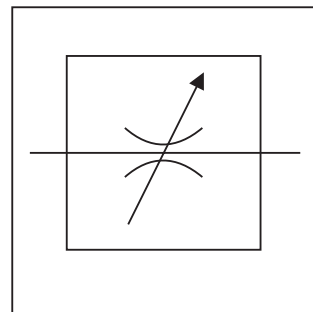
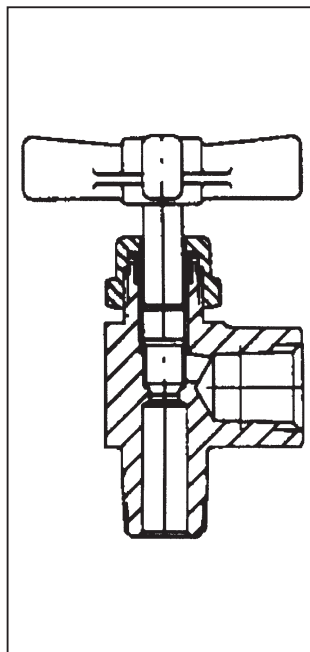


General Description

Series 133, 135, and 143 needle valves are capable of metering flow of a wide variety of liquids and gases. A soft seat design can be used when zero leakage is required.

Features

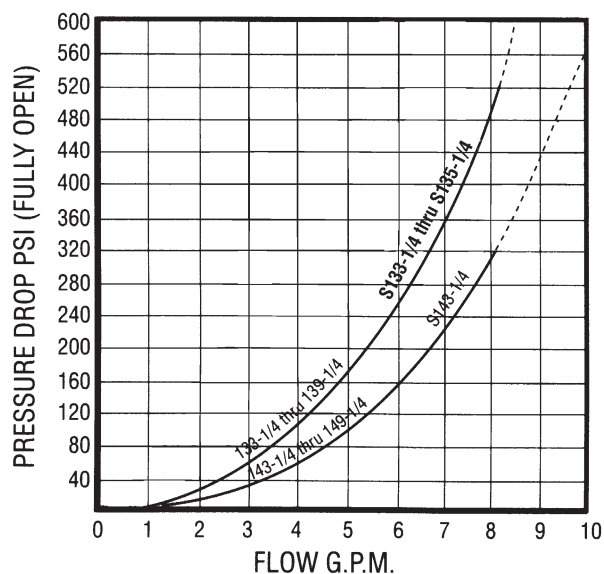
- Brass needle valves available in metal and soft seat designs
- Special stem designs offer precision control of small volume flows
- External pipe threaded ports are counterbored to accept solder-type tube fittings
- Stops, prevents stems from being screwed out accidentally
- In the soft seat type the resiliency of the captive thermoplastic nose assures positive shut-off



Specifications

Service Applications	Liquids
Maximum Operating Pressure	Working: 345 Bar (5000 PSI) Proof: 517.5 Bar (7500 PSI) Burst: 862.5 Bar (12,500 PSI)
Sizes	NPT: 1/4
Ports	NPT: Pipe threads
Internal Leakage	Zero
Mounting	In-line or panel. Maximum panel thickness 1/2". Panel hole diameter 17/32".
Material	Body: Brass Cap: Brass Cap Washer: 316 Stainless Steel Locknut: Brass Stem: 303 or 316 Stainless Steel Stem Nose Soft Seat: Thermoplastic Washers: 304 Stainless Steel Packing: PTFE Handle: Aluminum alloy star (metal seat)
Operating Temperature	Brass: -54°C to 93°C (-65°F to 200°F) Consult factory for special temps.

Performance Curves

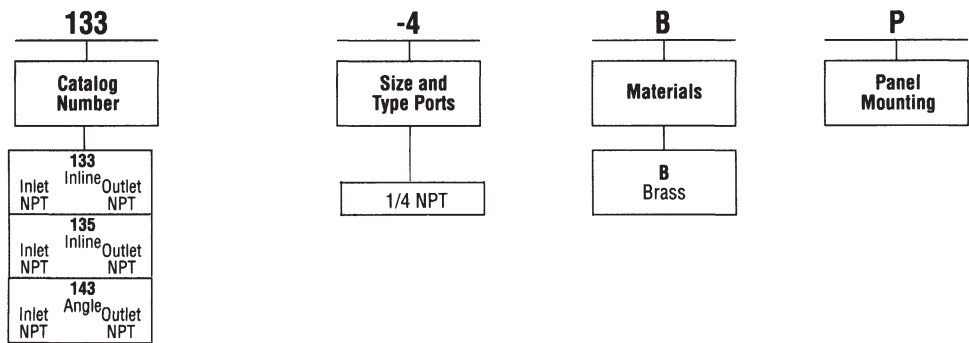


Size	CV Factors		Weights (Approx.)
	Inline	Angle	
1/4	.19	.37	.25 Lb.

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

D1_Cat3000.indd, ddp, 04/19

Ordering Information

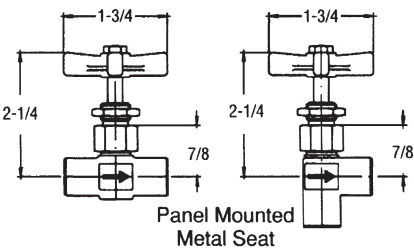


Dimensions

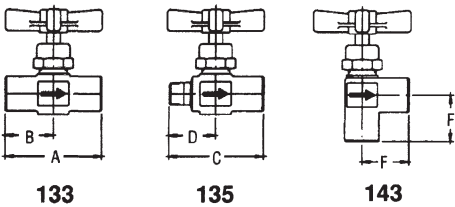
Dimensions are shown in inches



Handle and Centerline



Flow Direction of Soft Seat is Reverse of Arrows Shown Below



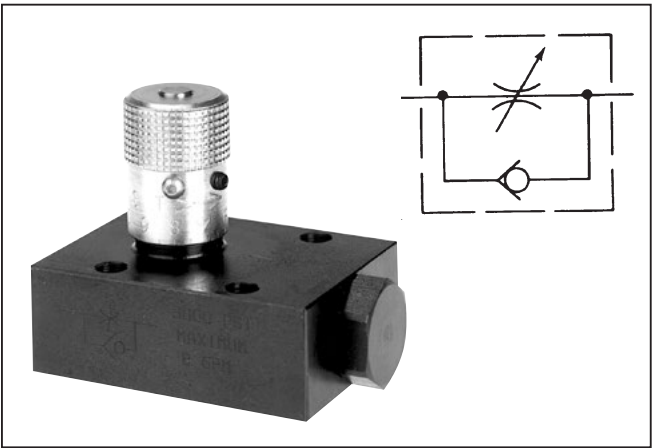
Dimensions Apply to Both Regular and Panel-Mounting Types, Metal and Soft Seat

Dash Number	Size		A	B	C	D	E	F	G	H	J
	Tube	Pipe									
1/4	—	1/4	1-7/8	15/16	1-13/16	7/8	1-3/4	7/8	15/16	—	—

General Description

Series FS flow control valves provide precise control of flow and shutoff in one direction, and automatically permit full flow in the opposite direction.

A two-step needle allows fine adjustment at low flow by using the first three turns of the adjusting knob; the next three turns open the valve to full flow, and also provide standard throttling adjustments.



Features

- The exclusive “Colorflow” color-band reference scale on the valve stem is a great convenience and time-saver in setting the valve originally and in returning it to any previous setting
- A simple set screw locks the valve on any desired setting
- Stainless steel poppets are standard

Specifications

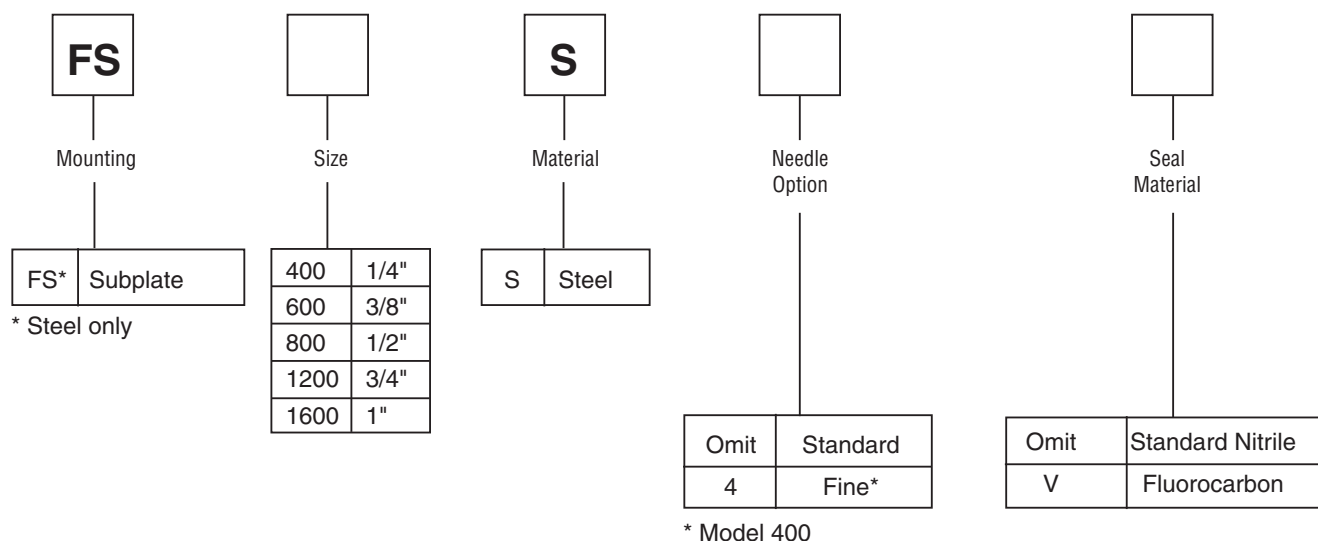
Maximum Operating Pressure	210 Bar (3000 PSI)
Nominal Cracking Pressure	0.3 Bar (5 PSI) For return check poppet
Poppet Style	Solid metal poppet, steel
Needles	Standard needle on all models except: Fine needle option on FS400 and FS600

Flow Data

Model Number	Free Flow Rate, Max. GPM (LPM)	Free Flow Orifice Area in ²	Free Flow Cv	Orifice Area, Effective Control Flow, in ²	Effective Control Flow Cv	Port Size
FS400	5 (19)	0.068	1.56	.0194	.433	1/4
FS600	8 (30)	0.099	2.27	.0344	.787	3/8
FS800	15 (57)	0.224	5.11	.0427	.976	1/2
FS1200	25 (95)	0.348	7.95	.1080	2.470	3/4
FS1600	40 (151)	0.453	10.35	.2300	5.250	1

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

D1_Cat3000.indd, ddp, 04/19



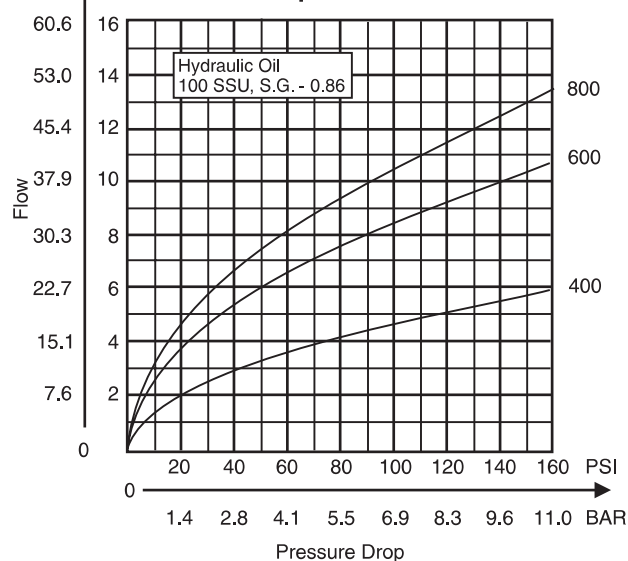
Bolt Kits To order bolt kits, specify bolt kit number

Valve	Bolt Kit	Bolt Specification*	Bolt Torque
FS400S	BK01	1/4-20 x 1-1/4"	13 Ft.-Lbs.
FS600S	BK02	1/4-20 x 1-1/2"	13 Ft.-Lbs.
FS800S	BK04	1/4-20 x 1-3/4"	13 Ft.-Lbs.
FS1200S	BK08	5/16-18 x 2-1/4"	27 Ft.-Lbs.
FS1600S	BK10	5/16-18 x 2-1/2"	27 Ft.-Lbs.

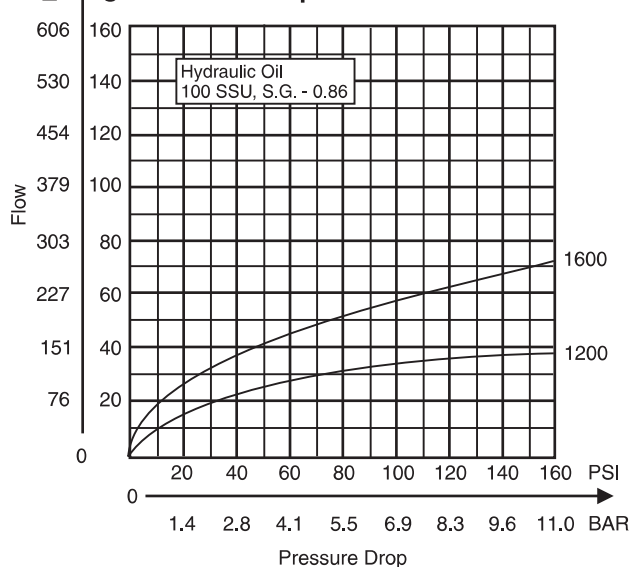
* Use SAE Grade 8 or Better.

D

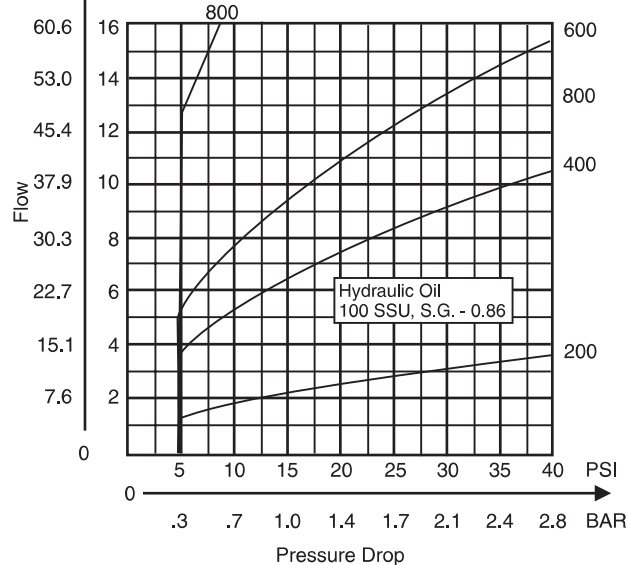
“FS” Series 400 thru 800
Controlled Flow vs. Pressure Drop
Needle Full Open



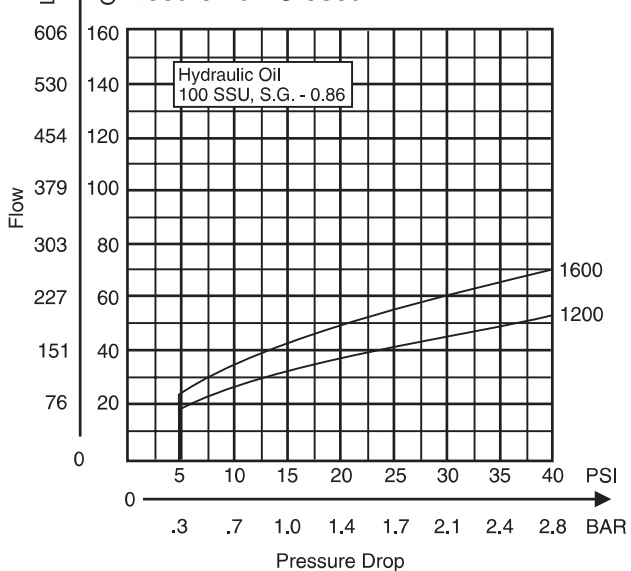
“FS” Series 1200 thru 1600
Controlled Flow vs. Pressure Drop
Needle Full Open



“FS” Series 400 thru 800
Free Flow vs. Pressure Drop
Needle Full Closed



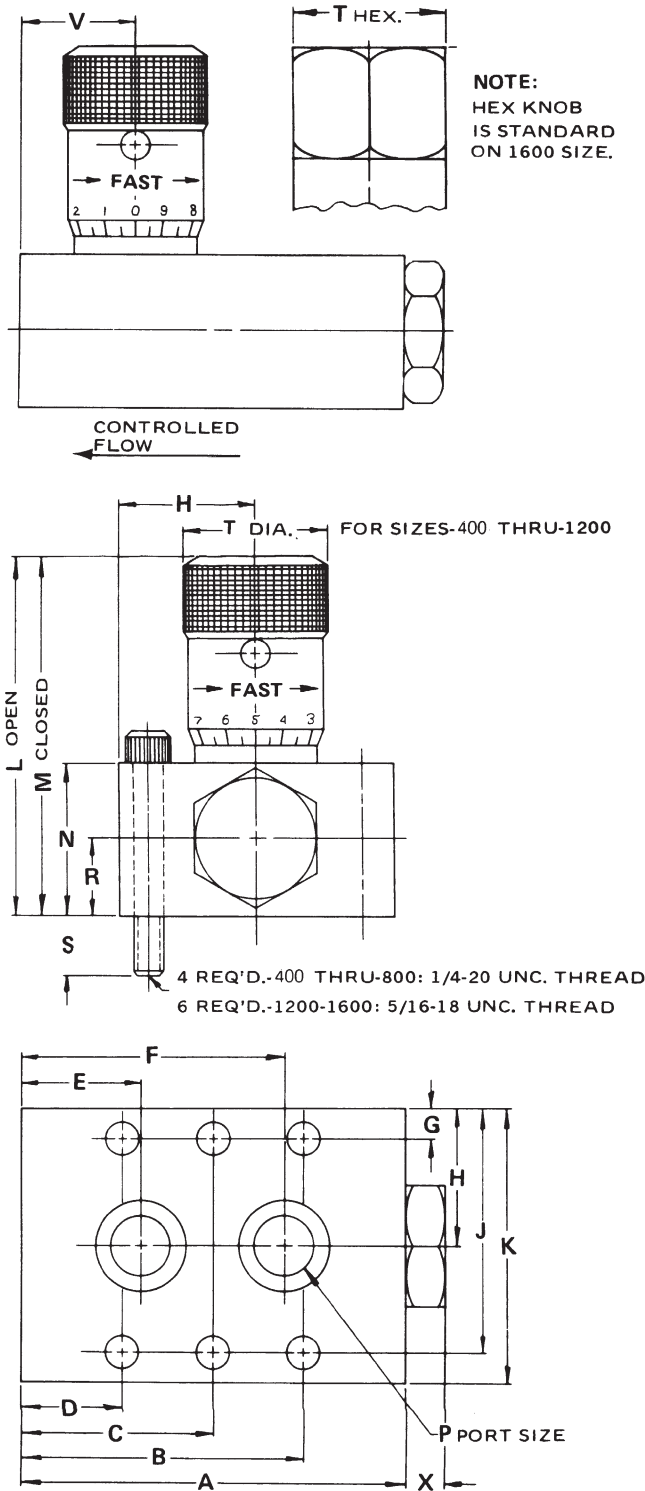
“FS” Series 1200 thru 1600
Free Flow vs. Pressure Drop
Needle Full Closed



Millimeter equivalents for inch dimensions are shown in (**)

Models FS400 through FS 1600

Subplate mounted Flow Control Valves



NOTE:
HEX KNOB
IS STANDARD
ON 1600 SIZE.



	Valve Model				
	FS400	FS600	FS800	FS1200	FS1600
A	2.50 (63.5)	2.75 (69.9)	3.19 (81.0)	4.09 (103.9)	5.00 (127.0)
B	1.94 (49.3)	2.03 (51.6)	2.34 (59.4)	3.55 (90.2)	4.38 (111.3)
C	—	—	—	2.05 (52.1)	2.50 (63.5)
D	.56 (14.2)	.72 (18.3)	.84 (21.3)	.55 (14.0)	.62 (15.7)
E	.75 (19.1)	.88 (22.4)	1.00 (25.4)	.99 (25.1)	1.38 (35.1)
F	1.75 (44.5)	1.88 (47.8)	2.19 (55.6)	3.12 (79.2)	3.62 (92.0)
G	.22 (5.6)	.25 (6.4)	.25 (6.4)	.31 (7.9)	.31 (7.9)
H	.88 (22.4)	1.00 (25.4)	1.12 (28.4)	1.38 (35.1)	1.50 (38.1)
J	1.53 (38.9)	1.75 (44.5)	2.00 (50.8)	2.44 (62.0)	2.69 (68.3)
K	1.75 (44.5)	2.00 (50.8)	2.25 (57.2)	2.75 (69.9)	3.00 (76.2)
L	2.21 (56.1)	2.65 (67.3)	3.29 (83.6)	4.35 (110.5)	5.76 (146.3)
M	2.01 (51.1)	2.40 (61.0)	3.00 (76.2)	3.76 (95.5)	5.10 (129.5)
N	.87 (22.1)	1.00 (25.4)	1.25 (31.8)	1.75 (44.5)	2.00 (50.8)
P	.28 (7.1)	.41 (10.4)	.47 (11.9)	.66 (16.8)	.88 (22.4)
R	.43 (10.9)	.50 (12.7)	.62 (15.7)	.87 (22.1)	1.00 (25.4)
S	.38 (9.7)	.50 (12.7)	.50 (12.7)	.50 (12.7)	.50 (12.7)
T	.81 (20.6)	1.00 (25.4)	1.18 (30.0)	1.37 (34.8)	1.87 (47.5)
V	.84 (21.3)	1.00 (25.4)	1.21 (30.7)	1.52 (38.6)	1.78 (45.2)
X	.31 (7.9)	.32 (8.1)	.32 (8.1)	.42 (10.7)	.42 (10.7)

D

Millimeter equivalents for inch dimensions are shown in (**)

Subplate

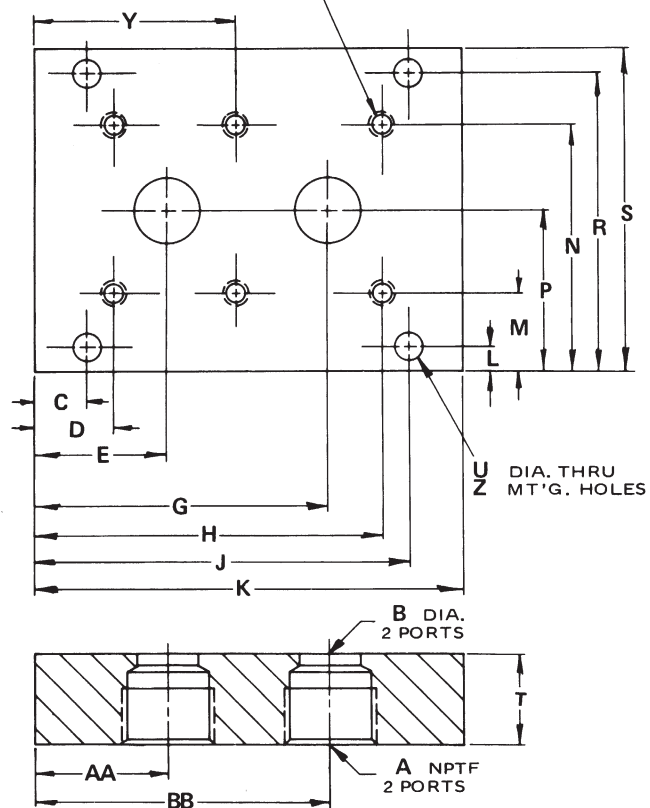
Models FS400 through FS1600

Reference Data Only

(Subplates are not available)



X UNC-2B THREAD
VALVE MOUNTING HOLES
CC DEEP



	Valve Numbers				
	FS 400	FS 600	FS 800	FS 1200	FS 1600
A	1/4"	3/8"	1/2"	3/4"	1"
B	.281 (7.1)	.406 (10.3)	.469 (11.9)	.656 (16.7)	.875 (22.2)
C	.375 (9.5)	.375 (9.5)	.500 (12.7)	.344 (8.7)	.344 (8.7)
D	.562 (14.3)	.843 (21.4)	.875 (22.2)	.750 (19.1)	1.125 (28.6)
E	.750 (19.1)	1.000 (25.4)	1.031 (26.2)	1.188 (30.2)	1.875 (47.6)
G	1.750 (44.5)	2.000 (50.8)	2.219 (56.4)	3.312 (84.1)	4.125 (104.8)
H	1.938 (49.2)	2.156 (54.8)	2.375 (60.3)	3.750 (95.3)	4.875 (123.8)
J	2.125 (54.0)	2.625 (66.7)	2.750 (69.9)	4.156 (105.6)	5.656 (143.7)
K	2.50 (63.5)	3.00 (76.2)	3.25 (82.6)	4.50 (114.3)	6.00 (152.4)
L	.344 (8.7)	.250 (6.4)	.438 (11.1)	.344 (8.7)	.344 (8.7)
M	.844 (21.4)	.750 (19.1)	1.125 (28.6)	1.062 (27.0)	1.062 (27.0)
N	2.156 (54.8)	2.250 (57.2)	2.875 (73.0)	3.188 (81.0)	3.438 (87.3)
P	1.500 (38.1)	1.500 (38.1)	2.000 (50.8)	2.125 (54.0)	2.250 (57.2)
R	2.656 (67.5)	2.750 (69.9)	3.562 (90.5)	3.906 (99.2)	4.156 (105.6)
S	3.00 (76.2)	3.00 (76.2)	4.00 (101.6)	4.25 (108.0)	4.50 (114.3)
T	1.125 (28.6)	1.125 (28.6)	1.125 (28.6)	1.125 (28.6)	1.250 (31.8)
U	.281 (7.1)	.281 (7.1)	.359 (9.1)	.422 (10.7)	.422 (10.7)
X	1/4-20	1/4-20	1/4-20	5/16-18	5/16-18
Y	—	—	—	2.250 (57.2)	3.000 (76.2)
Z	4	4	4	6	6
AA	.750 (19.1)	1.000 (25.4)	1.031 (26.2)	1.188 (30.2)	1.875 (47.6)
BB	1.750 (44.5)	2.000 (50.8)	2.219 (56.4)	3.312 (84.5)	4.125 (104.8)
CC	.505 (12.8)	.525 (13.3)	.525 (13.3)	.525 (13.3)	.525 (13.3)

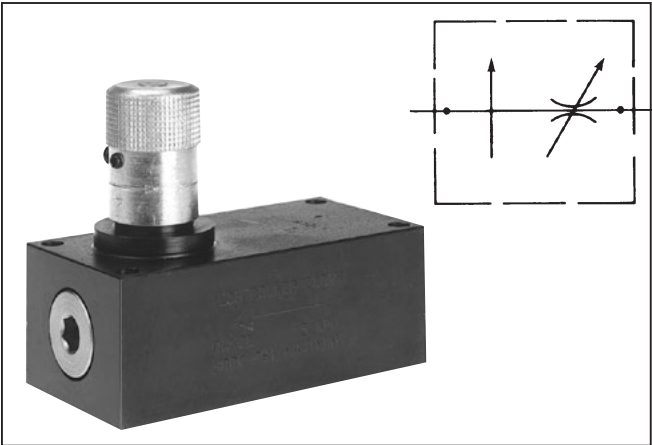
General Description

Series PC*MS pressure compensated flow control valves are designed to regulate flow at a selected rate, then maintain this flow constant within $\pm 5\%$ as inlet and outlet pressures vary. However, changes in fluid temperature will prevent flow from holding constant.

Series PCMS valves can be adjusted for required flows after being installed.

Features

- Available with reverse flow check
- The exclusive “Colorflow” color-band reference scale on the valve stem is a great convenience and time-saver in setting the valve originally and in returning it to any previous setting
- A simple set screw locks the valve on any desired setting



Specifications

Service App.	Meter-in/meter-out and bleedoff circuits
Maximum Operating Pressure	210 Bar (3000 PSI)
Minimum Pressure Inlet / Outlet Differential	7 Bar (100 PSI) for sizes 1/4" and 3/8" 11 Bar (150 PSI) for sizes 1/2" through 1" Reverse-flow check valve optional

Flow Data

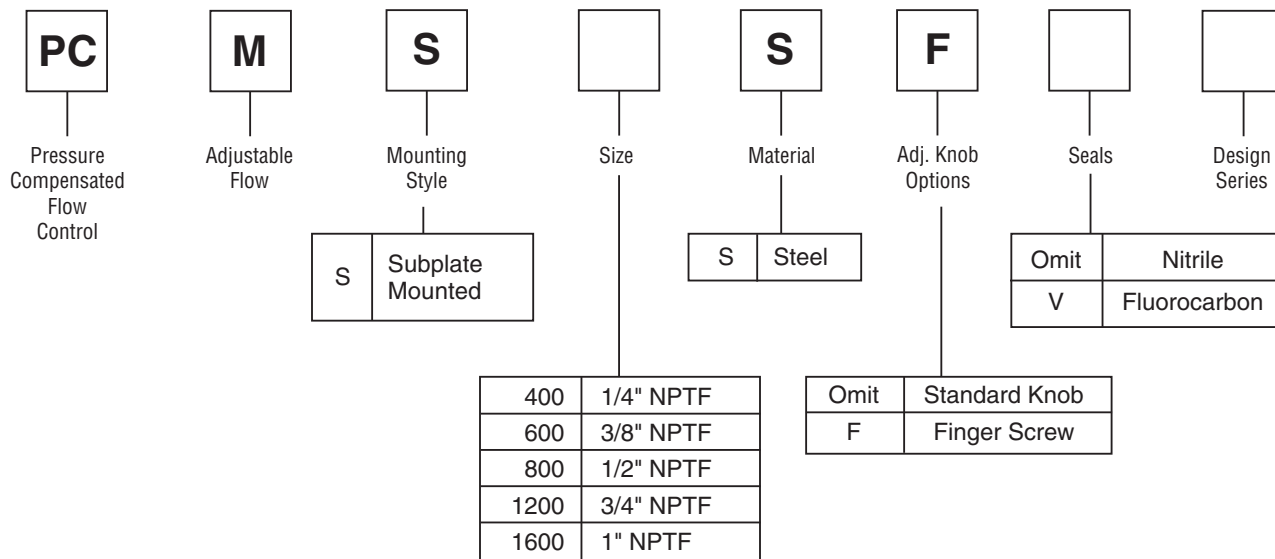
Valve Model	Flow		Reverse Flow, max. thru check, GPM (LPM)	Pressure Drop ΔP at max. Reverse Flow thru check, PSI (Bar)	Mounting	Port Size, in.
	Minimum GPM (LPM)	Maximum GPM (LPM)				
PC*MS400S	0.3 (1)	3.0 (11)	5 (19)	40 (3)	Subplate	1/4
PC*MS600S	0.6 (2)	6.0 (23)	8 (30)	40 (3)	Subplate	3/8
PC*MS800S	1/5 (6)	15.0 (57)	20 (76)	114 (8)	Subplate	1/2
PC*MS1200S	2.5 (10)	25.0 (95)	35 (132)	120 (8)	Subplate	3/4
PC*MS1600S	5.0 (19)	50.0 (189)	60 (227)	140 (10)	Subplate	1

* For optional reverse-flow check, insert “C” in model number at asterisk (*).

 **WARNING:** This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

D1_Cat3000.indd, ddp, 04/19

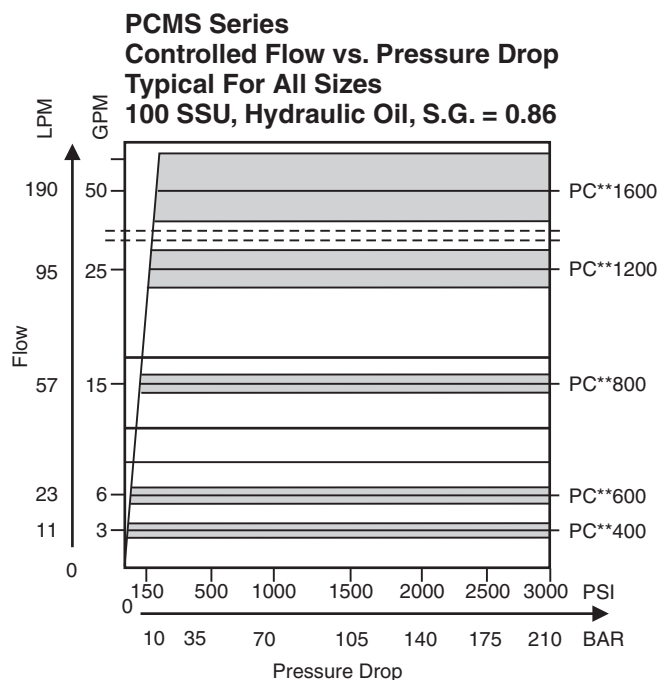
Ordering Information



Bolt Kits

Valve No.	Bolt Kit	Bolts (SAE8 or better)	Torque (ft. lb.)
PCMS400S	BK02	1/4-20 x 1-1/2	15
PCMS600S	BK04	1/4-20 x 1-3/4	15
PCMS800S	BK60	1/4-20 x 2-1/4	15
PCMS1200S	BK25	5/16-18 x 2-3/4	30
PCMS1600S	BK46	5/16-18 x 3-1/4	30

Performance Curves

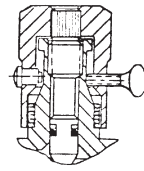


D1_Cat3000.indd, ddp, 04/19

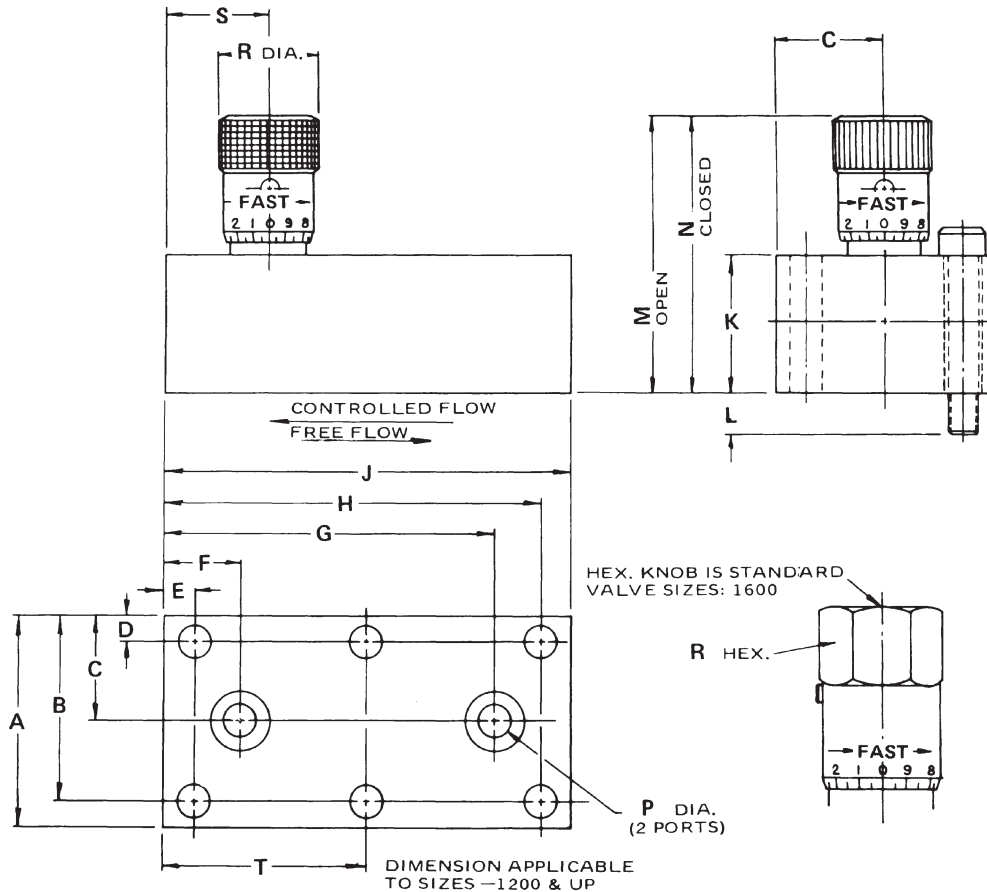
Millimeter equivalents for inch dimensions are shown in (**)

Model PCMS400S thru PCMS 1600S

Manifold mounted, pressure compensated
Flow Control Valves



Finger screw
option (Code "F")
provides this
thumbscrew in
place of set screw.



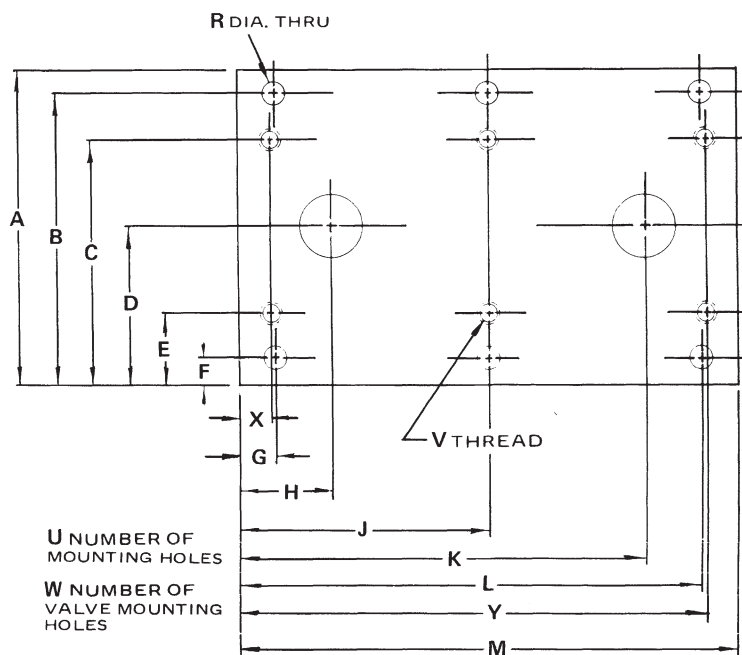
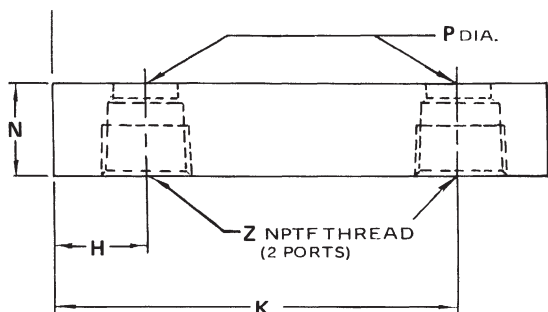
Valve Model	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T
PC*MS400S	1.75 (44.5)	1.53 (38.9)	.88 (22.4)	.22 (5.6)	.25 (6.4)	.62 (15.7)	2.75 (69.9)	3.12 (79.2)	3.38 (85.9)	1.12 (28.4)	.38 (9.7)	2.47 (62.7)	2.27 (57.7)	.28 (7.1)	.81 Dia. (20.6)	.84 (21.3)	—
PC*MS600S	2.00 (50.8)	1.75 (44.5)	1.00 (25.4)	.25 (6.4)	.25 (6.4)	.66 (16.8)	3.34 (84.8)	3.75 (95.3)	4.00 (101.6)	1.25 (31.8)	.50 (12.7)	2.89 (73.4)	2.67 (67.8)	.34 (8.6)	1.00 Dia. (25.4)	1.00 (25.4)	—
PC*MS800S	2.25 (57.2)	2.00 (50.8)	1.12 (28.4)	.25 (6.4)	.25 (6.4)	.75 (19.1)	3.88 (98.6)	4.38 (111.3)	4.62 (117.3)	1.75 (44.5)	.50 (12.7)	4.04 (102.6)	3.74 (95.0)	.47 (11.9)	1.19 Dia. (30.2)	1.75 (44.5)	—
PC*MS1200S	2.75 (69.9)	2.44 (62.0)	1.38 (35.1)	.31 (7.9)	.38 (9.7)	1.00 (25.4)	4.62 (117.3)	5.25 (133.4)	5.62 (142.7)	2.25 (57.2)	.50 (12.7)	5.06 (128.5)	4.56 (115.8)	.66 (16.8)	1.38 Dia. (35.1)	1.59 (40.4)	2.81 (71.4)
PC*MS1600S	3.00 (76.2)	2.69 (68.3)	1.50 (38.1)	.31 (7.9)	.50 (12.7)	1.25 (31.8)	5.50 (139.7)	6.25 (158.8)	6.75 (171.5)	2.75 (69.9)	.50 (12.7)	6.90 (175.3)	6.23 (158.2)	.88 (22.4)	1.88 Hex. (47.8)	1.94 (49.3)	3.38 (85.9)

Millimeter equivalents for inch dimensions are shown in (**)

Subplate

Reference Data Only

(Subplates are not available)



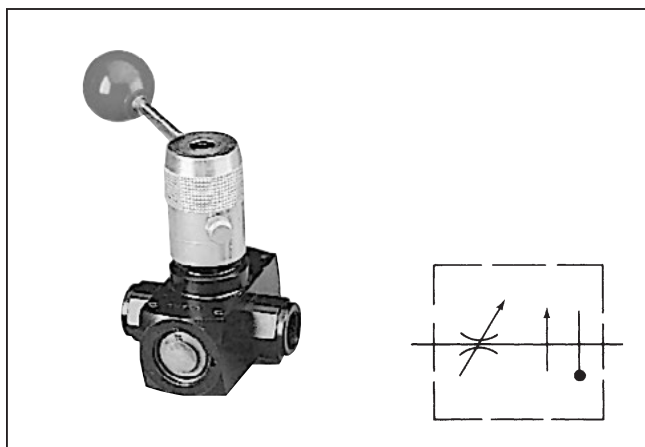
Valve Model	PCMS400S	PCMS600S	PCMS800S	PCMS 1200S	PCMS 1600S
N.P.T.F. Port Size	1/4—18	3/8—18	1/2—14	3/4—14	1—11-1/2
A	2.75 (69.9)	3.00 (76.2)	3.50 (88.9)	4.00 (101.6)	4.50 (114.3)
B	2.500 (63.5)	2.750 (69.9)	3.188 (81.0)	3.688 (93.7)	4.125 (104.8)
C	2.031 (51.6)	2.250 (57.2)	2.625 (66.7)	3.062 (77.8)	3.438 (87.3)
D	1.375 (34.9)	1.500 (38.1)	1.750 (44.5)	2.000 (50.8)	2.250 (57.2)
E	.719 (18.3)	.750 (19.1)	.875 (22.2)	.938 (23.8)	1.062 (27.0)
F	.250 (6.4)	.250 (6.4)	.312 (7.9)	.312 (7.9)	.375 (9.5)
G	.250 (6.4)	.250 (6.4)	.312 (7.9)	.375 (9.5)	.500 (12.7)
H	.625 (15.9)	.656 (16.7)	.750 (19.1)	1.000 (25.4)	1.250 (31.8)
J	—	—	—	2.812 (71.4)	3.375 (85.7)
K	2.750 (69.9)	3.344 (84.9)	3.875 (98.4)	4.625 (117.5)	5.500 (139.7)
L	3.125 (79.4)	3.750 (95.3)	4.312 (109.5)	5.250 (133.4)	6.250 (168.3)
M	3.375 (85.7)	4.000 (101.6)	4.625 (117.5)	5.625 (142.9)	6.750 (171.5)
N	1.125 (28.6)	1.125 (28.6)	1.125 (28.6)	1.125 (28.6)	1.125 (28.6)
P	.281 (7.1)	.343 (8.7)	.468 (11.9)	.656 (16.7)	.875 (22.2)
R	.281 (7.1)	.281 (7.1)	.359 (9.1)	.359 (9.1)	.422 (10.7)
U	4	4	4	6	6
V	1/4—20	1/4—20	1/4—20	5/16—18	5/16—18
W	4	4	4	6	6
X	.250 (6.4)	.250 (6.4)	.250 (6.4)	.375 (9.5)	.500 (12.7)
Y	3.125 (79.4)	3.750 (95.3)	4.375 (111.1)	5.250 (133.4)	6.250 (168.3)
Z	1/4—18	3/8—18	1/2—14	3/4—14	1—11-1/2

General Description

Series TPC valves are pressure compensated and are insensitive to variations in oil temperature. These valves are ideal for use on meter-in, meter-out or bleed-off circuits.

Features

- Maintains constant flow with changing inlet and outlet pressures. Minimum pressure differential between inlet and outlet ports must be 100 PSI (7 Bar) for Model TPC600 to function properly; 150 PSI (10.5 Bar) for Model TPC1200
- Maintains flow setting within approximately $\pm 5\%$ variation over pressure drop range 100 to 3000 PSI (7 to 210 Bar)
- Optional reverse flow check valves available on Models TPCC600 and TPCC1200; check valve cracking pressure is 5 PSI (0.4 Bar)
- Insensitivity to oil temperature change allows constant flow rate over a wide change of fluid temperature
- Optional lunge control available on Model TPC600 to limit compensator piston travel. This control prepositions the compensator piston to minimize actuator lunge.



Specifications

Maximum Operating Pressure	3000 PSI (210 Bar)		
Pressure Compensation	TPC600	100 PSI (7 Bar) Minimum	
	TPC1200	150 PSI (10.5 Bar)	
Flow Setting	±5% 100 to 3000 PSI (7 to 210 Bar)		

Quick Reference Data Chart

Valve Model	Flow (max.) GPM (L/M)	Reverse Flow (max.) (thru check) GPM (L/M)	Pressure Drop ΔP at max. (reverse flow thru check) PSI (Bar)	Mounting	Port Size, in.
TPC600	6(23)	12 (45)	40 (3)	In-line	3/8 NPTF
TPCS600	6 (23)	—	—	Subplate	3/8
TPC1200	25 (95)	35 (133)	40 (3)	In-line	3/4 NPTF

Needle Flow Chart

FLOW RANGES — TPC600			TEMPERATURE COMPENSATION RANGE (For an 80-220 SSU viscosity change)	
Needle Number	Min. Flow	Max. Flow	Flow Range	% Flow Variation
01	5 CIPM (81.96 CC/M)	25 CIPM (410 CC/M)	5-25 CIPM (82-410 CC/M)	$\pm 5\%$
02	5 CIPM (81.96 CC/M)	50 CIPM (820 CC/M)	5-50 CIPM (82-820 CC/M)	$\pm 5\%$
06	5 CIPM (81.96 CC/M)	140 CIPM (2300 CC/M)	5-139 CIPM (82-2279 CC/M) 51-140 CIPM (836-2295 CC/M)	$\pm 5\%$ $\pm 3\%$
3	0.06 GPM (.22 L/M)	3 GPM (12 L/M)	0.1-1.0 GPM (.4-4 L/M) 1.0-3.0 GPM (4-8 L/M)	$\pm 5\%$ $\pm 3\%$
6	0.12 GPM (.45 L/M)	6 GPM (23 L/M)	0.1-1.9 GPM (.4-8 L/M) 2.0-4.0 GPM (8-15 L/M) 4.0-6.0 GPM (8-23 L/M)	$\pm 5\%$ $\pm 4\%$ $\pm 3\%$
TPC1200				
28	0.1 GPM (.4 L/M)	25 GPM (95 L/M)	1.0-3.0 GPM (.4-8 L/M) 3.0-8.0 GPM (8-30 L/M) 8.0-25 GPM (30-95 L/M)	$\pm 7\%$ $\pm 5\%$ $\pm 3\%$

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

D1_Cat3000.indd, ddp, 04/19

TPC

Temperature
Pressure
Compensated
Flow Control

Reverse
Check

Code	Description
Omit	Without Check
C	With Check (Line mounted only)

Flow
Range

Code	Description
01*	5 - 25 CIPM
02*	5 - 50 CIPM
06*	5 - 140 CIPM
3*	0.1 - 3 GPM
6*	0.1 - 6 GPM
28**	1.0 - 25 GPM

* 3/8" size only.
** 3/4" size only.

S

Material

Code	Description
S	Steel

Size

Code	Description
600	3/8"
1200	3/4"

Seals

Code	Description
Omit	Nitrile
V	Fluorocarbon

D

NOTE: See Needle Flow Chart in Engineering Performance section for flow information.

Bolt Kits

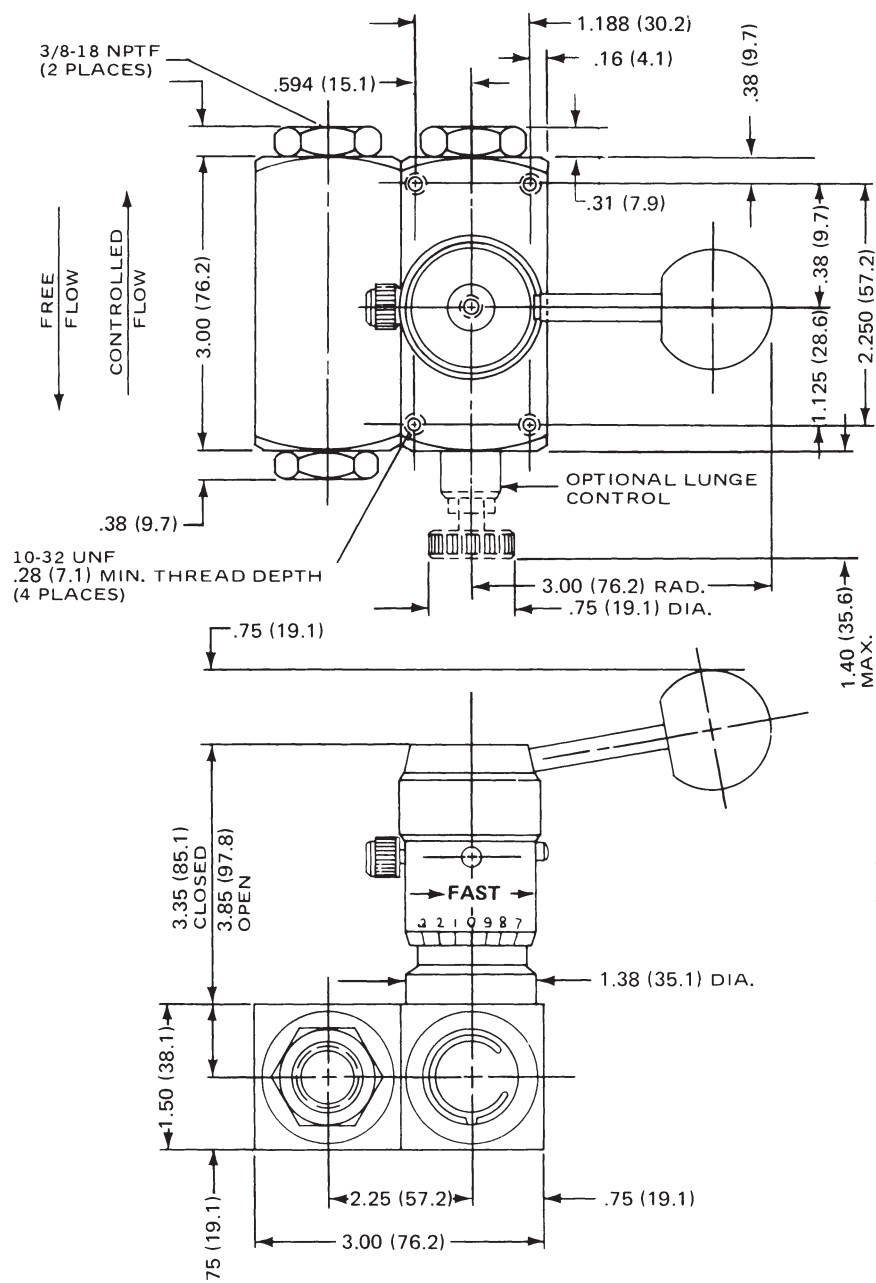
TPCS600	Bolt Kit No. BK07	Bolt specification 5/16" - 18 x 1"	Bolt torque 19 ft. lb.
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Millimeter equivalents for inch dimensions are shown in (**)

Model TPC600S

In-line mounted, pressure compensated, temperature insensitive

Flow Control Valve with check

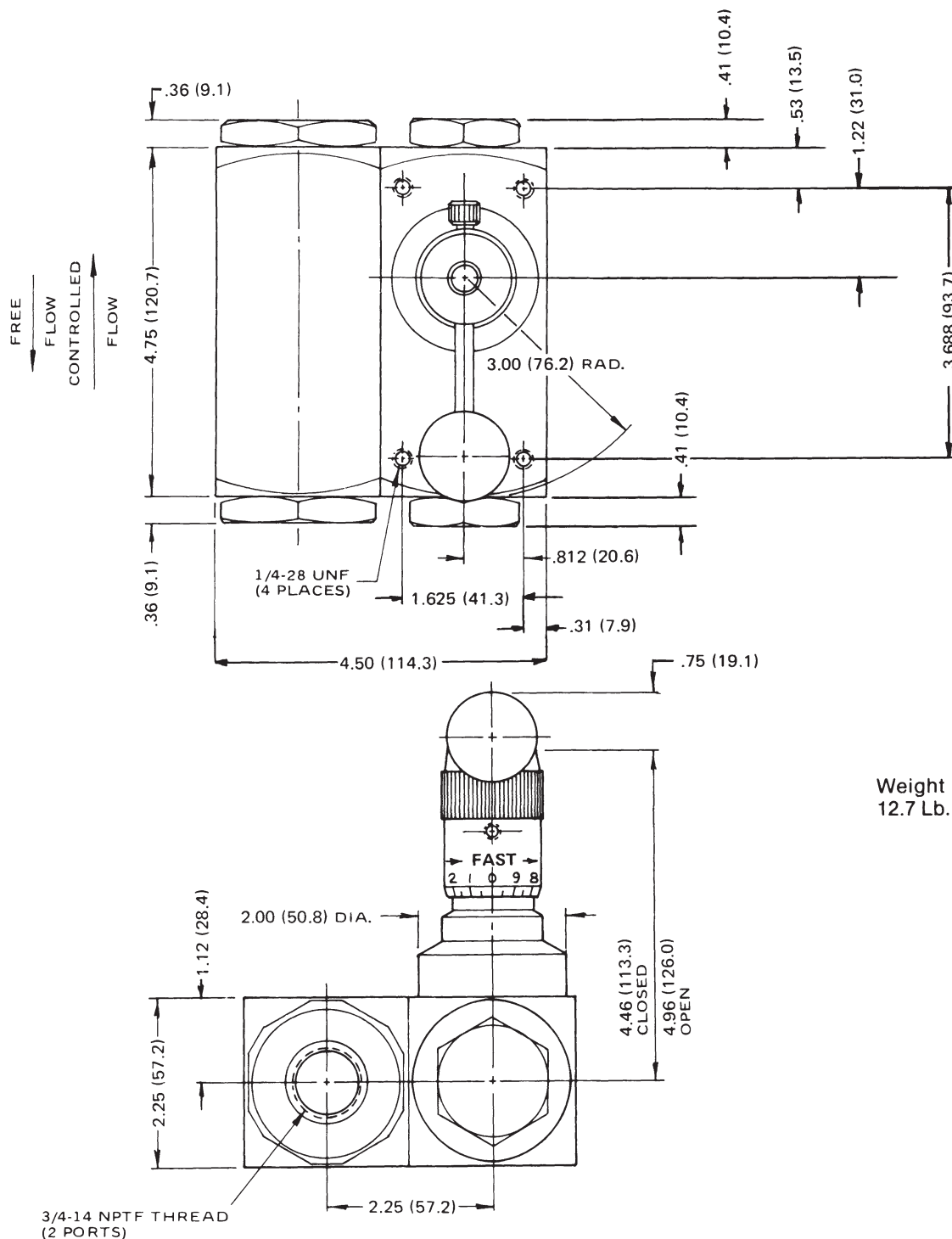


Weight
4.3 Lb. (3 Kg)

Millimeter equivalents for inch dimensions are shown in (**)

Model TPCC1200S-28

In-line mounted, pressure compensated, temperature insensitive
Flow Control Valve

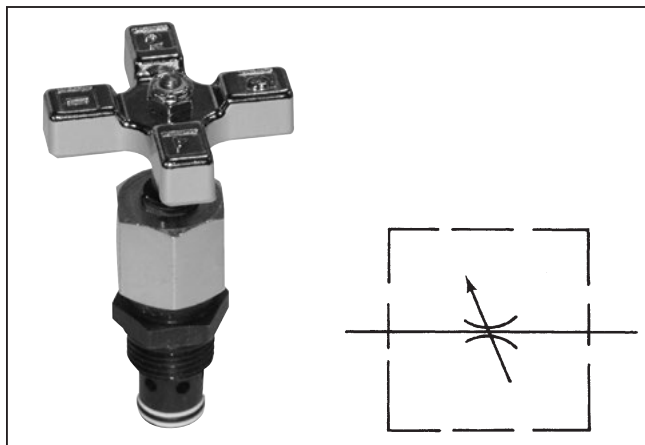


Weight
12.7 Lb. (6 Kg)

General Description

Series MVI cartridge-type needle valves are designed for installation in a precision-machined cavity made in the manifold of the machine. Detailed instructions for machining the required cavity for the valve are given on page D30.

Properly installed in precision-machined cavities, these needle valves provide precise metering control and full shutoff of flow. An o-ring and backup ring installed on the cartridge fully isolate the inlet and outlet ports of the machined cavity from each other.



Features

- The exclusive “Colorflow” color-band reference scale on the valve stem is a great convenience and time-saver in setting the valve originally and in returning it to any previous setting
- Fine and Micro-fine needles available for extremely fine control
- High efficiency o-ring stem seal that eliminates packing

Specifications

Maximum Operating Pressure	340 Bar (5000 PSI)
Flow	See table
Needles	Standard 30° taper Optional fine V-notch for Series MVI400 valves only Optional 0.006" slotted for Series MVI400 only
Material	Steel, compatible in steel or aluminum manifold block cavities

Flow Data

Valve Model	Flow (Max.) GPM (L/M)	ΔP @ Max. Flow	Orifice Area in ² Full Open	C _v * Factor	Valve Size
MVI400	5 (19)	100 PSI (7 Bar)	0.0216	0.493	1/4"
MVI400-2	2.8 (11)	200 PSI (14 Bar)	0.0081	0.186	1/4"
MVI400-3	0.5 (2)	200 PSI (14 Bar)	0.0014	0.032	1/4"
MVI600	8 (30)	35 PSI (3 Bar)	0.0567	1.294	3/8"
MVI800	15 (57)	45 PSI (3 Bar)	0.0845	1.930	1/2"
MVI1200	25 (95)	51 PSI (4 Bar)	0.1400	3.205	3/4"

*C_v factor — Flow of water in GPM that valve will pass @ ΔP of 1 PSI.

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

D1_Cat3000.indd, ddp, 04/19

Ordering Information

MVI

Cartridge
Needle Valve

Size

400	1/4"
600	3/8"
800	1/2"
1200	3/4"

S

Material

S	Steel
---	-------

Optional
Needle

Omit	Standard
2*	Fine
3*	Micro-Fine

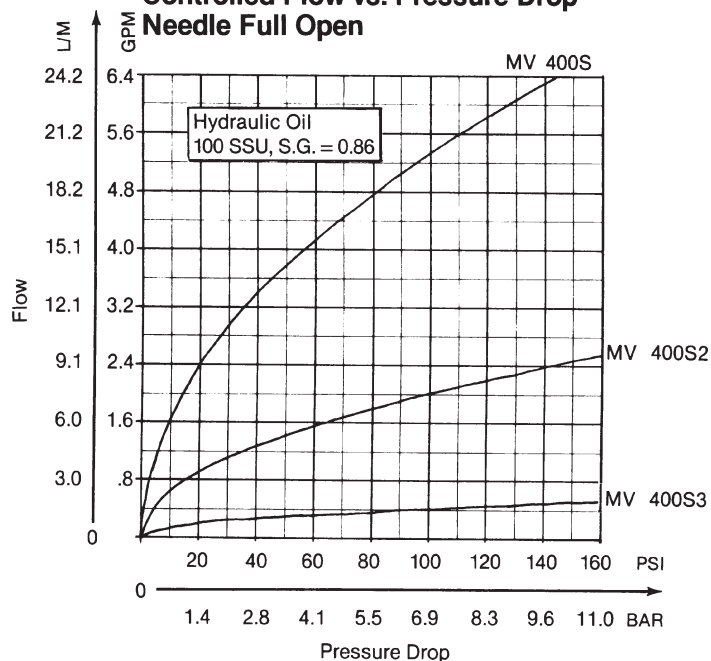
*Available on
MVI400 only

Seals

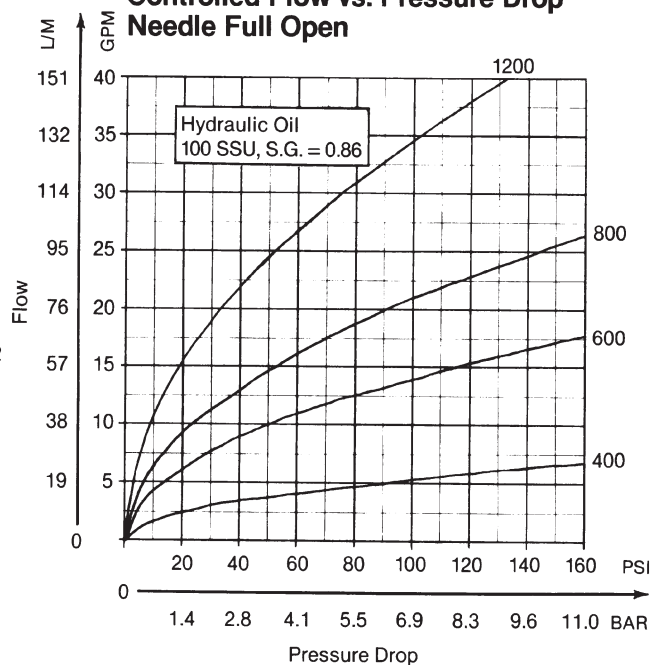
Omit	Nitrile
V	Fluorocarbon

Performance Curves

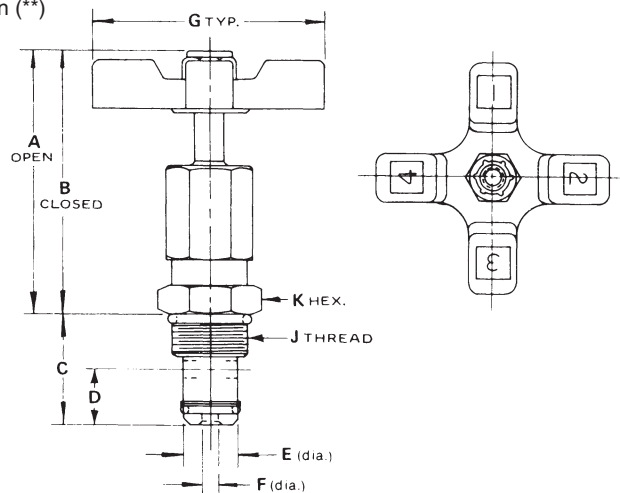
MVI 400S* Series
Controlled Flow vs. Pressure Drop
Needle Full Open



MVI 400S thru 1200
Controlled Flow vs. Pressure Drop
Needle Full Open

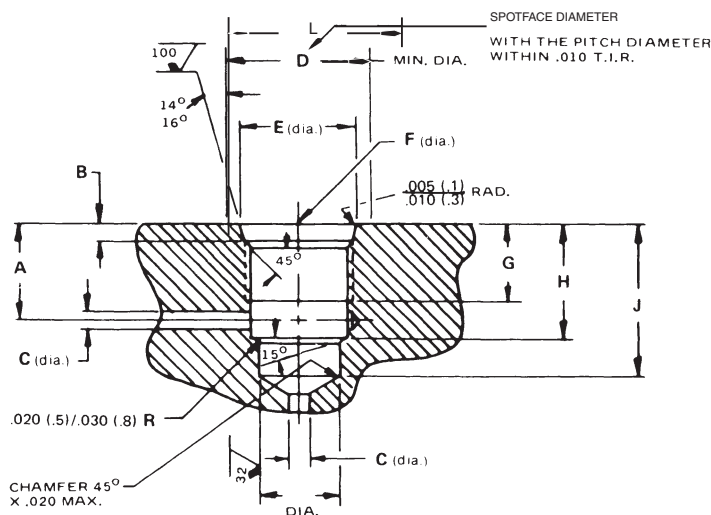


Millimeter equivalents for inch dimensions are shown in (**)



Valve Model	A	B	C	D	E	F	G	J	K	Wt. lb. (kg)
MVI400S*	2.54 (64.5)	2.34 (59.4)	1.00 (25.4)	0.43 (10.9)	.56 (14.2)	.18 (4.6)	2.00 (50.8)	3/4-16UNF-2A	.87 (22.1)	0.4 (0.2)
MVI600S	3.16 (80.3)	2.86 (72.6)	1.18 (30.0)	0.53 (13.5)	.62 (15.7)	.31 (7.9)	2.50 (63.5)	7/8-14UNF-2A	1.00 (25.4)	0.6 (0.3)
MVI800S	3.59 (91.2)	3.09 (78.5)	1.56 (39.6)	0.60 (15.2)	.80 (20.3)	.37 (9.4)	3.25 (82.6)	1-1/16-12UN-2A	1.25 (31.8)	1.2 (0.5)
MVI1200S	4.00 (101.6)	3.45 (87.6)	1.71 (43.4)	0.75 (19.1)	1.06 (26.9)	.46 (11.7)	3.87 (98.3)	1-5/16-12UN-2A	1.50 (38.1)	2.0 (0.9)

Machining the Cavity



Valve Model	A	B	C	D	E	F	G	H	J	K	L
MVI400S	.56 (14.2)	.100/.115 (2.5/2.9)	.21 (5.3)	.87 (22.1)	.811/.816 (20.6/20.7)	3/4-16 UNF-2B	.56 (14.2)	.70 (17.8)	1.06 (26.9)	.562/.564 (14.3/14.3)	1.188 (30.2)
MVI600S	.65 (16.5)	.100/.115 (2.5/2.9)	.32 (8.1)	1.00 (25.4)	.942/.947 (23.9/24.1)	7/8-14 UNF-2B	.65 (16.5)	.85 (21.6)	1.25 (31.8)	.624/.626 (15.8/15.9)	1.344 (34.1)
MVI800S	.95 (24.1)	.130/.145 (3.3/3.7)	.40 (10.2)	1.25 (31.8)	1.148/1.153 (29.2/29.3)	1-1/16-12 UN-2B	.75 (19.1)	1.18 (30.0)	1.62 (41.1)	.811/.813 (20.6/20.7)	1.625 (41.3)
MVI1200S	.97 (24.6)	.130/.145 (3.3/3.7)	.50 (12.7)	1.50 (38.1)	1.398/1.403 (35.3/35.6)	1-5/16-12 UN-2B	.75 (19.1)	1.25 (31.8)	1.78 (45.2)	1.062/1.064 (26.9/26.9)	1.910 (48.5)

D1_Cat3000.indd, ddp, 04/19

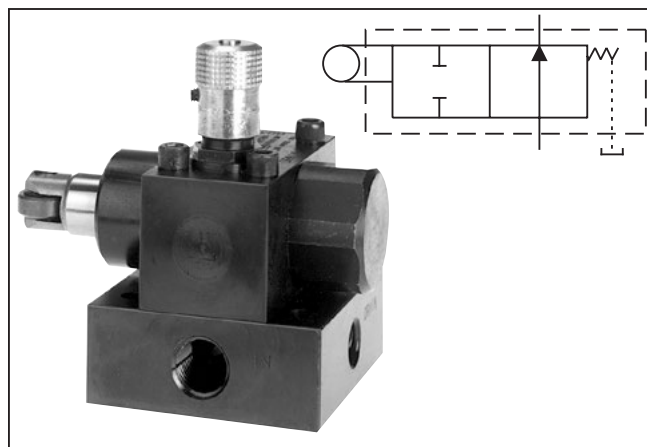
General Description

Series D deceleration valve is a cam operated 2-way valve with tapered spool. As the cam depresses the plunger, flow through the valve is gradually decreased to the cut-off point.

This valve is also available as a normally closed, cam operated 2-way valve.

Specifications

Maximum Operating Pressure	210 Bar (3000 PSI)
Maximum Flow	See flow vs. pressure drop curves, reverse flow vs. pressure drop, flow vs. plunger travel curves
Nominal Flow	D600 37.9 LPM (10 GPM) D1200 132.5 LPM (35 GPM)
Port Configurations	See dimensional drawings and/or ordering information for configuration availability



Features

- The exclusive “Colorflow” color-band reference scale on the valve stem is a great convenience and time-saver in setting the valve originally and in returning it to any previous setting
- A simple set screw locks the valve on any desired setting

Flow Data

Valve Model	Flow, max. GPM (L/M)	Pressuer Drop ΔP @ (Max.) PSI (Bar) (Plunger Full Open)	Mounting	Port Size
D600	19 (72)	200 (14)	Inline	3/8" NPTF
DC600	19 (72)	200 (14)	Inline	3/8" NPTF
DF600	19 (72)	200 (14)	Inline	3/8" NPTF
DN600	19 (72)	200 (14)	Inline	3/8" NPTF
D1200	60 (227)	120 (8)	Inline	3/4" NPTF
DC1200	60 (227)	120 (8)	Inline	3/4" NPTF
DF1200	60 (227)	120 (8)	Inline	3/4" NPTF
DN1200	60 (227)	120 (8)	Inline	3/4" NPTF

Reverse Flow

Valve Model	With Check GPM (L/M)	With Needle	With Check & Needle GPM (L/M)	Flow Path
D*600S	19 (72)	N.O. valve reverse flow is proportional to needle setting	19 (72)	Normally Open
D*1200S	60 (227)		60 (227)	

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

D1_Cat3000.indd, ddp, 04/19

D

Deceleration
Valves

Options

Size

S

Material

Seals

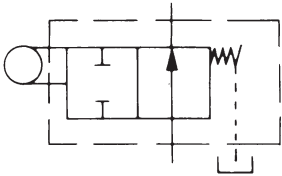
Code	Description
Omit	Standard
N	With Needle By-Pass
C	With Reverse Check
F	With Needle By-Pass and Reverse Check

Code	Description
600	3/8"
1200	3/4"

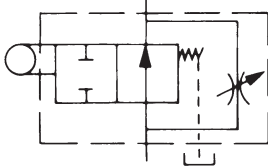
Code	Description
S	Steel

Code	Description
Omit	Nitrile
V	Fluorocarbon

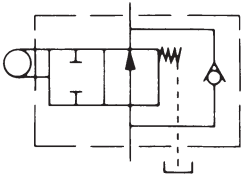
D



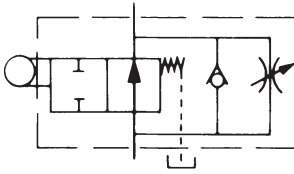
STANDARD
DECELERATION VALVE



DECELERATION VALVE
WITH NEEDLE BY-PASS

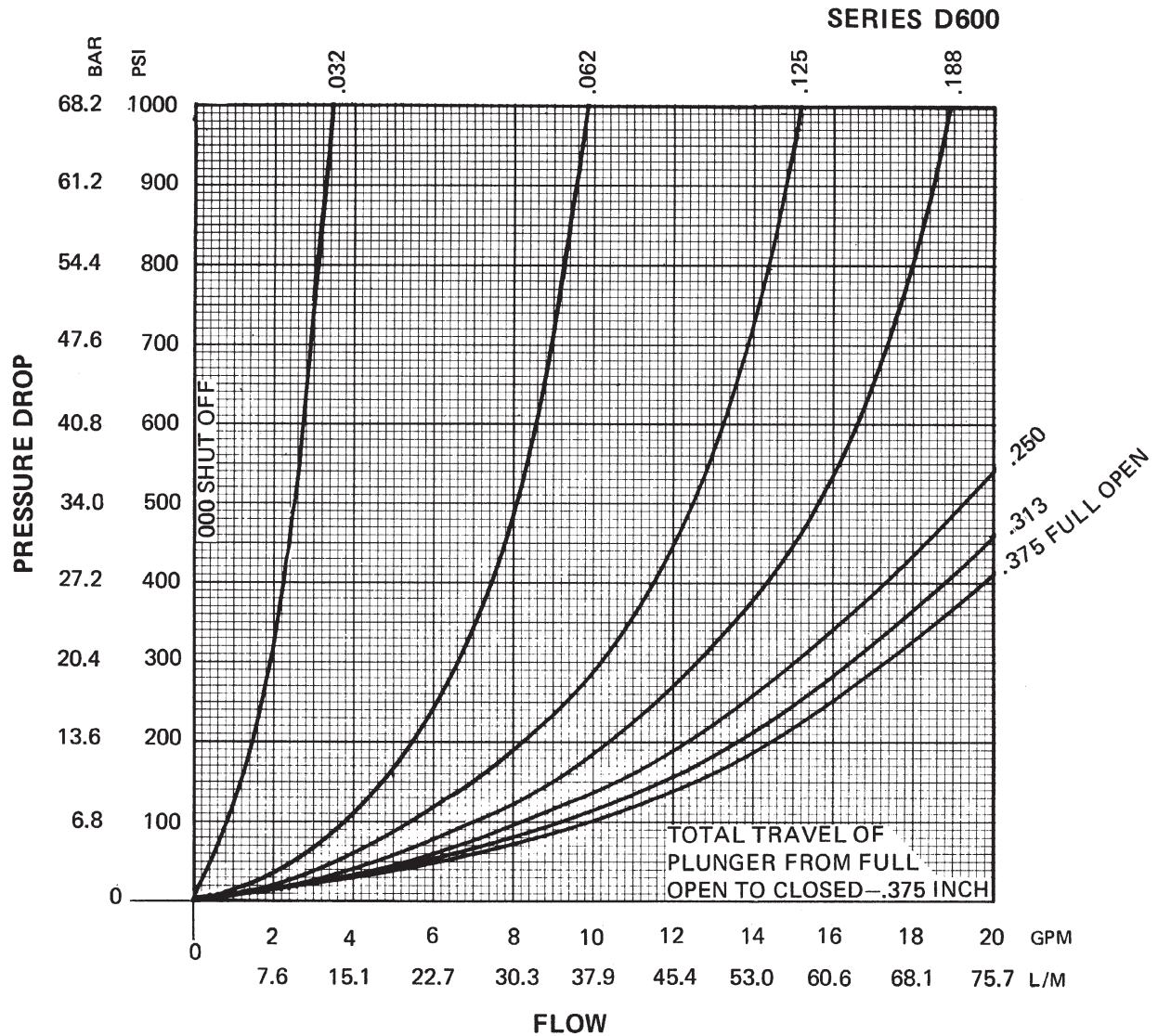


DECELERATION VALVE
WITH REVERSE CHECK

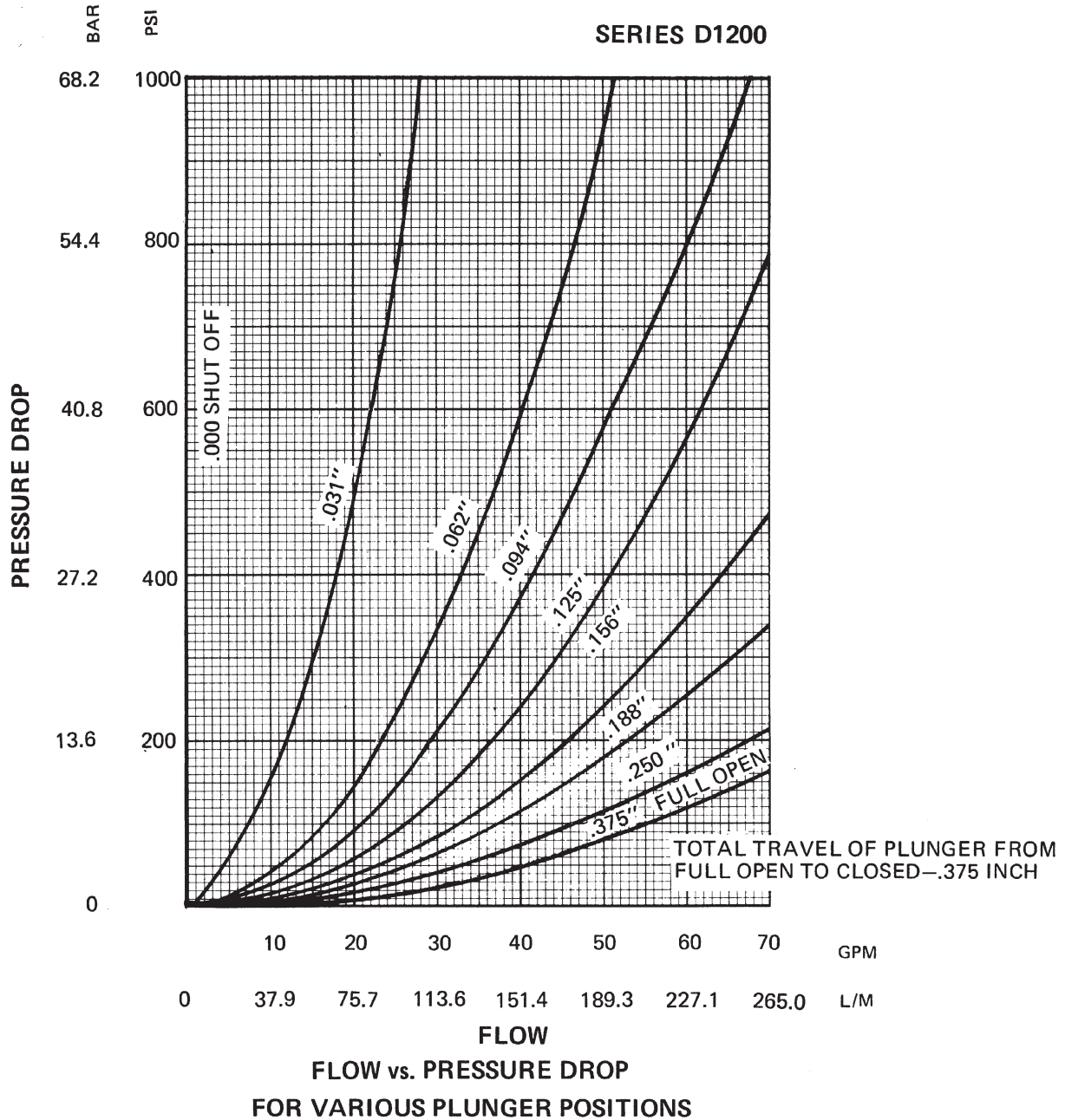


DECELERATION VALVE
WITH NEEDLE BY-PASS
AND REVERSE CHECK.

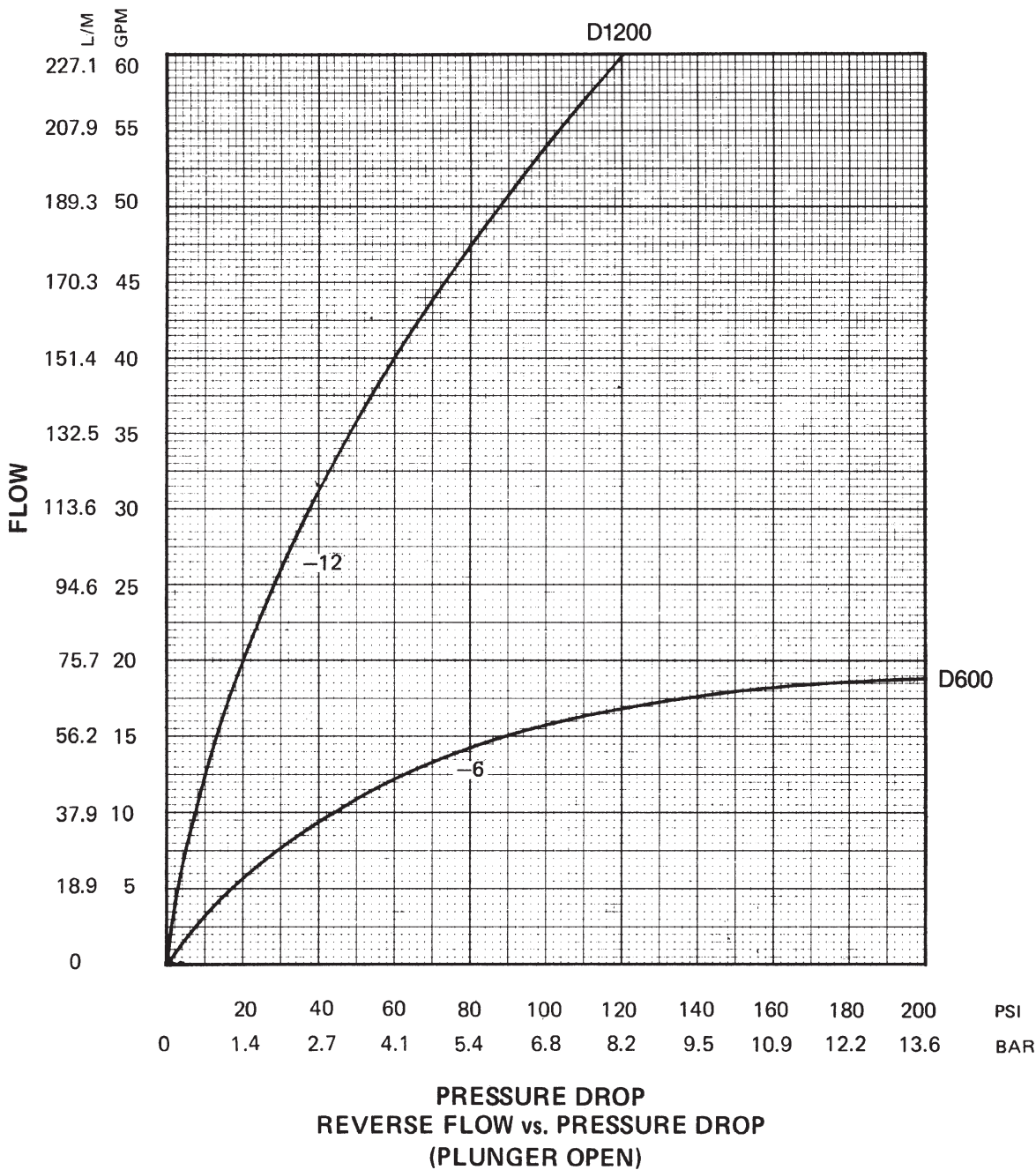
D



**FLOW vs. PRESSURE DROP
 FOR VARIOUS PLUNGER POSITIONS**



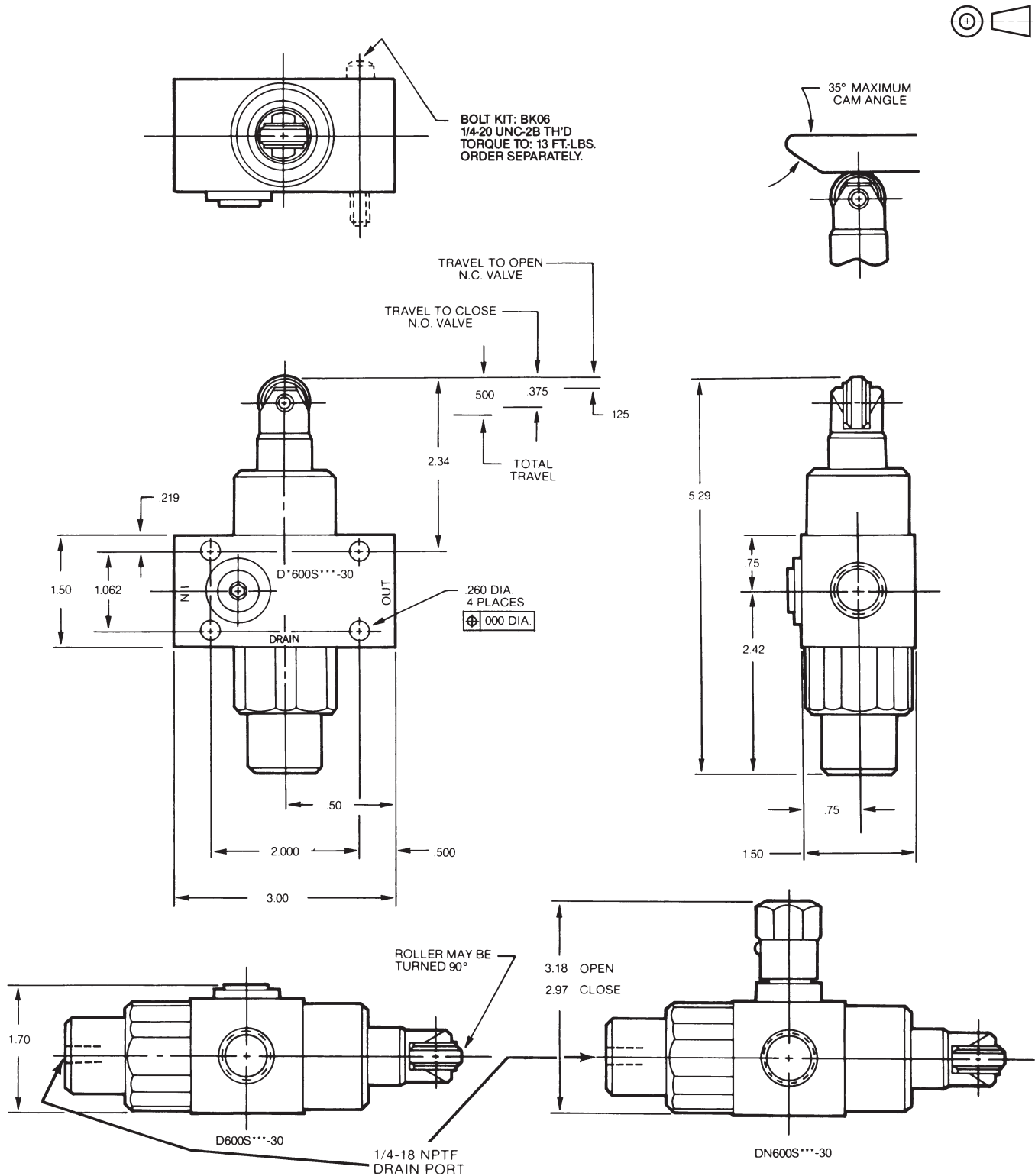
D



Dimensions are shown in inches

Model D600S

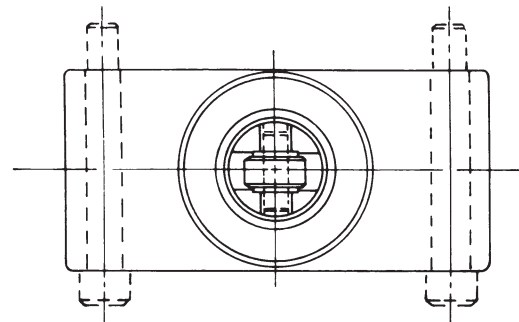
In-line mounted Deceleration Valves



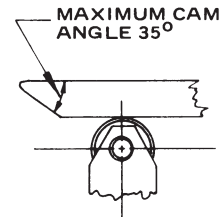
Millimeter equivalents for inch dimensions are shown in (**)

Model D1200S

In-line mounted, normally-open Deceleration Valves

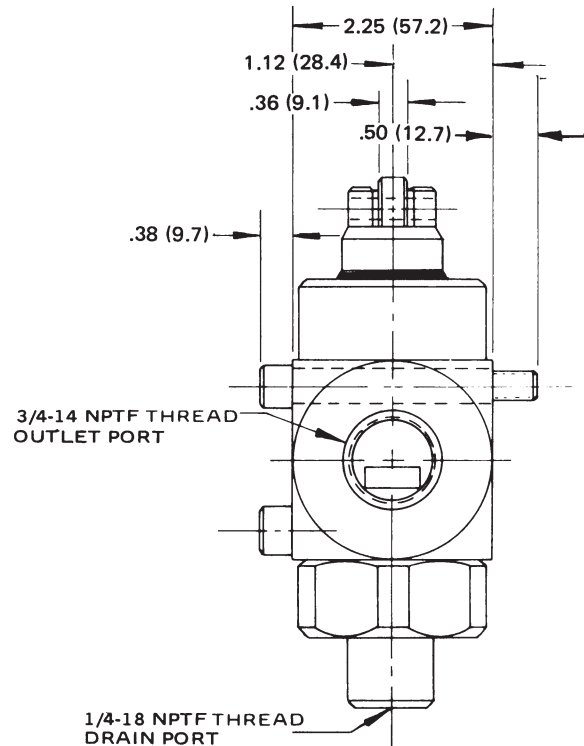
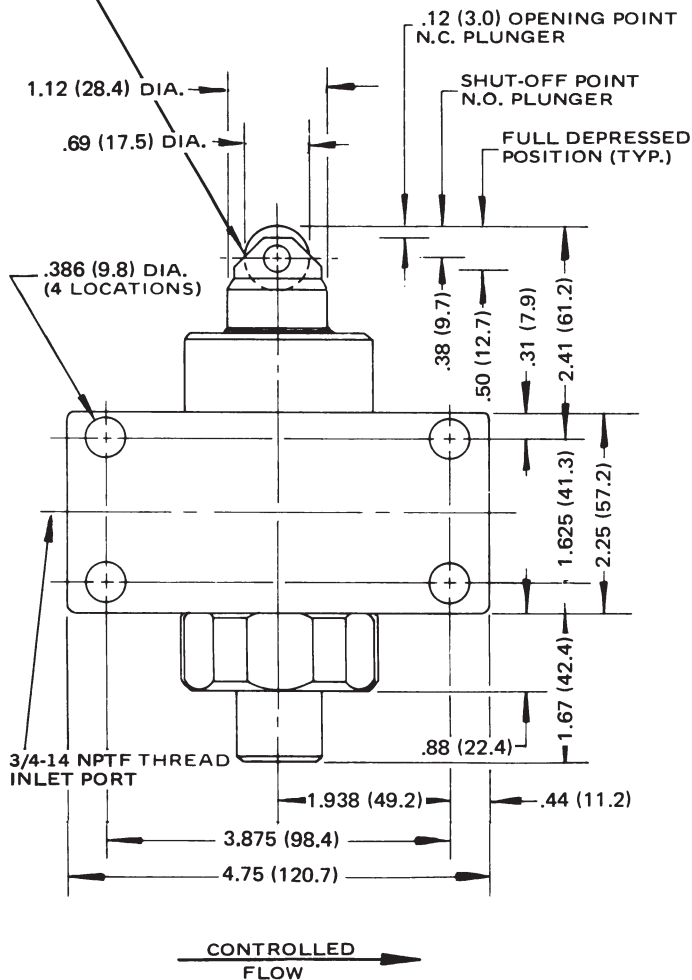


Weight
6.5 Lb. (3.0 Kg.)



D

PLUNGER AND ROLLER
TO BE ASSEMBLED IN
PLANE AS SHOWN.
CAN BE ROTATED 90°
FROM POSITION SHOWN.



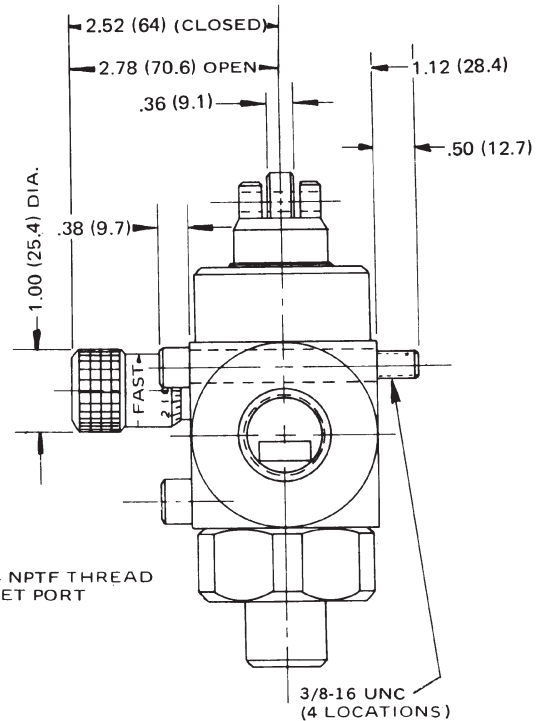
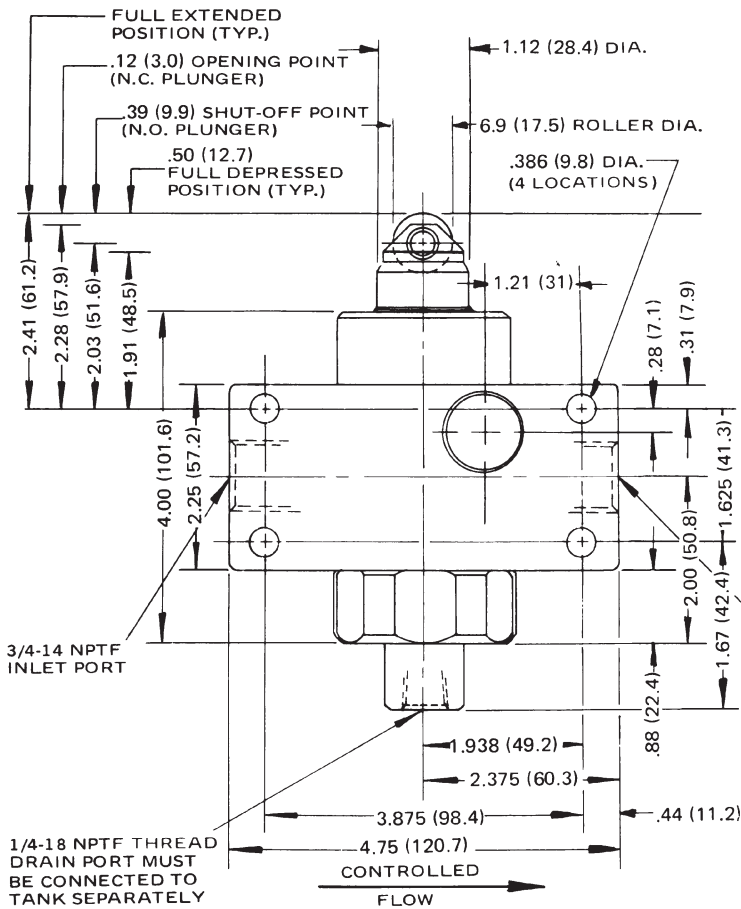
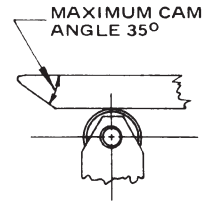
1. WORKING PRESSURE, MAX.: 3000 PSI (210 Bar)
2. DRAIN: MAX. ALLOWABLE BACK PRESSURE: 30 PSI (2 Bar)
3. FORCE TO DEPRESS PLUNGER: 50 Lbs. (22.8 Kg.) (DRAIN PRESSURE INCREASES FORCE REQ'D. TO DEPRESS PLUNGER.)

Millimeter equivalents for inch dimensions are shown in (**)

Model DN1200S

In-line mounted Deceleration Valve
 with bypass needle

Weight
 7.5 Lb. (3.4 Kg.)

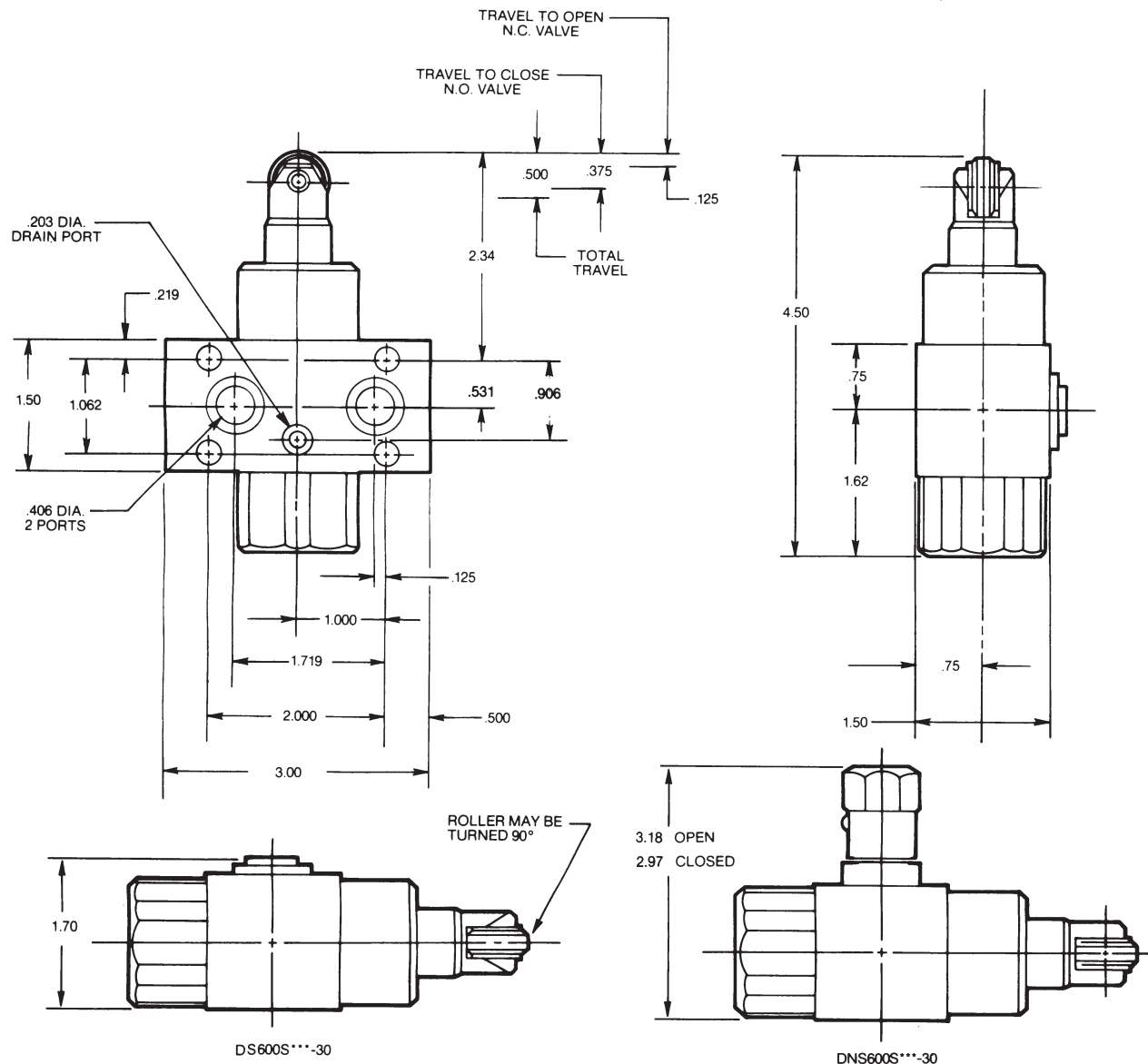
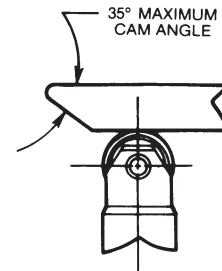
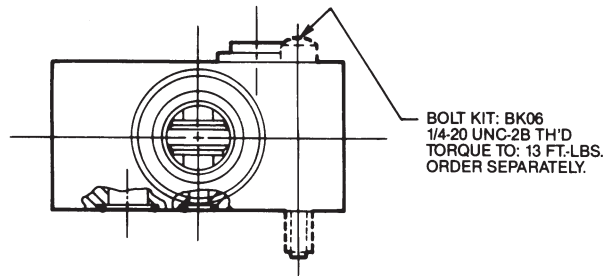


1. WORKING PRESSURE, MAX.: 3000 PSI (210 Bar)
2. DRAIN: MAX. ALLOWABLE BACK PRESSURE: 30 PSI (2 Bar)
3. FORCE TO DEPRESS PLUNGER: 50 Lbs. (22.8 Kg.) (DRAIN PRESSURE INCREASES FORCE REQ'D. TO DEPRESS PLUNGER.)

Dimensions are shown in inches

Model DS600S

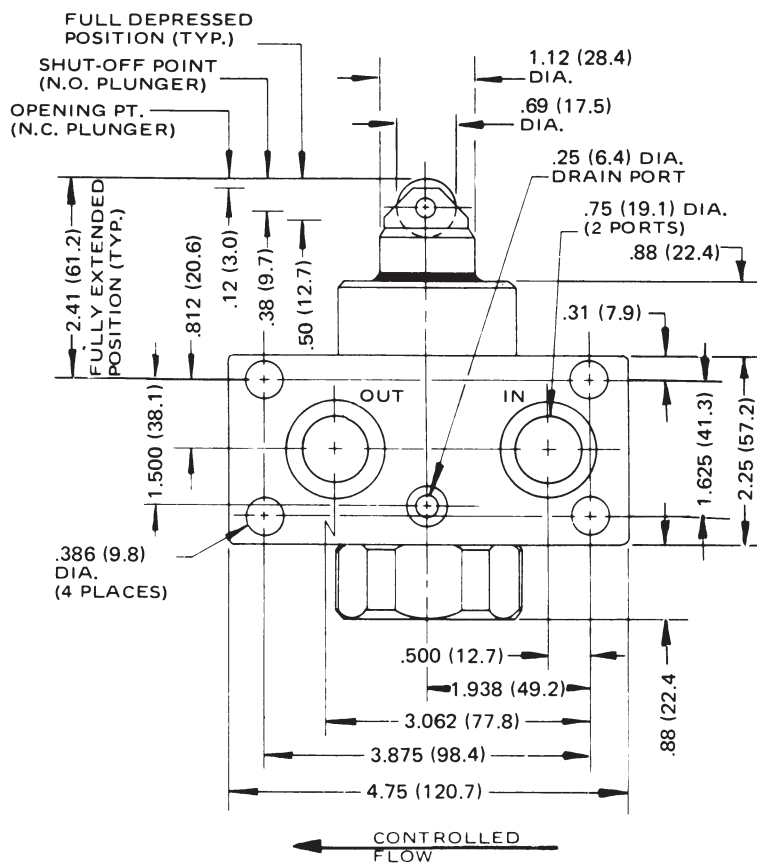
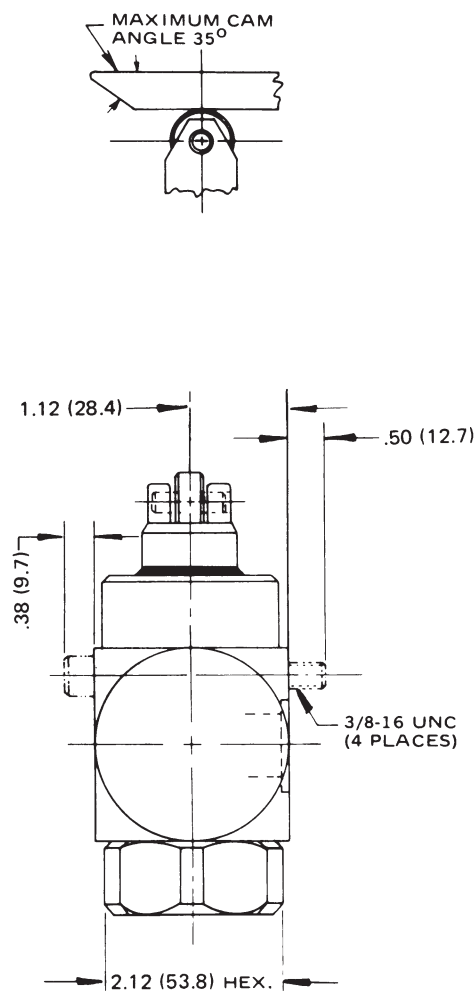
Manifold mounted Deceleration Valves



Millimeter equivalents for inch dimensions are shown in (**)

Model DS1200S

Manifold mounted, normally open Deceleration Valve



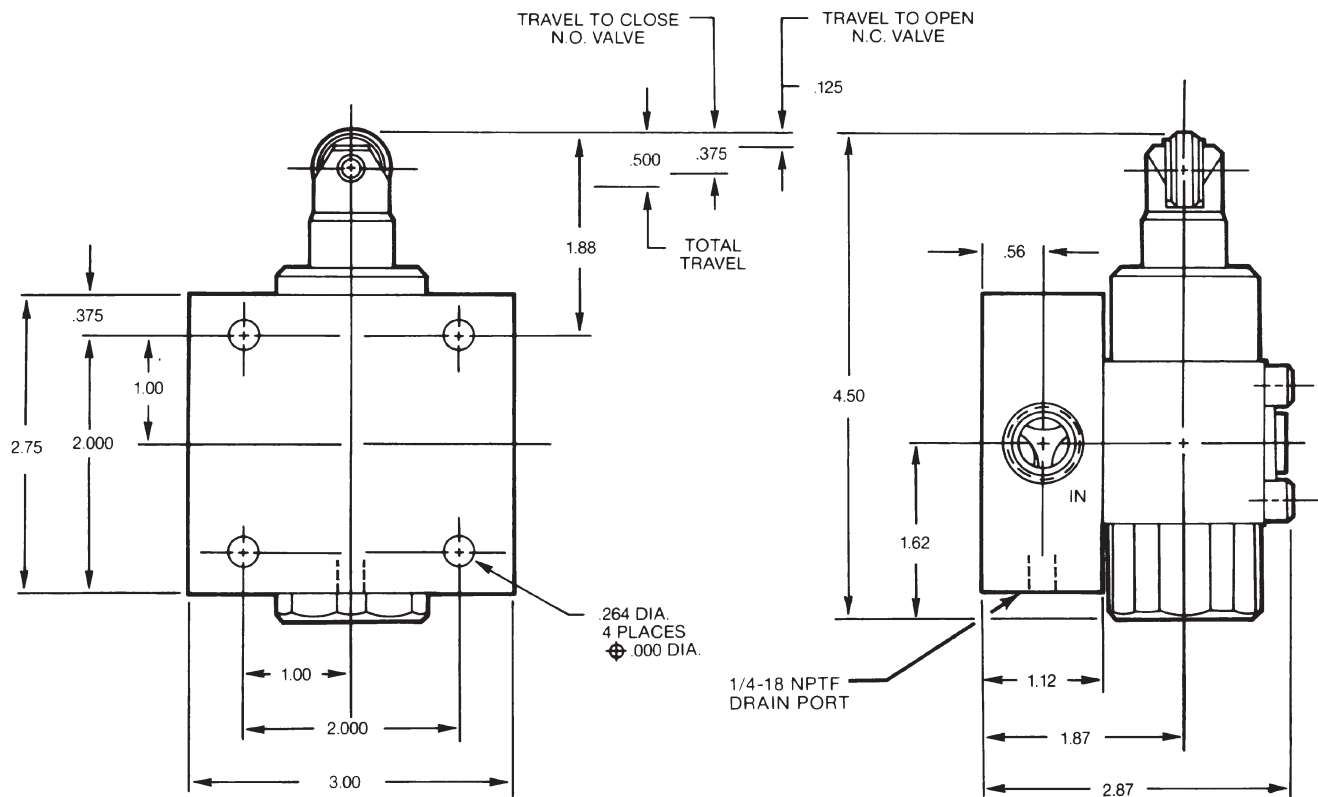
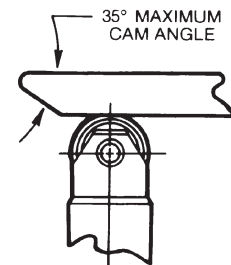
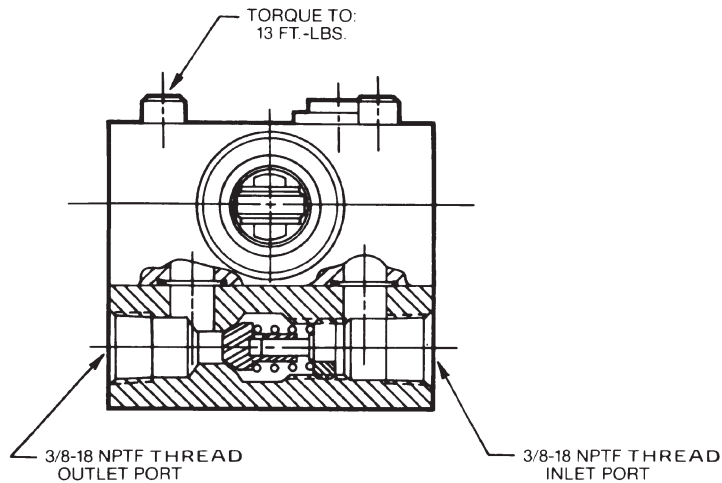
NOTES:

1. MAX. WORKING PRESSURE 3000 PSI.
 2. DRAIN-MAX. ALLOWABLE BACK PRESSURE 30 PSI.
 3. FORCE-REQ'D. TO DEPRESS PLUNGER 50 LBS.
- "DRAIN PRESSURE INCREASES FORCE REQ'D. TO DEPRESS PLUNGER."

Dimensions are shown in inches

Model DC600S

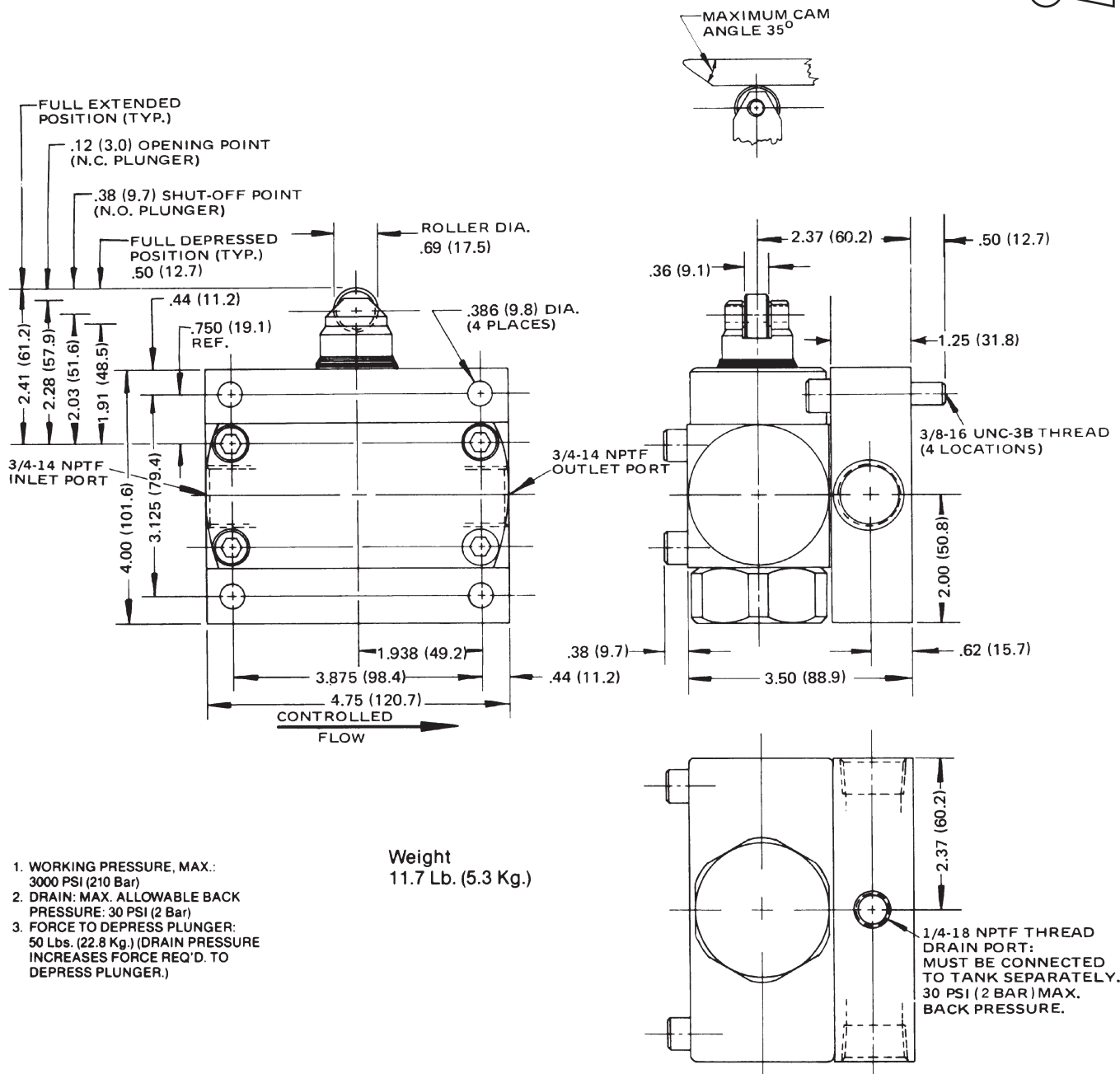
In-line mounted Deceleration Valve
with reverse check



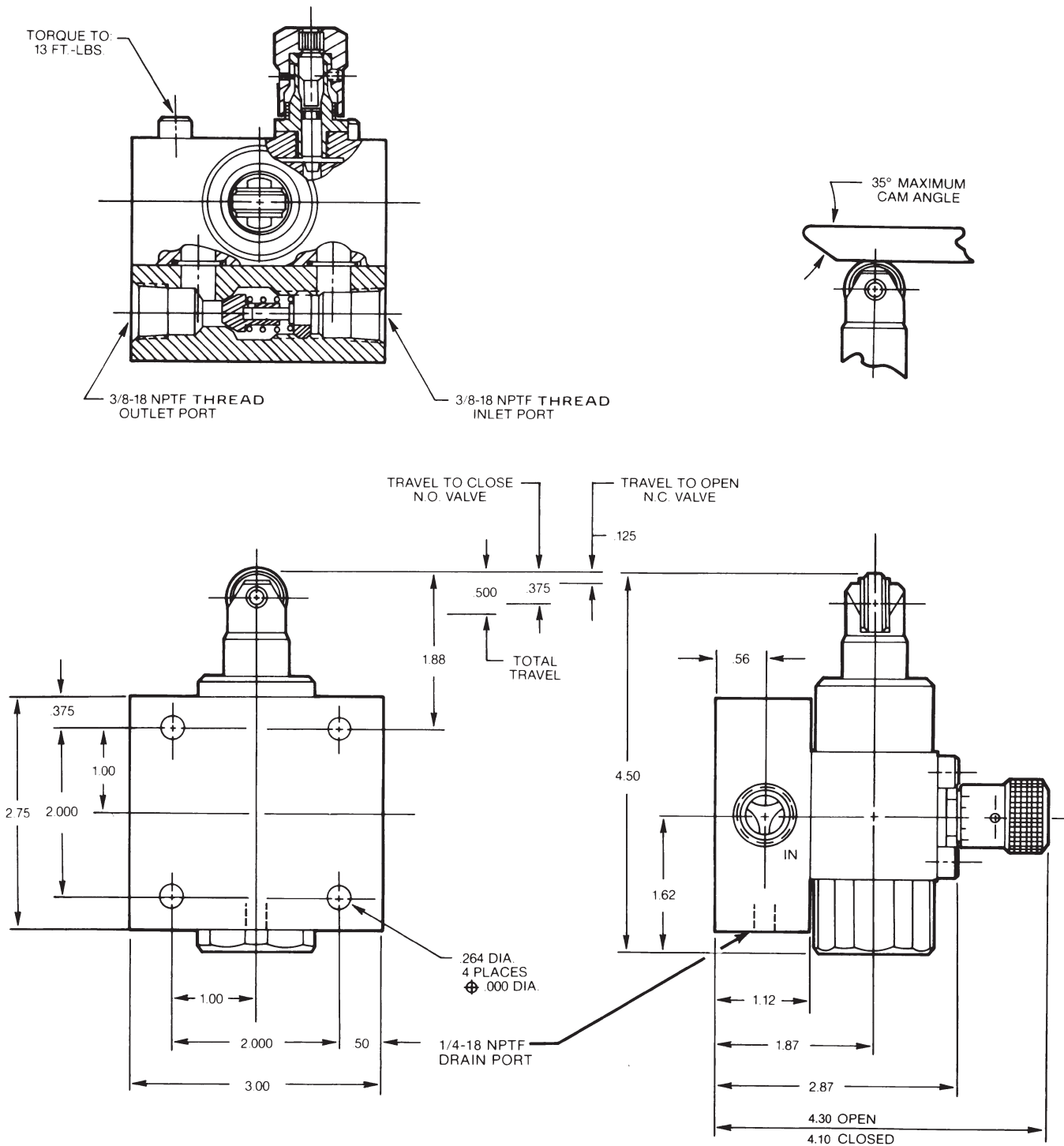
Millimeter equivalents for inch dimensions are shown in (**)

Model DC1200S

In-line mounted Deceleration Valve
with reverse check



Dimensions are shown in inches

Model DF600SIn-line mounted Deceleration Valve
with reverse check and bypass needle

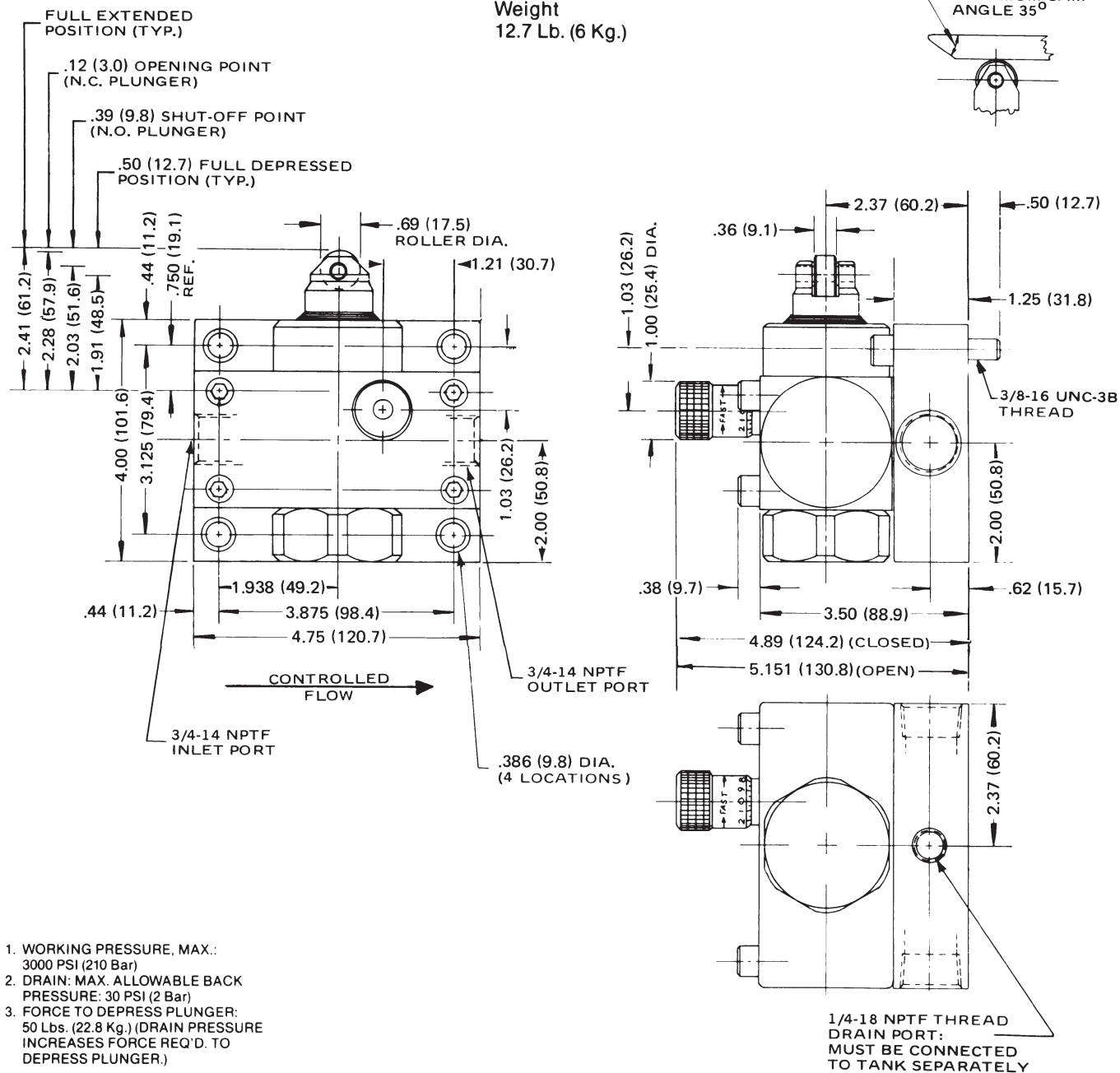
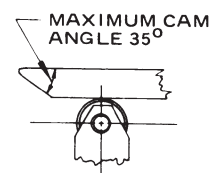
Millimeter equivalents for inch dimensions are shown in (**)

Model DF1200S

In-line mounted Deceleration Valve
with reverse check and bypass needle



Weight
12.7 Lb. (6 Kg.)



1. WORKING PRESSURE, MAX.: 3000 PSI (210 Bar)
2. DRAIN: MAX. ALLOWABLE BACK PRESSURE: 30 PSI (2 Bar)
3. FORCE TO DEPRESS PLUNGER: 50 Lbs. (22.8 Kg.) (DRAIN PRESSURE INCREASES FORCE REQ'D. TO DEPRESS PLUNGER.)

General Description

Series NS needle valves provide excellent speed control and shutoff for hydraulic applications where a reverse-flow check valve is not required. They also take minimum space for installation, conserving space.

The two-step needle valve allows fine tuning at low flow with the first three turns of the adjusting knob, with full-open flow plus conventional precision throttling with the final three turns of the knob.

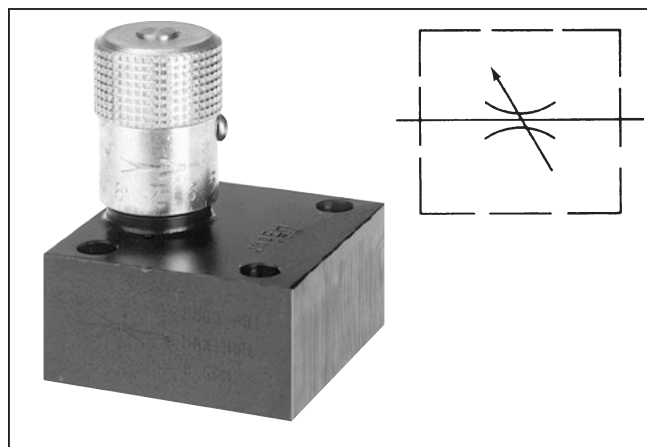
Exclusive “Colorflow” color bands permit fast, accurate setting and time-saving return to a previous setting.

Features

- The exclusive “Colorflow” color-band reference scale on the valve stem is a great convenience and time-saver in setting the valve originally and in returning it to any previous setting
- A simple set screw locks the valve on any desired setting

Flow Data

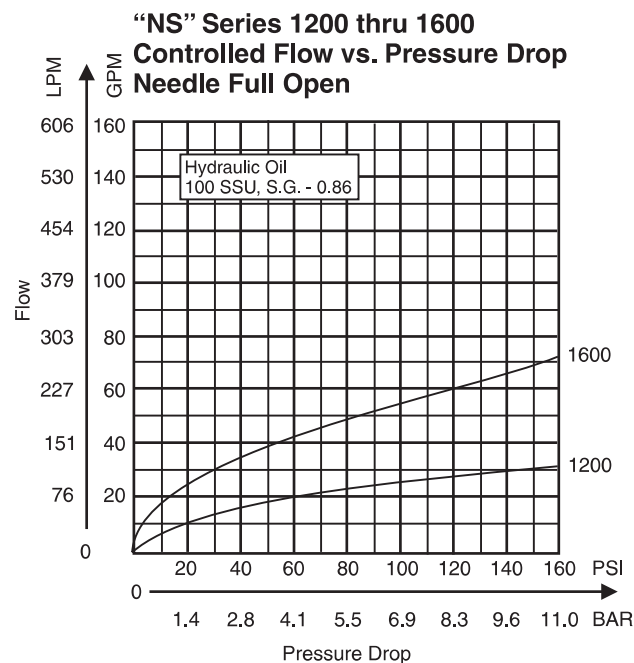
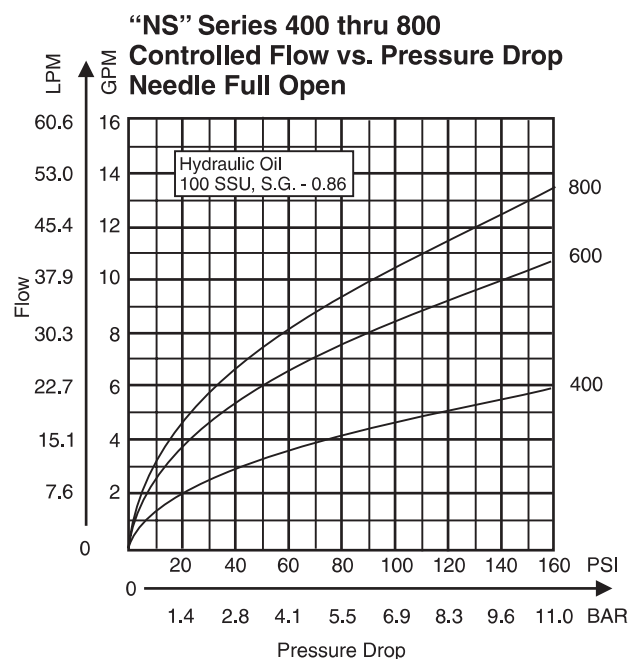
Valve Model	Flow, Max. GPM (L/M)	Orifice Area Control Flow (Sq. In.)	Effective Control Flow CV	Port Size
NS400	5 (19)	.0194	.443	1/4
NS600	8 (30)	.0344	.787	3/8
NS800	15 (57)	.0427	.976	1/2
NS1200	25 (95)	.1080	2.470	3/4
NS1600	40 (151)	.2300	5.250	1



Specifications

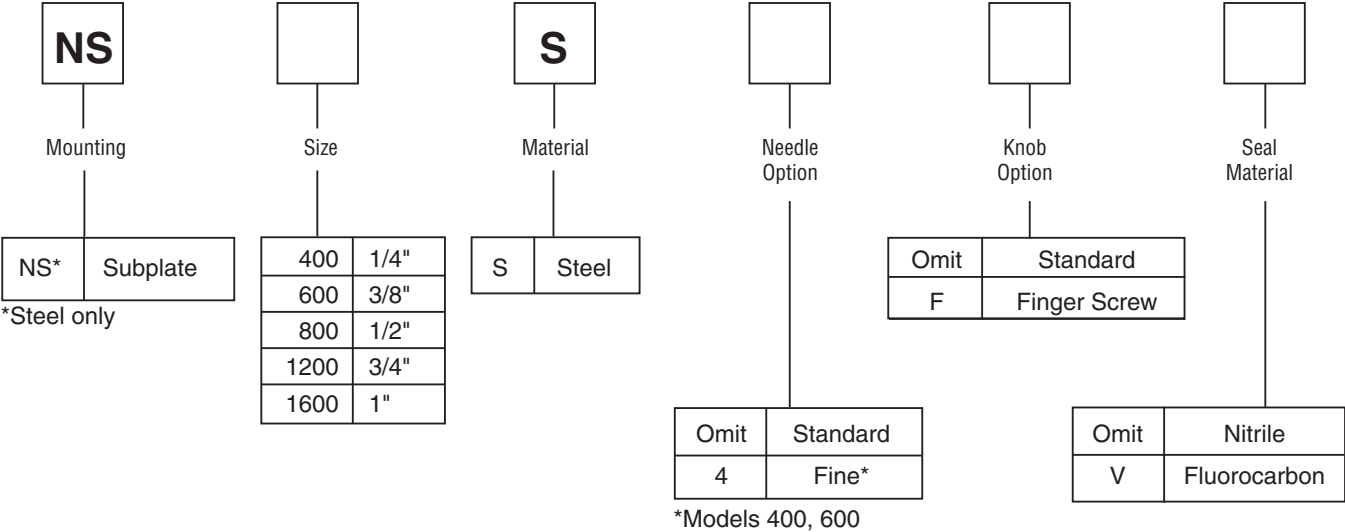
Maximum Operating Pressure	210 Bar (3000 PSI)
Needles	Standard Needle on all models Fine needle optional on Models NS400 and NS600
Nominal Flow	D600 37.9 LPM (10 GPM) D1200 132.5 LPM (35 GPM)
Port Configurations	See dimensional drawings and/or ordering information for configuration availability

Performance Curves



WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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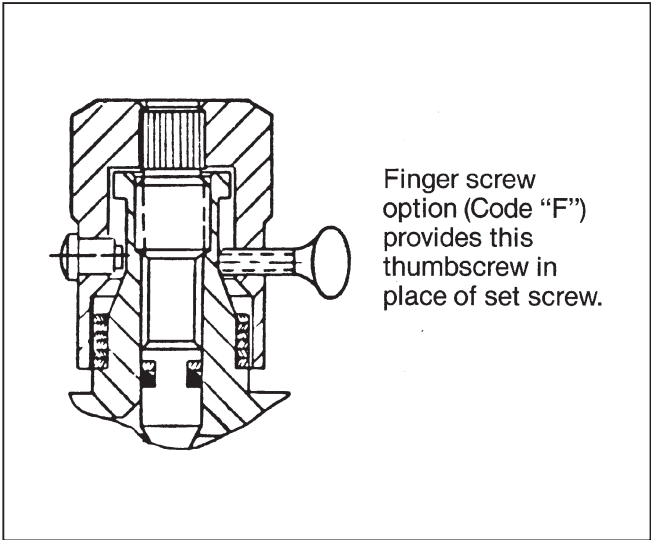


Bolt Kits

Valve	Bolt Kit	Bolt Specification*	Bolt Torque
NS400	BK01	1/4-20 x 1-1/4"	9 Ft.-Lbs.
NS600	BK02	1/4-20 x 1-1/2"	9 Ft.-Lbs.
NS800	BK02	1/4-20 x 1-1/2"	9 Ft.-Lbs.
NS1200	BK05	5/16-18 x 1-3/4"	19 Ft.-Lbs.
NS1600	BK08	5/16-18 x 2-1/4"	19 Ft.-Lbs.

*Use SAE Grade 8 or Better.

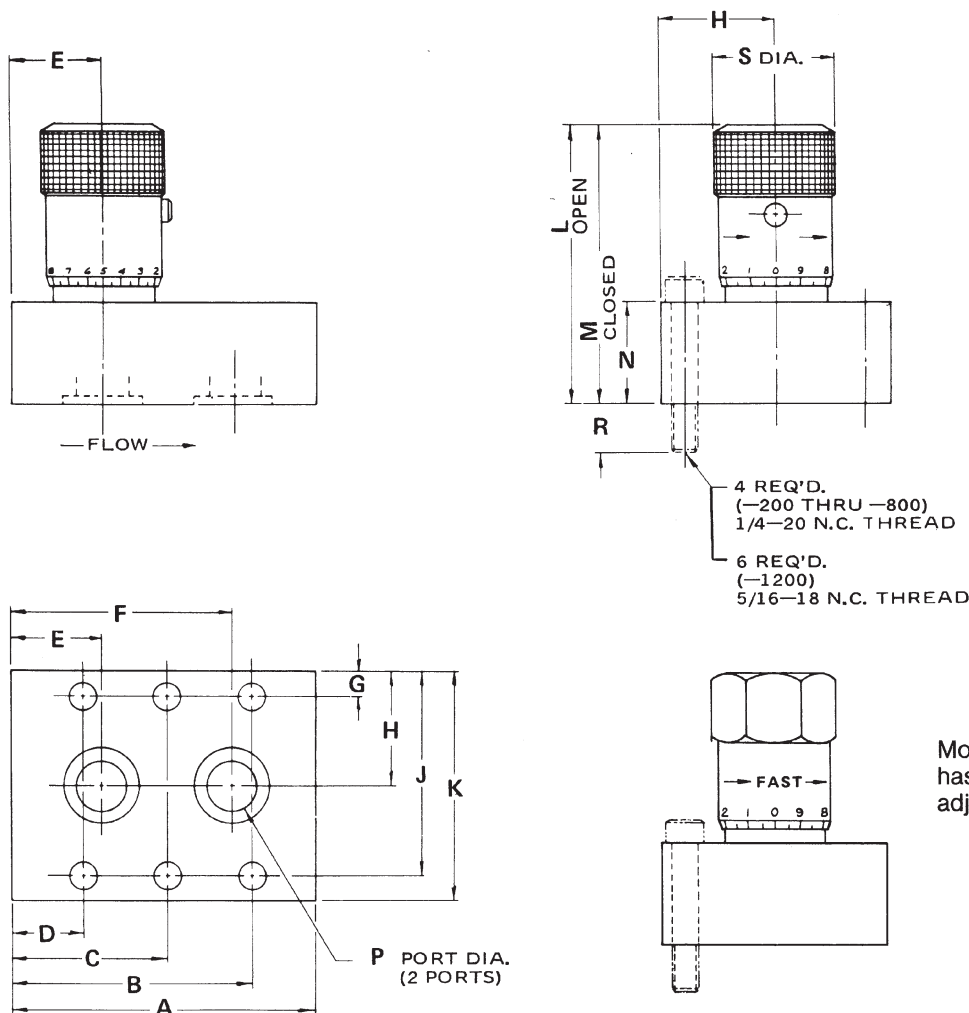
Knob Options



Millimeter equivalents for inch dimensions are shown in (**)

Models NS400S through NS1600S

Manifold mounted Needle Valves

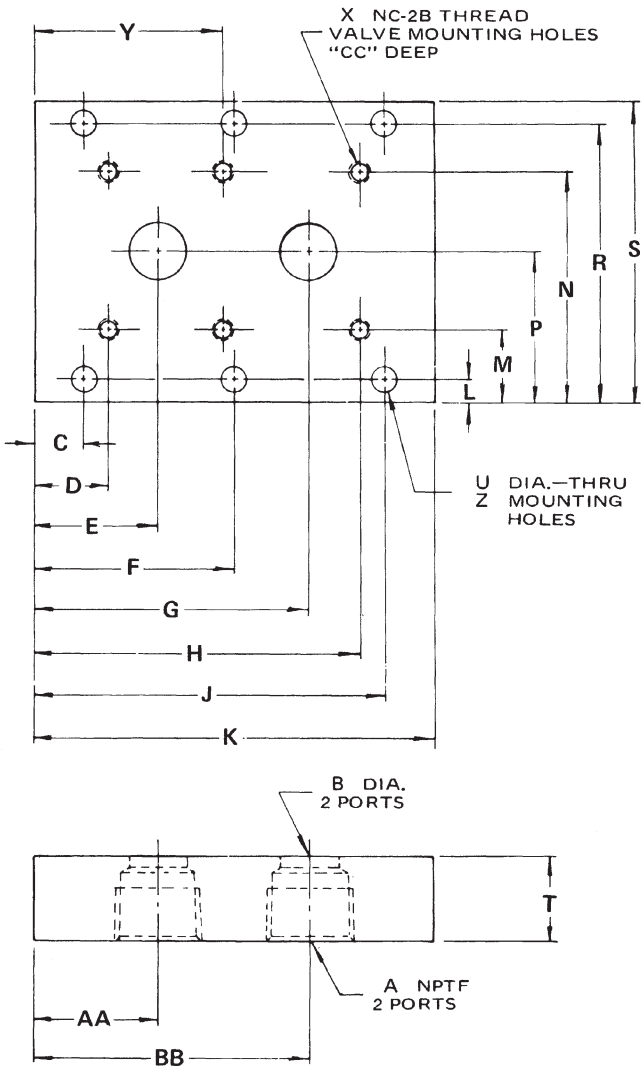


Valve Model	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	Weight Lb. (Kg)
NS400S	1.88 (47.8)	1.62 (41.1)		.25 (6.4)	.44 (11.2)	1.44 (36.6)	.22 (5.6)	.88 (22.4)	1.53 (38.9)	1.75 (44.5)	2.15 (54.6)	1.95 (49.5)	.88 (22.4)	.28 (7.1)	.44 (11.2)	.81 (20.6)	0.8 (0.4)
NS600S	2.00 (50.8)	1.66 (42.2)		.34 (8.6)	.50 (12.7)	1.50 (38.1)	.25 (6.4)	1.00 (25.4)	1.75 (44.5)	2.00 (50.8)	2.65 (67.3)	2.40 (61.0)	1.00 (25.4)	.34 (8.6)	.50 (12.7)	1.00 (25.4)	1.3 (0.6)
NS800S	2.97 (75.4)	2.23 (56.6)		.73 (18.5)	.89 (22.6)	2.08 (52.8)	.25 (6.4)	1.12 (28.4)	2.00 (50.8)	2.25 (57.2)	3.04 (77.2)	2.75 (69.9)	1.00 (25.4)	.47 (11.9)	.50 (12.7)	1.18 (30.0)	2.3 (1.0)
NS1200S	3.69 (93.7)	3.34 (84.8)	1.84 (46.7)	.34 (8.6)	.78 (19.8)	2.92 (74.2)	.31 (7.9)	1.38 (35.1)	2.44 (62.0)	2.75 (69.9)	3.72 (94.5)	3.13 (79.3)	1.12 (28.4)	.66 (16.8)	.63 (16.0)	1.37 (34.8)	3.7 (2.0)
NS1600S	4.38 (111.3)	4.06 (100.1)	2.19 (55.6)	.31 (7.9)	1.06 (26.9)	3.31 (84.1)	.31 (7.9)	1.50 (38.1)	2.69 (68.3)	3.00 (76.2)	5.51 (140.0)	4.85 (123.2)	1.75 (44.5)	.88 (22.4)	.50 (12.7)	1.87 (47.5)	8.0 (4.0)

Millimeter equivalents for inch dimensions are shown in (**)

Subplate

Reference Data Only
(Subplates are not available)



	Valve Series				
	NS -400	NS -600	NS -800	NS -1200	NS -1600
NPTF Port Size	1/4	3/8	1/2	3/4	1
B	.281 (7.1)	.406 (10.3)	.469 (11.9)	.656 (16.7)	.875 (22.2)
C	.375 (9.5)	.375 (9.5)	.500 (12.7)	.344 (8.7)	.344 (8.7)
D	.562 (14.3)	.843 (21.4)	.875 (22.2)	.750 (19.1)	1.125 (28.6)
E	.750 (19.1)	1.000 (25.4)	1.031 (26.2)	1.188 (30.2)	1.875 (47.6)
G	1.750 (44.5)	2.000 (50.8)	2.219 (56.4)	3.312 (84.1)	4.125 (104.8)
H	1.938 (49.2)	2.156 (54.8)	2.375 (60.3)	3.750 (95.3)	4.875 (123.8)
J	2.125 (54.0)	2.625 (66.7)	2.750 (69.9)	4.156 (105.6)	5.656 (143.6)
K	2.50 (63.5)	3.00 (76.2)	3.25 (82.6)	4.50 (114.3)	6.00 (152.4)
L	.344 (8.7)	.250 (6.4)	.438 (11.1)	.344 (8.7)	.344 (8.7)
M	.844 (21.4)	.750 (19.1)	1.125 (28.6)	1.062 (27.0)	1.062 (27.0)
N	2.156 (54.8)	2.250 (57.2)	2.875 (73.0)	3.188 (81.0)	3.438 (87.3)
P	1.500 (38.1)	1.500 (38.1)	2.000 (50.8)	2.125 (54.0)	2.250 (57.2)
R	2.656 (67.5)	2.750 (69.9)	3.562 (90.5)	3.906 (99.2)	4.156 (105.6)
S	3.00 (76.2)	3.00 (76.2)	4.00 (101.6)	4.25 (108.0)	4.50 (114.3)
T	1.125 (28.6)	1.125 (28.6)	1.125 (28.6)	1.125 (28.6)	1.250 (31.8)
U	.281 (7.1)	.281 (7.1)	.359 (9.1)	.422 (10.7)	.422 (10.7)
X	1/4-20	1/4-20	1/4-20	5/16-18	5/16-18
Y	—	—	—	2.250 (57.2)	3.000 (76.2)
Z	4 Holes	4 Holes	4 Holes	6 Holes	6 Holes
AA	.750 (19.1)	1.000 (25.4)	1.031 (26.2)	1.188 (30.2)	1.875 (47.6)
BB	1.750 (44.5)	2.000 (50.8)	2.219 (56.4)	3.312 (84.5)	4.125 (104.8)
CC	.505 (12.8)	.525 (13.3)	.525 (13.3)	.525 (13.3)	.525 (13.3)

D

Pressure Control Valves

Series 630-647 In-line Mounted Direct-Acting Relief E2 - E4

Series 665 In-line Mounted Direct-Acting Relief E5 - E6

Series P6701 Remote Pilot E7 - E8

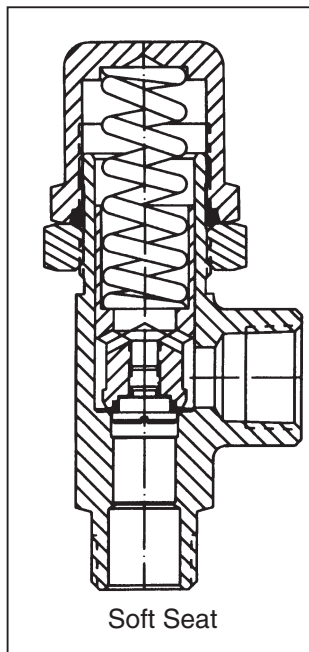


General Description

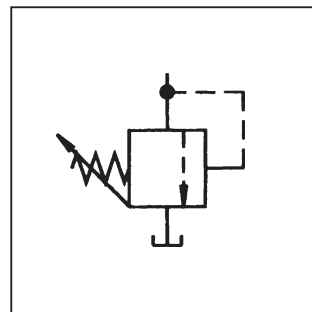
Series 630 - 647 in-line pressure control valves open the system to tank when the system pressure reaches the pressure setting of the control valve. The pressure setting is externally adjustable so that it can be tuned accordingly within its range.

Specifications

Service App.	Hydraulic and Pneumatic		
Maximum Operating Pressure	Working:	0.3 to 248.4 Bar (4 to 3600 PSI) in 13 ranges	
	Reseat:	Range 1: 80% of cracking press. Ranges 2 - 13: 90% of cracking pressure	
Sizes	NPT	1/4", 1/2", 3/4"	
Ports	NPT	Pipe threads	
	IST	Internal straight threads	
	FLD	Flared Tube Connection SAE 37°	
Material	Body, Cap	Brass, stainless steel	
	Finish	Anodized; stainless steel	
	Poppet	416 Stainless Steel (Hard seat) 303 Stainless Steel (Soft seat)	
	Seat (soft)	Ranges 1 -3: Synthetic rubber - Code 2 Ranges 4 - 13: PTFE	
	Spring	Stainless steel	
	Cap O-ring	Synthetic rubber	
Operating Temperature	-40°C to +121°C (-40°F to +250°F) Higher on special order		



Soft Seat



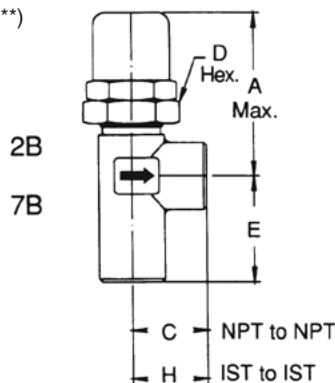
Hard Seat available in Brass and Stainless Steel

Features

- Externally adjustable
- Available for hydraulic or pneumatic service
- Quick response for venting applications

Dimensions –

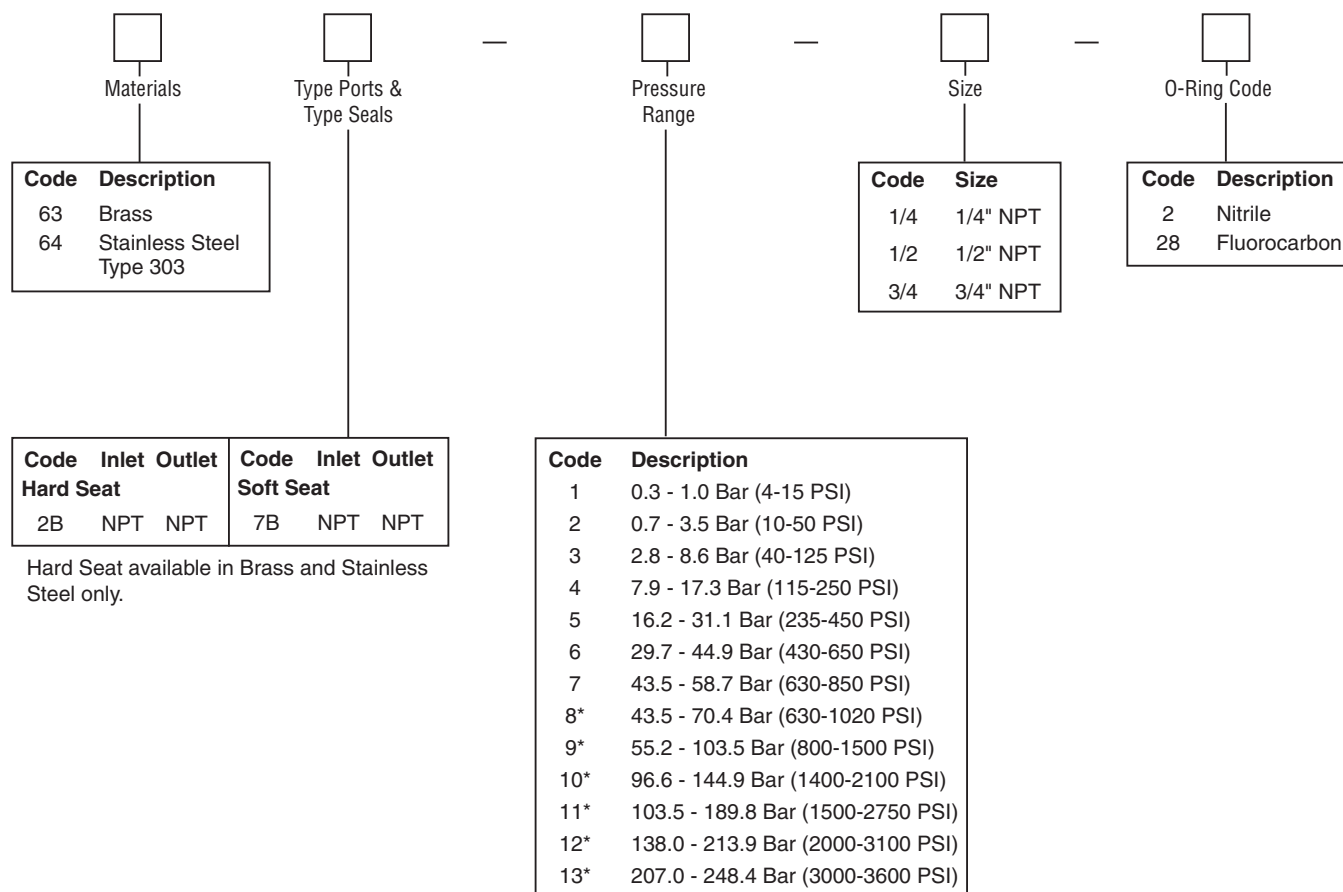
Inch equivalents for millimeter dimensions are shown in (**)



Valve Size		Dimensions								Maximum Rated Flow LPM (GPM)	Weights (Approx.)	
Pipe	Tube	A	B	C	D	E	F	G	H		Brass	Stainless Steel
1/4	6	60.3 (2.38)	34.9 (1.38)	27.0 (1.06)	31.8 (1.25)	32.5 (1.28)	36.5 (1.44)	38.1 (1.50)	27.0 (1.06)	15.1 (4.0)	10 oz.	12 oz.
1/2	10	94.5 (3.72)	54.0 (2.13)	38.1 (1.50)	44.5 (1.75)	54.8 (2.16)	52.4 (2.06)	55.6 (2.19)	38.1 (1.50)	37.9 (10.0)	2 lbs. 2 oz.	2 lbs. 4 oz.
3/4	12	94.5 (3.72)	54.0 (2.13)	39.7 (1.56)	44.5 (1.75)	55.6 (2.19)	53.2 (2.09)	55.6 (2.19)	39.7 (1.56)	56.8 (15.0)	2 lbs. 2 oz.	2 lbs. 4 oz.

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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* Hard Seat only.

PTFE seats for Ranges 4, 5, 6 and 7 only.

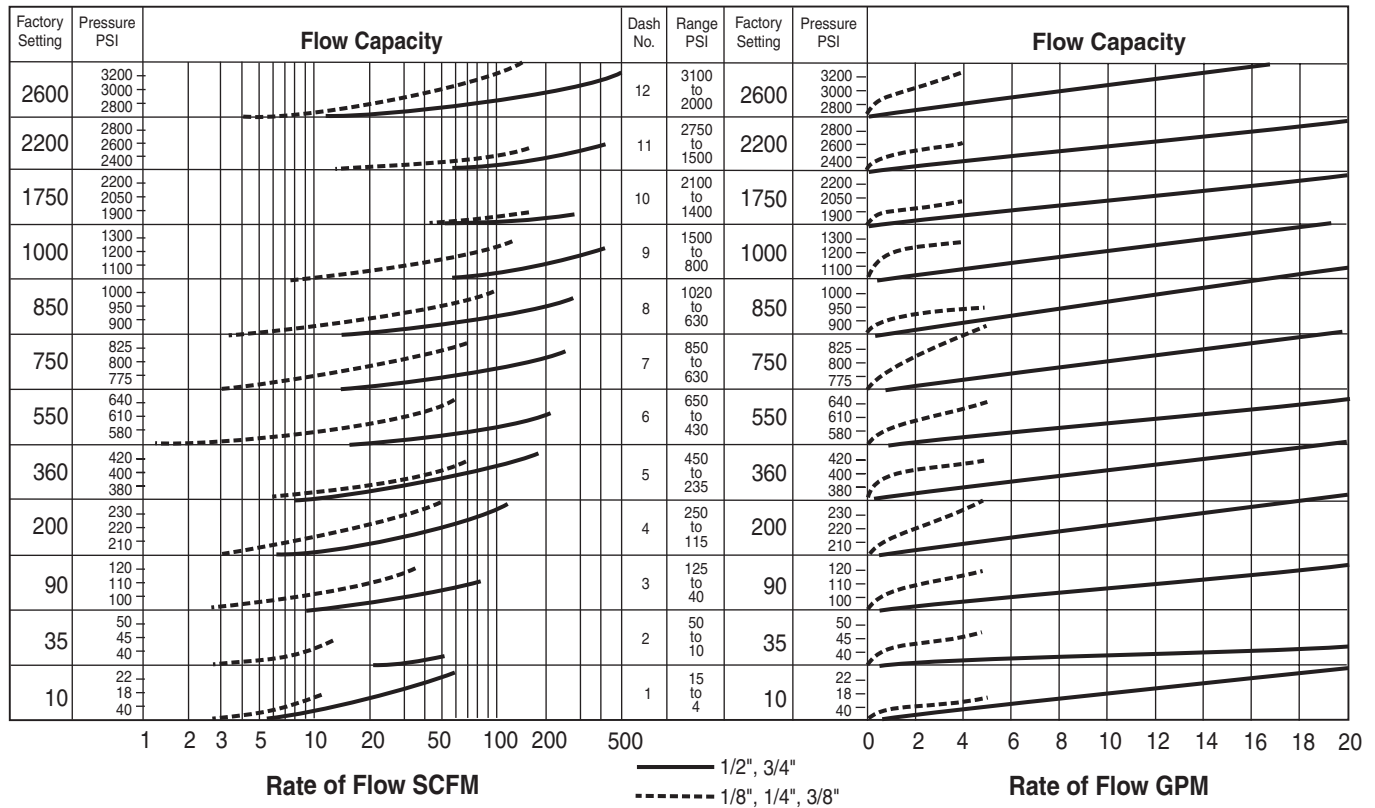
Pressure Range

Range Bar (PSI)	Pre-Set Cracking Pressure	Soft Seat Material (when used)	Range Dash Number
0.3 - 1.0 Bar (4-15 PSI)	0.7 Bar (10 PSI)	Synthetic Rubber	-1
0.7 - 3.5 Bar (10-50 PSI)	2.4 Bar (35 PSI)	Synthetic Rubber	-2
2.8 - 3.5 Bar (40-125 PSI)	6.2 Bar (90 PSI)	Synthetic Rubber	-3
7.9 - 17.3 Bar (115-250 PSI)	13.8 Bar (200 PSI)	PTFE	-4
16.2 - 31.1 Bar (235-450 PSI)	24.8 Bar (360 PSI)	PTFE	-5
29.7 - 44.9 Bar (430-650 PSI)	38.0 Bar (550 PSI)	PTFE	-6
43.5 - 58.7 Bar (630-850 PSI)	51.8 Bar (750 PSI)	PTFE	-7
43.5 - 70.4 Bar (630-1020 PSI)	58.7 Bar (850 PSI)	PTFE	-8
55.2 - 103.5 Bar (800-1500 PSI)	69.0 Bar (1000 PSI)	PTFE	-9
96.6 - 144.9 Bar (1400-2100 PSI)	120.8 Bar (1750 PSI)	PTFE	-10
103.5 - 189.8 Bar (1500-2750 PSI)	151.8 Bar (2200 PSI)	PTFE	-11
138.0 - 213.9 Bar (2000-3100 PSI)	179.4 Bar (2600 PSI)	PTFE	-12
207.0 - 248.4 Bar (3000-3600 PSI)	220.8 Bar (3200 PSI)	PTFE	-13

Definitions:

Cracking pressure – Liquid: 15 tp 20 DPM
 Air: steady stream of bubbles
 Reseat leakage – Less than 1 DPM or 1 BPM





Examples

Pneumatic:

- Establish cracking pressure setting of 1/2" valve for flow of 70 SCFM at 27.6 Bar (400 PSI) pressure:
1. Project 70 SCFM on vertical scale.
 2. Project 27.6 Bar (400 PSI) scale horizontally intersectiong 1.
 3. Project line parallel to curves back to vertical line 1.
 4. Read cracking pressure setting: 24.8 Bar (360 PSI).

Hydraulic:

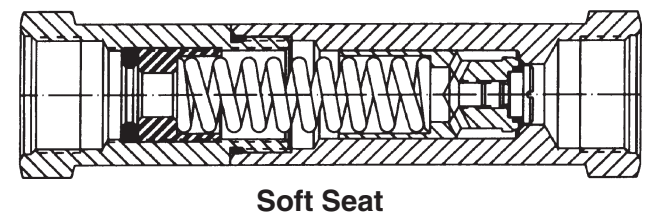
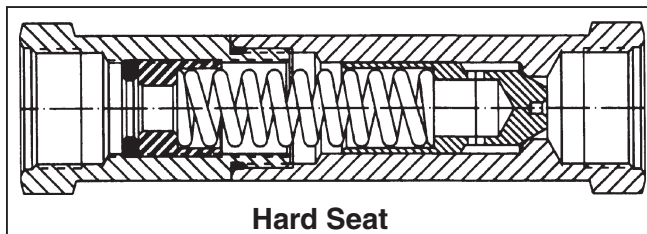
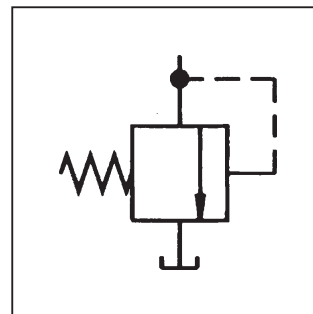
- Find amount of pressure increase above 24.8 Bar (360 PSI) cracking pressure when flow through 3/4" valve is increased to 54 LPM (14 GPM):
1. From 360 on vertical pressure scale, follow 3/4" curve until it intersects with the vertical line representing 54 LPM (14 GPM).
 2. Project intersecting point horizontally and read pressure, i.e., 29 Bar (420 PSI).
 3. Accumulated Pressure:
 $420 \text{ minus } 360 = 4.1 \text{ Bar (60 PSI)}.$

General Description

Series 665 relief valves are adjustable, in-line direct-acting relief valves. The valve opens when the system pressure exceeds the pressure at which the valve is set.

Specifications

Service App.	Hard seat: Hydraulic Soft seat: Hydraulic and air
Maximum Operating Pressure	Working: 0.3 to 248.4 Bar (4 to 3600 PSI) in 13 ranges Reseat: Range 1: 80% of cracking press. Ranges 2 - 13: 90% of cracking pressure Proof: 310.5 Bar (4500 PSI)
Sizes	NPT 1/2", 3/4", 1"
Ports	NPT Pipe threads
Material	Body, Cap Aluminum alloy, anodized Stainless steel Poppet, 416 Stainless Steel (Hard seat) Adj. Screw 303 Stainless Steel (Soft seat) Locknut 303 Stainless steel Spring Stainless steel AMS5688 and 17-7PH O-ring Synthetic rubber
Operating Temperature	-40°C to +121°C (-40°F to +250°F) Higher on special order



E

Features

- Internal adjustment ideal for tamper-proof applications
- Available for hydraulic or pneumatic service
- In-line design saves space in power unit application

Ordering Information

665	-1	-1/8	D	2	
Catalog Number	Pressure Range	Size	Materials	O-Ring Code	
665 Inline Direct-Acting Relief	2 10 - 50 PSI 3 40 - 125 PSI 4 115 - 250 PSI 5 235 - 450 PSI 6 430 - 650 PSI 7 630 - 850 PSI	8 630 - 1020 PSI 9 800 - 1500 PSI 10 1400 - 2100 PSI 12 2000 - 3100 PSI 13 3000 - 3600 PSI ML* MH**	1/2 NPT 3/4 NPT 1 NPT	D Aluminum Alloy SS Stainless Steel	2 Nitrile Others Available

Pressure Range

Range PSI	Pre-Set Cracking Pressure	Soft Seat Material (when used)	Range Dash Number
10-50	35	Synthetic Rubber	-2
40-125	90		-3
115-250	200	PTFE	-4
235-450	360		-5
430-650	550		-6
630-850	750		-7
630-1020	850		-8
800-1500	1000		-9
1400-2100	1750		-11
2000-3100	2600		-12
3000-3600	3200		-13

Definitions:

Cracking pressure – Liquid: 15 to 20 DPM

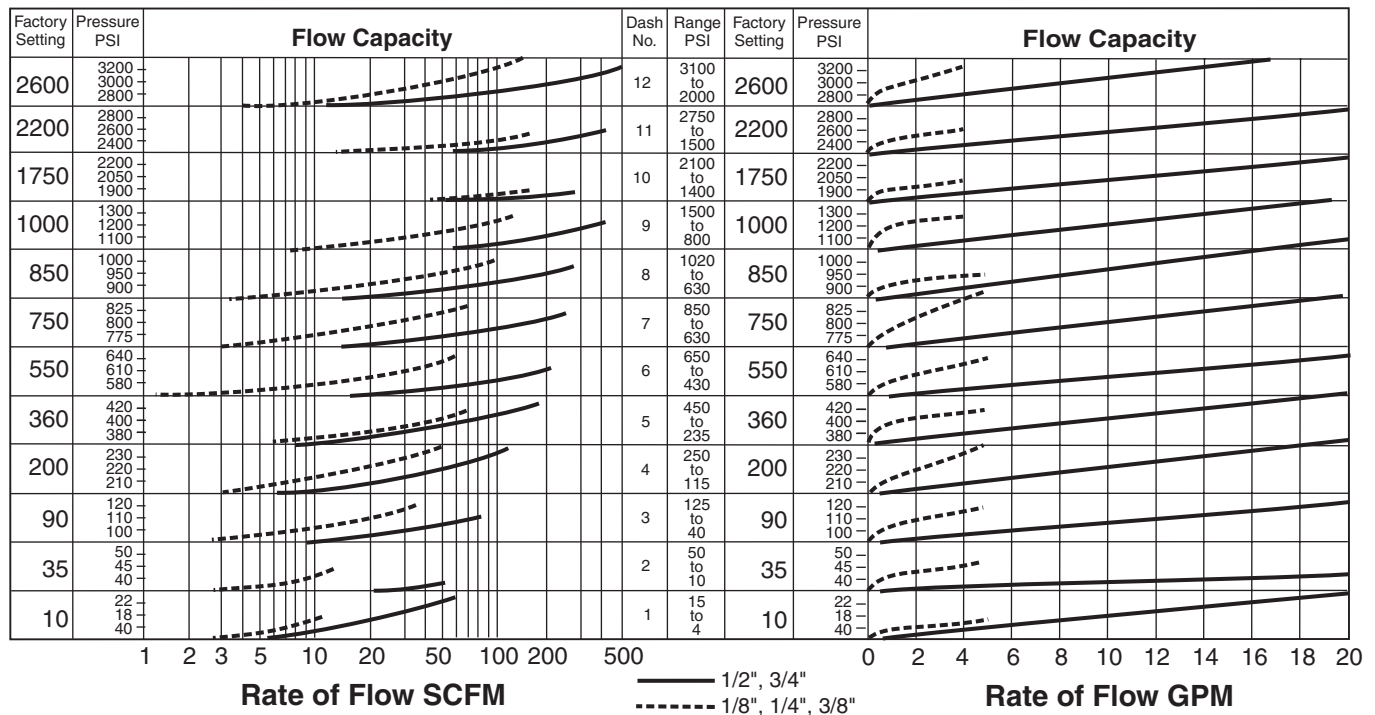
Air: steady stream of bubbles

Reseat leakage – Less than 1 DPM or 1 BPM

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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Performance Curves



Examples

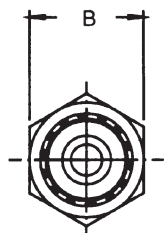
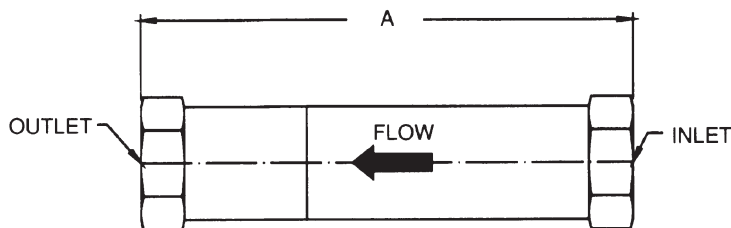
Pneumatic:

- Establish cracking pressure setting of 1/2" valve for flow of 70 SCFM at 27.6 Bar (400 PSI) pressure:
1. Project 70 SCFM on vertical scale.
 2. Project 27.6 Bar (400 PSI) scale horizontally intersectiong 1.
 3. Project line parallel to curves back to vertical line 1.
 4. Read cracking pressure setting: 24.8 Bar (360 PSI).

Hydraulic:

- Find amount of pressure increase above 24.8 Bar (360 PSI) cracking pressure when flow through 3/4" valve is increased to 54 LPM (14 GPM):
1. From 360 on vertical pressure scale, follow 3/4" curve until it intersects with the vertical line representing 54 LPM (14 GPM).
 2. Project intersecting point horizontally and read pressure, i.e., 29 Bar (420 PSI).
 3. Accumulated Pressure:
 $420 \text{ minus } 360 = 4.1 \text{ Bar (60 PSI).}$

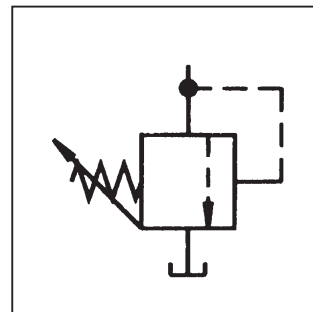
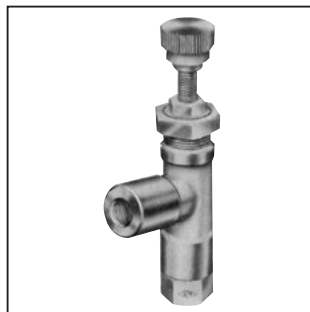
Dimensions – Shown in inches



Valve Size NPT	A	B	Max. Rated Flow GPM	Weights (Approx.)	
				Aluminium Alloy	Stainless Steel
1/2	5	1-3/16	10	0.6 Lbs.	1.3 Lbs.
3/4	7	1-5/8	15	1.7 Lbs.	3.2 Lbs.
1	7	1-5/8	15		

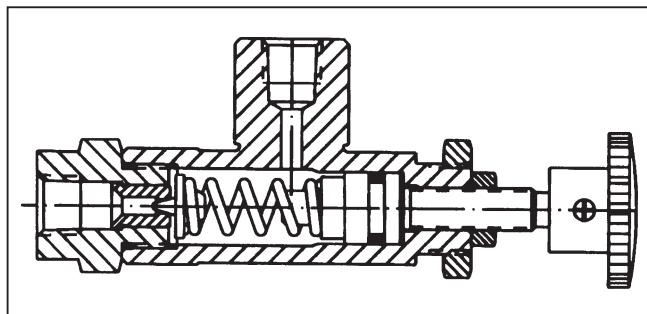
General Description

Series P6701 valves serve as a remote pilot for a pilot operated parent valve. Adjustable in three pressure ranges: 6.9 to 82.8 Bar (100 to 1200 PSI), 69 to 207 Bar (1000 to 3000 PSI) and 207 to 345 Bar (3000 to 6000 PSI).



Features

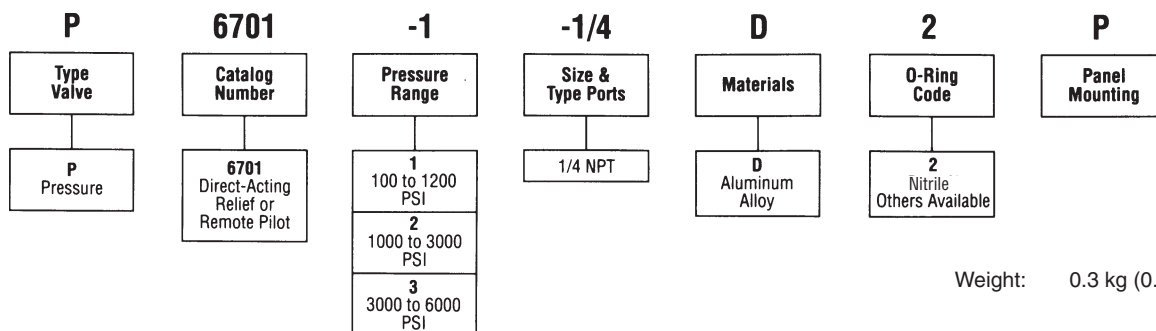
- Remote pilot for R6701, R6703, S6701, S6703, PR6701 and PR6703
- Ideal for adjustable vent valve



Specifications

Service App.	Hydraulic Oil	Internal Leakage	Less than 1 DPM at 90% of cracking pressure
Pressure Adjustment Range	Range 1: 6.9 - 82.8 Bar (100 - 1200 PSI) Range 2: 69 - 207 Bar (1000 - 3000 PSI) Range 3: 207 - 414 Bar (3000 - 6000 PSI)	Mounting	Panel hole 27/32" diameter
Maximum Operating Pressure	Proof: 517.5 Bar (7500 PSI) Burst: 828 Bar (12,000 PSI)	Material	Body Forged aluminum alloy Trim Steel and Stainless steel O-rings Synthetic rubber
Sizes	NPT 1/4"	Operating Temperature	-40°C to +121°C (-40°F to +250°F)
Orifice Dia.	1/8"		
Ports	NPT Pipe threads		

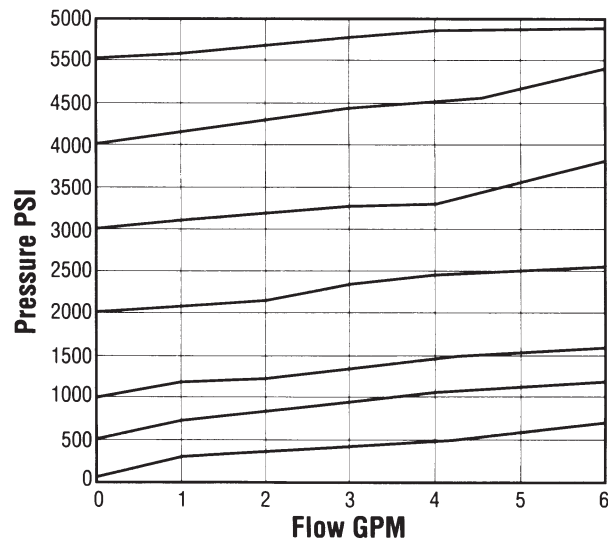
Ordering Information



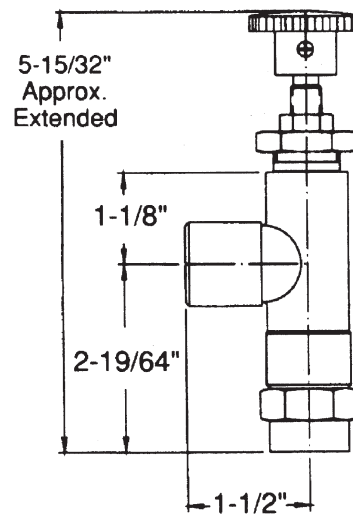
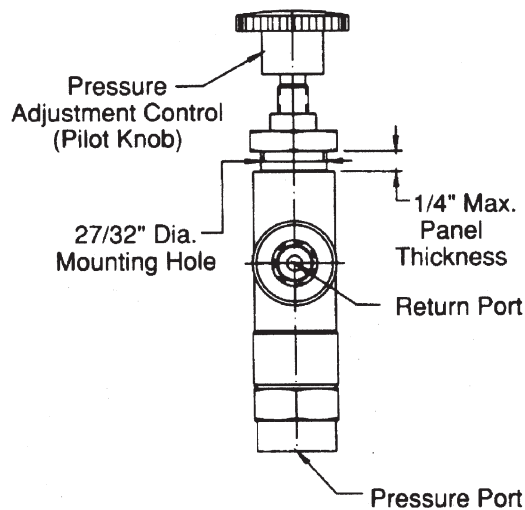
WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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Performance Curves



Dimensions — Shown in inches



In-Line Mounted Plug Valves

Series 300 PTFE Plug, 3 and 4-Way F2 - F3

Series 700 Metal Plug, 3 and 4-Way F2 - F3

Series 744 PTFE Plug, Cylindrical, 4-Way F4



General Description

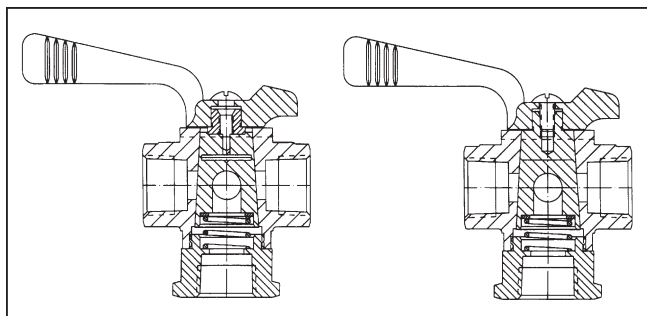
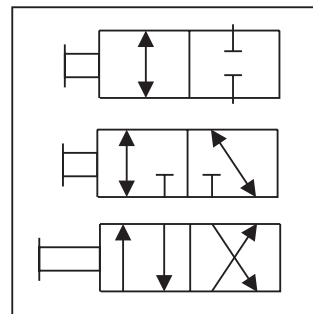
Series 300 and 700 are 3 and 4-way plug valves which can handle a variety of media. Series 300 contains a self-lubricating PTFE plug. Series 700 features a metal plug which requires lubrication. The different valve configurations allow for shut off or the selection of a particular flow pattern.

Features

- PTFE plug design requires no lubrication and is ideal for sampling applications
- Wide selection of flow patterns available
- Metal plug available with a wide range of lubricants for most applications

Specifications

Service App.	Liquid and air	
Pressure Range	Liquid:	6.2 Bar (90 PSI)
	Air:	3.5 Bar (50 PSI)
Internal Leakage	Liquid:	Zero
	Air:	1 bubble in 4 seconds at 3.5 Bar (50 PSI)
Sizes	See chart	
Ports	NPT	Pipe threads
	FLD	Flared Tube Connection SAE 37°
Mounting	Flanged	
Material	Series 300: Body Brass, aluminum alloy, stainless steel Plug Stainless steel impregnated PTFE Spring Stainless steel Handle Die cast aluminum alloy Series 700: Body Brass with brass plug; aluminum alloy with stainless steel plug; stainless steel with stainless steel plug Spring Stainless Steel Handle Die cast aluminum	
Temperature Range	Series 300: Non-operating: -40°C to +121°C (-40°F to +250°F) Operating: -18°C to 71°C (0°F to +160°F) Series 700: 0°C to +71°C (32°F to +160°F)	



CV Factor

Size and Dash No.		1/8 4	1/4 6	3/8 8	1/2 10	3/4 12
Max.	Alum. Alloy	.13	.25	.50	.62	.75
Weight	Brass	.25	.43	1.00	1.50	1.75
Lbs.	Stainless Steel	.37	.75	1.25	1.62	1.87
CV Factor	Inline	1.00	2.00	5.00	9.00	16.00
	Angle	.60	1.00	2.70	5.00	8.60

NOTE:

Each plug and body assembly is individually ground and lapped for perfect fit. Plugs and bodies are not replaceable or interchangeable in the field. Most plug valves, other than 2-way, have port interflow when turning handle. If interflow is a problem, consult our technical department.

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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Ordering Information

310-3

Catalog Number	Type	Number of Ports	Type Porting			Sizes and Materials	Handle Turns	Flow Patterns
			A	B	C			
310-3 or 710-3	Flanged Inline	3	NPT	—	—	1/4B	90°	
310-6 or 710-6	Flanged Inline	4	NPT	—	—	1/4B	90°	
	Flanged Inline	4	NPT	—	—	1/2B, 1/4B, 3/4B	90°	

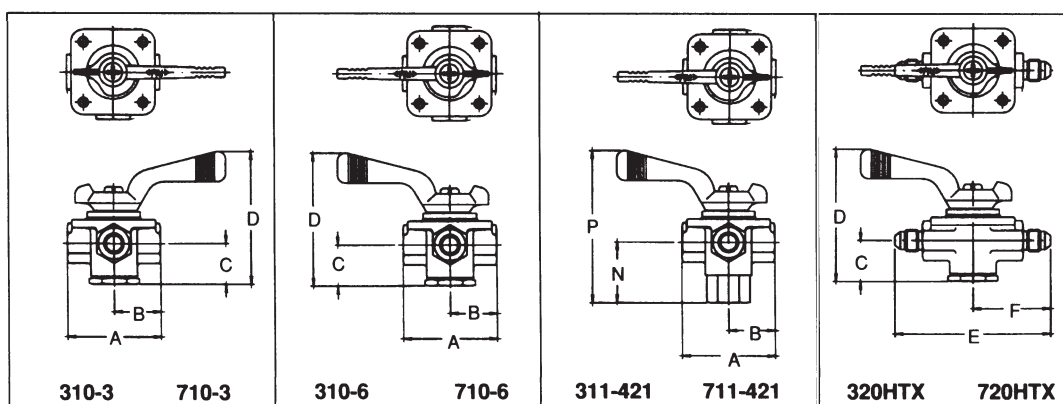
-1/4

Size
See Available Sizes from Chart

B

Materials
B Brass
D Aluminum Alloy

Dimensions



Tube Size	Pipe Size	All Dimensions are in Inches													
		A*	B	C	D	E	F	G	H	J	K	L	M	N	P
4	1/8"	1-7/16	23/32	47/64	2-9/32	2-5/8	1-5/16	1-13/16	0.884	0.687	6-32	3/16	11/32	1-1/16	2-39/64
6	1/4"	1-7/8	15/16	13/16	2-41/64	3-1/8	1-9/16	2-1/4	1.193	0.937	10-32	3/16	7/16	1-13/64	3-1/32
10	1/2"	2-1/2	1-1/4	1-9/64	3-15/32	4-1/4	2-1/8	3-1/8	1.724	1.406	1/4-28	1/4	5/8	1-23/32	4-3/64
12	3/4"	2-15/16	1-15/32	1-21/64	3-31/32	4-9/16	2-9/32	3-9/16	1.856	1.625	1/4-28	1/4	3/4	1-31/32	4-39/64

* Between spotfaces, not overall diameter of the body.

Service Note: Valves taken from stock, or valves not used for some time, may be hard to turn. This condition is due to drying out of the lubricant. The plug may be loosened by squeezing the valve carefully in a vise, pressing against the center screw in the handle. Turning the handle several times will free-up the plug. If necessary, disassemble the valve, wash off all the old lubricant, and re-lubricate the valve using only a small quantity of the proper lubricant.

CAUTION – DO NOT USE ANY OF THE ABOVE IN LIQUID OXYGEN SYSTEMS.

General Description

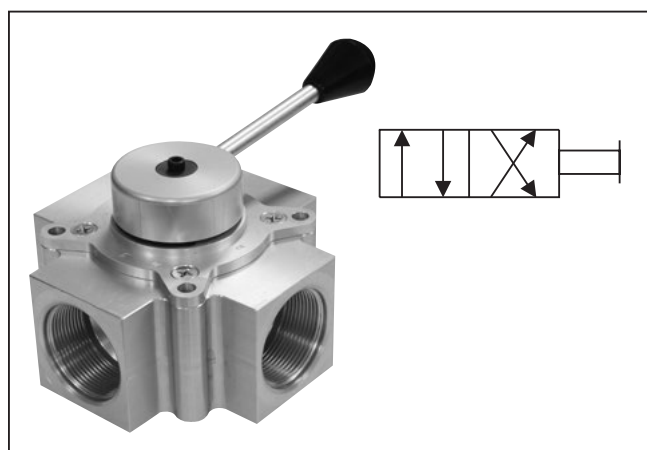
Series 744 4-way plug valves can handle a variety of media. The valve design requires low actuation torque and has a very low pressure drop. Series 744 contains a self-lubricating PTFE plug. The valve construction is compact and shifting the flow direction of the valve will not deadhead the pump.

Features

- Features high flow with low pressure drop
- Compact construction
- 17.3 Bar (250 PSI) service
- No lubrication necessary
- Low turning torque

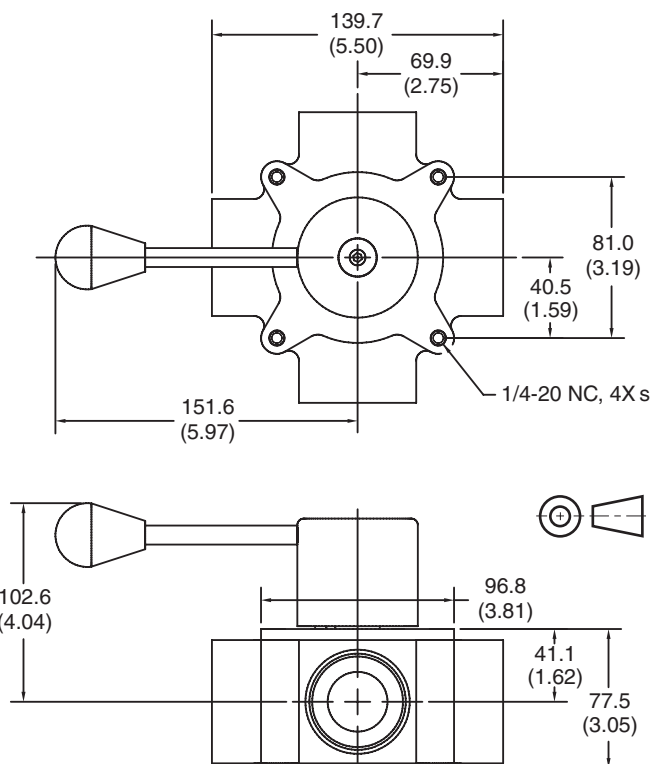
Specifications

Service Applications	Hydraulic or pneumatic; available for other service on special order	
Pressure Range	Liquid:	17.3 Bar (250 PSI)
	Air:	20 in hg. vacuum to 17.3 Bar (250 PSI)
	Proof:	20.7 Bar (300 PSI)
Internal Leakage	Liquid:	2 DPM maximum
	Air:	14 bubbles per minute
Sizes	NPT	1 1/4", 1 1/2"
	IST	20, 24
Ports	NPT	Pipe threads
	IST	Internal straight threads
CV Factor	1 1/4, 20 =	30
	1 1/2, 24 =	32
Mounting	Panel hole diameter 2 9/16"; maximum thickness 1/2"; four 1/4-20UNC-3B tapped holes; top cover plate drilled for bolt clearance	
Material	Body	Aluminum alloy
	Bearings	Delrin
	Port Seals	PTFE
	O-rings	Synthetic rubber
Temperature Range	-40°C to +107°C (-40°F to +225°F)	
	Higher temperatures on special order	

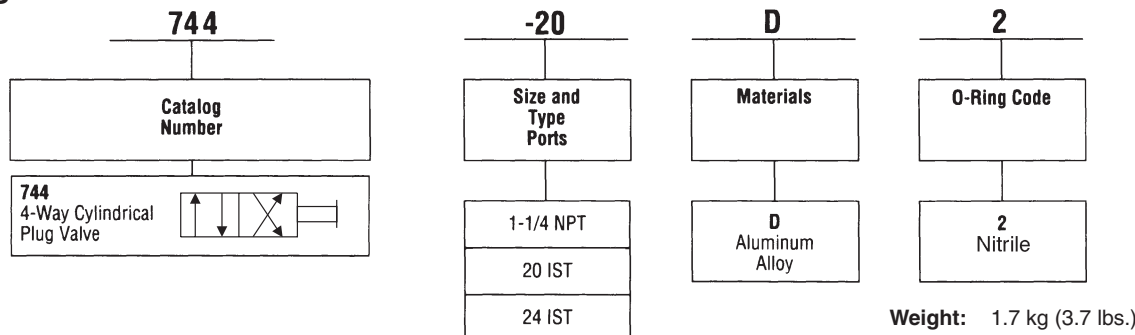


Dimensions

Inch equivalents for millimeter dimensions are shown in (**)



Ordering Information



WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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Accessories

Series 910 Hand Operated Pump..... G2 - G3

Series 910N.....Hand Operated Pump..... G4 - G5

Series 910R.....Hand Operated Pump..... G6 - G7

Series 913 Hand Operated Pump..... G8 - G9

Series 914 Hand Operated Pump..... G10 - G11

Series 915, 916 Hand Operated Pumps..... G12 - G13

Offer of Sale G14



General Description

Series 910 hand pumps are double-acting providing primary, backup or emergency hydraulic power. The hand pumps can be utilized anywhere; at any time, that hydraulic power is required, since the hand pump does not require an electrical or mechanical power source. They can be mounted in any position.

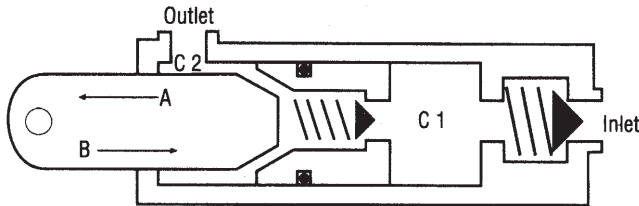
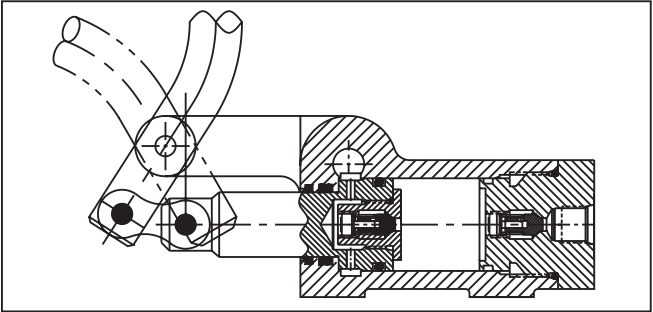
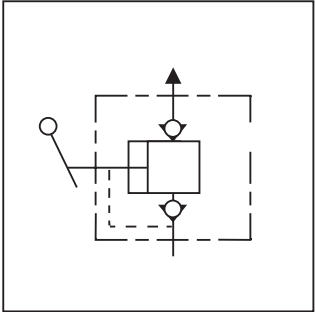
Operation

Piston Stroke — Direction A

Chamber C1 draws in fluid through INLET while chamber C2 discharges fluid through OUTLET.

Piston Stroke — Direction B

Volume in chamber C1 is transferred to chamber C2. Since chamber C2 holds half the volume of chamber C1, half of the fluid in chamber C2 is discharged through the OUTLET port.



Features

- Lightweight, double-acting hand pump delivers 33 cc (2 cu. in.) per cycle, 2 strokes
- Provides long maintenance-free service for any application where auxiliary hydraulic power is required

G

Specifications

Operating Pressure Range	0 to 103 Bar (1500 PSI) 1500 PSI based on 29 kg (64 lbs.) handle force at 578 mm (22.75 in.) handle/arm length	Materials: Body	Aluminum alloy
		Piston Handle Extension	Steel
Displacement	33 cc (2 cu. in.) per cycle 2 strokes	Poppets	Stainless steel type 303
Operating Temperature Range	-40°C to 121°C (-40°F to 250°F)	Springs	Stainless steel Type AMS5688
Operating Arc	60°	O-Rings	Synthetic rubber
Fluids	Hydraulic oil	Backup Rings	PTFE
Sizes	IST 6	Scraper	Synthetic rubber
Type Ports	IST	Molded Seal	Synthetic rubber
Mounting	Flanges (4) with 7 mm dia. (.281 in. dia.) holes	Handle	Extension furnished 508 mm (20 in.) long. Total 578 mm (22.75 in.)

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

G1_Cat3000.indd, ddp, 04/19

Ordering Information

910

Hand Pump

–

6

Size and Type

D

Materials

2

O-Ring

B

Discharge Port Location

C

Design Series

Code	Description
6	IST* port

* IST, military straight thread port, SAE compatible.

Code	Description
D	Aluminum Alloy

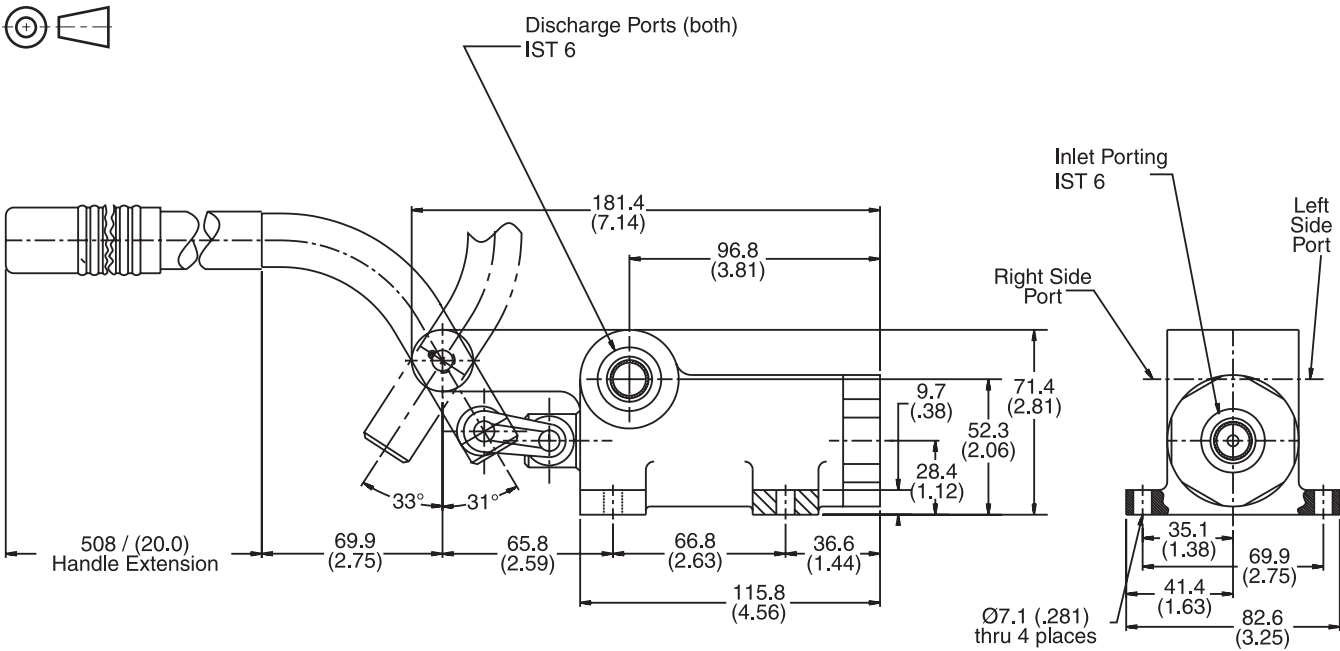
Code	Description
2	Nitrile

Code	Description
B	Both Sides*

Weight: 2.3 kg (5 lbs.)

Dimensions

Inch equivalents for millimeter dimensions are shown in (**)



General Description

Series 910N hand pumps are double-acting with needle valve providing primary, backup or emergency hydraulic power. Series 910N incorporates a cartridge needle valve that provides an easy method of bleeding an actuator or system back to tank. The hand pumps can be utilized anywhere; at any time, that hydraulic power is required, since the hand pump does not require an electrical or mechanical power source. They can be mounted in any position.

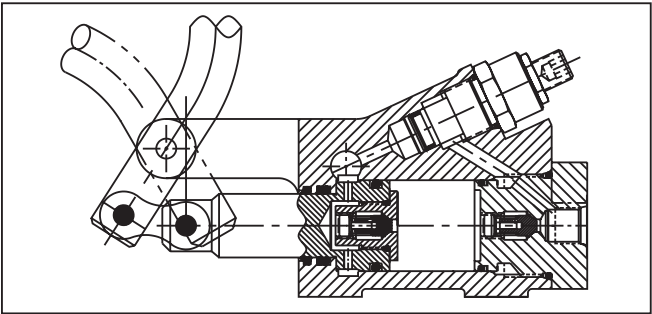
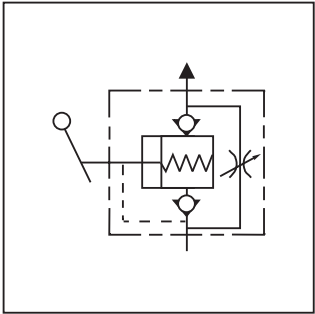
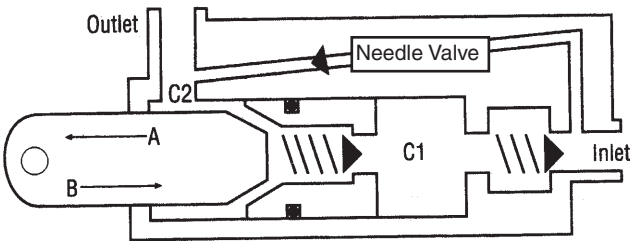
Operation

Piston Stroke — Direction A

Chamber C1 draws in fluid through INLET while chamber C2 discharges fluid through OUTLET.

Piston Stroke — Direction B

Volume in chamber C1 is transferred to chamber C2. Since chamber C2 holds half the volume of chamber C1, half of the fluid in chamber C2 is discharged through the OUTLET port.



Features

- Lightweight, double-acting hand pump delivers 33 cc (2 cu. in.) per cycle, 2 strokes
- Needle valve cartridge is a dependable, proven component that will allow the bleed-off of a circuit back to tank
- Provides long maintenance-free service for any application where auxiliary hydraulic power is required

Specifications

Operating Pressure Range	0 to 103 Bar (1500 PSI) 1500 PSI based on 29 kg (64 lbs.) handle force at 578 mm (22.75 in.) handle/arm length	Materials: Body	Aluminum alloy
		Piston Handle Extension	Steel
Displacement	33 cc (2 cu. in.) per cycle 2 strokes	Poppets	Stainless steel type 303
Operating Temperature Range	-40°C to 121°C (-40°F to 250°F)	Springs	Stainless steel Type AMS5688
		O-Rings	Synthetic rubber
Operating Arc	60°	Backup Rings	PTFE
Fluids	Hydraulic oil	Scraper	Synthetic rubber
Sizes	IST 6	Molded Seal	Synthetic rubber
Type Ports	IST	Handle	Extension furnished 508 mm (20 in.) long. Total 578 mm (22.75 in.)
Mounting	Flanges (4) with 7 mm dia. (.281 in. dia.) holes	Needle Valve Cartridge	Steel

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

G1_Cat3000.indd, ddp, 04/19

Ordering Information

910N

Hand Pump
with
Needle Valve

6

Size
and
Type

D

Materials

2

O-Ring

B

Discharge
Port
Location

C

Design
Series

Code	Description
6	IST* port

* IST, military straight thread port, SAE compatible.

Code	Description
D	Aluminum Alloy

Code	Description
2	Nitrile

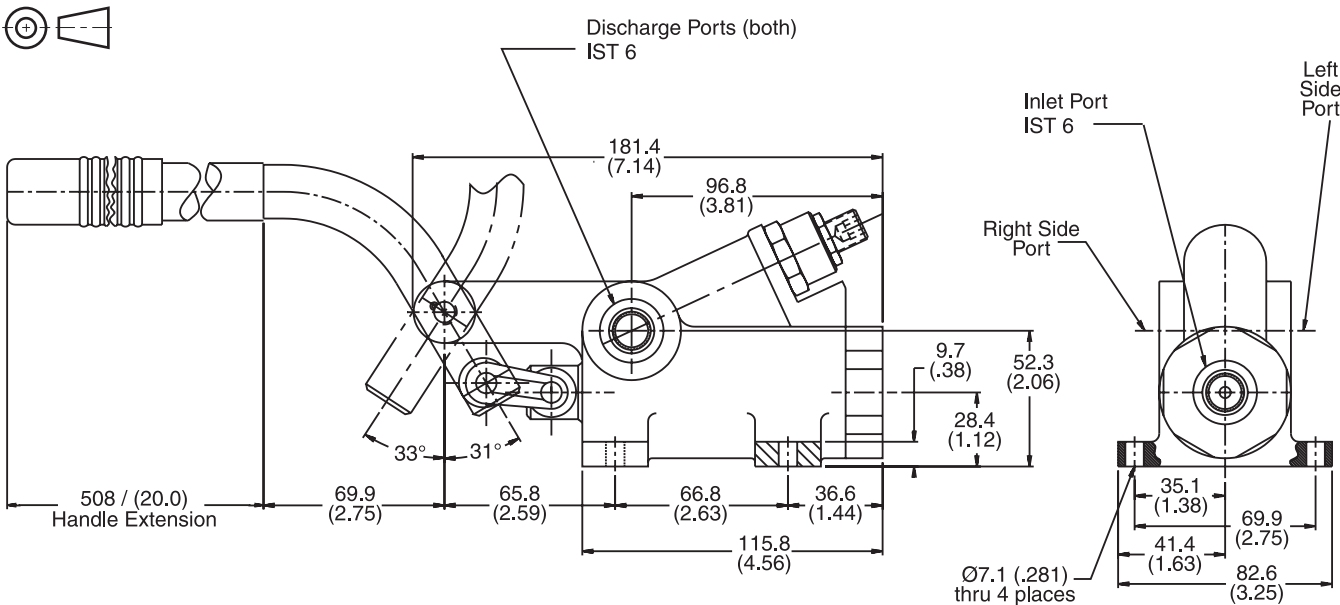
Code	Description
B	Both Sides*

* Note: one port to be plugged at installation.

Weight: 2.7 kg (6 lbs.)

Dimensions

Inch equivalents for millimeter dimensions are shown in (**)



General Description

Series 910R hand pumps are double-acting with relief valve providing primary, backup or emergency hydraulic power. Series 910R incorporates a cartridge relief valve that provides a smooth, quick unloading of the pump should the system become overloaded. The hand pumps can be utilized anywhere; at any time, that hydraulic power is required, since the hand pump does not require an electrical or mechanical power source. They can be mounted in any position.

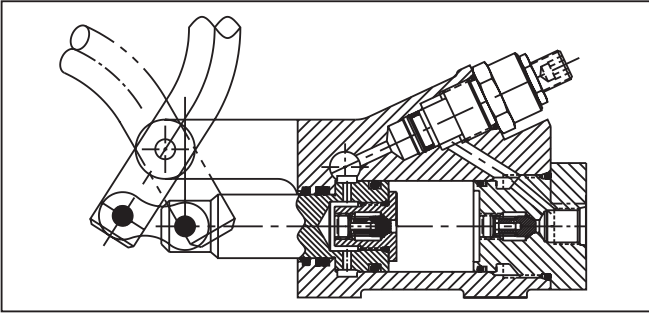
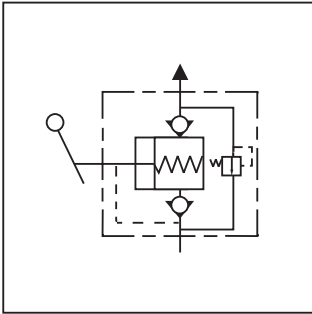
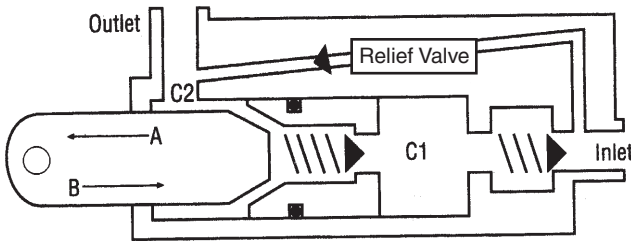
Operation

Piston Stroke — Direction A

Chamber C1 draws in fluid through INLET while chamber C2 discharges fluid through OUTLET.

Piston Stroke — Direction B

Volume in chamber C1 is transferred to chamber C2. Since chamber C2 holds half the volume of chamber C1, half of the fluid in chamber C2 is discharged through the OUTLET port.



Features

- Lightweight, double-acting hand pump delivers 33 cc (2 cu. in.) per cycle, 2 strokes
- Relief valve cartridge is a dependable, proven component that will protect any circuit from over pressurizing and adjustable from 6.8 to 103 Bar (100 to 1500 PSI)
- Provides long maintenance-free service for any application where auxiliary hydraulic power is required

Specifications

Operating Pressure Range	0 to 103 Bar (1500 PSI) 1500 PSI based on 29 kg (64 lbs.) handle force at 578 mm (22.75 in.) handle/arm length	Materials: Body	Aluminum alloy
		Piston Handle Extension	Steel
Displacement	33 cc (2 cu. in.) per cycle 2 strokes	Poppets	Stainless steel type 303
Operating Temperature Range	-40°C to 121°C (-40°F to 250°F)	Springs	Stainless steel Type AMS5688
Operating Arc	60°	O-Rings	Synthetic rubber
Fluids	Hydraulic oil	Backup Rings	PTFE
Sizes	IST 6	Scraper	Synthetic rubber
Type Ports	IST	Molded Seal	Synthetic rubber
Mounting	Flanges (4) with 7 mm dia. (.281 in. dia.) holes	Handle	Extension furnished 508 mm (20 in.) long. Total 578 mm (22.75 in.)
		Relief Valve Cartridge	Steel

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

G1_Cat3000.indd, ddp, 04/19

Ordering Information

910R

Hand Pump
with
Relief Valve

6

Size
and
Type

D

Materials

2

O-Ring

B

Discharge
Port
Location

C

Design
Series

Code	Description
6	IST* port

* IST, military straight thread port, SAE compatible.

Code	Description
D	Aluminum Alloy

Code	Description
2	Nitrile

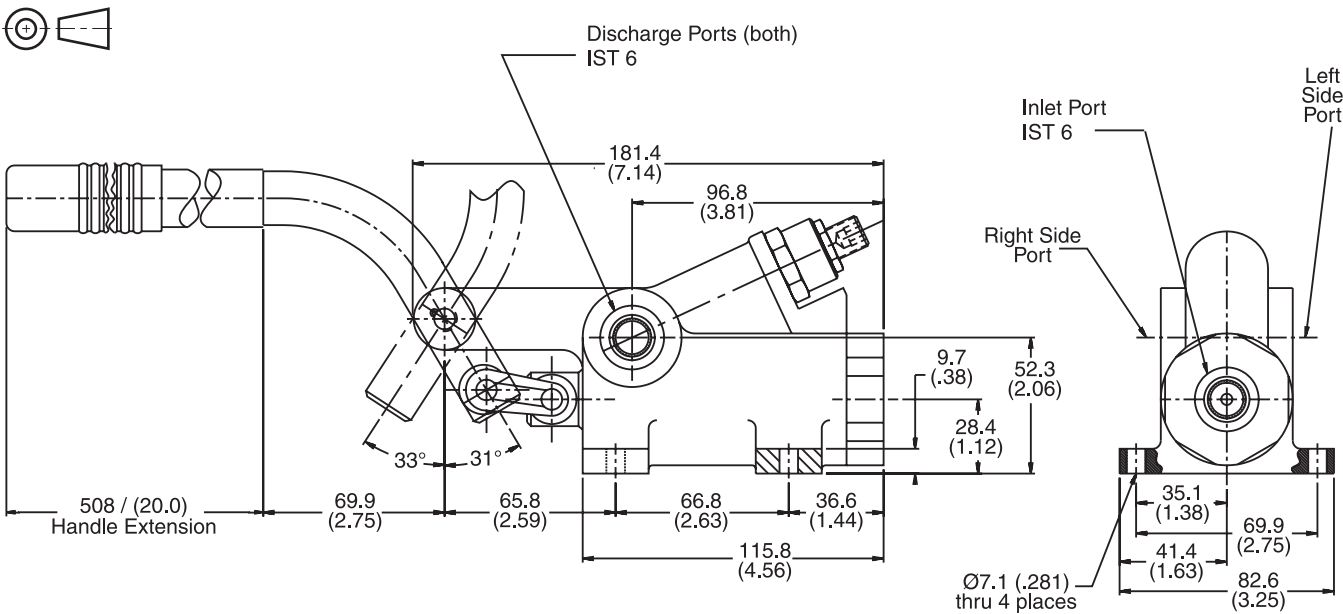
Code	Description
B	Both Sides*

* Note: one port to be plugged at installation.

Weight: 2.7 kg (6 lbs.)

Dimensions

Inch equivalents for millimeter dimensions are shown in (**)



General Description

Series 913 hand pumps are single-acting providing primary, backup, or emergency hydraulic power. The hand pumps can be utilized anywhere; at any time, that hydraulic power is required, since the hand pump does not require an electrical or mechanical power source. Series 913 hand pumps have two stages. The first stage allows a large volume to be pumped so that a cylinder or actuator quickly moves into its working position. At the second stage, the hand pump sequences to a lower volume at higher pressures.

Features

- When first stage reaches 0.7 Bar (10 PSI) maximum, pump automatically sequences to a lower volume at pressures up to 345 Bar (5000 PSI).

Operation

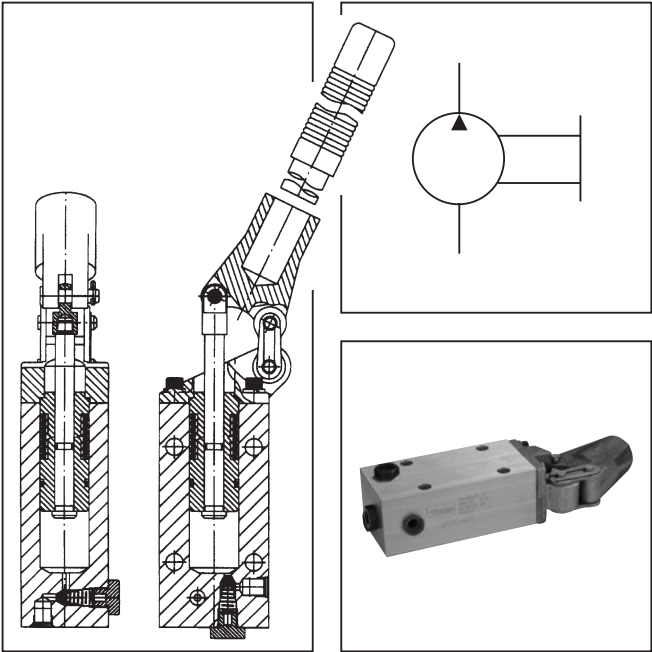
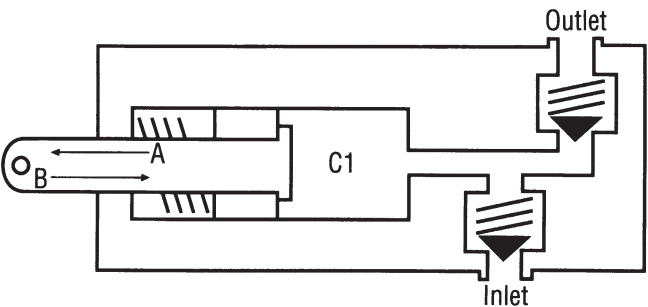
Piston Stroke — Direction A

Piston draws in fluid through INLET, charging chamber C1.

Piston Stroke — Direction B

Stage 1 (to 10 PSI): Volume C1 discharged through OUTLET.

Stage 2 (over 20 PSI): Build up of pressure in system causes piston to remain in retracted position (shown), and plunger moves forward, discharging low volume through OUTLET at high pressure. Piston remains in retracted position on next A stroke.



Specifications

Service App.	Hydraulic oil	
Pressure Range	Working: 0 - 345 Bar (0 - 5000 PSI) [345 Bar (5000 PSI) based on 50 lb. handle load at 23 in.]	
Sizes	IST	4
Ports	IST	Internal straight threads
Type	Single-acting	
Mounting	Holes (4) through, 9.9 mm (0.390 in.) dia.	
Displacement	16.4 cc - 0.7 Bar (1 cu. in. - 10 PSI) 3.1 cc - 345 Bar (0.19 cu. in. - 5000 PSI)	
Material	Body	Aluminum alloy
	Piston, Plunger	416 Stainless steel
	Springs	Stainless steel
	O-rings	Synthetic rubber
	Back-up rings	PTFE
Operating Arc	55°	
Handle	Not furnished. Available on special order	
Temperature Range	-40°C to +121°C (-40°F to +250°F)	

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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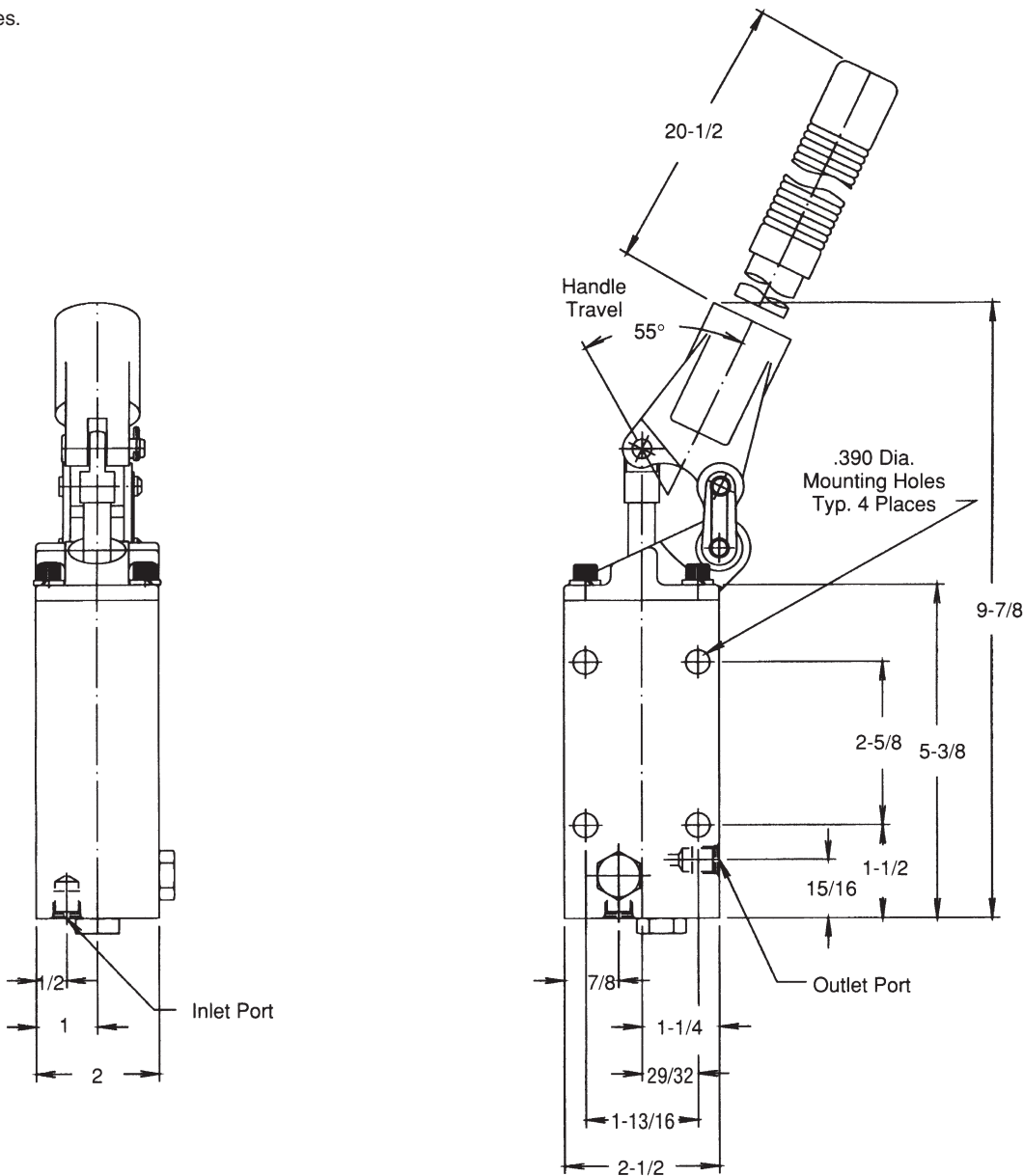
Ordering Information

913	-4	D	2
Catalog Number	Size and Type Ports	Materials	O-Ring Code
913 2-Stage Hand Pump	4 IST	D Aluminum Alloy	2 Nitrile

Weight: 1.6 kg (3.5 lbs.)

Dimensions

Shown in inches.



General Description

Series 914 hand pumps are double-acting providing primary, backup, or emergency hydraulic power. The hand pumps can be utilized anywhere; at any time, that hydraulic power is required, since the hand pump does not require an electrical or mechanical power source.

Features

- Integral resilient seated valves prevent backflow during operation.

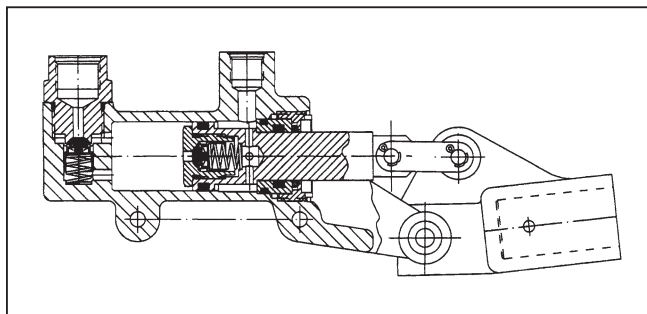
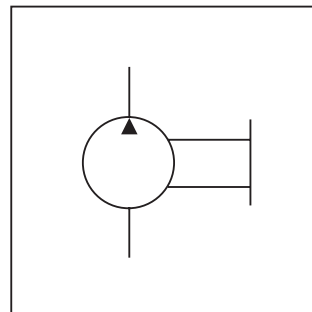
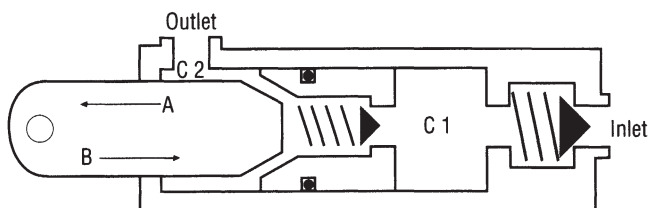
Operation

Piston Stroke — Direction A

Chamber C1 draws in fluid through INLET while chamber C2 discharges fluid through OUTLET.

Piston Stroke — Direction B

Volume in chamber C1 is transferred to chamber C2. Since chamber C2 holds half the volume of chamber C1, half of the fluid in chamber C2 is discharged through the OUTLET port.



Specifications

Service App.	Hydraulic oil	
Pressure Range	Working: 0 - 103.5 Bar (0 - 1500 PSI) [103.5 Bar (1500 PSI) based on 60 lb. handle load at 22 1/2 in.] Proof: 155.3 Bar (2250 PSI) Burst: 258.8 Bar (3750 SPI)	
Sizes	IST	8 (inlet)
	IST	6 (outlet)
Ports	IST	Internal straight threads, AND10050
Type	Double-acting	
Mounting	Holes (2) through, 6.5 mm (0.257 in.) dia.	
Displacement	20.5 to 24.6 cc (1.25 to 1.50 cu. in.) per cycle (2 strokes)	
Material	Body	Aluminum alloy
	Piston	Steel
	Poppets	303 Stainless steel
	Springs	AMS5688 Stainless steel
	Molded seals	Synthetic rubber
	Back-up rings	PTFE
	Scraper	Brass
	O-rings	Synthetic rubber
Operating Arc	60° maximum	
Handle	Not furnished. Available on special order	
Temperature Range	-54°C to +121°C (-65°F to +250°F)	

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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914	-8	D	27
Catalog Number	Size and Type Ports	Materials	O-Ring Code
914 Hand Pump to 1500 P.S.I.	8 IST Inlet 6 IST Outlet	D Aluminum Alloy	27 MIL-P-25732

Dimensions



General Description

Series 915 hand pumps are double-acting providing primary, backup, or emergency hydraulic power. The hand pumps can be utilized anywhere; at any time, that hydraulic power is required, since the hand pump does not require an electrical or mechanical power source.

Features

- Integral resilient seated valves prevent backflow during operation.

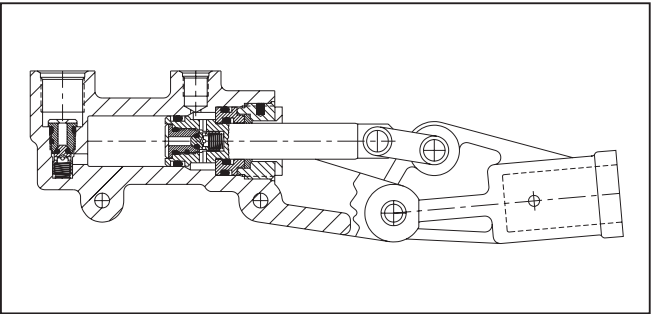
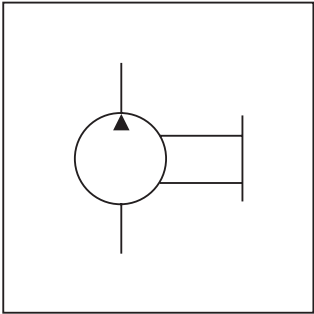
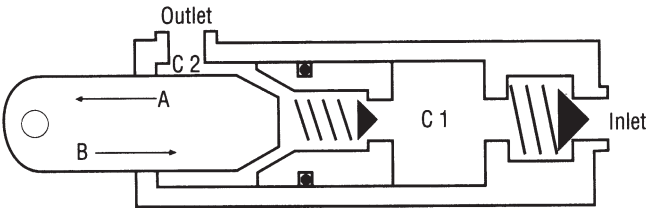
Operation

Piston Stroke — Direction A

Chamber C1 draws in fluid through INLET while chamber C2 discharges fluid through OUTLET.

Piston Stroke — Direction B

Volume in chamber C1 is transferred to chamber C2. Since chamber C2 holds half the volume of chamber C1, half of the fluid in chamber C2 is discharged through the OUTLET port.



Specifications

Service App.	Hydraulic oil	
Pressure Range	Working:	0 - 207 Bar (0 - 3000 PSI) [207 Bar (3000 PSI) based on 60 lb. handle load at 22 1/2 in.]
	Proof:	310.5 Bar (4500 PSI)
	Burst:	517.5 Bar (7500 PSI)
Sizes	IST	8 (inlet) 4 (outlet)
Ports	IST	Internal straight threads, 915-8D27 (AND10050), 916-8D27 (MS33649)
Type	Double-acting	
Mounting	Holes (2) through, 6.5 mm (0.257 in.) dia.	
Displacement	11.5 cc (0.7 cu. in.) per cycle (2 strokes)	
Material	Body	Aluminum alloy
	Piston Rod	420 Stainless steel
	Poppets	303 Stainless steel
	Springs	18-8 Stainless steel
	Molded seals	Synthetic rubber
	Back-up rings	PTFE
	Scraper	Brass
	O-rings	Synthetic rubber
Operating Arc	60°	
Handle	Not furnished.	
Temperature Range	-54°C to +121°C (-65°F to +250°F)	

WARNING: This product can expose you to chemicals including Lead, Nickel (Metallic), or 1,3-Butadiene which are known to the State of California to cause cancer, and Lead or 1,3-Butadiene which is known to the State of California to cause birth defects and other reproductive harm. For more information go to www.P65Warnings.ca.gov.

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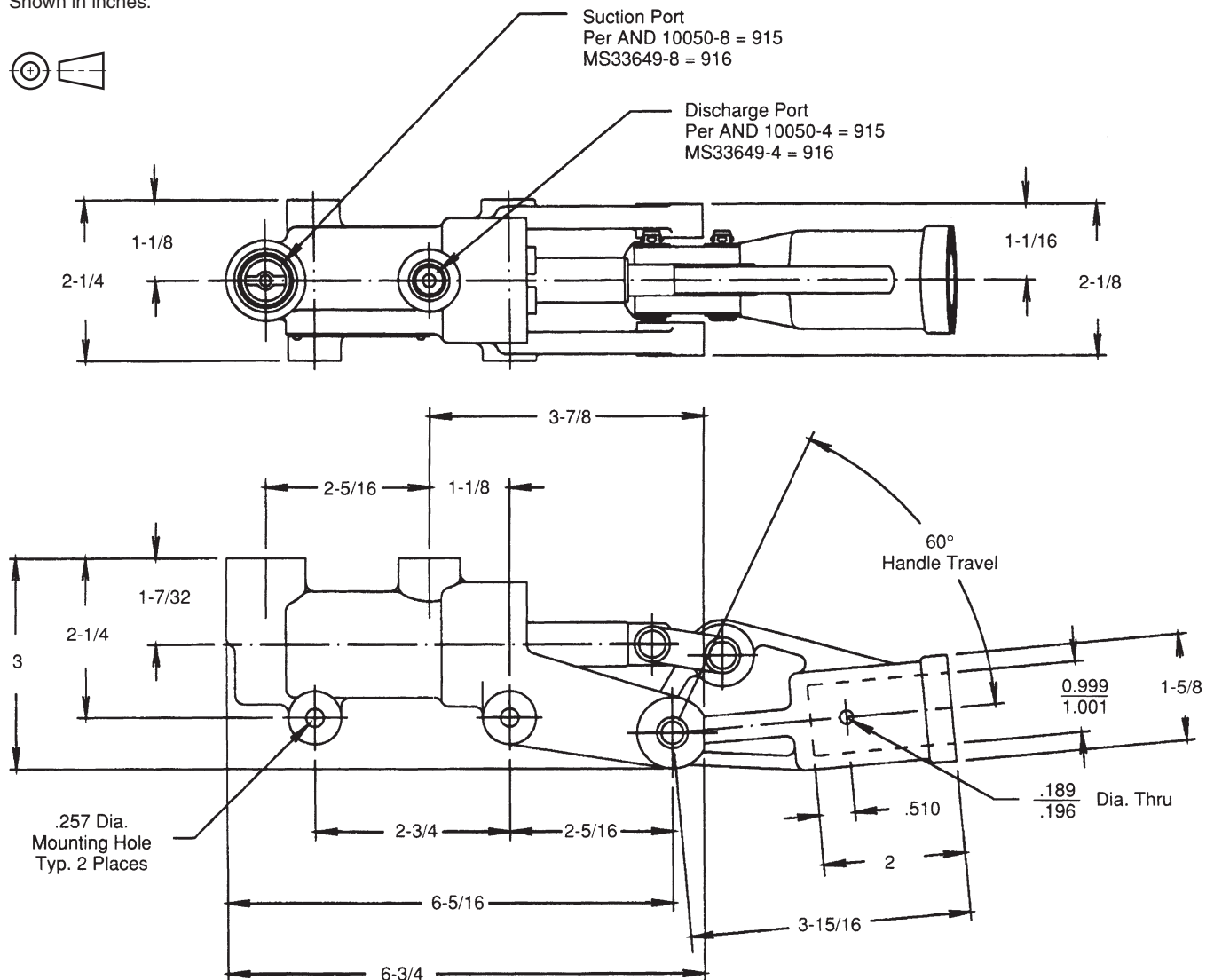
Ordering Information

915 or 916	-8	D	27
Catalog Number	Size and Type Ports	Materials	O-Ring Code
	8 IST Inlet	D Aluminum Alloy	27 MIL-P-25732
	4 IST Outlet		

Weight: 1.0 kg (2.1 lbs.)

Dimensions

Shown in inches.



Terms of Sale with Warranty Limitations

PARKER-HANNIFIN CORPORATION — HYDRAULIC VALVE DIVISION OFFER OF SALE

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

Buyer: means any customer receiving a Quote for Products from Seller.
Goods: means any tangible part, system or component to be supplied by the Seller.
Products: means the Goods, Services and/or Software as described in a Quote provided by the Seller.
Quote: means the offer or proposal made by Seller to Buyer for the supply of Products.
Seller: means Parker-Hannifin Corporation, including all divisions and businesses thereof.
Services: means any services to be supplied by the Seller.
Software: means any software related to the Products, whether embedded or separately downloaded.
Terms: means the terms and conditions of this Offer of Sale or any newer version of the same as published by Seller electronically at www.parker.com/saleterms.

2. Terms. All sales of Products by Seller are contingent upon, and will be governed by, these Terms and, these Terms are incorporated into any Quote provided by Seller to any 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 of purchase. No modification to these Terms will be binding on Seller unless agreed to in writing and signed by an authorized representative of Seller.

3. Price; Payment. The Products set forth in Seller's Quote are offered for sale at the prices indicated in Seller's Quote. Unless otherwise specifically stated in Seller's 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 at any time to adjust for any raw material price fluctuations. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2010). All sales are contingent upon credit approval and payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). 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.

4. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate. Seller is not responsible for damages resulting from any delay. 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 shipment carrier at Seller's facility. Unless otherwise agreed, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyer's request beyond the respective indicated shipping date will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions.

5. Warranty. The warranty related to the Products is as follows: (i) Goods are warranted against defects in material or workmanship for a period of eighteen (18) months from the date of delivery; (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 completion of the Services by Seller; 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:

DISCLAIMER OF WARRANTY: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING DESIGN, NON-INFRINGEMENT, 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. BUYER AGREES AND ACKNOWLEDGES THAT 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 the 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 PRODUCT, 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 ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, NON-COMPLETION OF SERVICES, USE, LOSS OF USE OF, OR INABILITY TO USE THE PRODUCTS OR ANY PART THEREOF, LOSS OF DATA, IDENTITY, PRIVACY, OR CONFIDENTIALITY, 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 PAID FOR THE PRODUCTS.**

8. Loss to Buyer's Property. Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which are or 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 Products 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. Special Tooling includes but is not limited to tooling, jigs, fixtures and associated manufacturing equipment acquired or necessary to manufacture Products. A tooling charge may be imposed for any Special Tooling. 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 Special Tooling belonging to Seller that is utilized in the manufacture of the Products, even if such Special Tooling 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. Security Interest. To secure payment of all sums due, 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 its security interest.

11. User Responsibility. The 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. The Buyer must analyze all aspects of the application and follow applicable industry standards, specifications, and other technical information provided with the Product. If Seller provides Product options based upon data or specifications provided G1_Cat3000.indd, ddp, 04/19

by the Buyer, the 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 the Buyer is not the end-user, Buyer will ensure such end-user complies with this paragraph.

12. Use of Products. Indemnity by Buyer. Buyer shall comply with all instructions, guides and specifications provided by Seller with the Products. Unauthorized Uses. If Buyer uses or resells the Products for any uses prohibited in 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. 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, 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 provided by Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, tooling, equipment, plans, drawings, designs or specifications or other information or things furnished by Buyer; (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 or tampering with the Products for any reason; or (e) Buyer's failure to comply with these Terms. Seller shall not indemnify Buyer under any circumstance except as otherwise provided in these Terms.

13. Cancellations and Changes. Buyer may not cancel or modify 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, at any time, may change Product features, specifications, designs and availability.

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

15. 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 ("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.

16. Waiver and Severability. Failure to enforce any provision of these Terms 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 these Terms by legislation or other rule of law shall not invalidate any other provision herein and, the remaining provisions will remain in full force and effect.

17. Termination. Seller may 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) 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.

18. Ownership of Software. Seller retains ownership of all Software supplied to Buyer hereunder. In no event shall Buyer obtain any greater right in and to the Software than a right in the nature of a license limited to the use thereof and subject to compliance with any other terms provided with the Software.

19. 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 ("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 sold hereunder infringes the Intellectual Property Rights of a third party in the country of delivery of the Products by the Seller to the 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 sold hereunder 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 so as 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; or (ii) directed to any Products provided hereunder 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 provided hereunder. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for such claims of infringement of Intellectual Property Rights.

20. Governing Law. These Terms 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.

21. Entire Agreement. These Terms, along with the terms set forth in the main body of any Quote, forms the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale. In the event of a conflict between any term set forth in the main body of a Quote and these Terms, the terms set forth in the main body of the Quote shall prevail. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter shall have no effect. These Terms may not be modified unless in writing and signed by an authorized representative of Seller.

22. 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 acknowledges 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 Product from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws.





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