



Hydraulic and Electrohydraulic Actuators

Series 2HX / 2HDX / 2HBX / 3HX / 3HDX / 3HBX



ENGINEERING YOUR SUCCESS.

In line with our policy of continuing product improvement, specifications and information contained in this catalog are subject to change.

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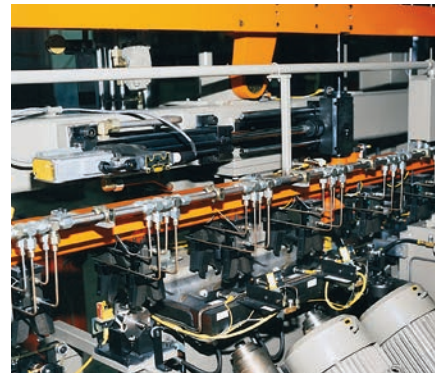
Parker is Engineering

Fluid Power and application expertise provide customers the opportunity to use us as an extension of their design teams. From new system design to improvements required for existing applications, Parker offers unparalleled engineering expertise. We'll help you develop cost saving, high performance solutions that provide value through increased productivity, improved machine efficiency, and reduced downtime.

Our design engineers utilize the highest quality materials and cutting edge manufacturing processes available to push the envelope for performance, value and reliability.

Parker components and systems are made to last. We offer complete system solutions for the following industries:

- Plastics
- Metal Forming
- Steel
- Press
- Off Shore Oil
- Forestry
- Mining
- Entertainment
- Flight Simulation
- Fatigue Testing
- Automation



Worldwide Supplier to Industrial Markets

Parker Hannifin is the world's leading supplier of motion and control technologies that include; motion control products, systems, and complete engineered solutions for industrial markets. Parker's broad and extensive breadth of product offer single source capability with limitless possibilities. Our industrial product solutions range from state of the art stand-alone components to complete engineered systems that are designed to provide value and efficiency to all of our customers. Each component and system is backed up with superior application expertise and technical support that you would expect from Parker Hannifin.



Manufacturing Locations



Corona, California

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Goodland, Indiana

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Atlanta, Georgia

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Eugene, Oregon

29289 Airport Road • Eugene, OR 97402-0079
Tel.: (541) 689-9111 • Fax: (541) 688-6771 • Fax: (800) 624-7996



Plymouth, Michigan

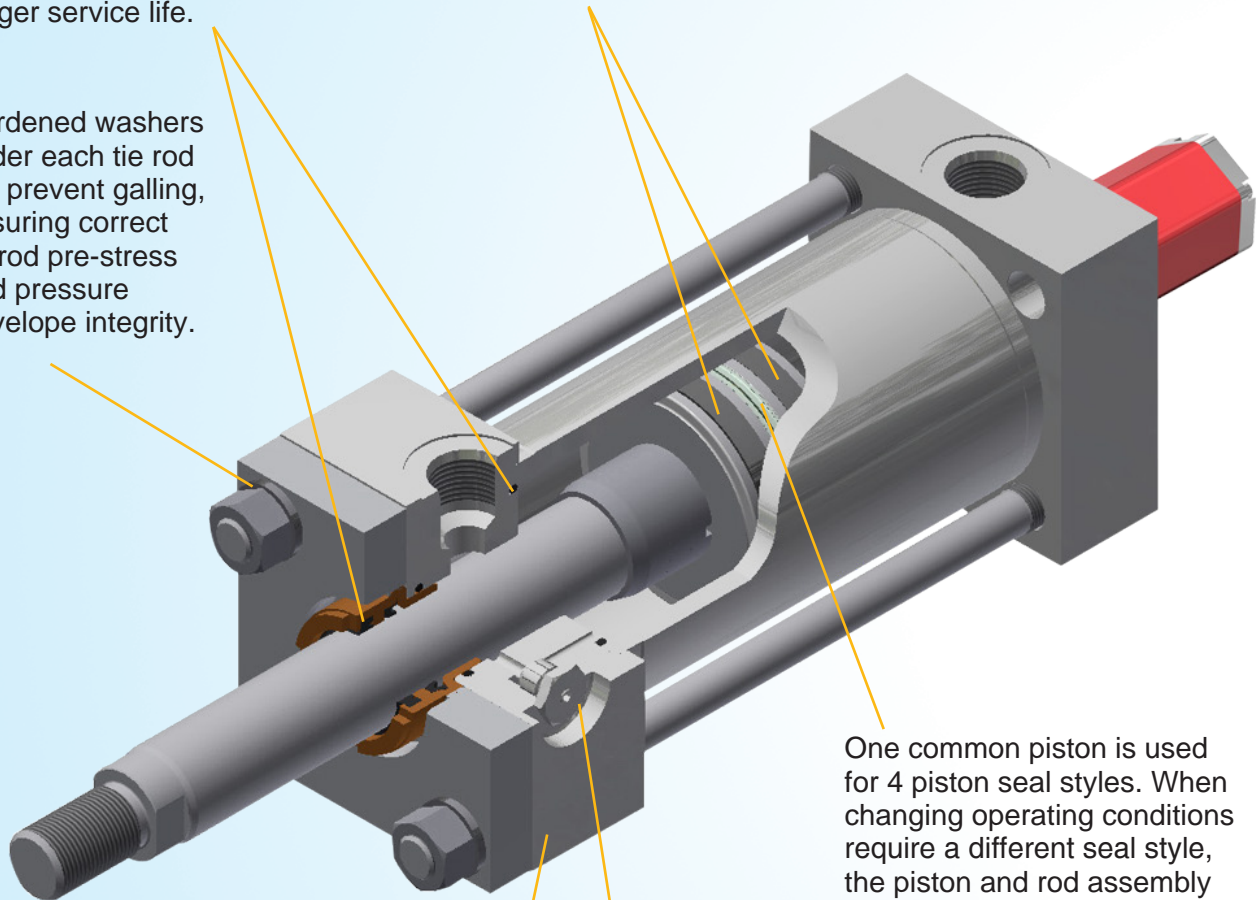
900 Plymouth Road • Plymouth, MI 48170
Tel.: (734) 455-1700 • Fax: (734) 455-1007

Series 2HX / 3HX Design Improvements Increase Reliability

Class 1 service polyurethane rod wiper, seal and o-rings (rod gland static seal and body end seals) offer superior abrasion and extrusion resistance for longer service life.

High compressive strength non-metallic piston wear rings, that minimize tube scoring, are standard on all configured piston selections.

Hardened washers under each tie rod nut prevent galling, ensuring correct tie rod pre-stress and pressure envelope integrity.



One common piston is used for 4 piston seal styles. When changing operating conditions require a different seal style, the piston and rod assembly is unchanged.

Cartridge style needle valve with captive micro adjust screw for precision cushion tuning.

Steel head and cap blocks are precision size, finished on all sides and are bored and grooved for concentric alignment of mating parts.

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One Common Platform – Three Construction Choices

Configurable Gland, Tie Rod & Non-Tie Rod Styles are all available when you need them.

Series 2HX & 3HX Tie Rod Style with Threaded Jewel Gland

Traditional Parker threaded Jewel gland construction with proven TS2000 rod sealing system. Industrial cylinder standard tie rod construction ensures head and cap remain in contact with tube ends to ensure leak free performance.

Advantages

- ✓ Rod gland serviceable, using gland and spanner wrenches, without disturbing tie rod torque
- ✓ High strength tie rod material with rolled thread for added strength



(WaveScale LDT model shown)

Series 2HDX & 3HDX Tie Rod Style with Bolt-On Gland

Bolt-on gland (see Gland Retention page for bore and mounting availability) with robust Tri-Lip rod sealing system. Industrial cylinder standard tie rod construction ensures head and cap remain in contact with tube ends to ensure leak free performance.

Advantages

- ✓ Rod gland serviceable, using a common hex key or allen wrench, without disturbing tie rod torque
- ✓ High strength tie rod material with rolled thread for added strength



(Manifold and Transfer Tube assembly shown)

Series 2HBX & 3HBX Non-Tie Rod Style with Bolt-On Gland

Non-tie rod style with bolt-on gland and robust Tri-Lip rod sealing system. Head and cap are bolted to threaded body flanges.

Advantages

- ✓ Improved fatigue life compared to welded flange construction
- ✓ Easier to service than tie rod styles in long strokes
- ✓ Clean appearance improves machine aesthetics
- ✓ Lower weight in long strokes



(Standard LDT model shown)

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Piston Sealing Solutions for the Most Demanding Applications

Piston Seal Technology For The 21st Century

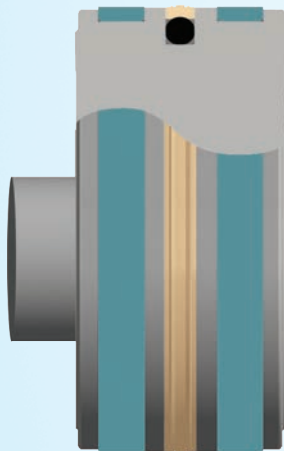
Parker's new universal piston seal design addresses the performance balance between low pressure sealability, low friction, extrusion resistance and seal life.

One piston style is used for all piston seal and wear ring configurations and will suit all application requirements. A common piston design permits field changing of seal configuration or seal and wear band material without replacing costly machined components when variations in application parameters occur, such as fluid, temperature or duty cycle.

All piston options include dual non-metallic wear rings to provide maximum stability and bearing area for protection against eccentric loads.

Parker WearGard™ wear rings are internally lubricated for reduced friction and formulated for heavy-duty load-bearing applications.

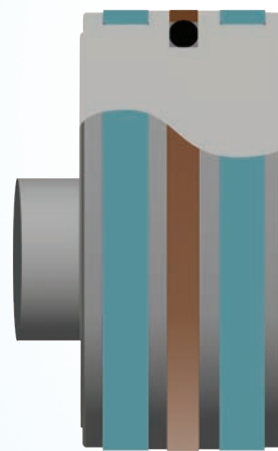
Parker HP Polyurethane Piston Seal



The Parker HP energized bi-directional piston seal improves upon the low friction and long wear of lipseals by including excellent low pressure sealing performance. Specially formulated polyurethane is long wearing and abrasion resistant with running friction comparable to lipseals. An o-ring energizer ensures virtually zero leakage in low pressure applications. Also, pressure trapping that can result with energized lipseals is not possible with a single energized seal.

Parker's HP piston seal is an excellent choice for most industrial applications operating with mineral based hydraulic oil and is available in Seal Classes 1 and 4.

Parker KP Filled PTFE Piston Seal



The Parker KP bronze filled PTFE seal ring material has low running friction for accurate positioning in closed loop servo applications.

When combined with a fluorocarbon energizing ring the Parker KP seal is rated for 400° F and will increase service intervals in high temperature applications when compared to fluorocarbon lipseals.

By combining the Parker KP seal with other energizer o-ring compounds and wear ring materials, the KP seal offers excellent service in all Seal Class environments.



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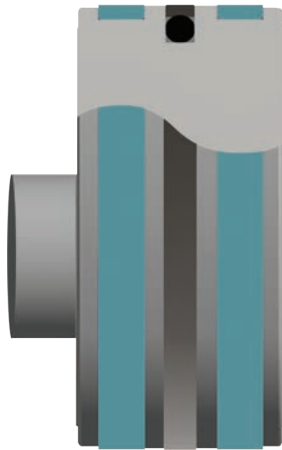


Piston Sealing Solutions for the Most Demanding Applications

Selection Guide

Application Demand	HP Seal	KP Seal	RP Seal	WP Seal
Load Holding	Best	Good	Good	Best
Fluid Compatibility	Good	Best	Better	Better
Heat Resistance	Good (200° F Max.)	Best (400° F Max.)	Better (300° F Max.)	Better (250° F Max.)
Dynamic Friction	Best	Best	Good	Better
Breakaway Friction	Good	Best	Good	Better
Extrusion Resistance	Good	Better	Best	Good
Fluid Isolation	N/A	N/A	N/A	Best

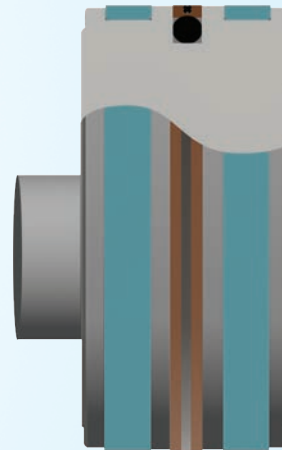
Parker RP Thermoplastic Seal



The Parker RP step cut ring is made of self-lubricating, glass reinforced, thermoplastic and is o-ring energized. Unlike cast iron rings that bypass oil, the Parker RP seal provides drift free operation throughout the operating pressure range. This tough seal is fully extrusion resistant, even in the face of extreme pressure spikes, thus ensuring superior wear resistance in the most demanding applications.

Parker RP can operate up to 300° F and is compatible with Seal Classes 1, 2, 3, 4, 5 and 6.

Parker WP Mixed Media Seal



The Parker WP Mixed Media seal is designed for applications requiring different media on either side of the piston. This option is ideal when hydraulic oil is on one side of the piston and air is on the opposite side; and it can be equally effective when dissimilar fluids are on either side of the piston.

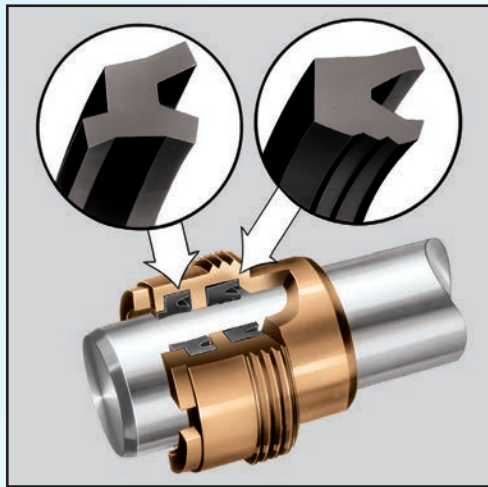
Superior low-friction bi-directional sealing is accomplished by combining an energized filled PTFE seal with a redundant elastomer seal. Energizer and redundant elastomer seal materials are available for compatibility with seal classes 1, 2, 3, 5 and 6. Note: WP piston seal groove is not universal in 1.50" bore.

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Versatile Piston Rod Sealing Systems Deliver Dry Rod Performance

Parker offers the best performing and broadest selection of rod sealing options. Our TS2000 threaded Jewel Gland sealing system in Series 2H and Tri-lip Bolt-on Gland in Series 2HD / 2HB are proven anchors of the offering.

As the rod strokes out, its motion and friction dynamically flex the multi-sealing edges of the TS2000 (shown above) and the Tri-Lip rod seal to maintain their contact with the rod. This provides a cutting action to shear the oil from the rod, allowing the rod to pass out of the rod seal practically dry. Any oil film that remains on the rod is stopped by the inner lip of the Wiperseal and held between it and the rod seal.



On the return stroke any dirt or foreign matter collected on the rod is wiped off by the leading edge, or outer lip of the Wiperseal. At the same time, any oil which may be trapped between the Wiperseal and the rod seal is returned into the cylinder. In other words, we have an automatic check valve that prevents any appreciable amount of oil to leak past the seals, and then returns any oil that has managed to wipe by the rod seal.

Both the TS2000 Jewel Gland and Tri-Lip glands are easily removed for service without loosening tie rods and disturbing the pressure envelope. Material options for both glands allow compatibility with Seal Classes 1, 2, 3, 4, 5 & 6.

Buffer Seal Gland

The Parker Buffer Seal, installed ahead of the primary rod seal, protects the primary seal from the effects of pressure spikes. The result is increased primary rod seal and wiperseal performance life when in severe applications.

The Parker Buffer Seal is a unique design that allows trapped pressure back into the cylinder. When the rod extends from the cylinder the Buffer Seal is riding on a high compression sealing point to limit leakage. On the retract stroke the seal rocks forward to allow trapped fluid to pass under the seal and return to the system.

Buffer Seals are available with Series 2HD and 2HB Bolt-on gland sealing systems in 1.50" - 8.00" bores. They are available with Seal Classes 1, 2, 3, 4, 5 & 6. Selection of the Buffer Seal is with a code in the cylinder model number.

To accommodate the Buffer Seal, rod bushing length is extended 0.31" to 0.81", depending on rod diameter. See Buffer Seal Gland page for piston rod extension details in catalog HY08-1314.



Low Friction Gland

The Parker Low Friction Gland is designed to minimize 'slip-stick' and 'chatter' in servo and 'dither' applications. Two unidirectional bronze filled PTFE primary rod seals and a bronze filled PTFE wiperseal minimize both breakaway and running friction.

Low Friction Rod Seals are available in both threaded Jewel Gland and Bolt-on gland styles for rod diameters 1.000" - 5.500" in 1.50" - 8.00" bores. They are offered with Seal Classes 1, 2, 3, 4, 5, 6 & 8. Selection of the Low Friction Gland is with a code in the cylinder model number.

See Piston & Gland Friction page for comparative seal friction data.



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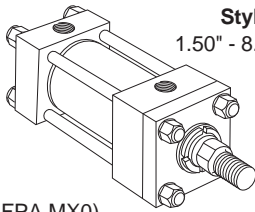
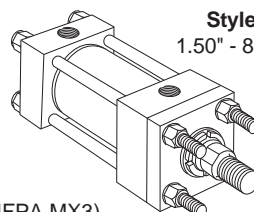
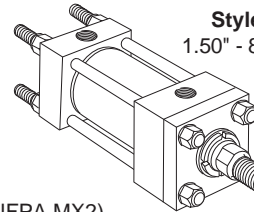
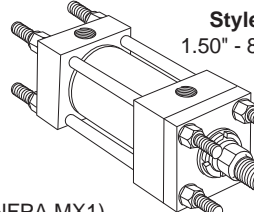
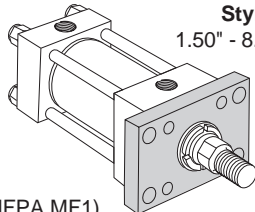
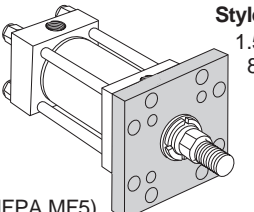
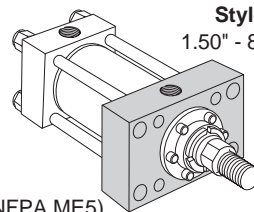
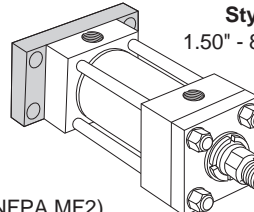
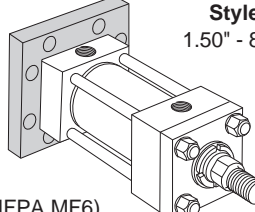
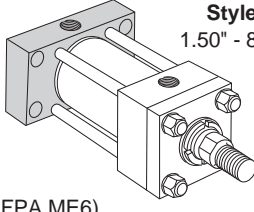
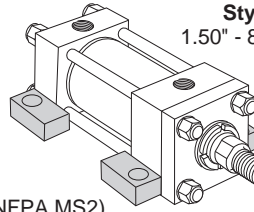
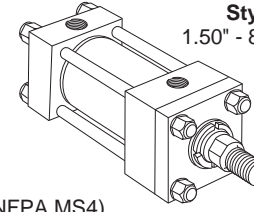
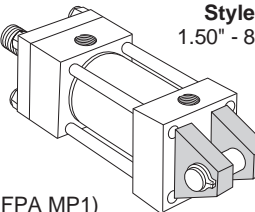
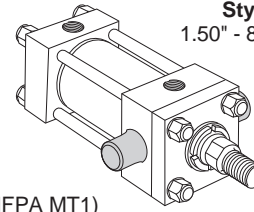
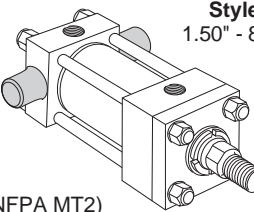
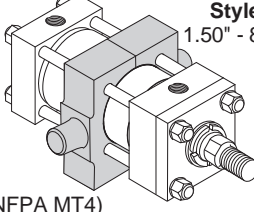
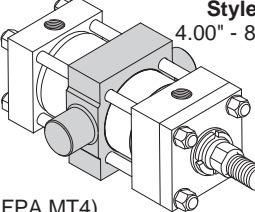
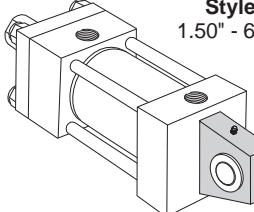
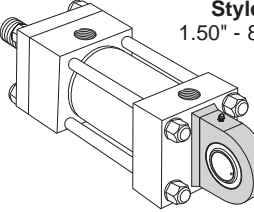

Section A

Series 2HX / 3HX Hydraulic and Electrohydraulic Actuators

How To Order 3 2HX & 3HX Family Model Code 4-5

A
Overview

Available Mounting Styles


<p>Basic Style T 1.50" - 8.00"</p>  <p>(NFPA MX0)</p>	<p>Tie Rods Extended Head End Style TB 1.50" - 8.00"</p>  <p>(NFPA MX3)</p>	<p>Tie Rods Extended Cap End Style TC 1.50" - 8.00"</p>  <p>(NFPA MX2)</p>	<p>Tie Rods Extended Both Ends Style TD 1.50" - 8.00"</p>  <p>(NFPA MX1)</p>
<p>Head Rectangular Flange Style J 1.50" - 8.00"</p>  <p>(NFPA MF1)</p>	<p>Head Square Flange Style JB 1.50" - 8.00"</p>  <p>(NFPA MF5)</p>	<p>Head Rectangular Style JJ 1.50" - 8.00"</p>  <p>(NFPA ME5)</p>	<p>Cap Rectangular Flange Style H 1.50" - 8.00"</p>  <p>(NFPA MF2)</p>
<p>Cap Square Flange Style HB 1.50" - 8.00"</p>  <p>(NFPA MF6)</p>	<p>Cap Rectangular Style HH 1.50" - 8.00"</p>  <p>(NFPA ME6)</p>	<p>Side Lug Style C 1.50" - 8.00"</p>  <p>(NFPA MS2)</p>	<p>Side Tapped Style F 1.50" - 8.00"</p>  <p>(NFPA MS4)</p>
<p>Cap Fixed Clevis Style BB 1.50" - 8.00"</p>  <p>(NFPA MP1)</p>	<p>Head Trunnion Style D 1.50" - 8.00"</p>  <p>(NFPA MT1)</p>	<p>Cap Trunnion Style DB 1.50" - 8.00"</p>  <p>(NFPA MT2)</p>	<p>Intermediate Fixed Trunnion Style DD 1.50" - 8.00"</p>  <p>(NFPA MT4)</p>
<p>HD Intermediate Fixed Trunnion Style DE 4.00" - 8.00"</p>  <p>(NFPA MT4)</p>	<p>Spherical Bearing Style SB 1.50" - 6.00"</p> 	<p>HD Spherical Bearing Style SE 1.50" - 8.00"</p> 	<p>Double Rod Cylinders Style KT Shown 1.50" - 8.00"</p>  <p>Most of the above illustrated mounting styles are available in double rod cylinders.</p>

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Notes

Notes



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How To Order

Parker Series 2HX/3HX cylinders can be described by a model number consisting of coded digits and letters used in a prescribed sequence. To develop a model number, select only those symbols that represent the cylinder required, and place them in the sequence indicated by the example in table opposite. The example makes use of all places, although many model numbers will not require them all as in the case where cushioning, double rod, or special modifications are not required or allowed. For additional cylinder specifications and dimensions, see the Heavy Duty Hydraulic Cylinders catalog HY08-1314, How To Order pages.

When a Series 2HX actuator is ordered the following information must be developed.

- 1) The basic actuator model number including 2HX or 3HX under Series as shown in table on next page.
- 2) If a rod extension is required, specify rod end thread Style 3.
- 3) A seven digit code describing the valve and feedback type if any, and the probe supplier (Parker or customer).
- 4) If an actuator is to accept a Group A or D servo or a D03, D05, D07, or D08 pattern valve, no additional information is necessary. If an actuator is to accept or include another valve furnished by Parker or others, a manufacturer and model number should be supplied below the seven digit code.

Note: Cap end cushion is not allowed on LRT and WaveScale cylinders.

If a cylinder is to include a feedback device, the following information must be called out below the seven digit code:

Linear Displacement Transducer (LDT)

Analog

- 1) "Other Analog" Position Output Signal
- 2) Connection type for a separate cable (D60 or S32)
- 3) or Integral Electrical Cable Length from probe

Digital Position

When specifying Pulse Width Modulation (PWM), specify Internal or External Interrogation and the number of circulations

SSI

Specify data length, output format, resolution, filtering performance, and measuring direction

CAN

Specify protocol, baud rate, and resolution
For all "Other Outputs," consult factory

Linear Potentiometer (LRT)

- 1) Electrical connector position 1-4 cap end
- 2) Gross and net stroke if 1.750" rod dia. or smaller. Cylinders with rod sizes less than 2.000" require the addition of a 1.25" spacer on the cap end of the piston to carry the wiper assembly.

WaveScale

Electrical block position 1-4 cap end

Analog

- 1) "Other Analog" Position Output Signal
- 2) Connection type for a separate cable (D60 or S32)
- 3) or Integral Electrical Cable Length from probe

SSI

Specify data length, output format, resolution, filtering performance, and measuring direction

CAN

Specify protocol, baud rate, and resolution
For all "Other Outputs," **consult factory**

Other Feedback Device

- 1) Device Type, Manufacturer, and Model Number
- 2) Output Signal

Bolt-On Manifold Option

The bolt-on manifold option is available with Parker Series 2HX/3HX Family. Manifolds may be located on either the head or cap end at any position that does not interfere with mounting. For manifolds available by bore size, see the dimensions section of the catalog.

Feedback Option

Parker Series 2HX/3HX Family actuators may be ordered prepared for or supplied with a feedback device. The Parker LRT and WaveScale option may only be ordered installed at the factory. See the ordering code on the next two pages.

To specify another manufacturer's position sensor, place an "X" in the Feedback Option code and provide the manufacturer's name and model number. Parker will install any other type and brand of feedback as long as it is reasonably designed to fit into an NFPA type cylinder — consult factory.

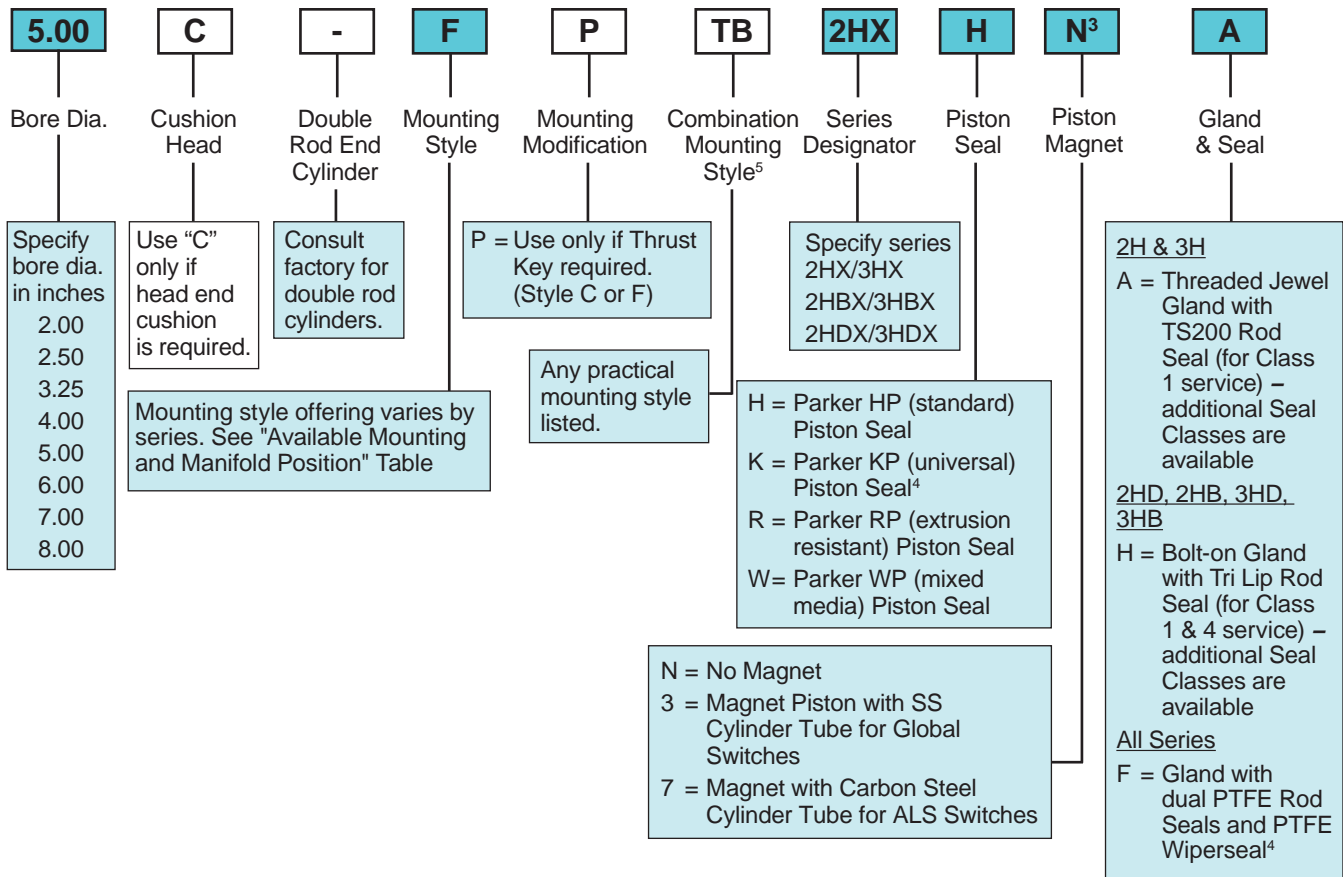
**PROP 65 WARNING**

WARNING: This product can expose you to chemicals including **Lead and Lead Compounds** which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov



2HX & 3HX Family Model Code

Overview



Valve Manifold

Code	Description
N	N - None
B	B - Bolt-On
I	I - Integral

For applications requiring integral cap, consult factory.

Valve Pattern Group

Code	Description
N	N - Not Applicable
A	A - Servo Group A
D	D - Servo Group D
G	G - D03 (Group G)
H	H - D05 (Group H)
K	K - D07 (Group K)
M	M - D08 (Group M)
X	X - Other, Please Specify

Valve Location

Code	Description
N	N - Not Applicable
H	H - Head
C	C - Cap

Shaded boxes identify required model number fields.

- ¹ Cap end cushion not available on LRT or WaveScale. Solid Cushion Orifice Design = F is not available on cylinders with probes but is available for Bolt on Manifolds.
- ² 2" Bore WaveScale will have #8 SAE ports.
- ³ Magnets are not available for cylinders with probes.
- ⁴ Piston seal code K and Gland & Seal code F must be selected for Class 8 service.

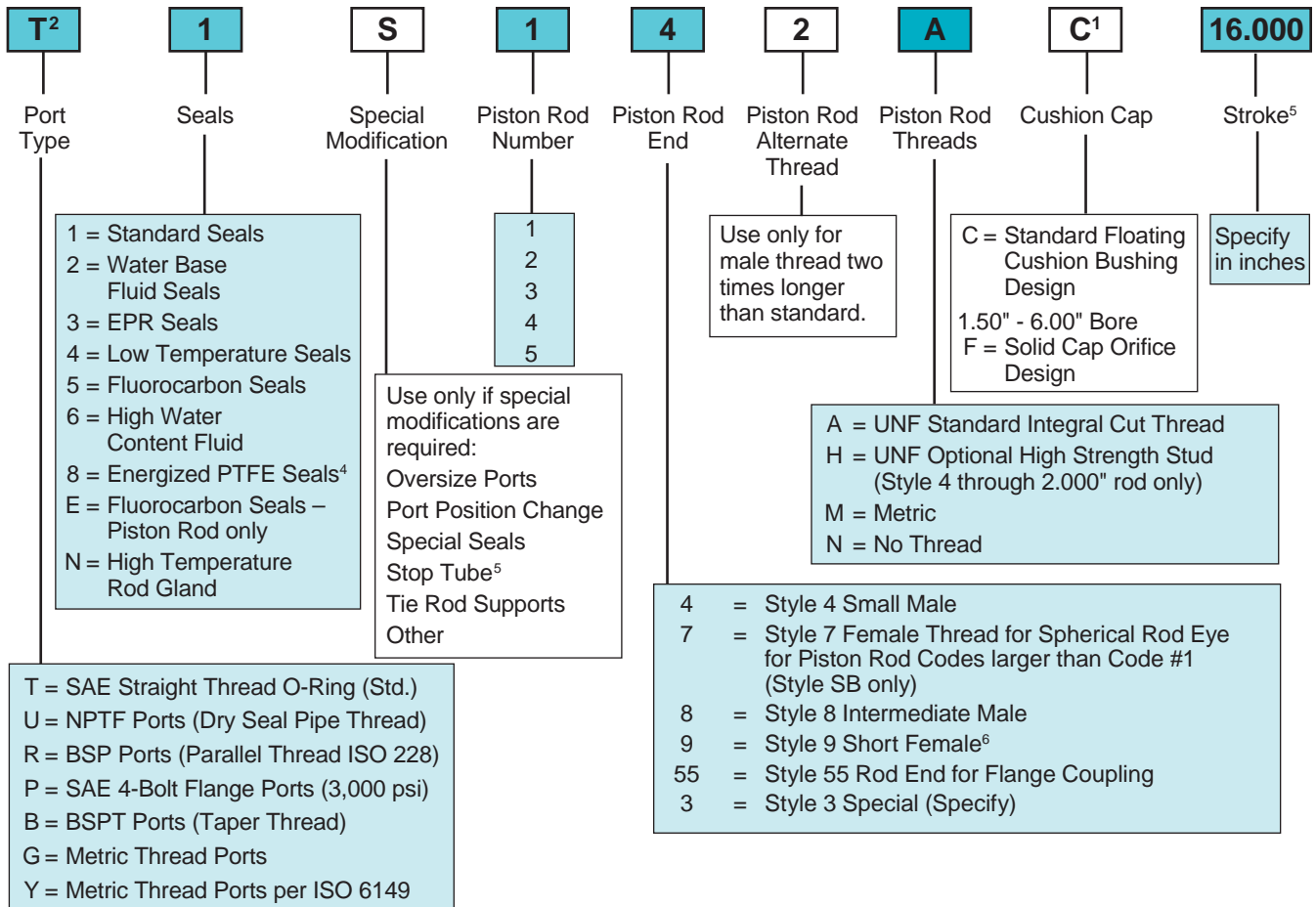
Note:
Consult current 2H/3H catalog for complete dimensions, specifications and model number information.

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Model Code / How To Order

2HX & 3HX Family Model Code



Feedback Option

Code	Description
N	N - None
C	C - MTS LDT
F	F - LRT
B	B - Balluff LDT
W	W - WaveScale
X	X - Other, Please Specify

Feedback Furnished

Feedback Furnished		Feedback Options		
Code	Description	C	B	W
NF	NF - No Feedback			
1P	1P - Prepare to Accept - Piston rod will be drilled to accept a probe with an electrical stroke equal to the cylinder net stroke.	✓	✓	
FR	FR - LRT Installed			
V0	V0 - 0 Vdc to +10 Vdc	✓	✓	✓
V1	V1 - +10 Vdc to 0 Vdc	✓	✓	✓
A0	A0 - 4 mA to 20 mA	✓	✓	✓
A1	A1 - 20 mA to 4 mA	✓	✓	✓
A4	A4 - Other Analog - Specify required output.	✓	✓	✓
DE	DE - PWM, External Interrogation	✓	✓	
DI	DI - PWM, Internal Interrogation	✓	✓	
SS	SS - SSI Output ⁷	✓	✓	✓
R0	R0 - Start/Stop	✓	✓	
D4	D4 - Other Digital - Specify required output.	✓	✓	✓

Feedback Protective Enclosures

Code	Description
N	N - Not Applicable
A	A - False Stage for LDT probes with integral cable
B	B - False Stage for LDT probes with connector and separate cable
D	D - Light Duty Cover
F	F - Medium Duty Cover for LDT probes with integral cable
G	G - Medium Duty Cover for LDT probe with connector and separate cable

⁵ S = Stop Tube. Specify: stop tube length, net stroke and gross stroke. Gross stroke = stop tube length + net stroke. Gross stroke to be placed in the model number field.
Example:
2.000 inches long stop tube
+14.000 inches net stroke
16.000 inches gross stroke
See tables for minimum allowable strokes and female Piston Rod End Styles.
⁶ Style 9 stroke restrictions may apply.
⁷ Refer to the "How To Order" page for information required for CAN and SSI output.

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Section B

Series 2HX / 3HX Hydraulic and Electrohydraulic Actuators

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Cylinder with Linear Displacement Transducer

Cylinders utilizing LDT feedback are available in the following mounting styles: TB, TC, TD, J, JB, JJ, C, F, D, DB, DD and DE.

On styles H, HB, HH, BB, SB and SE consult factory for dimensional changes. Style F is not available in 2.00" bore.

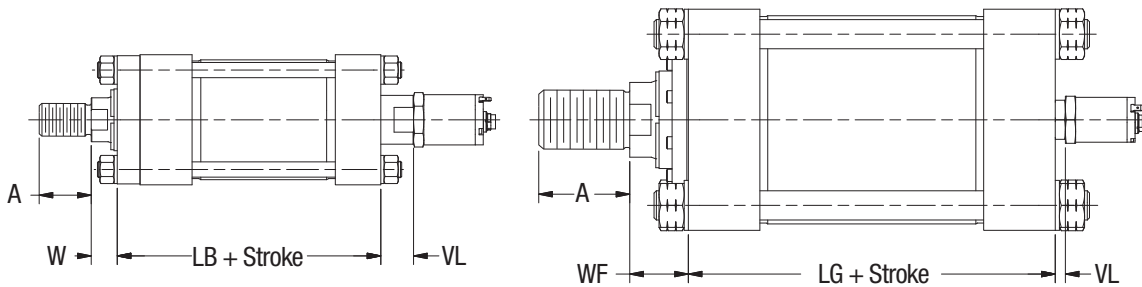


Table 1 – Envelope and Rod End Dimensions

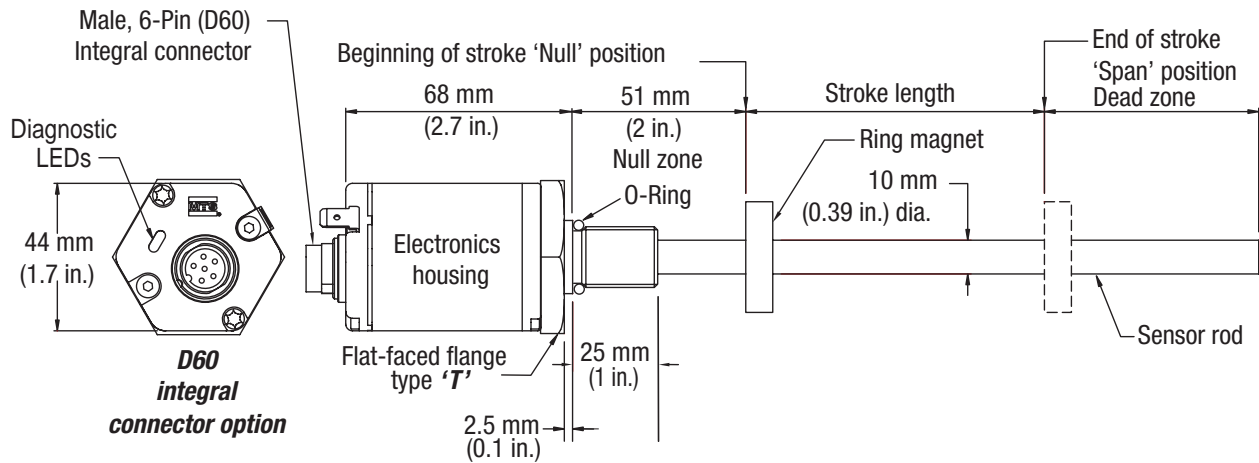
For additional dimensions, consult Series 2H and Series 3H 7.00" and 8.00" Bore pages in the HY08-1314 Catalog.

Bore Ø	Rod No.	MM Rod Ø	Thread		A	LB Add Stroke	LG Add Stroke	VL	Rated Operating Pressure PSI
			Style 8 CC	Style 4 KK					
2.00	1 (Std.)	1.000	7/8-14	3/4-16	1.13	5.25	-	1.43	3000
	2	1.375	1 1/4-12	1-14	1.63	5.25	-	1.43	3000
2.50	1 (Std.)	1.000	7/8-14	3/4-16	1.13	5.38	-	1.43	1800
	2	1.750	1 1/2-12	1 1/4-12	2.00	5.38	-	1.43	3000
	3	1.375	1 1/4-12	1-14	1.63	5.38	-	1.43	3000
3.25	1 (Std.)	1.375	1 1/4-12	1-14	1.63	6.25	-	1.26	2130
	2	2.000	1 3/4-12	1 1/2-12	2.25	6.25	-	1.26	3000
	3	1.750	1 1/2-12	1 1/4-12	2.00	6.25	-	1.26	3000
4.00	1 (Std.)	1.750	1 1/2-12	1 1/4-12	2.00	6.63	-	1.26	2580
	2	2.500	2 1/4-12	1 7/8-12	3.00	6.63	-	1.26	3000
	3	2.000	1 3/4-12	1 1/2-12	2.25	6.63	-	1.26	3000
5.00	1 (Std.)	2.000	1 3/4-12	1 1/2-12	2.25	7.13	-	1.26	2510
	2	3.500	3 1/4-12	2 1/2-12	3.50	7.13	-	1.26	3000
	3	2.500	2 1/4-12	1 7/8-12	3.00	7.13	-	1.26	3000
	4	3.000	2 3/4-12	2 1/4-12	3.50	7.13	-	1.26	3000
6.00	1 (Std.)	2.500	2 1/4-12	1 7/8-12	3.00	8.38	-	1.43	3000
	2	4.000	3 3/4-12	3-12	4.00	8.38	-	1.43	3000
	3	3.000	2 3/4-12	2 1/4-12	3.50	8.38	-	1.43	3000
	4	3.500	3 1/4-12	2 1/2-12	3.50	8.38	-	1.43	3000
7.00	1 (std.)	3.000	2 3/4-12	2 1/4-12	3.50	-	8.50	0.41	3000
	2	5.000	4 3/4-12	3 1/2-12	5.00	-	8.50	0.41	3000
	3	3.500	3 1/4-12	2 1/2-12	3.50	-	8.50	0.41	3000
	4	4.000	3 3/4-12	3-12	4.00	-	8.50	0.41	3000
	5	4.500	4 1/4-12	3 1/4-12	4.50	-	8.50	0.41	3000
8.00	1 (std.)	3.500	3 1/4-12	2 1/2-12	3.50	-	9.50	0.41	3000
	2	5.500	5 1/4-12	4-12	5.50	-	9.50	0.41	3000
	3	4.000	3 3/4-12	3-12	4.00	-	9.50	0.41	3000
	4	4.500	4 1/4-12	3 1/4-12	4.50	-	9.50	0.41	3000
	5	5.000	4 3/4-12	3 1/2-12	5.00	-	9.50	0.41	3000

Note: The rod end dimensions shown are based on the use of a linear displacement transducer with a rod end dead zone of 2.5 inches or less. LDT's with longer dead zones require a rod extension. The LDT will be permanently damaged if the proper rod extension is not used. Consult factory if an LDT with longer dead band is going to be used.

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Electrical Specifications	
Input Power	+24 VDC Nominal (20.4 to 28.8 VDC std) Optional: +9 to +28.8 VDC
Outputs	Analog: 0-10V, 10-0V, 4-20 mA, 20-4 mA Digital: Start/Stop or Pulse Width Modulation (PWM)
Resolution	Analog: Infinite Digital: 0.1, 0.01, and 0.005 mm
Hysteresis	< 4 μm
Repeatability	< ±0.001% full stroke (± 2.5 μm minimum)
Linearity Deviation	< ±0.02% full stroke (± 50 μm minimum)
Update Rate	Analog: < 1ms (typical) Digital: =probe length (inches) x 10 μsec/in. x number of circulations
Measuring Range	Analog: 50 to 2540 mm (2 to 100 in.) Digital: 50 to 7620 mm (2 to 300 in.)
Adjustability	Null/Span: 100% of electrical stroke length, 50 mm (2 in.) minimum distance between setpoints

General Specifications	
Operating Temperature	Operating: -40° F to 176° F (-40°C to 80°C); 185°F (85°C) maximum
Operating Pressure	5000 psi static 10,000 psi spike
Connection Type	D60 6-pin Male DIN, M16 Integral Connector Optional: 5-foot integral cable (pigtail termination)
Separate Cable	5-foot cable with D60 connector, standard, probe connector-style only (pigtail termination) (longer cable lengths are available)
Ingression	IP67 or IP68 for integral cable models
EMC Test	Emissions: IEC/EN 61000-6-3 Immunity: IEC/EN 61000-6-2 IEC/EN 61000-4-2/3/4/5/6/8, level 3/4 criterium A, CE qualified
Shock Rating	100 g (single hit) / IEC standard 68-2-27
Vibration Rating	15 g / 10-2000 Hz IEC standard 68-2-6
Null Zone	2 inches
Dead Zone	2.5 inches (2.6 inches for strokes greater than 197 inches)
Housing Style	Aluminum housing, diagnostic LED
Mounting Style	Threaded flange: 3/4-16 UNF-3A or M18 x 1.5

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MTS LDT Connections and Wiring

Standard Male (D60) 6-PIN DIN Integral Connector (M16)

Male, 6-pin (D60) integral connector pin-out as viewed from the end of the sensor.

Pin Number	Wire Color	Function / Digital-pulse outputs	Function / Analog outputs
1	Gray	(-) Gate for PWM (-) Stop for Start/Stop or programming (RS-422-TX-)	0 to 10, -10 to +10 VDC or 4 to 20 mA, 0 to 20 mA or reverse acting: 10 to 0, 10 to -10 VDC or 20 to 4 mA, 20 to 0 mA
2	Pink	(+) Gate for PWM (+) Stop for Start/Stop or programming (RS-422-TX+)	Return for pin 1
3	Yellow	(+) Interrogation for PWM (+) Stop for Start/Stop or programming (RS-422-RX+)	Programming (RS-485+)
4	Green	(-) Interrogation for PWM (-) Stop for Start/Stop or programming (RS-422 RX-)	Programming (RS-485-)
5	Red or Brown	Supply voltage (+VDC)	Supply voltage (+VDC)
6	White	DC ground (for supply)	DC ground (for supply)

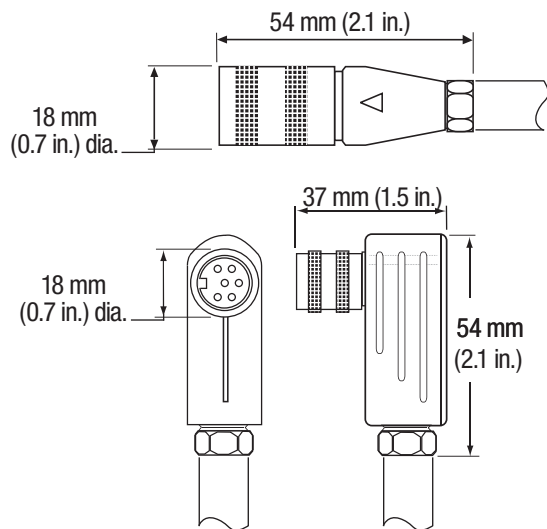


Notes:

1. A grounding lug on the end of the sensor is provided for convenient connection to earth ground.
2. Appropriate grounding of cable shield is required at the controller end.
3. For analog output sensors, the yellow wire (pin 3) and green wire (pin 4) provide serial communications. If possible, during sensor installation these wires should be placed for easy access if future programming or diagnostics are needed. When these wires are not used, they should be isolated with electrical tape to avoid unintended contact with other nearby wires or machine surfaces.

Connector and cable dimensions

Male, 6-pin (D60) integral connector pin-out as viewed from the end of the sensor.



Description	Part Number
Cable Connector, Female, Straight Exit (Field installable)	Part #0862208__6
6-Pin DIN (D60) Mates with standard male (M16) integral connector	

Description	Part Number
Cable Connector, Female, 90° Exit (Field installable)	Part #0862209__6
6-Pin DIN (D60) Mates with standard male (M16) integral connector	

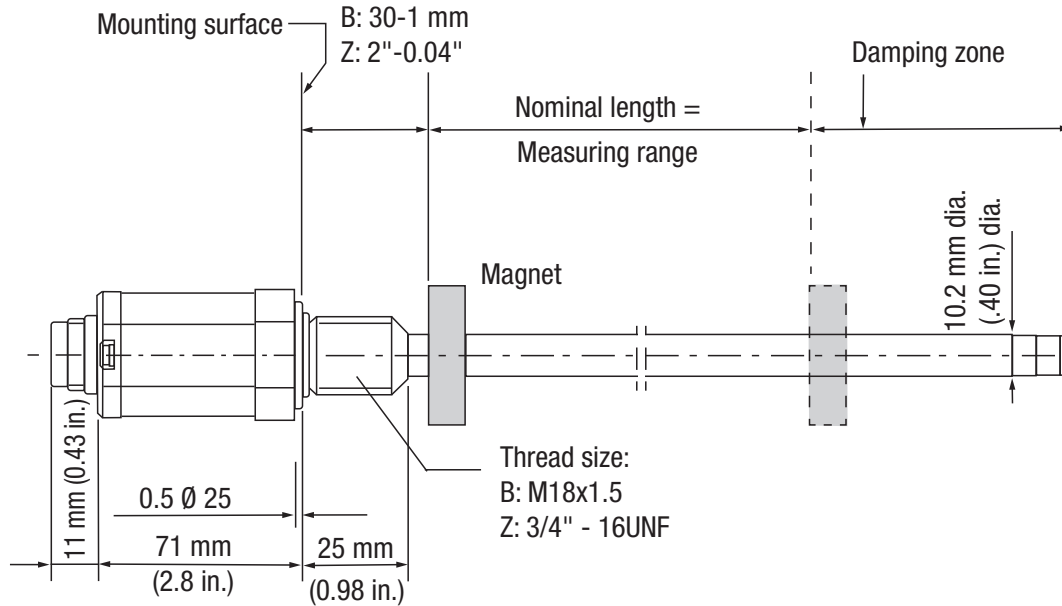
__ = cable length in feet

Example: 0862208156 - 15 ft extension cable
 D60 style connection, straight



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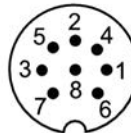
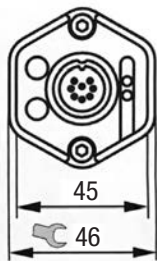
Electrical Specifications

Input Power	+24 VDC Nominal (20 to 28 VDC) Alternate: 10 to 30 VDC
Outputs	Analog: 0-10V, 10-0V, 4-20 mA, 20-4 mA Digital: Start/Stop or Pulse Width Modulation (PWM)
Resolution	Analog: ≤0.33 mV, ≤0.66 µA Digital: Controller dependent
Hysteresis	≤ 5 µm
Repeatability	< System resolution (2 µm minimum)
Linearity Deviation	± 50 µm to ≤500 mm stroke < ±0.01% 501 to 5500 mm stroke < ±0.02% full stroke >5500 mm
Update Rate	Analog: Maximum 4 kHz Digital: Controller dependent, 0.5 ms min.
Measuring Range	Analog: 25 to 2540 mm (1 to 100 in.) Digital: 51 to 7520 mm (2 to 296 in.)
Adjustability	Null/Span: 100% of electrical stroke length, 25 mm (1 in.) minimum distance between setpoints

General Specifications

Operating Temperature	Operating: -40° F to 185° F (-40°C to 85°C)
Operating Pressure	8700 psi static
Connection Type	S32 8-pin Male, M16 Integral Connector Optional: 2-meter integral cable (pigtail termination)
Separate Cable	2-meter cable with S32 connector, standard, probe connector-style only (pigtail termination) (longer cable lengths are available)
Ingression	IP67 or IP68 for integral cable models
EMC Test	Emissions: EN 61000-6-3/4 Immunity: EN 61000-6-1/2 EN 61000-4-2/3/4/5/6/8, level 2/3/4 CE qualified
Shock Rating	150 g/6 ms per EN 60068-2-27 150 g/2 ms per EN 60068-2-29 (continuous)
Vibration Rating	20 g / 10-2000 Hz EN 60068-2-6
Null Zone	2 inches
Dead Zone	2.36 inches (60 mm))
Housing Style	Aluminum housing, diagnostic LED
Mounting Style	Threaded flange: 3/4-16 UNF-3A or M18 x 1.5

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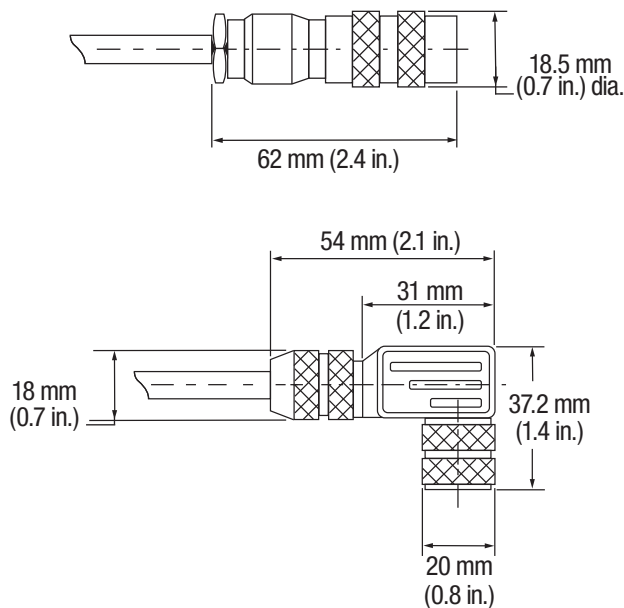


Pin assignment of S32 (view of connector pins of transducer), 8-pin M16 circular plug

S32 Pin	Cable Color	Analog Voltage Output		Analog Current Output	
1	Yellow	Not used ¹		0 to 20 mA	20 to 4 mA
2	Gray	0 V			
3	Pink	10 to 0 V	10 to -10 V	Not used ¹	
4	Red	La (programming input)			
5	Green	0 to 10 V	-10 to 10 V	Not used ¹	
8	White	Lb (programming input)			
6	Blue	DC Ground (for supply) ²			
7	Brown	Supply Voltage (+VDC)			

¹Unassigned leads can be connected to the GND on the controller side but not to the shield.

²Reference potential for supply voltage and EMC-GND.



Description	Part Number
Cable Connector, Female, Straight Exit (Field installable) 8-Pin DIN (S32) Mates with standard male integral connector	Part #09456001__

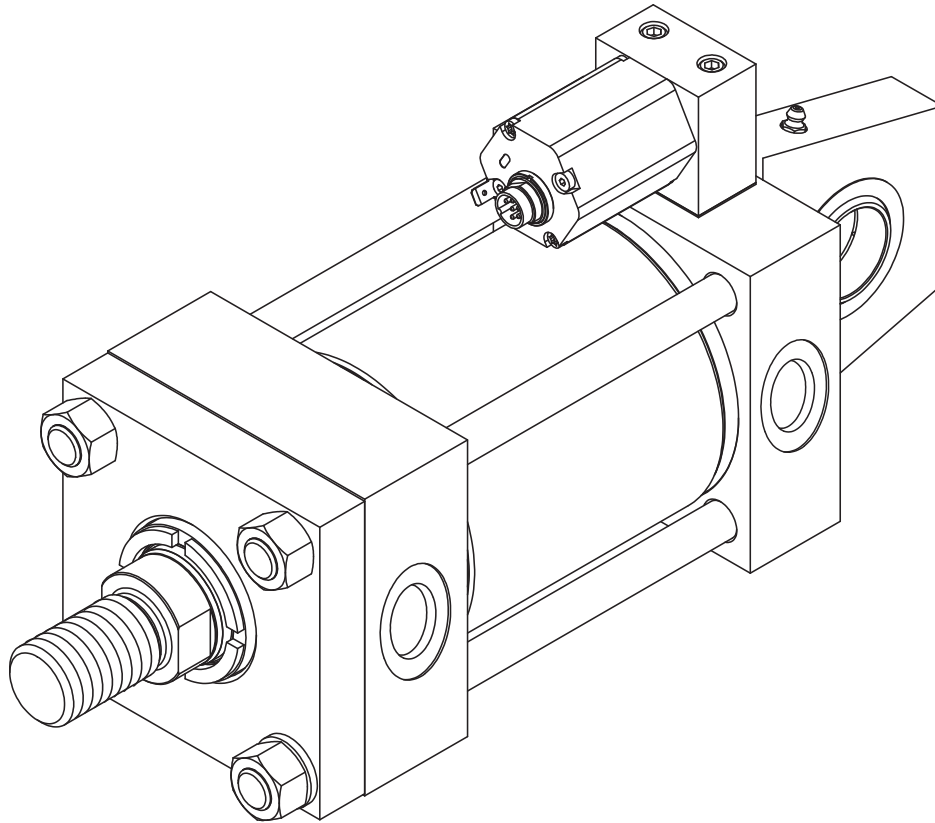
Description	Part Number
Cable Connector, Female, 90° Exit (Field installable) 8-Pin DIN (S32) Mates with standard male integral connector	Part #09456002__

__ = cable length in meters
Example: 094600202 - 2 meter extension cable
S32M style connection, right angle.

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LDT / WaveScale
B



This cylinder meets standard NFPA heavy duty hydraulic cylinder dimensions, 2" to 6" bore with a male piston rod end. The main advantage is no false stage is required for cap mounts.

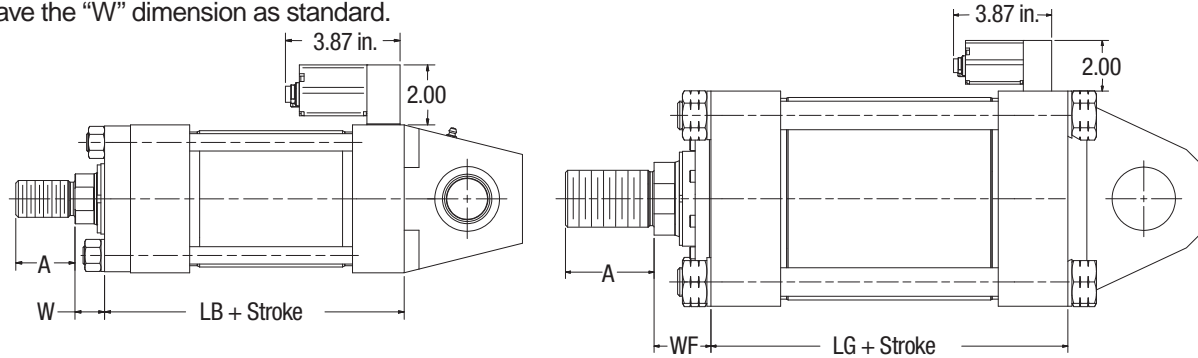
The overall length of the cylinder is not increased.

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WaveScale Pressure Ratings / Dimensions

The pressure rating is reduced on some bores and rod codes. Due to the gun drill depth required in the piston rod for WaveScale, standard "W" dimensions for Style 9 female thread cannot be supplied. Special Style 3 female thread with "KK" and minimum "W" dimensions shown in the table below can be supplied. Style 4 and 8 cannot be studded rod ends to have the "W" dimension as standard.



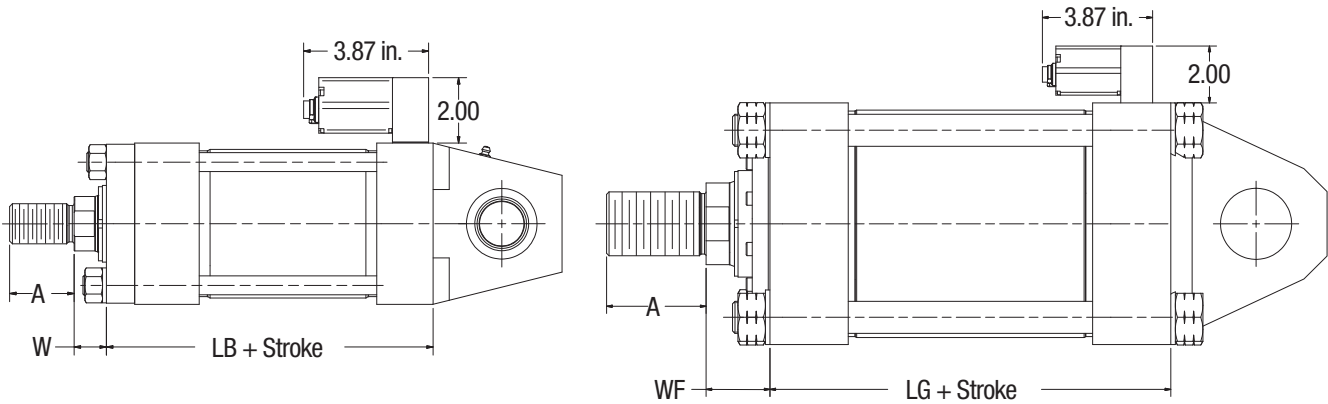
Envelope and Rod Dimensions All dimensions in the table below are in inches.

Bore Ø	Rod No.	MM Rod Ø	A	Thread		LB Add Stroke	LG Add Stroke	Special Female Thread Style 3 KK	Special Female Thread Style 3 W	Special Female Thread Style 3 WF	Rated Operating Pressure PSI
				Style 4 KK	Style 8 CC						
2.00	1 (Std.)	1.000	1.125	3/4-16	7/8-12	5.25	-	3/4-16	1 7/8	-	2300
	2	1.375	1.625	1-14	1 1/4-12	5.25	-	1-14	2 9/16	-	3000
2.50	1 (Std.)	1.000	1.125	3/4-16	7/8-12	5.38	-	3/4-16	1 3/4	-	1400
	2	1.750	2.000	1 1/4-12	1 1/2-12	5.38	-	1 1/4-12	2 7/8	-	3000
	3	1.375	1.625	1-14	1 1/4-12	5.38	-	1-14	2 3/8	-	3000
3.25	1 (Std.)	1.375	1.625	1-14	1 1/4-12	6.25	-	1-14	1 3/4	-	3000
	2	2.000	2.250	1 1/2-12	1 3/4-12	6.25	-	1 1/2-12	2 5/8	-	3000
	3	1.750	2.000	1 1/4-12	1 1/2-12	6.25	-	1 1/4-12	3 1/4	-	3000
4.00	1 (Std.)	1.750	2.000	1 1/4-12	1 1/2-12	6.63	-	1 1/4-12	1 7/8	-	3000
	2	2.500	3.000	1 7/8-12	2 1/4-12	6.63	-	1 7/8-12	3 1/8	-	3000
	3	2.000	2.250	1 1/2-12	1 3/4-12	6.63	-	1 1/2-12	2 1/4	-	3000
5.00	1 (Std.)	2.000	2.250	1 1/2-12	1 3/4-12	7.13	-	1 1/2-12	1 3/4	-	3000
	2	3.500	3.500	2 1/2-12	3 1/4-12	7.13	-	2 1/2-12	3 1/8	-	3000
	3	2.500	3.000	1 7/8-12	2 1/4-12	7.13	-	1 7/8-12	2 5/8	-	3000
	4	3.000	3.500	2 1/4-12	2 3/4-12	7.13	-	2 1/4-12	3 1/8	-	3000
6.00	1 (Std.)	2.500	3.000	1 7/8-12	2 1/4-12	8.38	-	1 7/8-12	1 7/8	-	3000
	2	4.000	4.000	3-12	3 3/4-12	8.38	-	3-12	3 1/16	-	3000
	3	3.000	3.500	2 1/4-12	2 3/4-12	8.38	-	2 1/4-12	2 3/8	-	3000
	4	3.500	3.500	2 1/2-12	3 1/4-12	8.38	-	2 1/2-12	2 3/8	-	3000
7.00	1 (Std.)	3.000	3.500	2 1/4-12	2 3/4-12	-	8.50	2 1/4-12	-	2 1/2	3000
	2	5.000	5.000	3 1/2-12	4 3/4-12	-	8.50	3 1/2-12	-	4	3000
	3	3.500	3.500	2 1/2-12	3 1/4-12	-	8.50	2 1/2-12	-	2 1/2	3000
	4	4.000	4.000	3-12	3 3/4-12	-	8.50	3-12	-	3	3000
	5	4.500	4.500	3 1/4-12	4 1/4-12	-	8.50	3 1/4-12	-	3 1/2	3000
8.00	1 (Std.)	3.500	3.500	2 1/2-12	3 1/4-12	-	9.50	2 1/2-12	-	2 1/4	3000
	2	5.500	5.500	4-12	5 1/4-12	-	9.50	4-12	-	3 3/4	3000
	3	4.000	4.000	3-12	3 3/4-12	-	9.50	3-12	-	2 1/4	3000
	4	4.500	4.500	3 1/4-12	4 1/4-12	-	9.50	3 1/4-12	-	2 3/4	3000
	5	5.000	5.000	3 1/2-12	4 3/4-12	-	9.50	3 1/2-12	-	3 1/4	3000



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Electrical Specifications	
Input Power	+24 VDC Nominal (-15% or +20% VDC)
Outputs	Analog: 0-10V, 10-0V, 4-20 mA, 20-4 mA Digital: N/A (Consult factory for SSI and other outputs)
Resolution	Output dependent
Hysteresis	< 4 μm, 2 μm typical
Repeatability	< ±0.001% full stroke (± 2.5 μm minimum)
Linearity Deviation	< ±0.02% full stroke (± 50 μm minimum)
Update Rate	Output dependent
Measuring Range	25 to 2540 mm (1 to 100 in.)
Adjustability	Null/Span: 100% of electrical stroke length, 25 mm (0.98 in.) minimum distance between setpoints

General Specifications	
Operating Temperature	Operating: -40° F to 176° F (-40°C to 80°C)
Operating Pressure	5000 psi static (350 bar) 10,000 psi spike (690 bar)
Connection Type	D60 6-pin Male DIN, M16 Integral Connector Optional: 5-foot integral cable (pigtail termination)
Separate Cable	5-foot cable with D60 connector, standard, probe connector-style only (pigtail termination) (longer cable lengths are available)
Ingression	IP67 (sensor electronics)
EMC Test	Electromagnetic emission: IEC/EN 50081-1 Electromagnetic susceptibility: IEC/EN 50082-2 IEC/EN 61000-4-2/3/4/6, level 3/4 criterium A CE qualified
Shock Rating	100 g (single hit) / IEC standard 68-2-27
Vibration Rating	10 g / 10-2000 Hz IEC standard 68-2-6
Null Zone	2 inches
Dead Zone	2.5 inches (2.6 inches for strokes greater than 197 inches)
Housing Style	Aluminum housing, diagnostic LED
Mounting Style	Threaded flange: 3/4-16 UNF-3A or M18 x 1.5

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Standard Male (D60) 6-PIN DIN Integral Connector (M16)

Male, 6-pin (D60) integral connector pin-out as viewed from the end of the sensor.



Pin Number	Wire Color	Function / Analog outputs
1	Gray	Output 1/ Position 1: 0 to 10, 10 to 0, -10 to +10, +10 to -10 VDC 4 to 20 , 20 to 4, 0 to 20, 20 to 0 mA (Required for programming mode / 0% setting)
2	Pink	Return for pin 1
3	Yellow	Output 2/ Position 2 or Speed: 0 to 10, 10 to 0, -10 to +10, +10 to -10 VDC 4 to 20, 20 to 4, 0 to 20, 20 to 0 mA (Required for programming mode / 100% setting)
4	Green	Return for pin 3
5	Red or Brown	+24 VDC (-15/+20%) (Required for programming mode)
6	White	DC ground (for supply) (Required for programming mode)

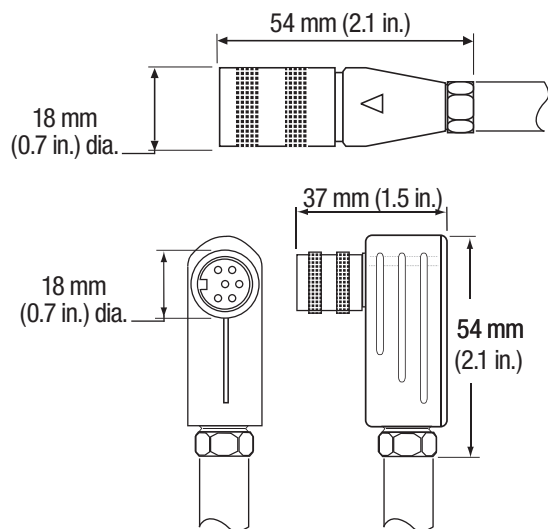
Note:

When using the single channel output, (pins 1 and 2), the unused pins for output 2 (pins 3 and 4) should be left floating (unconnected), unless sensor programming is being performed.



Cable Connector Options (Field Installable) 6-PIN DIN (D60) Female

(Drawing dimensions are for reference only)



Description	Part Number
Cable Connector, Female, Straight Exit (Field installable)	Part #0862208__6
6-Pin DIN (D60) Mates with standard male (M16) integral connector	

Description	Part Number
Cable Connector, Female, 90° Exit (Field installable)	Part #0862209__6
6-Pin DIN (D60) Mates with standard male (M16) integral connector	

__ = cable length in feet

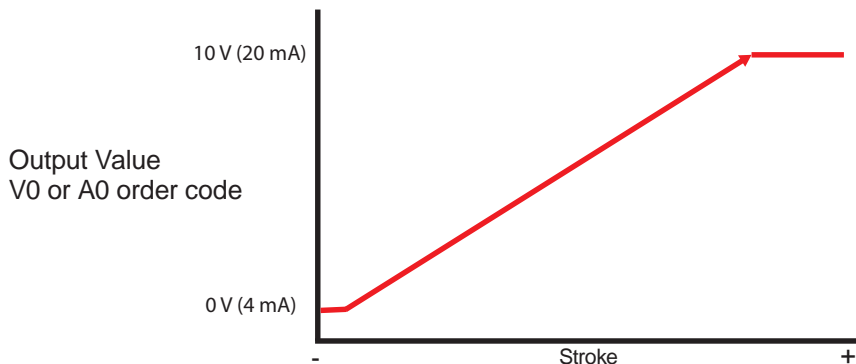
Example: 0862208156 - 15 ft extension cable

D60 style connection, straight

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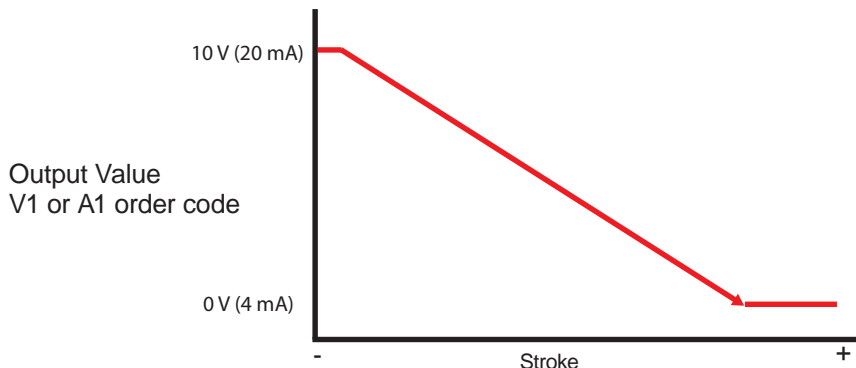


LDT and WaveScale Analog Output



With order codes "A0" (4-20 mA), "V0" (0-10 V) analog outputs, "zero" is set with the cylinder in the fully retracted position. "Span" (max setting) is set at full cylinder extension. As the cylinder is stroked, increasing output as cylinder extends.

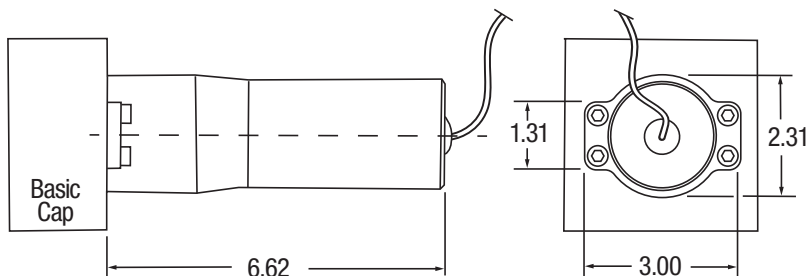
The **Zero** and **Span** can be set in field.



With order codes "A1" (20-4 mA) and "V1" (10-0 V) analog outputs, "zero" is set with the cylinder in the fully extended position. "Span" (max setting) is set at full retracted position. As the cylinder is stroked, decreasing output as cylinder extends.

Protective Enclosure for Feedback Devices

Style D (not available on 2" bore).

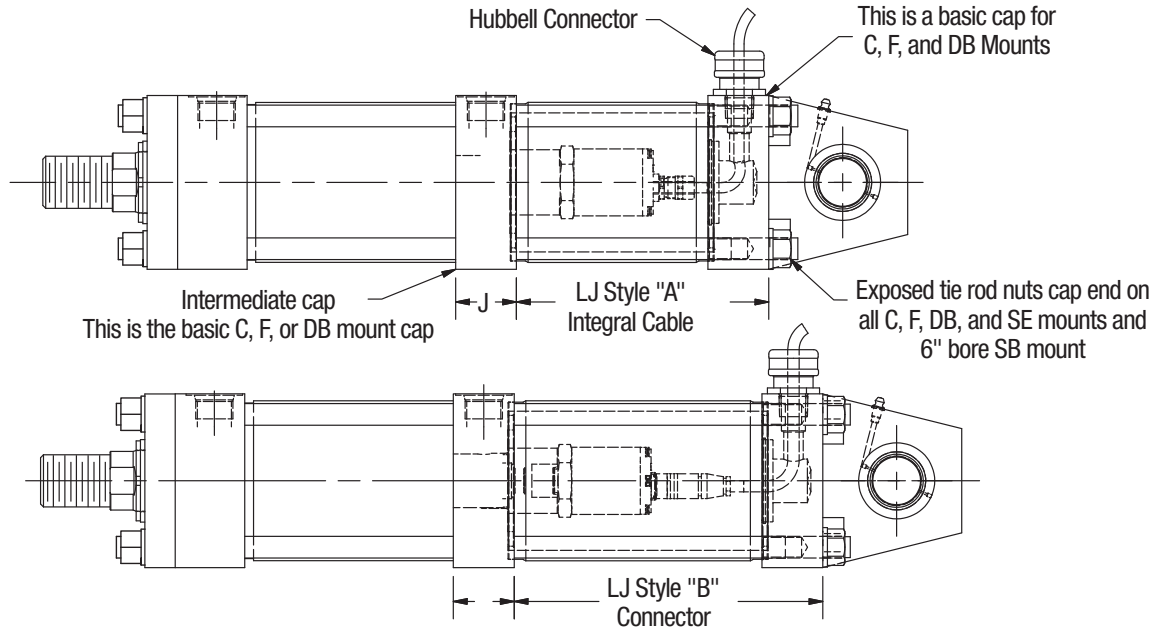


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False Stage and Heavy Duty Cover - Styles "A" & "B"

A False Stage is provided for cap mounts. Heavy Duty covers are provided for basic, C, F and DB cylinder mounts (SB mounting shown for depiction.) Standard cylinder dimensions are the same as the 2H. Any deviations from the standard are noted.

Bore Ø	2.00	2.50	3.25	4.00	5.00	6.00	7.00	8.00
J	1.50			1.75		2.25	2.75	3.00
LJ Style "A"	7.00			7.25		7.75	8.25	8.50
LJ Style "B"	8.75			8.88		9.50	9.00	9.25

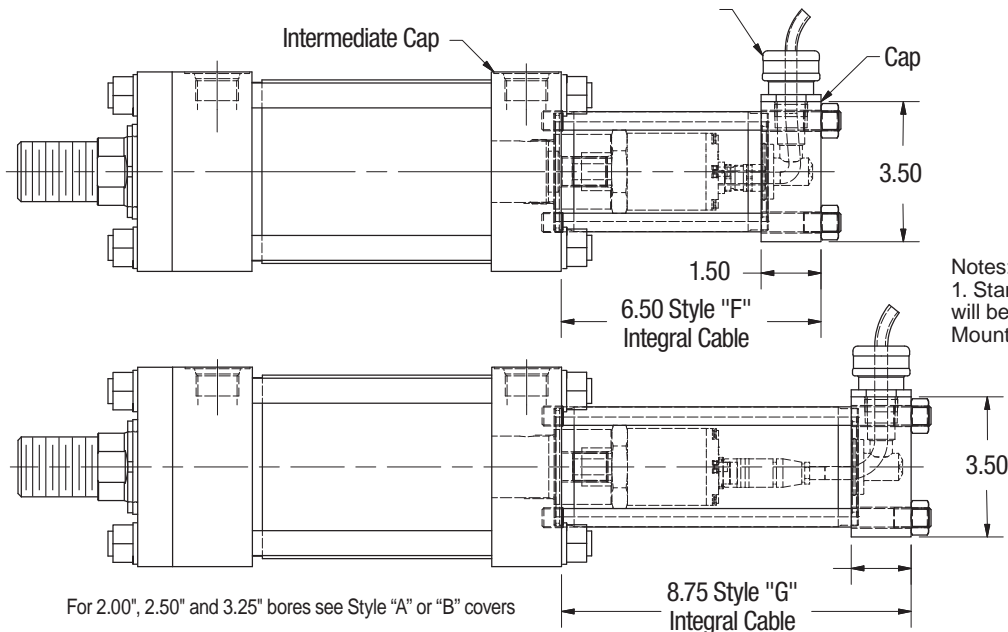


Notes:

1. Standard location for the connector will be at position #1.
2. This design uses common tie rods. The cylinder must be disassembled to service or install feedback devices.

Medium Duty Cover - Styles "F" & "G"

4" through 8" Bores only



Notes:

1. Standard location for the connector will be at position #1. No Cap End Mounting styles available.


For 2.00", 2.50" and 3.25" bores see Style "A" or "B" covers

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Notes



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Section C

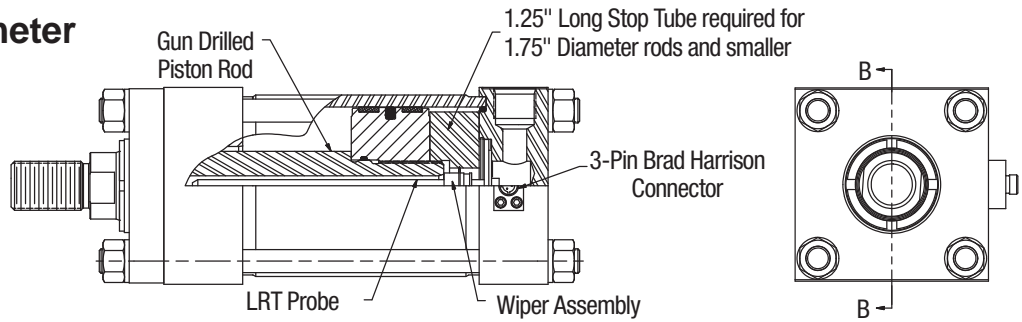
LRT - Linear Resistive Transducer (Linear Potentiometer) Series 2HX / 3HX

LRT Features and Specifications	20
LRT Pressure Ratings / Dimensions	21



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Linear Potentiometer Series 2HX-LRT



How It Works

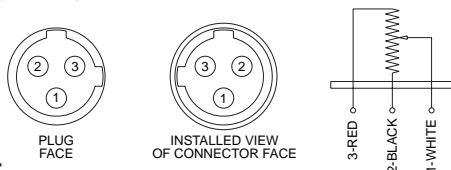
The Parker LRT is a uniquely designed position sensor that uses a resistive element and wiper assembly to provide an analog output signal of a cylinder's position. The LRT is a dual element type linear potentiometer with two independent elements mounted on either side of an anodized aluminum extrusion. The LRT operates as a voltage divider. This is done by shorting through the extrusion with the wiper assembly. The position of the wiper changes the resistive load proportional to its position along the cylinder stroke. The LRT is energized by applying a voltage across the unit, typically 10 VDC. As the resistive load changes with the cylinder stroke, the output voltage changes proportionally. The output voltage at the end point of the cylinder stroke is dictated by the input voltage applied across the device. The probe is mounted into the cylinder cap and inserted into the gun drilled piston rod. The compactness of the design only adds to the envelope dimensions of cylinders with 1-3/4" rods and smaller. Envelope dimensions of cylinders with larger rods are unaffected.

The accuracy of a given feedback device is a composite of the following factors:

Temperature Coefficient: The shift in output due to temperature change. This is a combination of the effect of temperature on the cylinder, the transducer and the electronics.

These factors which are normally additive refer to the feedback device itself. The performance achieved by a given system depends on the various factors such as system stiffness, valve performance, friction, temperature variation, and backlash in mechanical linkages to the cylinder.

In the case of front flange mounted cylinders, the stretch of the cylinder due to hydraulic pressure changes may affect position repeatability and system performance.



Pin Chart

Pin Number	On Cable	On LRT	Function
1	Green	White (wiper)	Output
2	Red w/Blk	Black (resistor base)	V-
3	Red w/White	Red (resistor tip. power)	V+

Electrical Specifications

Input Power	5-50 VDC Nominal
Outputs	Analog
Resolution	Infinite
Repeatability	0.001 (dependent stroke)
Non-Linearity	0.1% (48" maximum) 1% (120" maximum)
Impedance Interface	Greater than 250k Ohms
Total Resistance	800Ω + 800Ω/inch of stroke (+/-20%)
Stroke Resistance	800Ω/inch of stroke (+/-20%)
End Voltage Loss	(V source) x (400/stroke x 800)
Power Dissipation	(V source) ² x 800Ω + 800Ω/inch of stroke

General Specifications

Operating Temperature	Operating: -40° F to 160° F (-40°C to 80°C); Optional: 300°F maximum, consult factory
Operating Pressure	5000 psi static
Connection Type	3-pin Brad Harrison micro connector
Separate Cable	Not provided unless ordered separately
Cylinder Stroke Length	Up to 120 inches
Maximum Velocity (Hydraulic Fluid)	30 inches per second
Hydraulic Fluid	Must be non-water based
Life Expectancy	500 million inches of travel

The LRT requires a high impedance interface greater than 250 kΩ. A maximum of 1 microamp should be required from the LRT. The signal output is linear and not scaled. The signal needs to be conditioned to receive a 0-10Vdc or 4-20mA output.

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Cylinder with Linear Potentiometer Feedback (LRT)

Cylinders utilizing LRT feedback are available in all mounting styles.

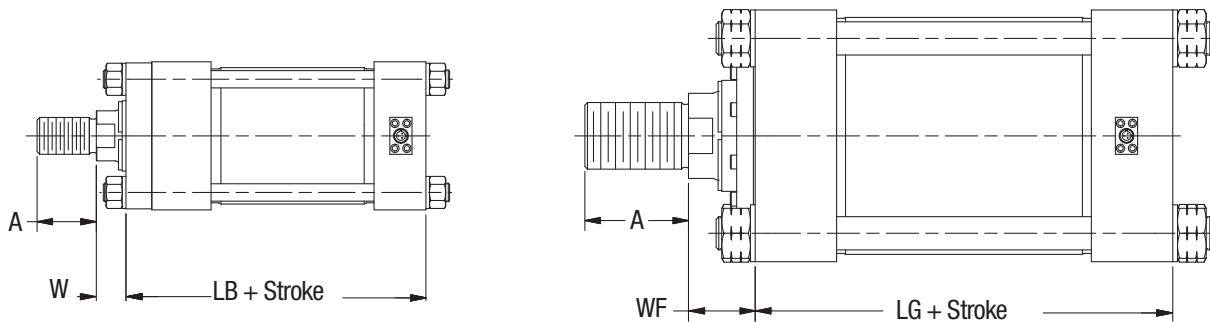


Table 1 – Envelope and Rod End Dimensions

For additional dimensions, consult Series 2H and Series 3H 7" and 8" Bore, of the Parker Cylinder catalog.

Bore Ø	Rod No.	MM Rod Ø	Thread		A	LB Add Stroke	LG Add Stroke	Rated Operating Pressure PSI
			Style 4 KK	Style 8 CC				
2.00	1 (Std.)	1.000 ¹	3/4-16	7/8-14	1.13	6.50	-	3000
	2	1.375 ¹	1-14	1 1/4-12	1.63	6.50	-	3000
2.50	1 (Std.)	1.000 ¹	3/4-16	7/8-14	1.13	6.63	-	1800
	2	1.750 ¹	1 1/4-12	1 1/2-12	2.00	6.63	-	3000
	3	1.375 ¹	1-14	1 1/4-12	1.63	6.63	-	3000
3.25	1 (Std.)	1.375 ¹	1-14	1 1/4-12	1.63	7.50	-	2130
	2	2.000	1 1/2-12	1 3/4-12	2.25	6.25	-	3000
	3	1.750 ¹	1 1/4-12	1 1/2-12	2.00	7.50	-	3000
4.00	1 (Std.)	1.750 ¹	1 1/4-12	1 1/2-12	2.00	7.88	-	2580
	2	2.500	1 7/8-12	2 1/4-12	3.00	6.63	-	3000
	3	2.000	1 1/2-12	1 3/4-12	2.25	6.63	-	3000
5.00	1 (Std.)	2.000	1 1/2-12	1 3/4-12	2.25	7.13	-	2510
	2	3.500	2 1/2-12	3 1/4-12	3.50	7.13	-	3000
	3	2.500	1 7/8-12	2 1/4-12	3.00	7.13	-	3000
	4	3.000	2 1/4-12	2 3/4-12	3.50	7.13	-	3000
6.00	1 (Std.)	2.500	1 7/8-12	2 1/4-12	3.00	8.38	-	3000
	2	4.000	3-12	3 3/4-12	4.00	8.38	-	3000
	3	3.000	2 1/4-12	2 3/4-12	3.50	8.38	-	3000
	4	3.500	2 1/2-12	3 1/4-12	3.50	8.38	-	3000
7.00	1 (std.)	3.000	2 1/4-12	2 3/4-12	3.50	-	8.50	3000
	2	5.000	3 1/2-12	4 3/4-12	5.00	-	8.50	3000
	3	3.500	2 1/2-12	3 1/4-12	3.50	-	8.50	3000
	4	4.000	3-12	3 3/4-12	4.00	-	8.50	3000
	5	4.500	3 1/4-12	4 1/4-12	4.50	-	8.50	3000
8.00	1 (std.)	3.500	2 1/2-12	3 1/4-12	3.50	-	9.50	3000
	2	5.500	4-12	5 1/4-12	5.50	-	9.50	3000
	3	4.000	3-12	3 3/4-12	4.00	-	9.50	3000
	4	4.500	3 1/4-12	4 1/4-12	4.50	-	9.50	3000
	5	5.000	3 1/2-12	4 3/4-12	5.00	-	9.50	3000

¹ Cylinders with rod sizes less than 1.75" require the addition of a 1.25" spacer on the cap end of the piston to carry the wiper assembly. These LB dimensions reflect the additional length.

The LRT requires a high impedance interface greater than 250kΩ.

A maximum of 1 microamp should be required from the LRT.

The signal output is linear and not scaled. The signal needs to be conditioned to receive a 0-10VDC or 4-20mA output.



⚠ PROP 65 WARNING WARNING: This product can expose you to chemicals including **Lead and Lead Compounds** which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov





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Section D

Series 2HX / 3HX Hydraulic and Electrohydraulic Actuators

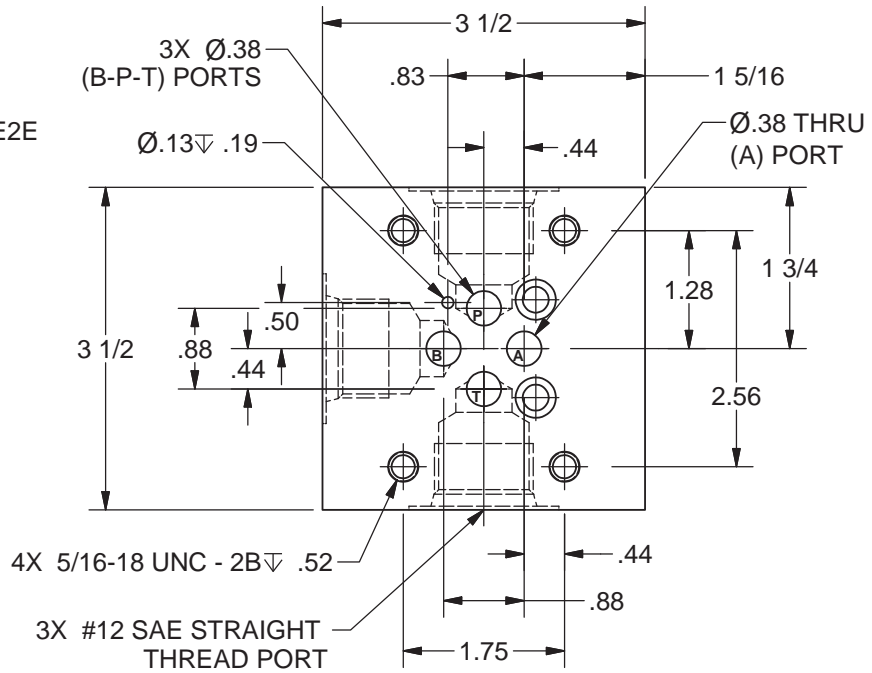
Bolt-On Manifold Valve Patterns	24-27
Group A Dimensions	28
Group A Dimensions, 7.00" & 8.00" Bore	29
Group D Dimensions	30
Group D Dimensions, 7.00" & 8.00" Bore	31
Group G Dimensions	32
Group G Dimensions, 7.00" & 8.00" Bore	33
Group H Dimensions	34
Group H Dimensions, 7.00" & 8.00" Bore	35
Group K Dimensions	36
Group K Dimensions, 7.00" & 8.00" Bore	37
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Mounting and Manifold Positions	40
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Parker Series 2HX cylinders are available with Bolt-on Manifolds. Manifolds can be mounted on the head or cap end of Parker Series 2H or 3H cylinders.

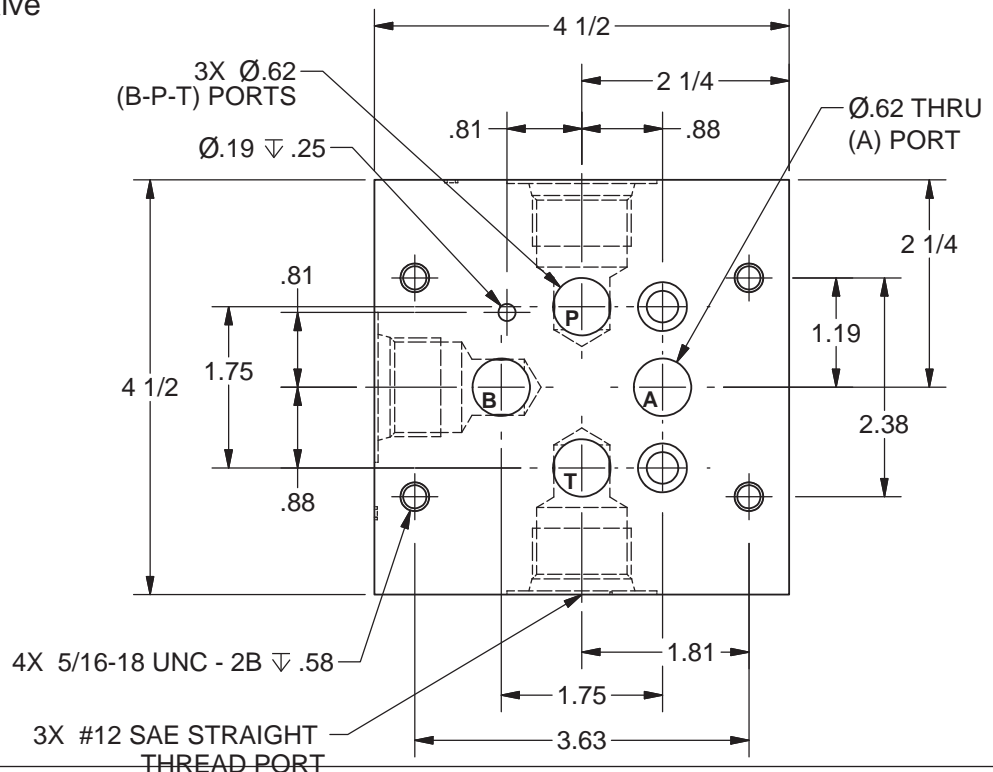
**Group A Servo Valve
Manifold Pattern**

Interchange Chart
Parker BD15, PH76, SE20, & SE2E
Atchley 215A & 320
HR Textron 27E
Moog 62, 730, & 760 Series
MTS 252.2X & 252.4X



**Group D Servo Valve
Manifold Pattern**

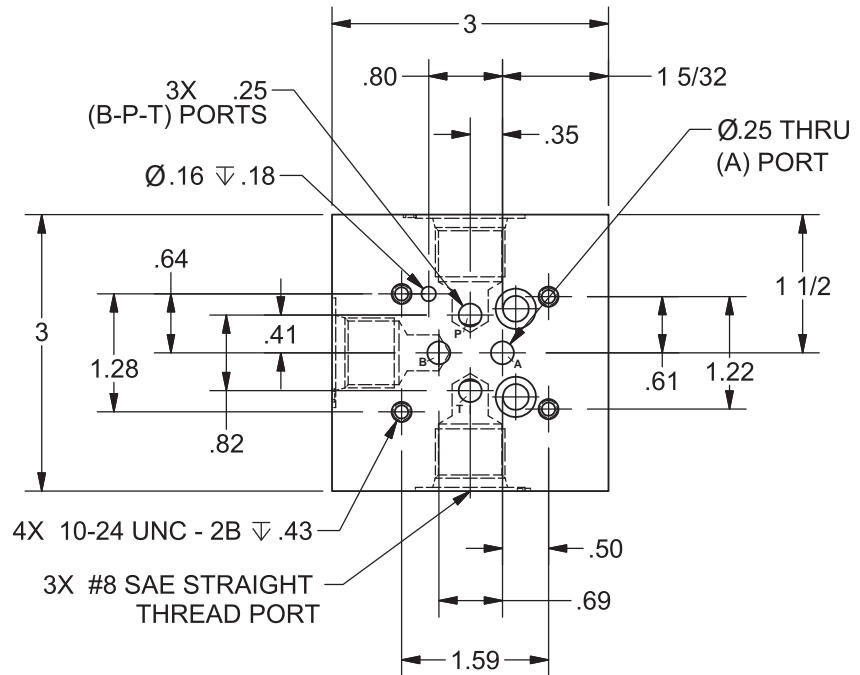
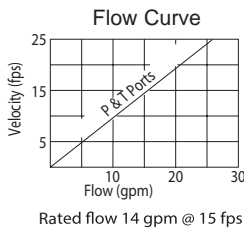
Interchange Chart
Parker BD30
Atchley 240
HR Textron 27G
Moog 78 Series



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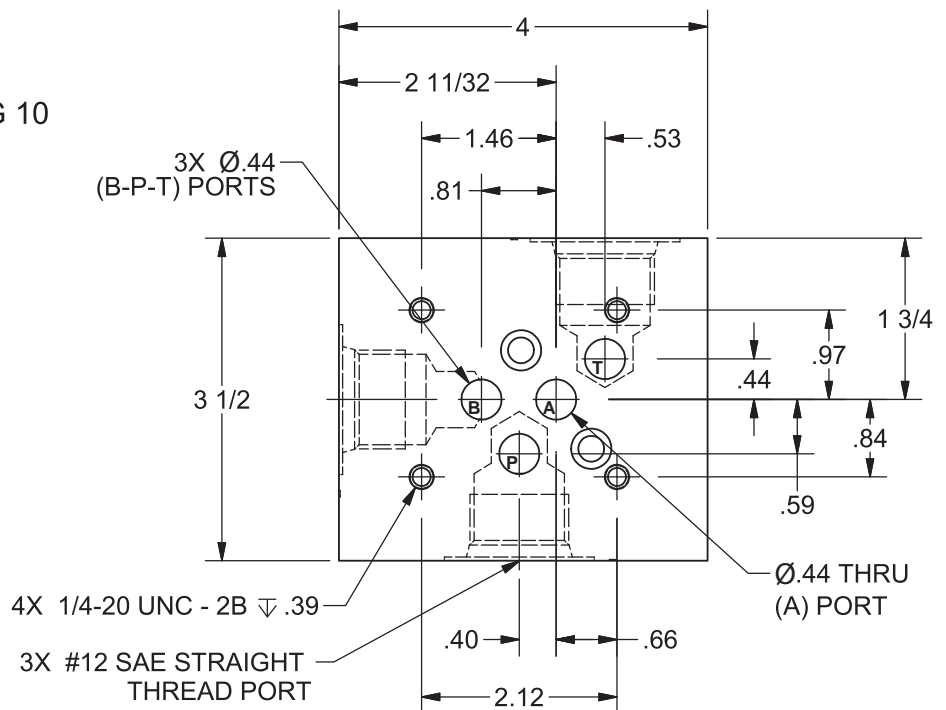
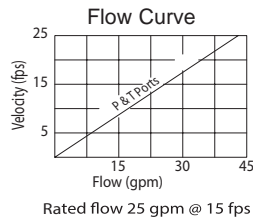
Group G Valve
 Manifold Pattern
 NFPA D03, CETOP 3, NG 6

Parker D1** Valves



Group H Valve
 Manifold Pattern
 NFPA D05, CETOP 5, NG 10

Parker D3** Valves

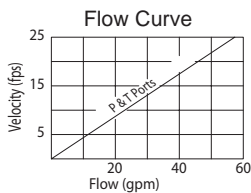
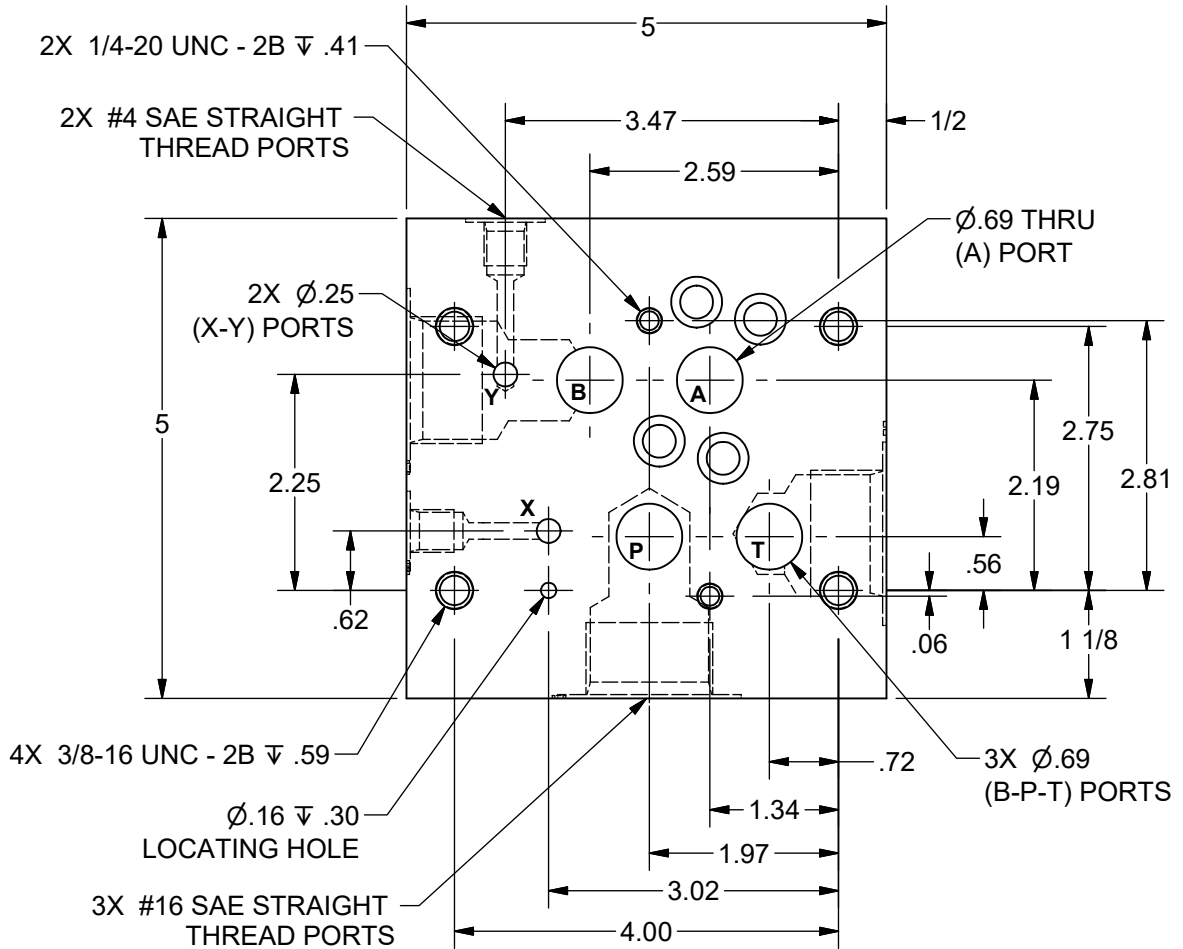


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Group K Valve
Manifold Pattern
NFFA D07, CETOP 7, NG 16

Parker D41** Valves



Rated flow Pressure 25 gpm @ 15 fps
Rated flow Tank 41 gpm @ 15 fps

Bolt-On Manifold



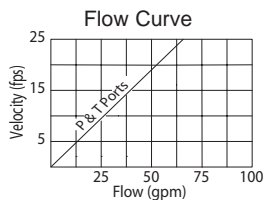
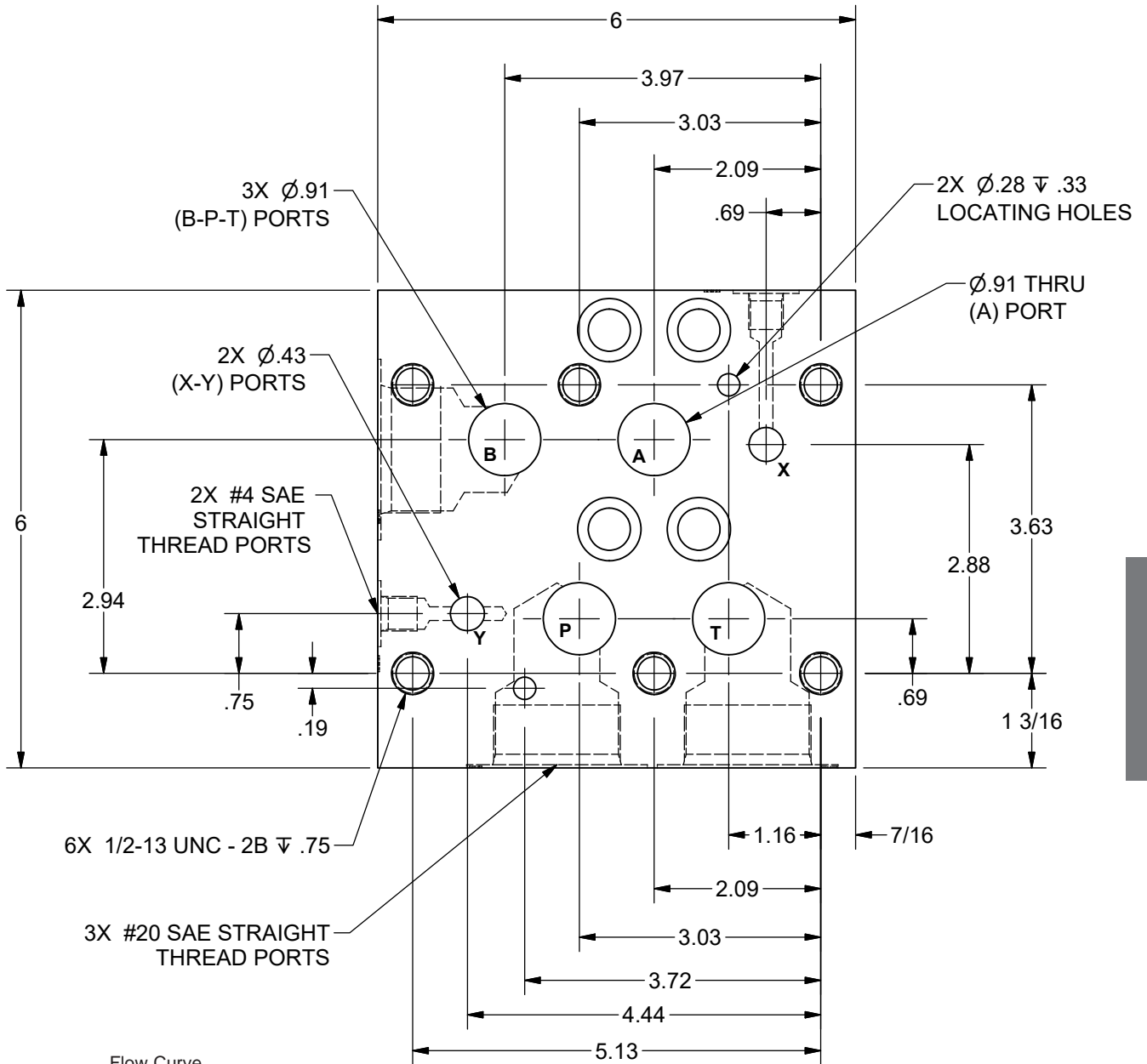
PROP 65 WARNING

WARNING: This product can expose you to chemicals including **Lead and Lead Compounds** which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov



Group M Valve
 Manifold Pattern
 NFPA D08, CETOP 8, NG 25

Parker D61** Valves



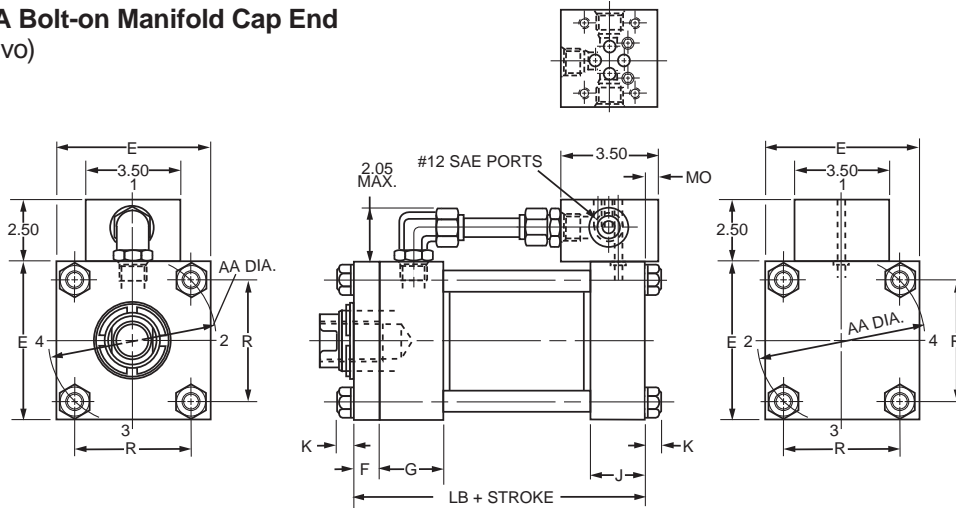
Rated flow Pressure 41 gpm @ 15 fps
 Rated flow Tank 72 gpm @ 15 fps



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2HX with Group A Bolt-on Manifold Cap End
(Parker BD-15 Servo)

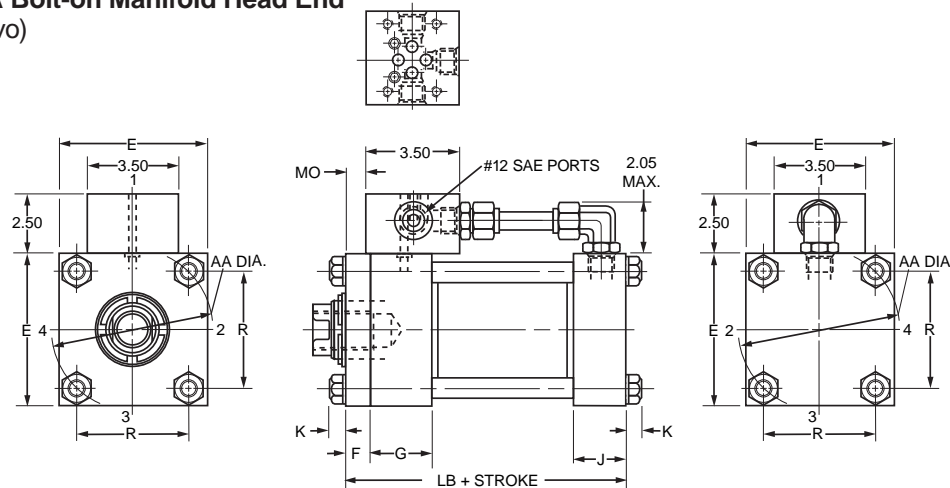


Group A/Parker BD-15 Valve Manifold, Cap End Mounted, Series 2HX Cylinder

Bore Ø	MO	E	F	G	J	K	AA	R	LB	Min. Stroke
2.00	0.56	3.00	0.63	1.75	1.50	0.44	2.90	2.05	5.25	1.63
2.50	0.56	3.50	0.63	1.75	1.50	0.44	3.61	2.55	5.38	1.50
3.25	0.47	4.50	0.75	2.00	1.75	0.56	4.60	3.25	6.25	0.88
4.00	0.47	5.00	0.88	2.00	1.75	0.56	5.40	3.82	6.63	0.63
5.00	0.47	6.50	0.88	2.00	1.75	0.81	7.00	4.95	7.13	0.13
6.00	0.06	7.50	1.00	2.25	2.25	0.88	8.10	5.73	8.38	0

Consult Factory for 6.00" Bore DD Mount. Standard Operating Pressure is 3000 PSI. Bolt-On Manifold will overhang past cap face.

2HX with Group A Bolt-on Manifold Head End
(Parker BD-15 Servo)



Group A/Parker BD-15 Valve Manifold, Head End Mounted, Series 2HX Cylinder

Bore Ø	MO	E	F	G	J	K	AA	R	LB	Min. Stroke
2.00	0.31	3.00	0.63	1.75	1.50	0.44	2.90	2.05	5.25	1.63
2.50	0.31	3.50	0.63	1.75	1.50	0.44	3.61	2.55	5.38	1.50
3.25	0.53	4.50	0.75	2.00	1.75	0.56	4.60	3.25	6.25	0.88
4.00	0.66	5.00	0.88	2.00	1.75	0.56	5.40	3.82	6.63	0.63
5.00	0.66	6.50	0.88	2.00	1.75	0.81	7.00	4.95	7.13	0.13
6.00	0.94	7.50	1.00	2.25	2.25	0.88	8.10	5.73	8.38	0

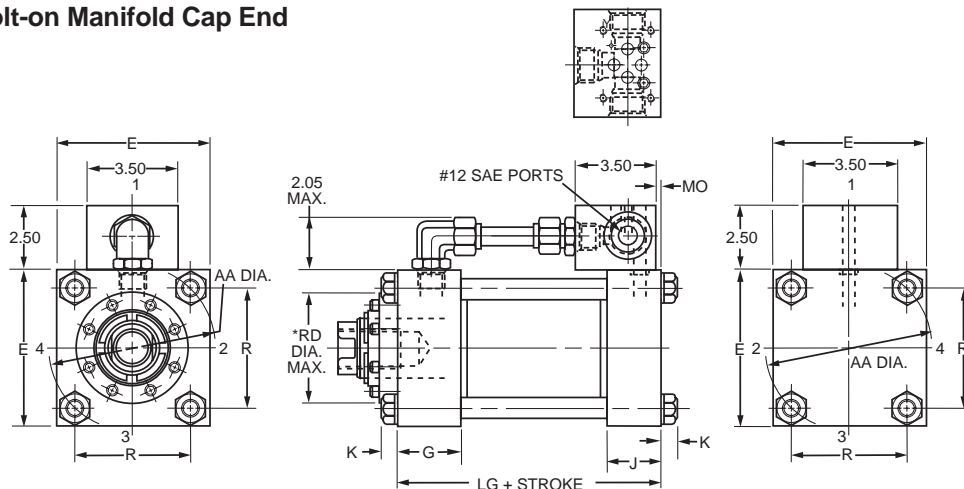
Consult Factory for 6.00" Bore DD Mount. Standard Operating Pressure is 3000 PSI.

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Bolt-On Manifold

3HX with Group A Bolt-on Manifold Cap End
(Parker BD-15 Servo)

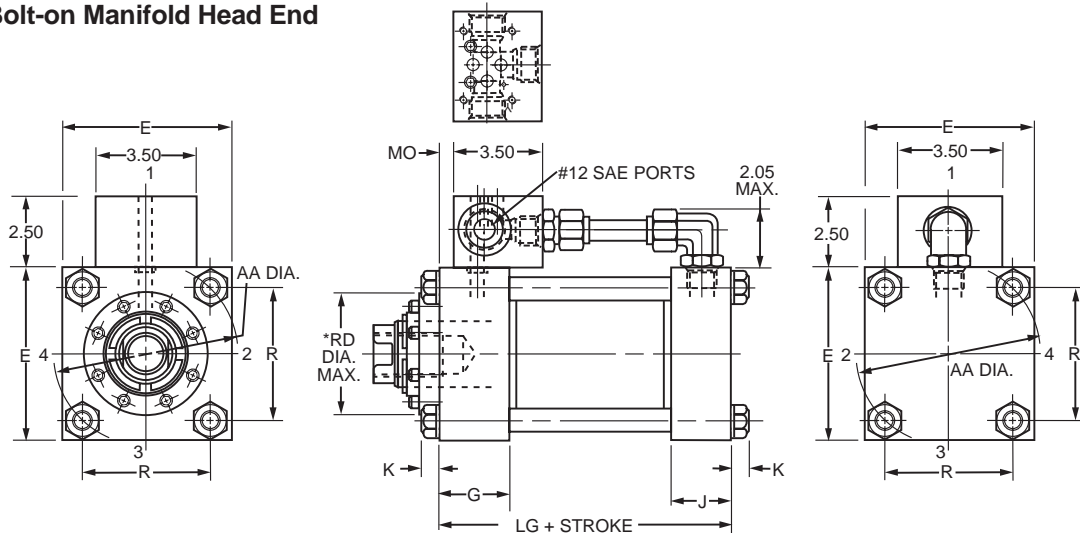


Group A/Parker BD-15 Valve Manifold, Cap End Mounted, Series 3HX Cylinder

Bore Ø	MO	E	G	J	K	AA	R	LG	Min. Stroke
7.00	0.19	8.50	2.75	2.75	1.00	9.31	6.58	8.50	0
8.00	0.31	9.50	3.00	3.00	1.06	10.61	7.50	9.50	0

Consult Factory for 6.00" Bore DD Mount. Standard Operating Pressure is 3000 PSI.

3HX with Group A Bolt-on Manifold Head End
(Parker BD-15 Servo)



Group A/Parker BD-15 Valve Manifold, Head End Mounted, Series 3HX Cylinder

Bore Ø	MO	E	G	J	K	AA	R	LG	Min. Stroke
7.00	0.19	8.50	2.75	2.75	1.00	9.31	6.58	8.50	0
8.00	0.31	9.50	3.00	3.00	1.06	10.61	7.50	9.50	0

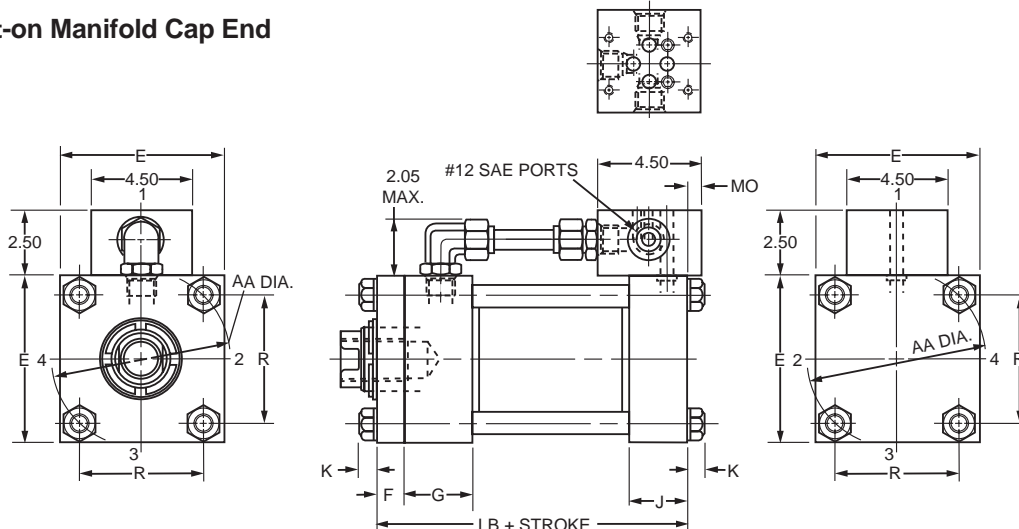
Consult Factory for 6.00" Bore DD Mount. Standard Operating Pressure is 3000 PSI.



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2HX with Group D Bolt-on Manifold Cap End
(Parker BD-30 Servo)

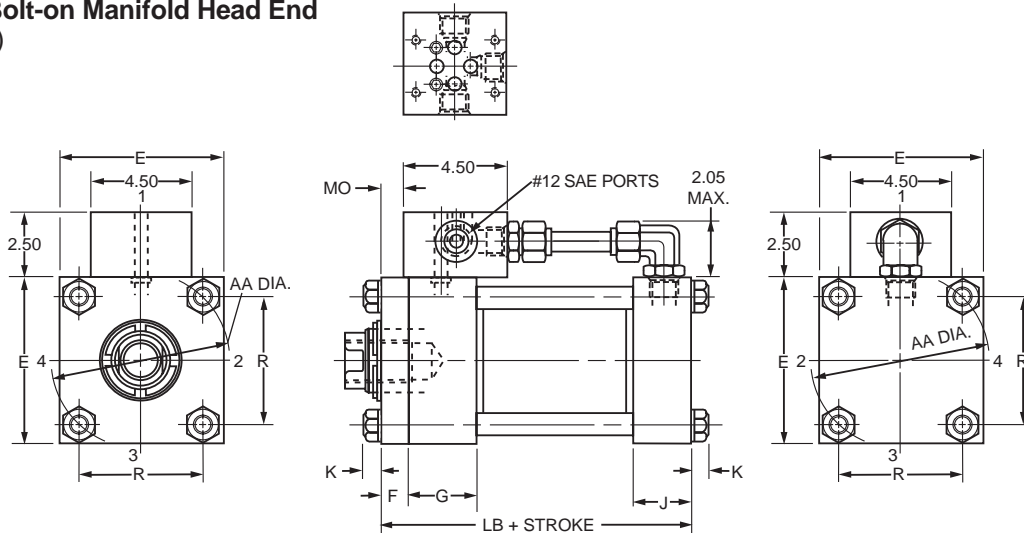


Group D/Parker BD-30 Valve Manifold, Cap End Mounted Series 2HX Cylinder

Bore Ø	MO	E	F	G	J	K	AA	R	LB	Min. Stroke
3.25	0.53	4.50	0.75	2.00	1.75	0.56	4.6	3.25	6.25	1.88
4.00	0.53	5.00	0.88	2.00	1.75	0.56	5.4	3.82	6.63	1.63
5.00	0.53	6.50	0.88	2.00	1.75	0.81	7.0	4.95	7.13	1.13
6.00	0.13	7.50	1.00	2.25	2.25	0.88	8.1	5.73	8.38	0.50

Consult factory for DD mount. Standard Operating Pressure is 3000 PSI. Bolt-On Manifold will overhang past cap face.

2HX with Group D Bolt-on Manifold Head End
(Parker BD-30 Servo)



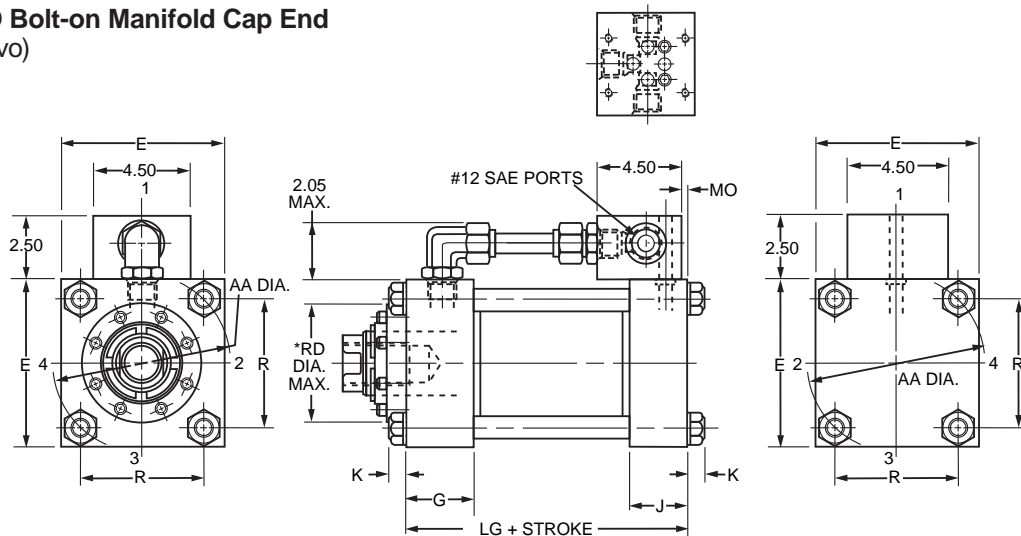
Group D/Parker BD-30 Valve Manifold, Head End Mounted Series 2HX Cylinder

Bore Ø	MO	E	F	G	J	K	AA	R	LB	Min. Stroke
3.25	0.47	4.50	0.75	2.00	1.75	0.56	4.6	3.25	6.26	1.88
4.00	0.60	5.00	0.88	2.00	1.75	0.56	5.4	3.82	6.63	1.63
5.00	0.60	6.50	0.88	2.00	1.75	0.81	7.0	4.95	7.13	1.13
6.00	0.88	7.50	1.00	2.25	2.25	0.88	8.1	5.73	8.38	0.50

Consult Factory for 6" Bore DD Mount. Standard Operating Pressure is 3000 PSI.

⚠ PROP 65 WARNING WARNING: This product can expose you to chemicals including **Lead and Lead Compounds** which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

3HX with Group D Bolt-on Manifold Cap End
(Parker BD-30 Servo)

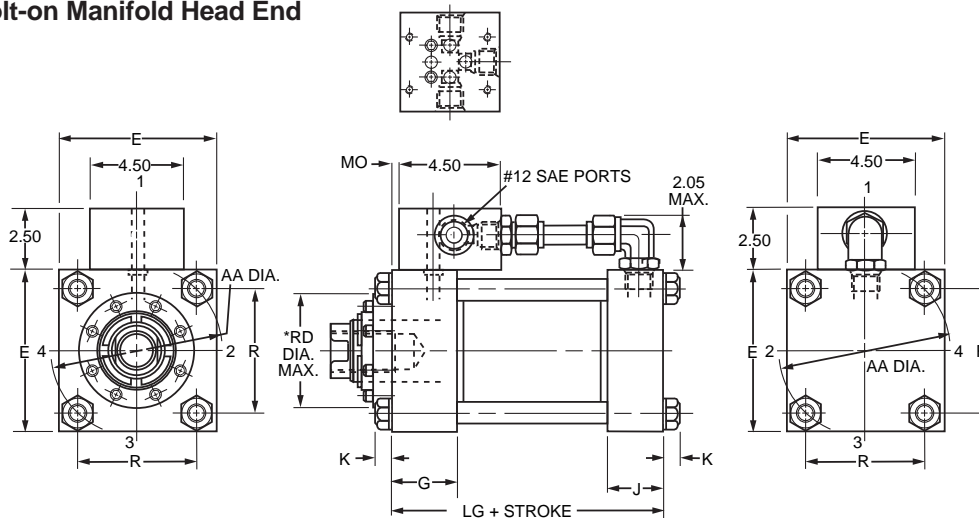


Group D/Parker BD-30 Valve Manifold, Cap End Mounted Series 3HX Cylinder

Bore Ø	MO	E	G	J	K	AA	R	LG	Min. Stroke
7.00	0.13	8.50	2.75	2.75	1.00	9.31	6.58	8.50	0
8.00	0.25	9.50	3.00	3.00	1.06	10.61	7.50	9.50	0

Consult factory for DD mount. Standard Operating Pressure is 3000 PSI.

3HX with Group D Bolt-on Manifold Head End
(Parker BD-30 Servo)



Group D/Parker BD-30 Valve Manifold, Head End Mounted Series 3HX Cylinder

Bore Ø	MO	E	G	J	K	AA	R	LG	Min. Stroke
7.00	0.13	8.50	2.75	2.75	1.00	9.31	6.58	8.50	0
8.00	0.25	9.50	3.00	3.00	1.06	10.61	7.50	9.50	0

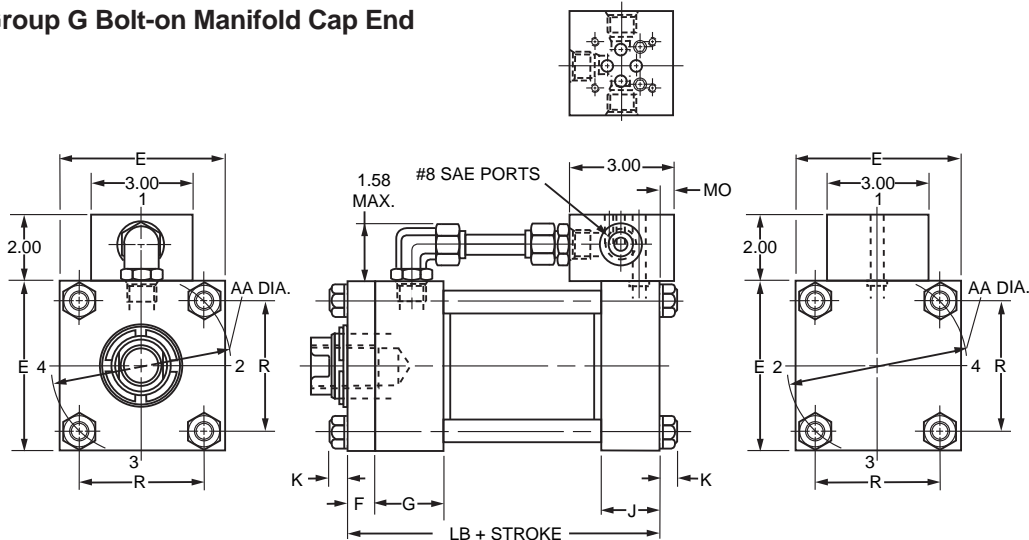
Consult factory for DD mount. Standard Operating Pressure is 3000 PSI.



⚠ PROP 65 WARNING WARNING: This product can expose you to chemicals including **Lead and Lead Compounds** which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov



2HX with Group G Bolt-on Manifold Cap End
 NFPA D03
 CETOP 3
 ISO NG6

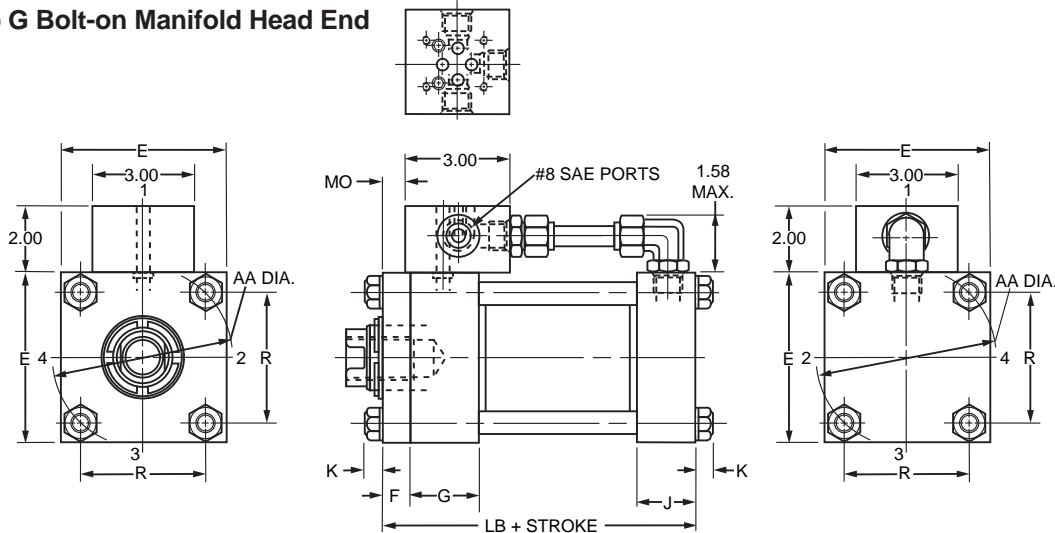


Group G/NFPA D03 Valve Manifold, Cap End Mounted Series 2HX Cylinder

Bore Ø	MO	E	F	G	J	K	AA	R	LB	Min. Stroke
2.00	0.41	3.00	0.63	1.75	1.50	0.44	2.90	2.05	5.25	0.88
2.50	0.41	3.50	0.63	1.75	1.50	0.44	3.61	2.55	5.38	0.75
3.25	0.31	4.50	0.75	2.00	1.75	0.56	4.60	3.25	6.25	0.25
4.00	0.31	5.00	0.88	2.00	1.75	0.56	5.40	3.82	6.63	0
5.00	0.31	6.50	0.88	2.00	1.75	0.81	7.00	4.95	7.13	0
6.00	N/A	7.50	1.00	2.25	2.25	0.88	8.10	5.73	8.38	0

Consult Factory for 6.00" Bore DD Mount. Standard Operating Pressure is 3000 PSI. Bolt-On Manifold will overhang past cap face.

2HX with Group G Bolt-on Manifold Head End
 NFPA D03
 CETOP 3
 ISO NG6



Group G/NFPA D03 Valve Manifold, Head End Mounted, Series 2HX Cylinder

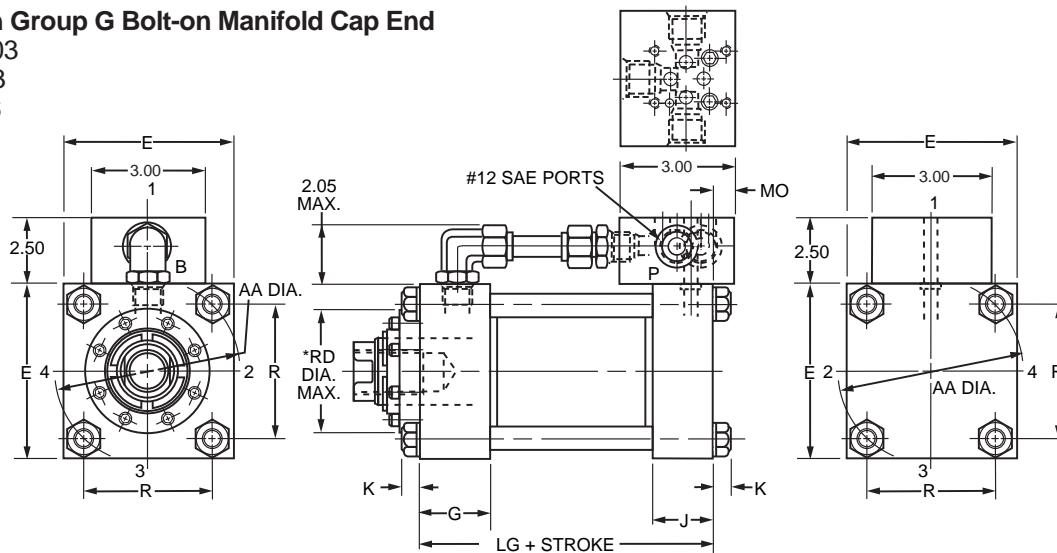
Bore Ø	MO	E	F	G	J	K	AA	R	LB	Min. Stroke
2.00	0.47	3.00	0.63	1.75	1.50	0.44	2.90	2.05	5.25	0.88
2.50	0.47	3.50	0.63	1.75	1.50	0.44	3.61	2.55	5.38	0.75
3.25	0.69	4.50	0.75	2.00	1.75	0.56	4.60	3.25	6.25	0.25
4.00	0.81	5.00	0.88	2.00	1.75	0.56	5.40	3.82	6.63	0
5.00	0.81	6.50	0.88	2.00	1.75	0.81	7.00	4.95	7.13	0
6.00	1.11	7.50	1.00	2.25	2.25	0.88	8.10	5.73	8.38	0

WARNING: This product contains lead and lead compounds which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

Bolt-On Manifold

3HX with Group G Bolt-on Manifold Cap End

NFPA D03
CETOP 3
ISO NG6



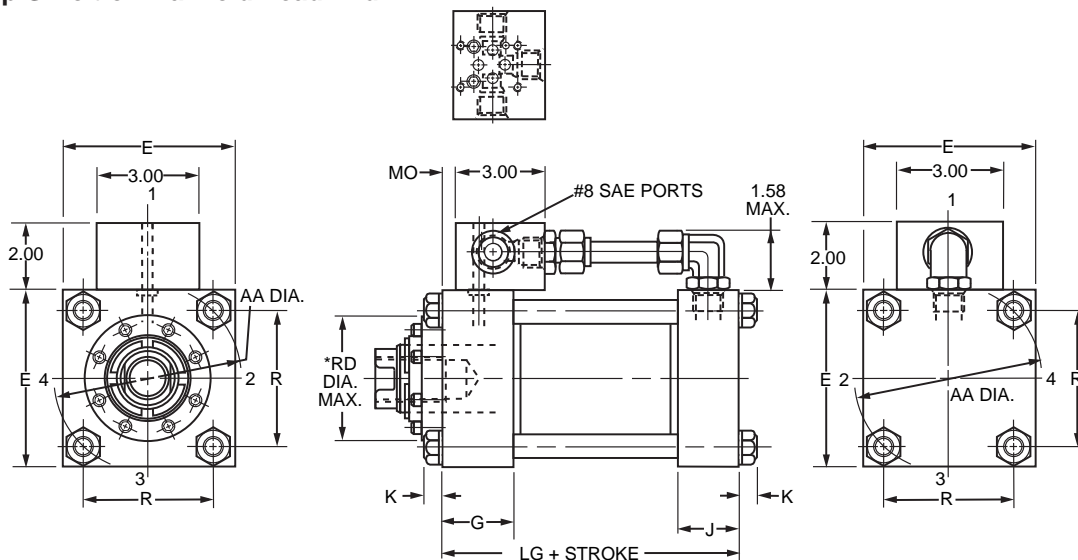
Group G/NFPA D03 Valve Manifold, Cap End Mounted Series 3HX Cylinder

Bore Ø	MO	E	G	J	K	AA	R	LG	Min. Stroke
7.00	0.34	8.50	2.75	2.75	1.00	9.31	6.58	8.50	0
8.00	0.47	9.50	3.00	3.00	1.06	10.61	7.50	9.50	0

Consult factory for DD mount. Standard Operating Pressure is 3000 PSI. Bolt-On Manifold will overhang past cap face.

3HX with Group G Bolt-on Manifold Head End

NFPA D03
CETO 3P
ISO NG6



Group G/NFPA D03 Valve Manifold, Head End Mounted Series 3HX Cylinder

Bore Ø	MO	E	G	J	K	AA	R	LG	Min. Stroke
7.00	0.34	8.50	2.75	2.75	1.00	9.31	6.58	8.50	0
8.00	0.47	9.50	3.00	3.00	1.06	10.61	7.50	9.50	0

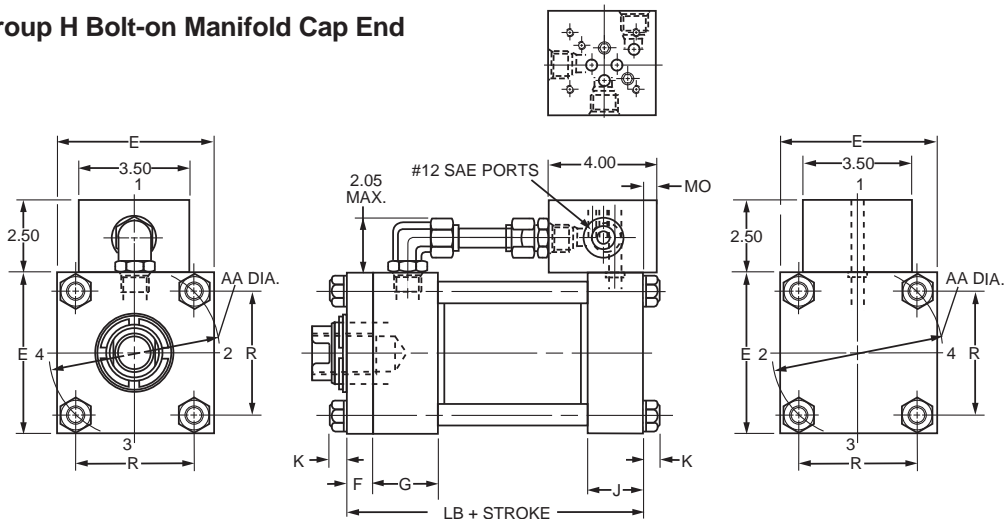
Consult factory for DD mount. Standard Operating Pressure is 3000 PSI.

D
Bolt-On Manifold

⚠ PROP 65 WARNING WARNING: This product can expose you to chemicals including **Lead and Lead Compounds** which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov



2HX with Group H Bolt-on Manifold Cap End
 NFPA D05
 CETOP 5
 ISO NG10

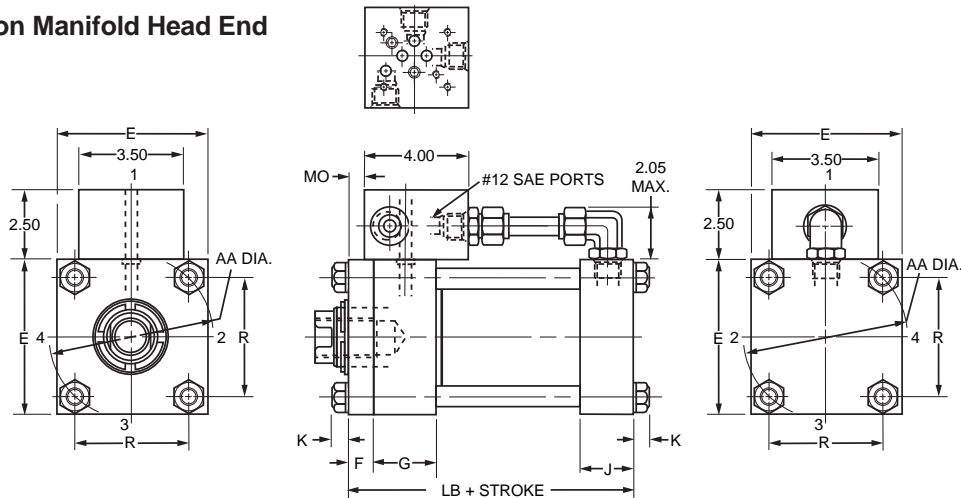


Group H/NFPA D05 Valve Manifold, Cap End Mounted Series 2HX Cylinder

Bore Ø	MO	E	F	G	J	K	AA	R	LB	Min. Stroke
2.00	0.89	3.00	0.63	1.75	1.50	0.44	2.90	2.05	5.25	1.75
2.50	0.89	3.50	0.63	1.75	1.50	0.44	3.61	2.55	5.38	1.63
3.25	0.80	4.50	0.75	2.00	1.75	0.56	4.60	3.25	6.26	1.13
4.00	0.80	5.00	0.88	2.00	1.75	0.56	5.40	3.82	6.63	0.88
5.00	0.80	6.50	0.88	2.00	1.75	0.81	7.00	4.95	7.13	0.38
6.00	0.39	7.50	1.00	2.25	2.25	0.88	8.10	5.73	8.38	0

Consult Factory for 6.00" Bore DD Mount. Standard Operating Pressure is 3000 PSI. Bolt-On Manifold will overhang past cap face.

2HX with Group H Bolt-on Manifold Head End
 NFPA D05
 CETOP 5
 ISO NG10



Group H/NFPA D05 Valve Manifold, Head End Mounted Series 2HX Cylinder

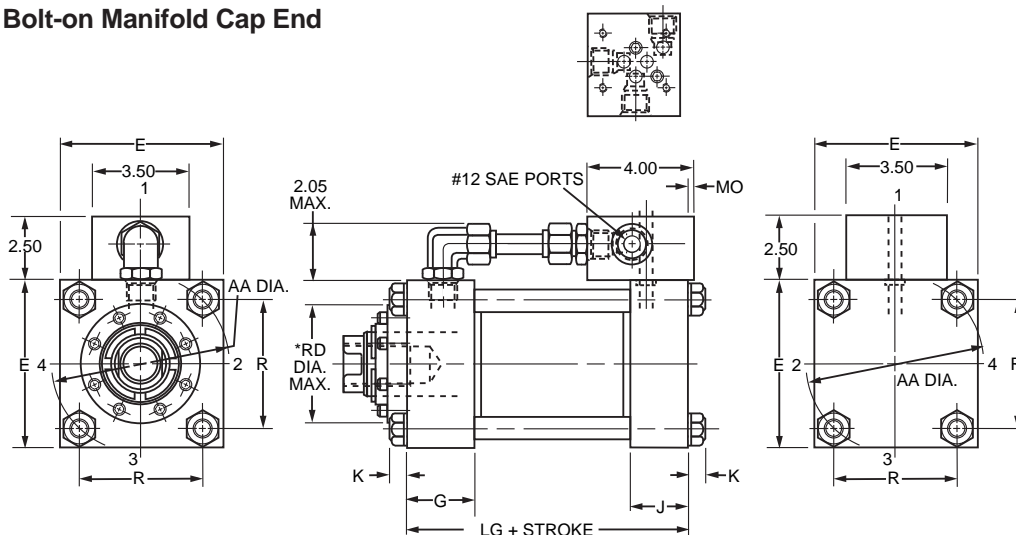
Bore Ø	MO	E	F	G	J	K	AA	R	LB	Min. Stroke
2.00	0	3.00	0.63	1.75	1.50	0.44	2.90	2.05	5.25	1.75
2.50	0	3.50	0.63	1.75	1.50	0.44	3.61	2.55	5.38	1.63
3.25	0.20	4.50	0.75	2.00	1.75	0.56	4.60	3.25	6.25	1.13
4.00	0.33	5.00	0.88	2.00	1.75	0.56	5.40	3.82	6.63	0.88
5.00	0.33	6.50	0.88	2.00	1.75	0.81	7.00	4.95	7.13	0.38
6.00	0.61	7.50	1.00	2.25	2.25	0.88	8.10	5.73	8.38	0

Consult Factory for 6.00" Bore DD Mount. Standard Operating Pressure is 3000 PSI.

⚠ PROP 65 WARNING WARNING: This product can expose you to chemicals including **Lead and Lead Compounds** which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

3HX with Group H Bolt-on Manifold Cap End

NFPA D05
CETOP 5
ISO NG10



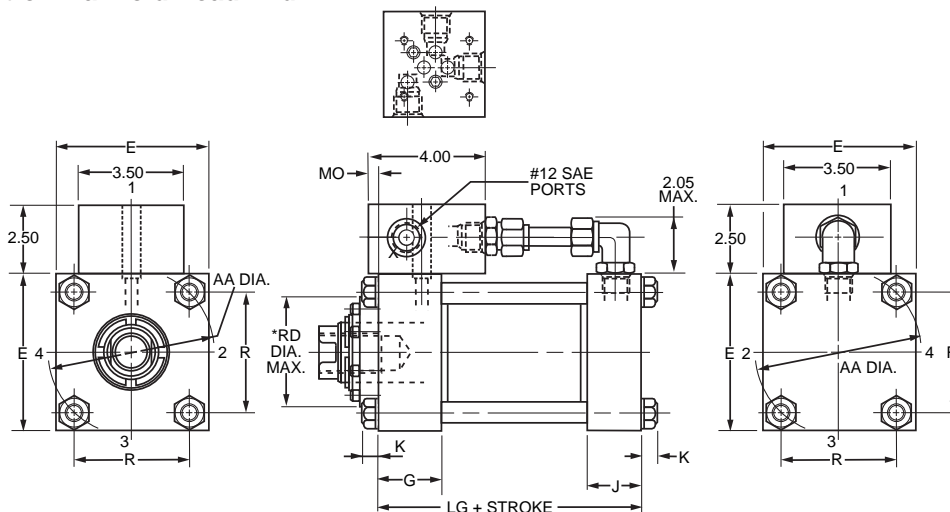
Group H/NFPA D05 Valve Manifold, Cap End Mounted Series 3HX Cylinder

Bore Ø	MO	E	G	J	K	AA	R	LG	Min. Stroke
7.00	0.14	8.50	2.75	2.75	1.00	9.31	6.58	8.50	0
8.00	0.02	9.50	3.00	3.00	1.06	10.61	7.50	9.50	0

Consult Factory for DD Mount. Standard Operating Pressure is 3000 PSI. BOM will overhang past cap face.

3HX with Group H Bolt-on Manifold Head End

NFPA D05
CETOP 5
ISO NG10



Group H/NFPA D05 Valve Manifold, Head End Mounted Series 3HX Cylinder

Bore Ø	MO	E	G	J	K	AA	R	LG	Min. Stroke
7.00	0.14	8.50	2.75	2.75	1.00	9.31	6.58	8.50	0
8.00	0.02	9.50	3.00	3.00	1.06	10.61	7.50	9.50	0

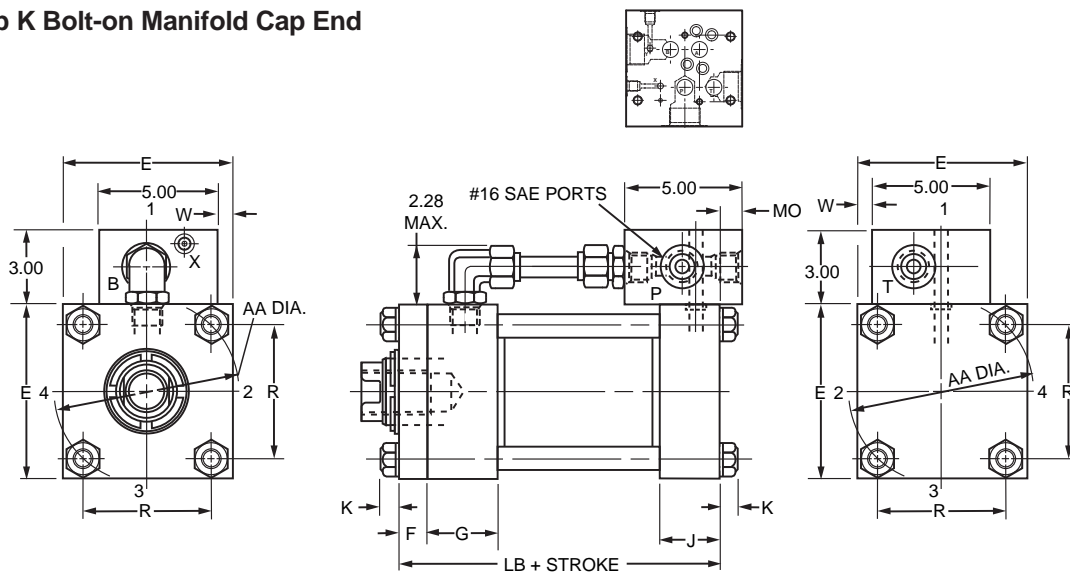
Consult Factory for DD Mount. Standard Operating Pressure is 3000 PSI. BOM will overhang past head face.

D Bolt-On Manifold

⚠ PROP 65 WARNING WARNING: This product can expose you to chemicals including **Lead and Lead Compounds** which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov



2HX with Group K Bolt-on Manifold Cap End
 NFPA D07
 CETOP 7
 ISO NG16



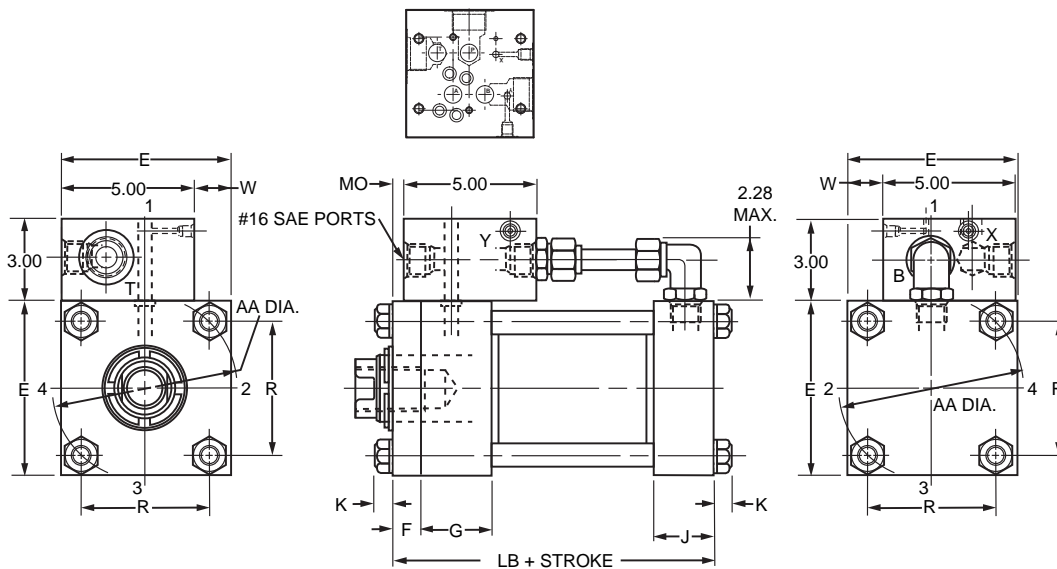
Group K/NFPA D07 Valve Manifold, Cap End Mounted Series 2HX Cylinder

Bore Ø	MO	E	F	G	J	K	AA	R	LB	W	Min. Stroke
6.00	0.59	7.50	1.00	2.25	2.25	0.88	8.10	5.73	8.38	0.44	1.10

Consult Factory for DD Mount. Standard Operating Pressure is 3000 PSI. Bolt-On Manifold will overhang past cap face.

2HX with Group K Bolt-on Manifold Head End

NFPA D07
 CETOP 7
 ISO NG16



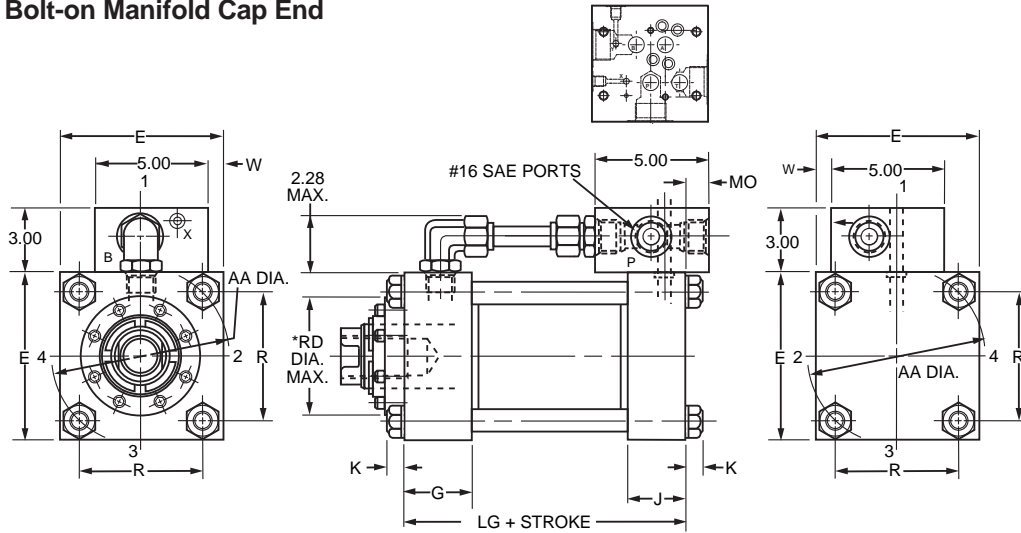
Group K/NFPA D07 Valve Bolt-on Manifold, Head End Mounted, Series 2HX Cylinder

Bore Ø	MO	E	F	G	J	K	AA	R	W	LB	Min. Stroke
6.00	0.41	7.50	1.00	2.25	2.25	0.88	8.10	5.73	2.07	8.38	1.10

Consult Factory for DD Mount. Standard Operating Pressure is 3000 PSI.

⚠ PROP 65 WARNING WARNING: This product can expose you to chemicals including **Lead and Lead Compounds** which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

3HX with Group K Bolt-on Manifold Cap End
NFPA D07
CETOP 7
ISO NG16



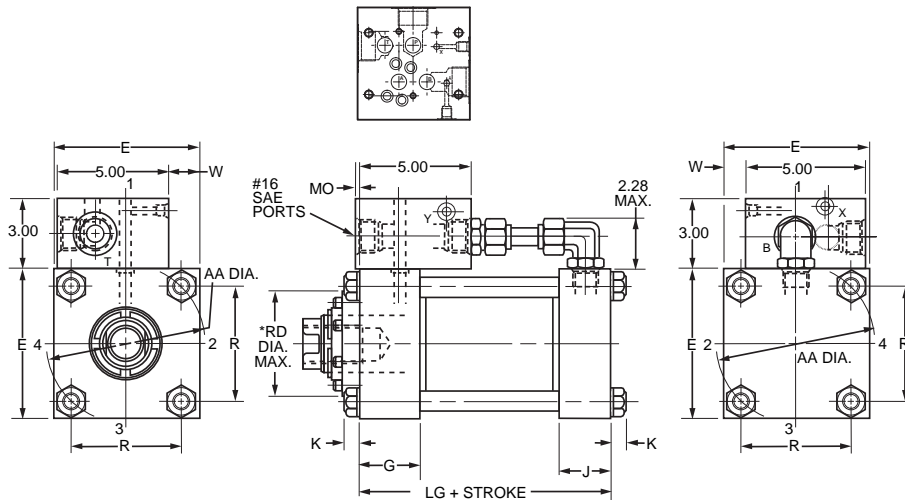
Group K/NFPA D07 Valve Manifold, Cap End Mounted Series 3HX Cylinder

Bore Ø	MO	E	G	J	K	AA	R	LG	W	Min. Stroke
7.00	0.34	8.50	2.75	2.75	1.00	9.30	6.58	8.50	0.94	0.75
8.00	0.22	9.50	3.00	3.00	1.06	10.60	7.50	9.50	1.44	0

Consult Factory for DD Mount. Standard Operating Pressure is 3000 PSI. Bolt-On Manifold will overhang past cap face.

3HX with Group K Bolt-on Manifold Head End

NFPA D07
CETOP 7
ISO NG16



Group K/NFPA D07 Valve Bolt-on Manifold, Head End Mounted, Series 3HX Cylinder

Bore Ø	MO	E	G	J	K	AA	R	LG	W	Min. Stroke
7.00	0.34	8.50	2.75	2.75	1.00	9.31	6.58	8.50	2.57	0.75
8.00	0.22	9.50	3.00	3.00	1.06	10.61	7.50	9.50	3.07	0

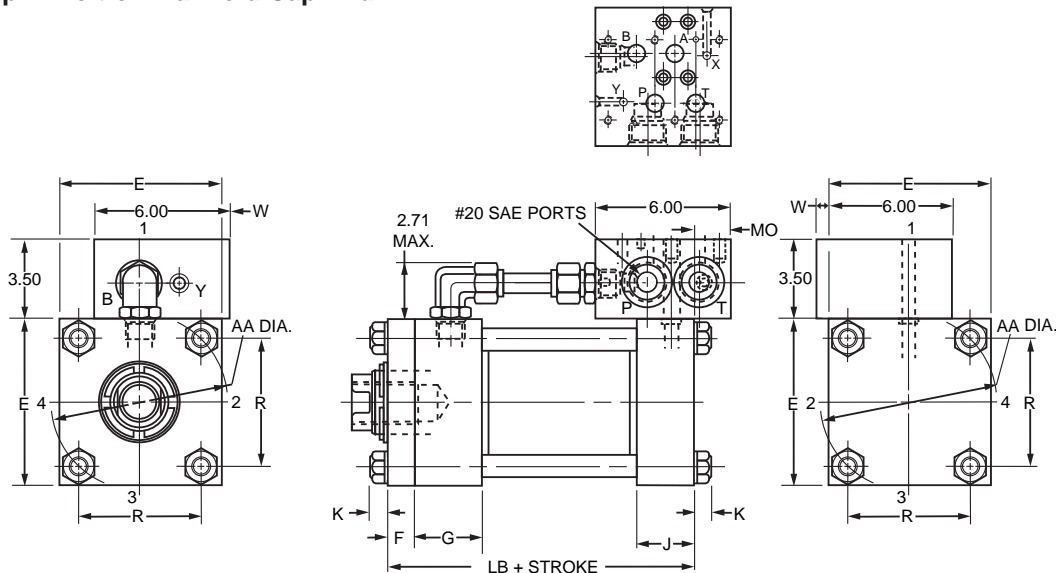
Consult Factory for DD Mount. Standard Operating Pressure is 3000 PSI.

D
Bolt-On Manifold

⚠ PROP 65 WARNING WARNING: This product can expose you to chemicals including **Lead and Lead Compounds** which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov



2HX with Group M Bolt-on Manifold Cap End
 NFPA D08
 CETOP 8
 ISO NG25



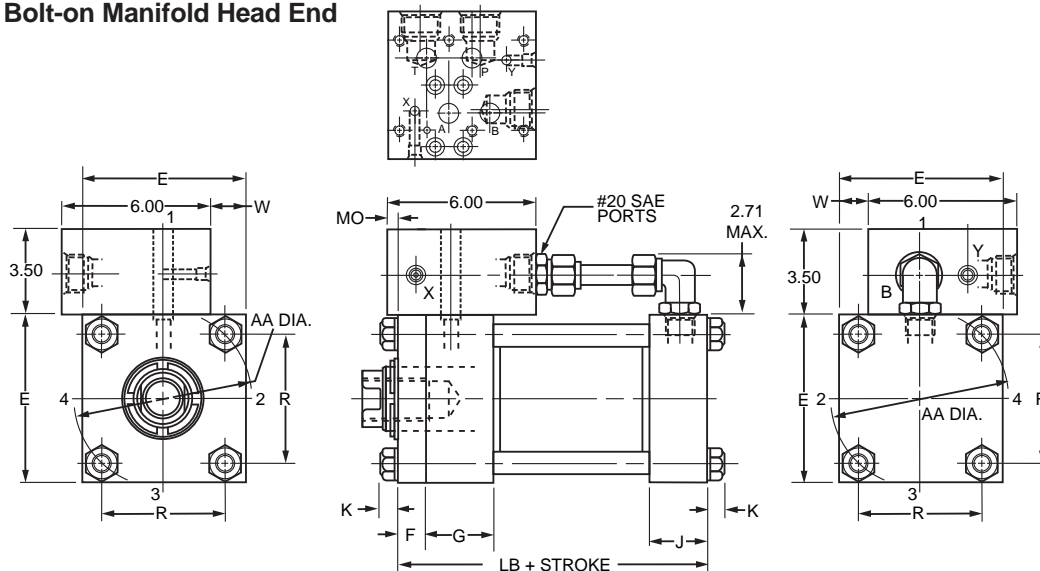
Group M/NFPA D08 Valve Manifold, Cap End Mounted Series 2HX Cylinder

Bore Ø	MO	E	F	G	J	K	AA	R	LB	W	Min. Stroke
6.00	1.57	7.50	1.00	2.25	2.25	0.88	8.10	5.73	8.38	0.25	1.75

Consult Factory for DD Mount. Standard Operating Pressure is 3000 PSI. Bolt-On Manifold will overhang past cap face.

2HX with Group M Bolt-on Manifold Head End

NFPA D08
 CETOP 8
 ISO NG25



Group M/NFPA D08 Valve Bolt-on Manifold, Head End Mounted, Series 2HX Cylinder

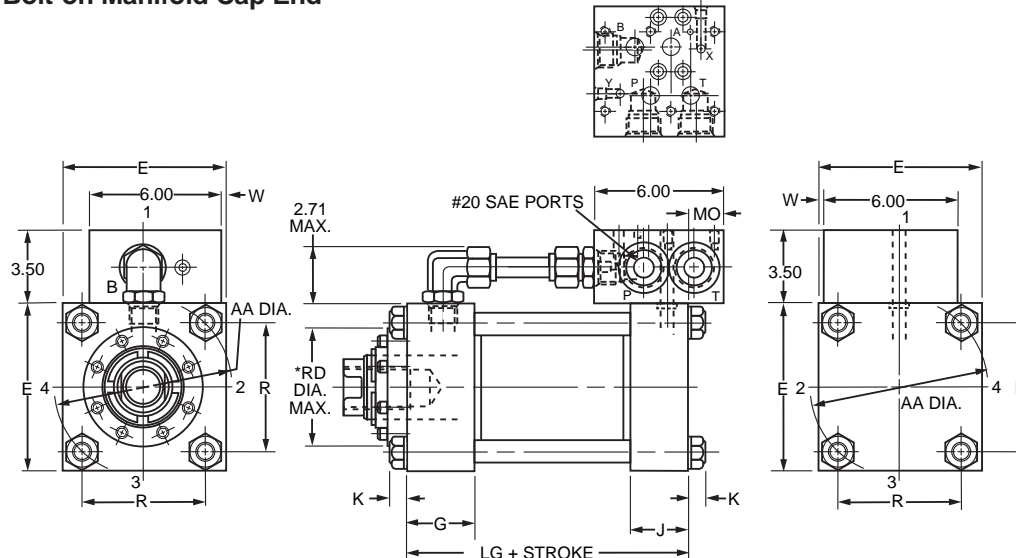
Bore Ø	MO ¹	E	F	G	J	K	AA	R	W ²	LB	Min. Stroke
6.00	0.50	7.50	1.00	2.25	2.25	0.88	8.10	5.73	1.76	8.38	1.75

Consult Factory for DD Mount. Standard Operating Pressure is 3000 PSI. Bolt-On Manifold will overhang past head face.

⚠ PROP 65 WARNING WARNING: This product can expose you to chemicals including **Lead and Lead Compounds** which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov

3HX with Group M Bolt-on Manifold Cap End

NFPA D08
CETOP 8
ISO NG25



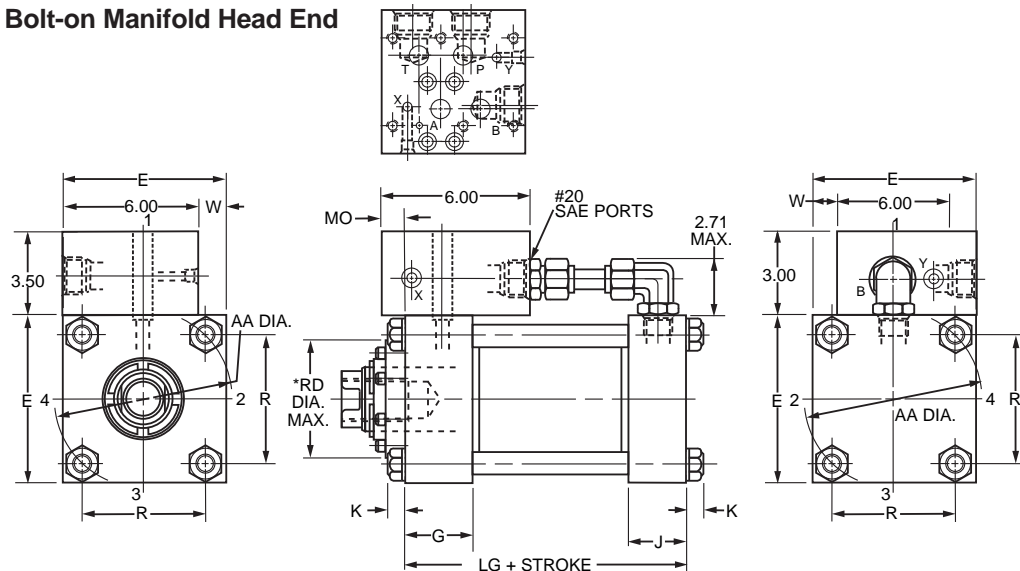
Group M/NFPA D08 Valve Manifold, Cap End Mounted Series 3H Cylinder

Bore Ø	MO	E	G	J	K	AA	R	LG	W	Min. Stroke
7.00	1.03	8.50	2.75	2.75	1.00	9.30	6.58	8.50	0.25	1.38
8.00	0.91	9.50	3.00	3.00	1.06	10.61	7.50	9.50	0.75	0.63

Consult Factory for DD Mount. Standard Operating Pressure is 3000 PSI. Bolt-On Manifold will overhang past cap face.

3HX with Group M Bolt-on Manifold Head End

NFPA D08
CETOP 8
ISO NG25



Group M/NFPA D08 Valve Bolt-on Manifold, Head End Mounted, Series 3HX Cylinder

Bore Ø	MO	E	G	J	K	AA	R	LG	W	Min. Stroke
7.00	1.03	8.50	2.75	2.75	1.00	9.31	6.58	8.50	2.25	1.38
8.00	0.91	9.50	3.00	3.00	1.06	10.61	7.50	9.50	2.75	0.63

Consult Factory for DD Mount. Standard Operating Pressure is 3000 PSI. Bolt-On Manifold will overhang past head face.

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Table A - Available Mounting and Manifold Position

MOUNTING STYLE	DESCRIPTION	BOLT-ON-MANIFOLD MOUNTING POSITION		APPLICABLE FEEDBACK DEVICES
		CAP END	HEAD END	
TB	Head Tie Rods Extended	1,2,3,4	1,2,3,4	LRT, LDT, and WaveScale
TC	Cap Tie Rods Extended	1,2,3,4	1,2,3,4	LRT and WaveScale
TD	Both Ends Tie Rods Extended	1,2,3,4	1,2,3,4	
J	Head Rectangular Flange	1,2,3,4	CF	LRT, LDT, and WaveScale
JB	Head Square Flange	1,2,3,4	N/A	
JJ	Head Rectangular	1,2,3,4	CF	
H	Cap Rectangular Flange	CF	1,2,3,4	LRT and WaveScale
HB	Cap Square Flange	N/A	1,2,3,4	
HH	Cap Rectangular	CF	1,2,3,4	LRT, LDT, and WaveScale
C	Side Lug	1	1	LRT, LDT, and WaveScale
F	Side Tapped	1	1	
BB*	Cap Fixed Clevis	CF	1,2,3,4	LRT, LDT, and WaveScale
D	Head Trunnion	1,2,3,4	1,3	LRT, LDT, and WaveScale
DB	Cap Trunnion	1,3	1,2,3,4	
DD	Intermediate Fixed Trunnion	1,3	1,3	
DE	Heavy Duty Intermediate Fixed Trunnion	1,3	1,3	
SB*	Spherical Bearing	CF	1,2,3,4	LRT, LDT, and WaveScale
SE*	Heavy Duty Spherical Bearing	CF	1,2,3,4	LRT, LDT, and WaveScale

Notes:

Bolt-On-Manifolds may overhang and affect the mounting and application of the cylinder.

LDT Feedback devices extend beyond the face of the cap and may interfere with cap end mounts.

*A false stage cylinder body is required when LDT Feedback devices are selected with these cap end mounts.

N/A = Not Available CF = Consult Factory

¹WaveScale mounting block will interfere with flange mounting holes on small bore sizes.

Series 2HX and 3HX Mounting Dimensions

The Parker Series 2HX and 3HX Bolt-on Manifold option does not affect the standard envelope and mounting dimensions of the base Parker Series 2H or 3H Heavy Duty Hydraulic Cylinder except where noted on previous pages of this catalog. All standard Parker Series 2H and 3H mounting styles are available with the Series 2HX and 3HX Bolt-on Manifold option. For base cylinder dimensions refer to the Parker Series 2H and 3H sections of the Parker Actuator Catalog HY08-1314.

Series 2HX and 3HX Bolt-on Manifolds may be specified at any head or cap position which does not interfere with the mounting style selected. For available manifold mounting positions see Table A above. Manifold position must be specified when ordering.

For Parker mounting style DD refer to the minimum and maximum XI dimensions in Table 1 through Table 4, opposite page.

Consult Factory for 6" Bore 2HX and 7.00"-8.00" Bore 3HX with Style DD Mounts.

⚠ PROP 65 WARNING **WARNING:** This product can expose you to chemicals including **Lead and Lead Compounds** which are known to the State of California to cause cancer and birth defects or other reproductive harm. For more information go to www.P65Warnings.ca.gov



Table 1 - Head End Mounted Bolt-on Manifold, Minimum Stroke and Minimum/Maximum 'XI' location for Style DD

Series	Bore Ø	Bolt-on Manifold													
		Group A			Group D			Group G			Group H			Group K	Group M
		Min Stroke	MN	MX	Min Stroke	MN	MX	Min Stroke	MN	MX	Min Stroke	MN	MX		
2HX	2.00	4.50	5.50	1.88	-	-	-	3.25	5.50	2.25	4.50	6.38	1.88	N/A	N/A
	2.50	4.25	5.50	2.00	-	-	-	3.25	5.50	2.38	4.50	6.38	2.00		
	3.25	4.25	5.75	2.50	5.25	7.63	2.50	3.25	6.00	2.88	4.50	6.88	2.50		
	4.00	4.00	5.88	2.88	5.00	7.75	2.88	3.00	6.13	3.25	4.25	7.00	2.88		
	5.00	3.50	5.88	3.38	4.50	7.75	3.38	2.50	6.13	3.75	3.75	7.00	3.38		
3HX	6.00	Consult Factory													
	7.00														
	8.00														

Table 2 - Head End Mounted Bolt-on Manifold, Minimum Stroke and Minimum/Maximum 'XI' location for Style DE

Series	Bore Ø	MX Bolt-on Manifold													
		Group A			Group D			Group G			Group H			Group K	Group M
		Min Stroke	MN	MX	Min Stroke	MN	MX	Min Stroke	MN	MX	Min Stroke	MN	MX		
2HX	4.00	4.25	7.00	2.75	5.25	7.88	2.75	3.25	6.25	3.13	4.50	7.13	2.75	N/A	N/A
	5.00	4.25	7.25	3.00	5.25	8.13	3.00	3.25	6.50	3.38	4.50	7.38	3.00		
	6.00	Consult Factory													
3HX	7.00														
	8.00														

Table 3 - Cap End Mounted Bolt-on Manifold, Minimum Stroke and Minimum/Maximum 'XI' location for Style DD

Series	Bore Ø	Bolt-on Manifold													
		Group A			Group D			Group G			Group H			Group K	Group M
		Min Stroke	MN	MX	Min Stroke	MN	MX	Min Stroke	MN	MX	Min Stroke	MN	MX		
2HX	2.00	4.50	4.25	-0.13	-	-	-	3.25	3.88	0.63	4.50	4.25	-0.26	N/A	N/A
	2.50	4.25	4.25	0.00	-	-	-	3.25	3.88	0.75	4.50	4.25	-0.13		
	3.25	4.25	4.75	0.50	5.25	4.75	-0.38	3.25	4.38	1.25	4.50	4.75	0.38		
	4.00	4.00	4.88	0.88	5.00	4.88	0.00	3.00	4.50	1.63	4.25	4.88	0.75		
	5.00	3.50	4.88	1.38	4.50	4.88	0.50	2.50	4.50	2.13	3.75	4.88	1.25		
3HX	6.00	Consult Factory													
	7.00														
	8.00														

Table 4 - Cap End Mounted Bolt-on Manifold, Minimum Stroke and Minimum/Maximum 'XI' location for Style DE

Series	Bore Ø	Bolt-on Manifold													
		Group A			Group D			Group G			Group H			Group K	Group M
		Min Stroke	MN	MX	Min Stroke	MN	MX	Min Stroke	MN	MX	Min Stroke	MN	MX		
2HX	4.00	4.25	5.00	0.75	5.25	5.00	-0.13	3.25	4.63	1.50	4.50	5.00	0.63	N/A	N/A
	5.00	4.25	5.25	1.00	5.25	5.25	0.13	3.25	4.88	1.75	4.50	5.25	0.88		
	6.00	Consult Factory													
3HX	7.00														
	8.00														

Maximum and Minimum 'XI' Location

Min. 'XI' = W + MN

Max. 'XI' = W + MX + Gross Stroke




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Section E

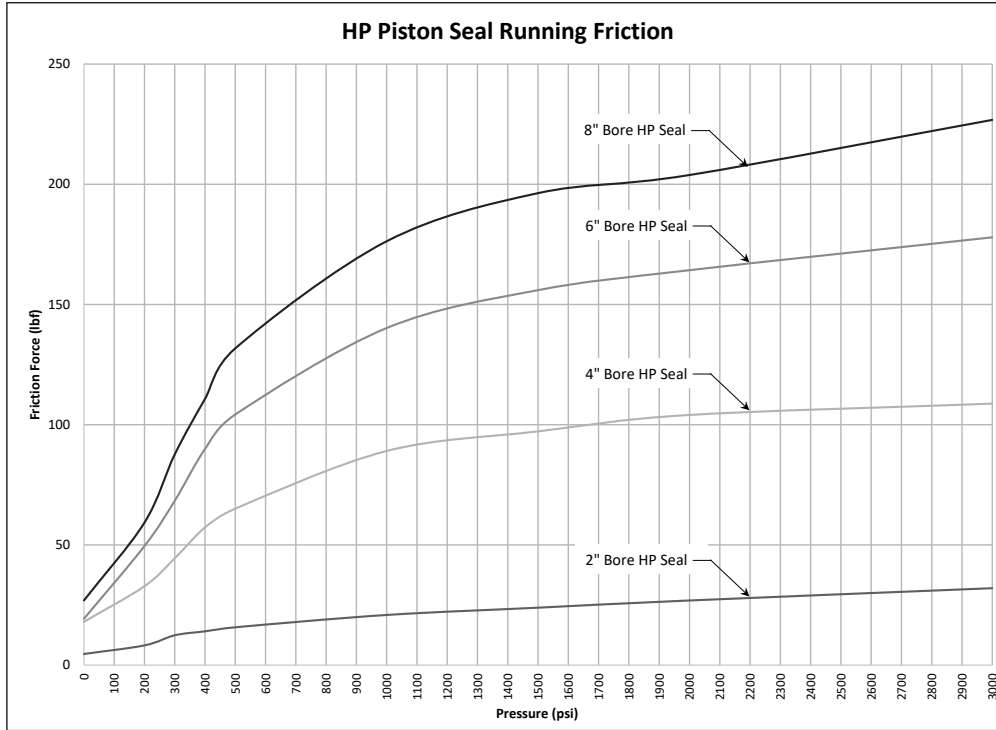
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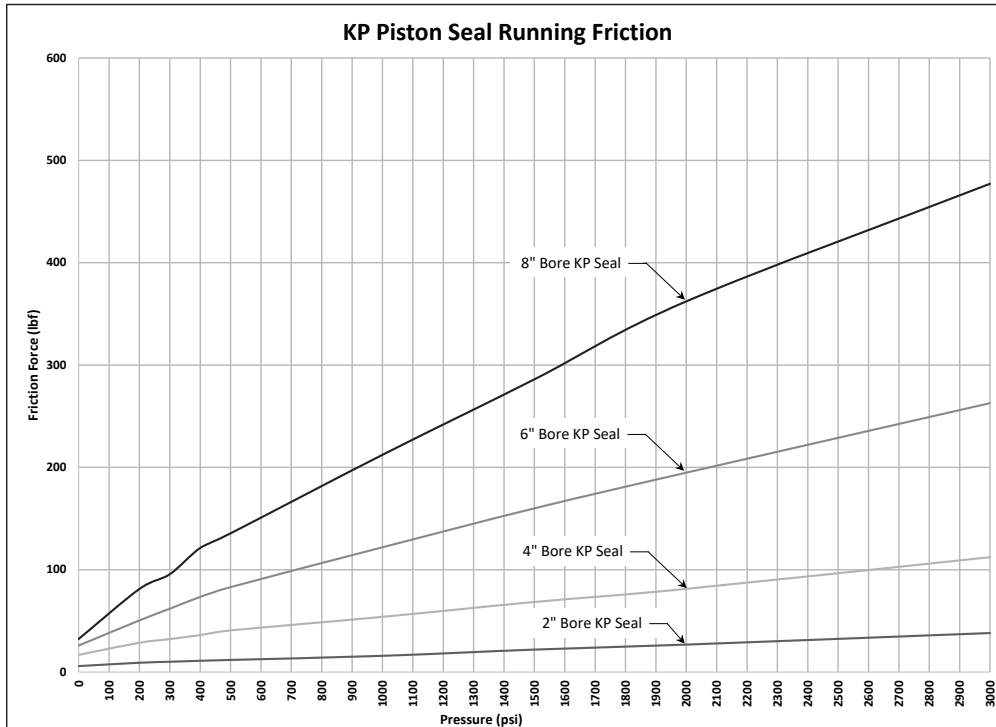
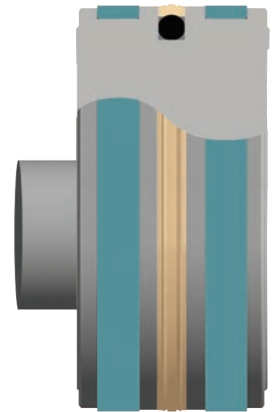
Piston Friction

Parker's new universal piston design provides not only superior sealing and wear performance, but also conserves operating energy with reduced running friction when compared to traditional sealing technologies. Running friction test results for the most

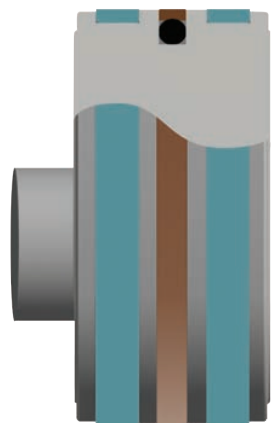
popular seal configurations, HP Polyurethane Piston Seal and KP filled PTFE Piston Seal in 2.00", 4.00", 6.00" and 8.00" bores are shown in graphs below. Friction for intermediate bore sizes can be estimated using curves for bore sizes tested.



Parker HP Polyurethane Piston Seal



Parker KP Filled PTFE Piston Seal

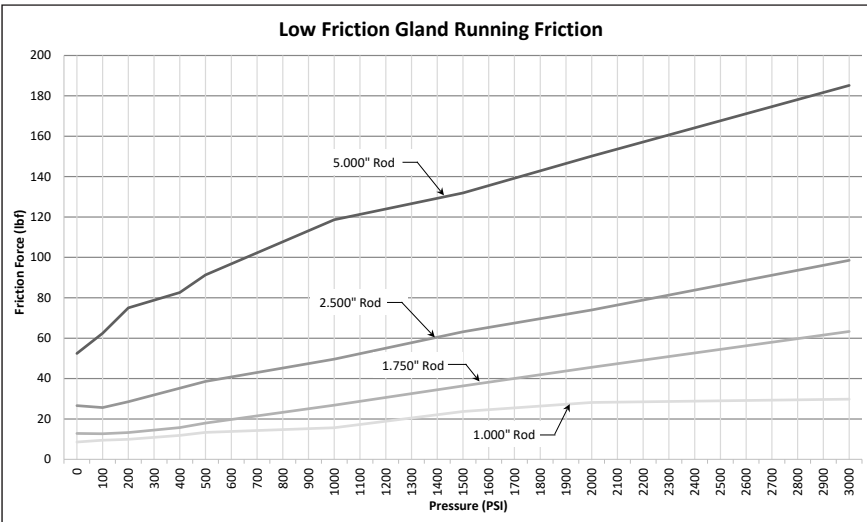
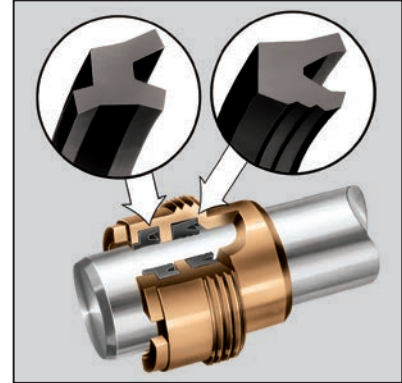
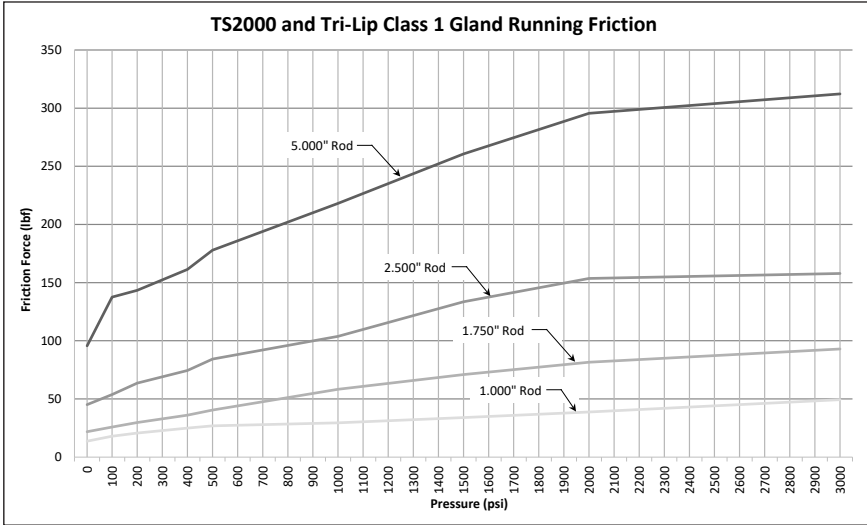


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Gland Friction

Gland friction is also a factor in cylinder operating efficiency and combined with piston seal friction will yield an overall cylinder running friction value. Running friction test results for 2H (TS2000) and 2HD / 2HB (Tri-Lip)

lipseal glands and Low Friction glands in 1.000", 1.750", 2.500" and 5.000" piston rod diameters are shown in the graphs below. Friction for intermediate rod diameters can be estimated using curves for bore sizes tested.



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Safety Guide for Selecting and Using Hydraulic, Pneumatic Cylinders and Their Accessories

WARNING: ⚠️ **FAILURE OF THE CYLINDER, ITS PARTS, ITS MOUNTING, ITS CONNECTIONS TO OTHER OBJECTS, OR ITS CONTROLS CAN RESULT IN:**

- Unanticipated or uncontrolled movement of the cylinder or objects connected to it.
- Falling of the cylinder or objects held up by it.
- Fluid escaping from the cylinder, potentially at high velocity.

THESE EVENTS COULD CAUSE DEATH OR PERSONAL INJURY BY, FOR EXAMPLE, PERSONS FALLING FROM HIGH LOCATIONS, BEING CRUSHED OR STRUCK BY HEAVY OR FAST MOVING OBJECTS, BEING PUSHED INTO DANGEROUS EQUIPMENT OR SITUATIONS, OR SLIPPING ON ESCAPED FLUID.

Before selecting or using Parker Hannifin Corporation (the Company) cylinders or related accessories, it is important that you read, understand and follow the following safety information. Training is advised before selecting and using the Company's products.

1.0 General Instructions

1.1 Scope – This safety guide provides instructions for selecting and using (including assembling, installing, and maintaining) cylinder products. This safety guide is a supplement to and is to be used with the specific Company publications for the specific cylinder products that are being considered for use.

1.2 Fail Safe – Cylinder products can and do fail without warning for many reasons. All systems and equipment should be designed in a fail-safe mode so that if the failure of a cylinder product occurs people and property won't be endangered.

1.3 Distribution – Provide a free copy of this safety guide to each person responsible for selecting or using cylinder products. Do not select or use the Company's cylinders without thoroughly reading and understanding this safety guide as well as the specific Company publications for the products considered or selected.

1.4 User Responsibility – Due to very wide variety of cylinder applications and cylinder operating conditions, the Company does not warrant that any particular cylinder is suitable for any specific application. This safety guide does not analyze all technical parameters that must be considered in selecting a product. The hydraulic and pneumatic cylinders outlined in this catalog are designed to the Company's design guidelines and do not necessarily meet the design guideline of other agencies such as American Bureau of Shipping, ASME Pressure Vessel Code etc. The user, through its own analysis and testing, is solely responsible for:

- Making the final selection of the cylinders and related accessories.
- Determining if the cylinders are required to meet specific design requirements as required by the Agency(s) or industry standards covering the design of the user's equipment.
- Assuring that the user's requirements are met, OSHA requirements are met, and safety guidelines from the applicable agencies such as but not limited to ANSI are followed and that the use presents no health or safety hazards.
- Providing all appropriate health and safety warnings on the equipment on which the cylinders are used.

1.5 Additional Questions – Call the appropriate Company technical service department if you have any questions or require any additional information. See the Company publication for the product being considered or used, or call 1-847-298-2400, or go to www.parker.com, for telephone numbers of the appropriate technical service department.

2.0 Cylinder and Accessories Selection

2.1 Seals – Part of the process of selecting a cylinder is the selection of seal compounds. Before making this selection, consult the "seal information page(s)" of the publication for the series of cylinders of interest.

The application of cylinders may allow fluids such as cutting fluids, wash down fluids etc. to come in contact with the external area of the cylinder. These fluids may attack the piston rod wiper and/or the primary seal and must be taken into account when selecting and specifying seal compounds.

Dynamic seals will wear. The rate of wear will depend on many operating factors. Wear can be rapid if a cylinder is mis-aligned or if the cylinder has been improperly serviced. The user must take seal wear into consideration in the application of cylinders.

2.2 Piston Rods – Possible consequences of piston rod failure or separation of the piston rod from the piston include, but are not limited to are:

- Piston rod and or attached load thrown off at high speed.
- High velocity fluid discharge.
- Piston rod extending when pressure is applied in the piston retract mode.

Piston rods or machine members attached to the piston rod may move suddenly and without warning as a consequence of other conditions occurring to the machine such as, but not limited to:

- Unexpected detachment of the machine member from the piston rod.
- Failure of the pressurized fluid delivery system (hoses, fittings, valves, pumps, compressors) which maintain cylinder position.
- Catastrophic cylinder seal failure leading to sudden loss of pressurized fluid.
- Failure of the machine control system.

Follow the recommendations of the "Piston Rod Selection Chart and Data" in the publication for the series of cylinders of interest. The suggested piston rod diameter in these charts must be followed in order to avoid piston rod buckling.

Piston rods are not normally designed to absorb bending moments or loads which are perpendicular to the axis of piston rod motion. These additional loads can cause the piston rod to fail. If these types of additional loads are expected to be imposed on the piston rod, their magnitude should be made known to our engineering department.

The cylinder user should always make sure that the piston rod is securely attached to the machine member.

On occasion cylinders are ordered with double rods (a piston rod extended from both ends of the cylinder). In some cases a stop is threaded on to one of the piston rods and used as an external stroke adjuster. On occasions spacers are attached to the machine member connected to the piston rod and also used as a stroke adjuster. In both cases the stops will create a pinch point and the user should consider appropriate use of guards. If these external stops are not perpendicular to the mating contact surface, or if debris is trapped between the contact surfaces, a bending moment will be placed on the piston rod, which can lead to piston rod failure. An external stop will also negate the effect of cushioning and will subject the piston rod to impact loading. Those two (2) conditions can cause piston rod failure. Internal stroke adjusters are available with and without cushions. The use of external stroke adjusters should be reviewed with our engineering department.

The piston rod to piston and the stud to piston rod threaded connections are secured with an anaerobic adhesive. The strength of the adhesive decreases with increasing temperature. Cylinders which can be exposed to temperatures above +250°F (+121°C) are to be ordered with a non studded piston rod and a pinned piston to rod joint.

2.3 Cushions – Cushions should be considered for cylinder applications when the piston velocity is expected to be over 4 inches/second.

Cylinder cushions are normally designed to absorb the energy of a linear applied load. A rotating mass has considerably more energy than the same mass moving in a linear mode. Cushioning for a rotating mass application should be reviewed by our engineering department.

2.4 Cylinder Mountings – Some cylinder mounting configurations may have certain limitations such as but not limited to minimum stroke for side or foot mounting cylinders or pressure de-ratings for certain mounts. Carefully review the catalog for these types of restrictions.

Always mount cylinders using the largest possible high tensile alloy steel socket head cap screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

2.5 Port Fittings – Hydraulic cylinders applied with meter out or deceleration circuits are subject to intensified pressure at piston rod end.

The rod end pressure is approximately equal to:

$$\frac{\text{operating pressure} \times \text{effective cap end area}}{\text{effective rod end piston area}}$$

Contact your connector supplier for the pressure rating of individual connectors.

3.0 Cylinder and Accessories Installation and Mounting

3.1 Installation

3.1.1 – Cleanliness is an important consideration, and cylinders are shipped with the ports plugged to protect them from contaminants entering the ports. These plugs should not be removed until the piping is to be installed. Before making the connection to the cylinder ports, piping should be thoroughly cleaned to remove all chips or burrs which might have resulted from threading or flaring operations.

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3.1.2 – Cylinders operating in an environment where air drying materials are present such as fast-drying chemicals, paint, or weld splatter, or other hazardous conditions such as excessive heat, should have shields installed to prevent damage to the piston rod and piston rod seals.

3.1.3 – Proper alignment of the cylinder piston rod and its mating component on the machine should be checked in both the extended and retracted positions. Improper alignment will result in excessive rod gland and/or cylinder bore wear. On fixed mounting cylinders attaching the piston rod while the rod is retracted will help in achieving proper alignment.

3.1.4 – Sometimes it may be necessary to rotate the piston rod in order to thread the piston rod into the machine member. This operation must always be done with zero pressure being applied to either side of the piston. Failure to follow this procedure may result in loosening the piston to rod-threaded connection. In some rare cases the turning of the piston rod may rotate a threaded head and loosen it from the cylinder body. Confirm that this condition is not occurring. If it does, re-tighten the head firmly against the cylinder body.

For double rod cylinders it is also important that when attaching or detaching the piston rod from the machine member that the torque be applied to the piston rod end of the cylinder that is directly attaching to the machine member with the opposite end unrestrained. If the design of the machine is such that only the rod end of the cylinder opposite to where the rod attaches to the machine member can be rotated, consult the factory for further instructions.

3.2 Mounting Recommendations

3.2.1 – Always mount cylinders using the largest possible high tensile alloy steel socket head screws that can fit in the cylinder mounting holes and torque them to the manufacturer's recommendations for their size.

3.2.2 – Side-Mounted Cylinders – In addition to the mounting bolts, cylinders of this type should be equipped with thrust keys or dowel pins located so as to resist the major load.

3.2.3 – Tie Rod Mounting – Cylinders with tie rod mountings are recommended for applications where mounting space is limited. Nuts used for this mounting style should be torqued to the same value as the tie rods for that bore size.

3.2.4 – Flange Mount Cylinders – The controlled diameter of the rod gland extension on head end flange mount cylinders can be used as a pilot to locate the cylinders in relation to the machine. After alignment has been obtained, the flanges may be drilled for pins or dowels to prevent shifting.

3.2.5 – Trunnion Mountings – Cylinders require lubricated bearing blocks with minimum bearing clearances. Bearing blocks should be carefully aligned and rigidly mounted so the trunnions will not be subjected to bending moments. The rod end should also be pivoted with the pivot pin in line and parallel to axis of the trunnion pins.

3.2.6 – Clevis Mountings – Cylinders should be pivoted at both ends with centerline of pins parallel to each other. After cylinder is mounted, be sure to check to assure that the cylinder is free to swing through its working arc without interference from other machine parts.

4.0 Cylinder and Accessories Maintenance, Troubleshooting and Replacement

4.1 Storage – At times cylinders are delivered before a customer is ready to install them and must be stored for a period of time. When storage is required the following procedures are recommended.

4.1.1 – Store the cylinders in an indoor area which has a dry, clean and noncorrosive atmosphere. Take care to protect the cylinder from both internal corrosion and external damage.

4.1.2 – Whenever possible cylinders should be stored in a vertical position (piston rod up). This will minimize corrosion due to possible condensation which could occur inside the cylinder. This will also minimize seal damage.

4.1.3 – Port protector plugs should be left in the cylinder until the time of installation.

4.1.4 – If a cylinder is stored full of hydraulic fluid, expansion of the fluid due to temperature changes must be considered. Installing a check valve with free flow out of the cylinder is one method.

4.1.5 – When cylinders are mounted on equipment that is stored outside for extended periods, exposed unpainted surfaces, e.g. piston rod, must be coated with a rust-inhibiting compound to prevent corrosion.

4.2 Cylinder Trouble Shooting

4.2.1 – External Leakage

4.2.1.1 – Rod seal leakage can generally be traced to worn or damaged seals. Examine the piston rod for dents, gouges or score marks, and replace piston rod if surface is rough.

Rod seal leakage could also be traced to bearing wear. If clearance is excessive, replace rod bearing and seal. Rod seal leakage can also be traced to seal deterioration. If seals are soft or gummy or brittle, check compatibility of seal material with lubricant used if air cylinder, or operating fluid if hydraulic cylinder. Replace with seal material, which is compatible with these fluids. If the seals are hard or have lost elasticity, it is usually due to exposure to temperatures in excess of 165°F. (+74°C). Shield the cylinder from the heat source to limit temperature to 350°F. (+177°C.) and replace with fluorocarbon seals.

4.2.1.2 – Cylinder body seal leak can generally be traced to a loose head. Torque the head to manufacturer's recommendation for that bore size.

Excessive pressure can also result in cylinder body seal leak. Determine maximum pressure to rated limits. Replace seals and retorque head as in paragraph above. Excessive pressure can also result in cylinder body seal leak. Determine if the pressure rating of the cylinder has been exceeded. If so, bring the operating pressure down to the rating of the cylinder and have the head replaced.

Pinched or extruded cylinder body seal will also result in a leak. Replace cylinder body seal and retorque as in paragraph above.

Cylinder body seal leakage due to loss of radial squeeze which shows up in the form of flat spots or due to wear on the O.D. or I.D. – Either of these are symptoms of normal wear due to high cycle rate or length of service. Replace seals as per paragraph above.

4.2.2 – Internal Leakage

4.2.2.1 – Piston seal leak (by-pass) 1 to 3 cubic inches per minute leakage is considered normal for piston ring construction. Virtually no static leak with lipseal type seals on piston should be expected. Piston seal wear is a usual cause of piston seal leakage. Replace seals as required.

4.2.2.2 – With lipseal type piston seals excessive back pressure due to over-adjustment of speed control valves could be a direct cause of rapid seal wear. Contamination in a hydraulic system can result in a scored cylinder bore, resulting in rapid seal wear. In either case, replace piston seals as required.

4.2.2.3 – What appears to be piston seal leak, evidenced by the fact that the cylinder drifts, is not always traceable to the piston. To make sure, it is suggested that one side of the cylinder piston be pressurized and the fluid line at the opposite port be disconnected. Observe leakage. If none is evident, seek the cause of cylinder drift in other component parts in the circuit.

4.2.3 – Cylinder Fails to Move the Load

4.2.3.1 – Pneumatic or hydraulic pressure is too low. Check the pressure at the cylinder to make sure it is to circuit requirements.

4.2.3.2 – Piston Seal Leak – Operate the valve to cycle the cylinder and observe fluid flow at valve exhaust ports at end of cylinder stroke. Replace piston seals if flow is excessive.

4.2.3.3 – Cylinder is undersized for the load – Replace cylinder with one of a larger bore size.

4.3 Erratic or Chatter Operation

4.3.1 – Excessive friction at rod bearing or piston bearing due to load misalignment – Correct cylinder-to-load alignment.

4.3.2 – Cylinder sized too close to load requirements – Reduce load or install larger cylinder.

4.3.3 – Erratic operation could be traced to the difference between static and kinetic friction. Install speed control valves to provide a back pressure to control the stroke.

4.4 Cylinder Modifications, Repairs, or Failed Component – Cylinders as shipped from the factory are not to be disassembled and/or modified. If cylinders require modifications, these modifications must be done at company locations or by the Company's certified facilities. The Cylinder Division Engineering Department must be notified in the event of a mechanical fracture or permanent deformation of any cylinder component (excluding seals). This includes a broken piston rod, head, mounting accessory or any other cylinder component. The notification should include all operation and application details. This information will be used to provide an engineered repair that will prevent recurrence of the failure.

It is allowed to disassemble cylinders for the purpose of replacing seals or seal assemblies. However, this work must be done by strictly following all the instructions provided with the seal kits.

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2. Price; Payment. The Products set forth in the Quote are offered for sale at the prices indicated in the Quote. Unless otherwise specifically stated in the Quote, prices are valid for thirty (30) days and do not include any sales, use, or other taxes or duties. Seller reserves the right to modify prices 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 2020). All sales are contingent upon credit approval and full payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). 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.

3. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate, and 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 carrier at Seller's facility. Unless otherwise agreed prior to shipment and for domestic delivery locations only, Seller will select and arrange, at Buyer's sole expense, the carrier and means of delivery. When Seller selects and arranges the carrier and means of delivery, freight and insurance costs for shipment to the designated delivery location will be prepaid by Seller and added as a separate line item to the invoice. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions. Buyer shall not return or repackage any Products without the prior written authorization from Seller, and any return shall be at the sole cost and expense of Buyer.

4. Warranty. The warranty for 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 or 2,000 hours of use, whichever occurs first; (ii) Services shall be performed in accordance with generally accepted practices and using the degree of care and skill that is ordinarily exercised and customary in the field to which the Services pertain and are warranted for a period of six (6) months from the date of completion of the Services; and (iii) Software is only warranted to perform in accordance with applicable specifications provided by Seller to Buyer for ninety (90) days from the date of delivery or, when downloaded by a Buyer or end-user, from the date of the initial download. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **EXEMPTION CLAUSE; DISCLAIMER OF WARRANTY, CONDITIONS, REPRESENTATIONS: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY, CONDITION, AND REPRESENTATION, PERTAINING TO PRODUCTS. SELLER DISCLAIMS ALL OTHER WARRANTIES, CONDITIONS, AND REPRESENTATIONS, WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THOSE RELATING TO DESIGN, 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. 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".**

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to Seller within ten (10) days of delivery. Buyer shall notify Seller of any alleged breach of warranty within thirty (30) days after the date the non-conformance is or should have been discovered by Buyer. Any claim or action against Seller based upon breach of contract or any other theory, including tort, negligence, or otherwise must be commenced within twelve (12) months from the date of the alleged breach or other alleged event, without regard to the date of discovery.

6. 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 INCLUDING ANY LOSS OF REVENUE OR PROFITS, WHETHER BASED IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE PAID FOR THE PRODUCTS.**

7. Confidential Information. Buyer acknowledges and agrees that any technical, commercial, or other confidential information of Seller, including, without limitation, pricing, technical drawings or prints and/or part lists, which has been or will be disclosed, delivered or made available, whether directly or indirectly, to Buyer ("Confidential Information"), has been and will be received in confidence and will remain the property of Seller. Buyer further agrees that it will not use Seller's Confidential Information for any purpose other than for the benefit of Seller.

8. Loss to Buyer's Property. Any tools, patterns, materials, equipment or information furnished by Buyer or which are or become Buyer's property ("Buyer's Property"), will be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer ordering the Products manufactured using Buyer's Property. Furthermore, Seller shall not be responsible for any loss or damage to Buyer's Property while it is in Seller's possession or control.

9. Special Tooling. "Special Tooling" includes but is not limited to tools, jigs, fixtures and associated manufacturing equipment acquired or necessary to manufacture Goods. Seller may impose a tooling charge 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 the Special Tooling, even if such Special Tooling has been specially converted or adapted for manufacture of Goods for Buyer and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller has the right to alter, discard or otherwise dispose of any Special Tooling or other property owned by Seller in its sole discretion at any time.

10. Security Interest. To secure payment of all sums due from Buyer, Seller retains a security interest in all Products delivered to Buyer and, Buyer's acceptance of these Terms is deemed to be a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect Seller's security interest.

11. User Responsibility. Buyer, through its own analysis and testing, is solely responsible for making the final selection of the Products and assuring that all performance, endurance, maintenance, safety and warning requirements of the application of the Products are met. Buyer must analyze all aspects of the application and follow applicable industry standards, specifications, and any technical information provided with the Quote or the Products, such as Seller's instructions, guides and specifications. If Seller provides options of or for Products based upon data or specifications provided by Buyer, Buyer is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products. In the event Buyer is not the end-user of the Products, Buyer will ensure such end-user complies with this paragraph.

12. Use of Products, Indemnity by Buyer. Buyer shall comply with all instructions, guides and specifications provided by Seller with the Quote or the Products. Unauthorized Uses. If Buyer uses or resells the Products in any way prohibited by Seller's instructions, guides or specifications, or Buyer otherwise fails to comply with Seller's

instructions, guides and specifications, Buyer acknowledges that any such use, resale, or non-compliance is at Buyer's sole risk. Further, Buyer shall indemnify, defend, and hold Seller harmless from any losses, claims, liabilities, damages, lawsuits, judgments and costs (including attorney fees and defense costs), whether for personal injury, property damage, intellectual property infringement or any other claim, arising out of or in connection with: (a) improper selection, design, specification, application, or any misuse of Products; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, tools, equipment, plans, drawings, designs, 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, tampering with or repackaging the Products; 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, including but not limited to movement of delivery dates for the Products, any order for any reason except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage and any additional expense. Seller, at any time, may change features, specifications, designs and availability of Products.

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

15. Force Majeure. Seller is not liable for delay or failure to perform any of its obligations by reason of events or circumstances beyond its reasonable control. Such circumstances include without limitation: accidents, labor disputes or stoppages, government acts or orders, acts of nature, pandemics, epidemics, other widespread illness, or public health emergency, delays or failures in delivery from carriers or suppliers, shortages of materials, war (whether declared or not) or the serious threat of same, riots, rebellions, acts of terrorism, fire or any reason whether similar to the foregoing or otherwise. Seller will resume performance as soon as practicable after the event of force majeure has been removed. All delivery dates affected by force majeure shall be tolled for the duration of such force majeure and rescheduled for mutually agreed dates as soon as practicable after the force majeure condition ceases to exist. Force majeure shall not include financial distress, insolvency, bankruptcy, or other similar conditions affecting one of the parties, affiliates and/or sub-contractors.

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

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) becomes or is deemed insolvent, (c) appoints or has appointed a trustee, receiver or custodian for all or any part of Buyer's property, (d) files a petition for relief in bankruptcy on its own behalf, or one is filed against Buyer by a third party, (e) makes an assignment for the benefit of creditors; or (f) dissolves its business or liquidates all or a majority of its assets.

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 Seller to Buyer. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of any such claim, and Seller having sole control over the defense of the claim including all negotiations for settlement or compromise. If one or more Products 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 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 and purchase. 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 and Drug Administration ("FDA"), 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 FDA and the FDA and certifies that Buyer will adhere to the requirements thereof and not take any action that would make Seller violate such requirements. Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly, to any governmental official, foreign political party or official thereof, candidate for foreign political office, or commercial entity or person, for any improper purpose, including the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller. Buyer further represents and agrees that it will not receive, use, service, transfer or ship any Products from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws. Buyer agrees to promptly and reliably provide Seller all requested information or documents, including end-user statements and other written assurances, concerning Buyer's ongoing compliance with Export Laws. 08/2020



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Aerospace **Key Markets**

Aftermarket services
Commercial transports
Engines
General & business aviation
Helicopters
Launch vehicles
Military aircraft
Missiles
Power generation
Regional transports
Unmanned aerial vehicles

Key Products

Control systems & actuation products
Engine systems & components
Fluid conveyance systems & components
Fluid metering, delivery & atomization devices
Fuel systems & components
Fuel tank inerting systems
Hydraulic systems & components
Thermal management
Wheels & brakes



Climate Control **Key Markets**

Agriculture
Air conditioning
Construction Machinery
Food & beverage
Industrial machinery
Life sciences
Oil & gas
Precision cooling
Process
Refrigeration
Transportation

Key Products

Accumulators
Advanced actuators
CO₂ controls
Electronic controllers
Filter driers
Hand shut-off valves
Heat exchangers
Hose & fittings
Pressure regulating valves
Refrigerant distributors
Safety relief valves
Smart pumps
Solenoid valves
Thermostatic expansion valves



Electromechanical **Key Markets**

Aerospace
Factory automation
Life science & medical
Machine tools
Packaging machinery
Paper machinery
Plastics machinery & converting
Primary metals
Semiconductor & electronics
Textile
Wire & cable

Key Products

AC/DC drives & systems
Electric actuators, gantry robots & slides
Electrohydraulic actuation systems
Electromechanical actuation systems
Human machine interface
Linear motors
Stepper motors, servo motors, drives & controls
Structural extrusions



Filtration **Key Markets**

Aerospace
Food & beverage
Industrial plant & equipment
Life sciences
Marine
Mobile equipment
Oil & gas
Power generation & renewable energy
Process
Transportation
Water Purification

Key Products

Analytical gas generators
Compressed air filters & driers
Engine air, coolant, fuel & oil filtration systems
Fluid condition monitoring systems
Hydraulic & lubrication filters
Hydrogen, nitrogen & zero air generators
Instrumentation filters
Membrane & fiber filters
Microfiltration
Sterile air filtration
Water desalination & purification filters & systems



Fluid & Gas Handling

Key Markets

Aerial lift
Agriculture
Bulk chemical handling
Construction machinery
Food & beverage
Fuel & gas delivery
Industrial machinery
Life sciences
Marine
Mining
Mobile
Oil & gas
Renewable energy
Transportation

Key Products

Check valves
Connectors for low pressure fluid conveyance
Deep sea umbilicals
Diagnostic equipment
Hose couplings
Industrial hose
Mooring systems & power cables
PTFE hose & tubing
Quick couplings
Rubber & thermoplastic hose
Tube fittings & adapters
Tubing & plastic fittings



Hydraulics

Key Markets

Aerial lift
Agriculture
Alternative energy
Construction machinery
Forestry
Industrial machinery
Machine tools
Marine
Material handling
Mining
Oil & gas
Power generation
Refuse vehicles
Renewable energy
Truck hydraulics
Turf equipment

Key Products

Accumulators
Cartridge valves
Electrohydraulic actuators
Human machine interfaces
Hybrid drives
Hydraulic cylinders
Hydraulic motors & pumps
Hydraulic systems
Hydraulic valves & controls
Hydrostatic steering
Integrated hydraulic circuits
Power take-offs
Power units
Rotary actuators
Sensors



Pneumatics

Key Markets

Aerospace
Conveyor & material handling
Factory automation
Life science & medical
Machine tools
Packaging machinery
Transportation & automotive

Key Products

Air preparation
Brass fittings & valves
Manifolds
Pneumatic accessories
Pneumatic actuators & grippers
Pneumatic valves & controls
Quick disconnects
Rotary actuators
Rubber & thermoplastic hose & couplings
Structural extrusions
Thermoplastic tubing & fittings
Vacuum generators, cups & sensors



Process Control

Key Markets

Alternative fuels
Biopharmaceuticals
Chemical & refining
Food & beverage
Marine & shipbuilding
Medical & dental
Microelectronics
Nuclear Power
Offshore oil exploration
Oil & gas
Pharmaceuticals
Power generation
Pulp & paper
Steel
Water/wastewater

Key Products

Analytical Instruments
Analytical sample conditioning products & systems
Chemical injection fittings & valves
Fluoropolymer chemical delivery fittings, valves & pumps
High purity gas delivery fittings, valves, regulators & digital flow controllers
Industrial mass flow meters/ controllers
Permanent no-weld tube fittings
Precision industrial regulators & flow controllers
Process control double block & bleeds
Process control fittings, valves, regulators & manifold valves



Sealing & Shielding

Key Markets

Aerospace
Chemical processing
Consumer
Fluid power
General industrial
Information technology
Life sciences
Microelectronics
Military
Oil & gas
Power generation
Renewable energy
Telecommunications
Transportation

Key Products

Dynamic seals
Elastomeric o-rings
Electro-medical instrument design & assembly
EMI shielding
Extruded & precision-cut, fabricated elastomeric seals
High temperature metal seals
Homogeneous & inserted elastomeric shapes
Medical device fabrication & assembly
Metal & plastic retained composite seals
Shielded optical windows
Silicone tubing & extrusions
Thermal management
Vibration dampening

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