Miller JV Series

Medium Duty Hydraulic Cylinders

Catalog M1130-3 September, 2011

Up to 1000 PSI
Bore Sizes 1" through 8"
18 Mounting Styles

Miller FLUID POWER

AV Series Cylinders

Up to 250 PSI Permanently Lubricated

Series AV air cylinders are available in bore sizes from 1-1/2" through 14" and up to 250 PSI operating pressure. Standard NFPA dimensions and proven Miller design features.

AL4 Series Aluminum Cylinders

Up to 250 PSI – Permanently Lubricated

Series AL4 air cylinders are available in bore sizes from 1-1/2" through 8" and up to 250 PSI operating pressure.

VL Series Cylinders

Up to 150 PSI

VL Series Cylinders for Valve Actuation feature a removable rod bushing for easy rod seal service. Optional welded or threaded lift eye. Bore sizes from 2" to 24".

HV2 Series Cylinders

3000 PSI

Miller's heavy-duty cylinder line for demanding hydraulic applications. Bore sizes from 1-1/2" to 8".

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

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Miller JV Series
Medium-Duty Hydraulic Cylinders

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Miller Fluid Power JV Series Medium-Duty Hydraulic Cylinder

When the job calls for reliable, medium-duty performance, specify JV Series. A 100,000 psi yield strength chrome-plated, case-hardened piston rod. A 125,000 psi yield strength rod-end stud with rolled threads. 100,000 psi yield strength tie rods. With construction like this, it's no wonder Miller Fluid Power's JV Series is rated up to 1000 psi hydraulic pressure.

They're truly premium quality cylinders, and to make sure every cylinder is premium quality, we subject each and every one – not just batch samples – to tough inspection and performance tests. See inside for the inside story on all the features that make JV Series the high performance, long lasting choice for all your medium-duty hydraulic applications.

Note: Rod diameters over 2½" will use a threaded rod bushing.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Standard Specifications

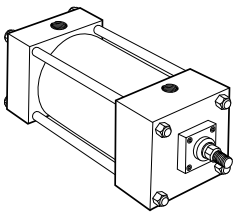
- Medium-Duty Service – ANSI/(NFPA) T3.6.7R2-1996 Specifications and Mounting Dimension Standards
- Standard Construction – Square Head – Tie Rod Design
- Nominal Pressure – 1000 PSI Dependent on Bore Size
- Standard Fluid – Hydraulic Oil
- Standard Temperature – -10° F. to +165°F.**
- Bore Sizes – 1" through 8"
- Piston Rod Diameters – 1/2" through 5 1/2"
- Mounting Styles – 18 standard styles at various application ratings
- Strokes – Available in any practical stroke length
- Cushions – Optional at either end or both ends of stroke. "Float Check" at cap end.
- Rod Ends – Three Standard Choices – Specials to Order

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

Mounting Styles and Ordering Notes

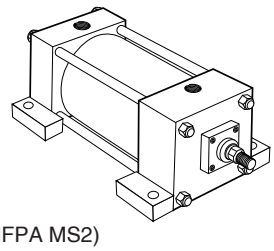
Available in all bore and rod combinations.

Side Tap
Model 74



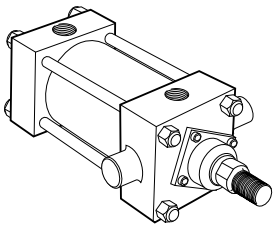
(NFPA MS4)

Side Lug
Model 72



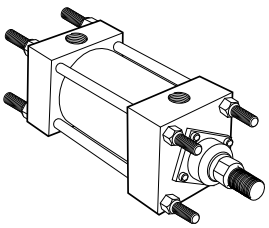
(NFPA MS2)

Trunnion Mounts
Head Model 81
Cap Model 82
Intermediate Model 83



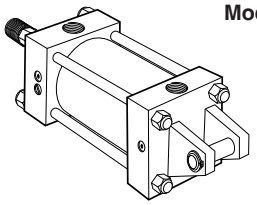
(HEAD NFPA MT1)
(CAP NFPA MT2)
(INTERMEDIATE NFPA MT4)

Tie Rods Extended
Both Ends Model 51
Cap End Model 52
Head End Model 53



(BOTH ENDS NFPA MX1)
(CAP END NFPA MX2)
(HEAD END NFPA MX3)

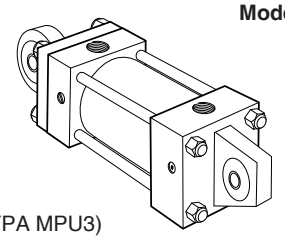
Cap Fixed Clevis
Model 84



Pivot Pin Included

(NFPA MP1)

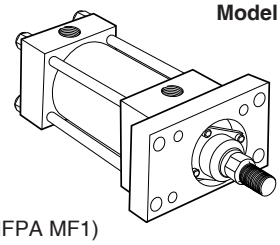
Cap Fixed Eye
with Spherical Bearing
Model 94



(NFPA MPU3)

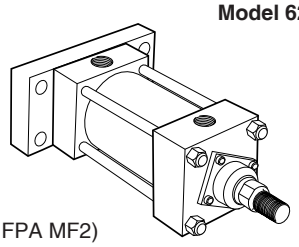
**Available in all bore and rod combinations through 6" bore.
8" bores supplied as Head Square (Model 63) and
Cap Square (Model 64) mounts.**

Head Rectangular Flange
Model 61



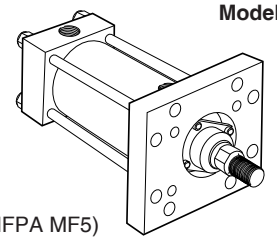
(NFPA MF1)

Cap Rectangular Flange
Model 62



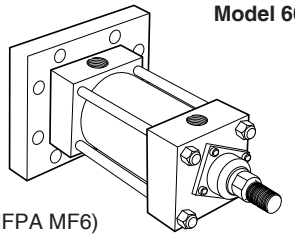
(NFPA MF2)

Head Square Flange
Model 65



(NFPA MF5)

Cap Square Flange
Model 66



(NFPA MF6)

Rod Bushing Construction

B = Bolted Bushing
R = Retainer Held Bushing

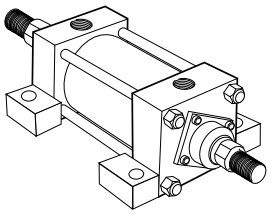
*61, 62, 65 and 66 not available in this bore size.

Note: See "How to Order" page for bushing retainer dimensions.

Bore	Rod Dia.	51, 52, 53, 62, 66, 72, 74, 81, 82, 84, 89, 94	61 65	63 64
1	1/2, 5/8	R	R	N/A
1 1/2	5/8	B	R	N/A
	1	R	R	N/A
2	5/8	B	B	N/A
	1	B	R	N/A
	1 3/8	R	R	N/A
2 1/2	5/8	B	B	N/A
	1	B	B	N/A
	1 3/8	R	R	N/A
	1 3/4	R	R	N/A
3 1/4	1	B	B	N/A
	1 3/8	B	B	N/A
	1 3/4, 2	B	R	N/A
4	1, 1 3/8	B	B	N/A
	1 3/4, 2	B	B	N/A
	2 1/2	B	R	N/A
5	1 - 2	B	B	N/A
	2 1/2	B	R	N/A
	3, 3 1/2	R	R	N/A
6	1 3/8 - 2 1/2	B	B	N/A
	3, 4	R	R	N/A
8*	1 3/8 - 4 1/2	B	N/A	B
	5, 5 1/2	B	N/A	B

Double End Construction

Available in all bore and rod combinations in the following models: 51, 53, 72, 74, 81, 89 and 61 (1"-6"). 65 (1"-6") and 63 (8").



Miller JV Series
Medium-Duty Hydraulic Cylinders

The inside story... Why JV Series is your best choice in medium-duty hydraulic cylinders.

Primary Seal – "Tuffseal" Special polyurethane seal is a proven leakproof design, which incorporates the pressure-compensated uni-directional characteristics of a "U CUP" with the multiple edge sealing effectiveness of compression-type stacked-packings.

Steel Head – Bored and grooved to provide concentricity for mating parts.

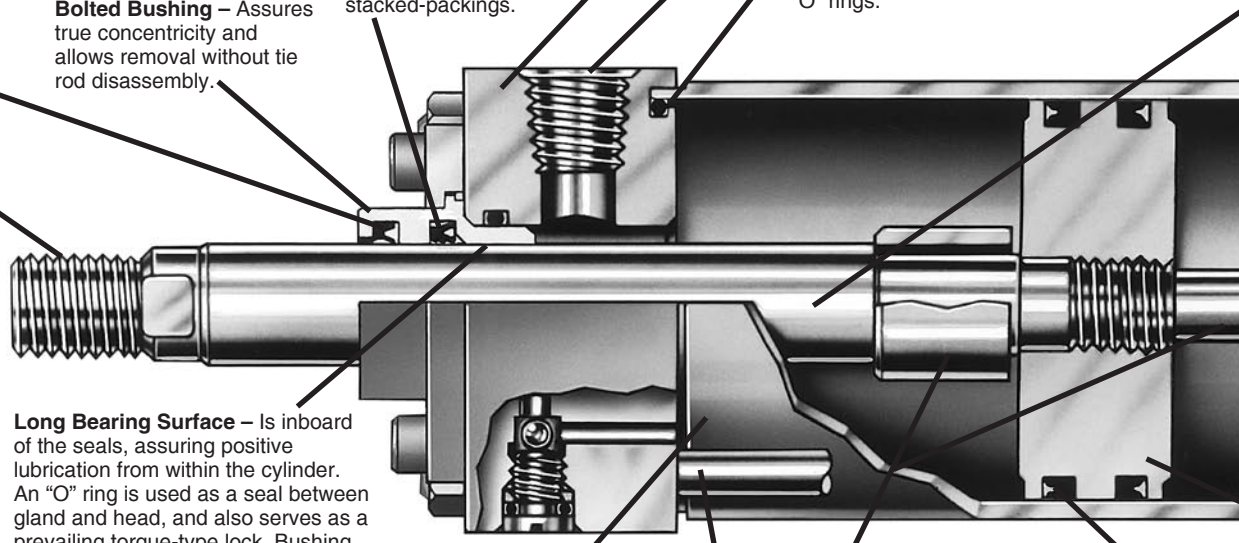
Ports – NPTF ports are standard. SAE ports available.

End Seals – Pressure-actuated cylinder body-to-head and cap "O" rings.

Secondary Seal – Double-Service Wiperseal™ – acts as a secondary pressure seal on the extend stroke and cleans the rod on the return stroke.

Bolted Bushing – Assures true concentricity and allows removal without tie rod disassembly.

Piston Rod Stud – Furnished on 2" diameter rods and smaller when standard style 2 rod end threads are required or on $1^{3}/_{8}$" diameter rods and smaller when style 5 threads are required. Also available in 2 times the catalog "A" dimension length. Studs have rolled threads and are made from high strength steel. Anaerobic adhesive is used to permanently lock the stud to the piston rod.

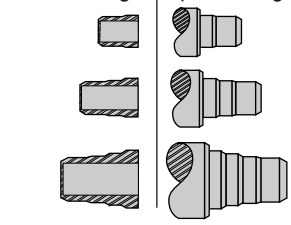


Long Bearing Surface – Is inboard of the seals, assuring positive lubrication from within the cylinder. An "O" ring is used as a seal between gland and head, and also serves as a prevailing torque-type lock. Bushing material is nodular iron with flash tin plating through $2^{1}/_{2}$" dia. rods. 3" and larger bushings are bronze.

The Cylinder Tube – Heavy-wall steel tubing, honed to a micro finish bore.

Adjustable Floating Cushions – Cushions are optional and can be supplied at head end, cap end, or both ends without change in envelope or mounting dimensions.

High Strength Tie Rods – Made from 100,000 psi minimum yield steel with rolled threads for added strength.



Optional Adjustable Floating Stepped Cushions

Adjustable Floating Stepped Cushions – Optional at extra charge. For faster cycle time and increased productivity – for maximum performance – economical and flexible for even the most demanding applications – reduces shock and machine noise – lower maintenance costs – can be supplied at head, cap or both ends.

Adjustable floating cushions

Cushions are optional, and can be supplied at head end, cap end, or both ends without change in envelope or mounting dimensions. Cushions are adjustable.

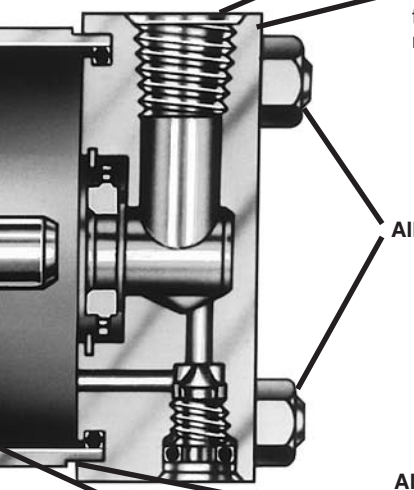
The JV Series cylinder design incorporates the longest cushion plungers that can be provided in the standard envelope without decreasing the rod bearing and piston bearing lengths.

(1) When a cushion is specified at the head end:
   a. A self-centering plunger is supplied on the piston rod assembly.
   b. A needle valve is provided that is flush with the side of the head when wide open. It may be identified by the fact that it is socket-keyed. It is located on side number 2 in all mountings except 81, 82, and 89. In these models it is located on side number 3.
   c. A springless check valve is provided that is also flush with the side of the head and is mounted on the face opposite the needle valve except on models 81, 82, and 89 where it is mounted next to the needle valve. It may be identified by the fact that it is slotted.
   d. The check and needle valves are interchangeable in the head.

(2) When a cushion is specified at the cap end:
   a. A cushion plunger is provided on the piston rod assembly.
   b. A "Float Check" self-centering bushing is provided which incorporates a large flow check valve for fast "out-stroke" action.
   c. A socket-keyed needle valve is provided that is flush with the side of the cap when wide open. It is located on side number 2 in all mountings except 81, 82, and 89. In these models it is located on side number 3.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Piston Rod – Medium carbon steel, induction case-hardened to 54Rc, hard chrome-plated and polished to 10 RMS finish. Piston rods are made from 90,000 to 100,000 psi minimum yield material in 1/2" through 4" diameters. Larger diameters vary between 57,000 and 90,000 psi minimum yield material, depending on rod diameter. The piston thread equals the catalog style #2 rod end thread for each rod diameter to assure proper piston-to-rod thread strength. Two wrench flats are provided for rod end attachment.



Ports – NPTF ports are standard. SAE ports available.

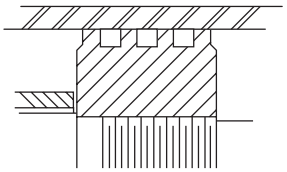
Steel Cap – Bored and grooved to provide concentricity for mating parts.

Alloy Steel Tie Rod Nuts

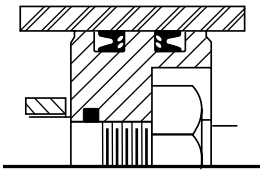
Align-A-Groove – A 3/16" wide surface machined at each end of the cylinder body. Makes precise mounting quick and easy.

One-Piece Nodular Iron Piston – The wide piston surface contacting cylinder bore reduces bearing loads. Anaerobic adhesive is used to permanently lock and seal the piston to the rod.

Piston Lipseal – Zero leakage under static conditions. Seals are self-compensating to conform to variations in pressure, mechanical deflection, and wear. Backup washers prevent extrusion.



Step Cut Iron Piston Rings are optional.



Piston with Retainer Nut – optional at extra charge.

Note: Threaded Rod Bushings are supplied on cylinders with rod diameters over 2 1/2".

Cushion Length

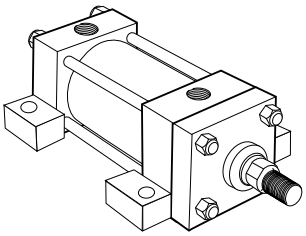
Cylinder Bore (Inches)	Rod Diameter* (Inches)	Cushion Length (Inches)	
		Head*	Cap
1	1/2	7/8	3/4
	5/8	7/8	3/4
1 1/2	5/8	7/8	13/16
	1	7/8	13/16
2	5/8	7/8	13/16
	1 3/8	7/8	13/16
2 1/2	1	7/8	13/16
	1 3/4	7/8	13/16
3 1/4	1	1 1/8	1
	2	13/16	1
4	1 3/8	1 1/8	1
	2 1/2	13/16	1

Cylinder Bore (Inches)	Rod Diameter* (Inches)	Cushion Length (Inches)	
		Head*	Cap
5	1 3/4	1 1/8	1
	3 1/2	13/16	1
6	1 3/4	1 3/8	1 1/4
	4	1 1/16	1 1/4
8	2	1 1/16	1 1/4
	5 1/2	15/16	1 1/4

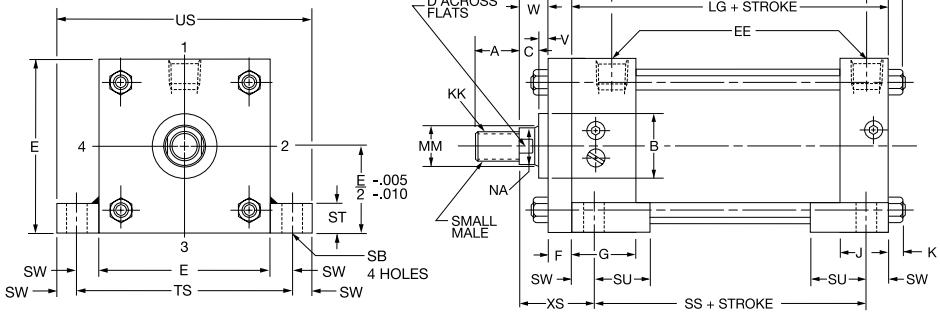
*Head end cushion for rod diameters not listed have cushion lengths within the limits shown.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Side Lug Mount
Model 72
1", 1 1/2", 2", 2 1/2", 5" and 6" Bore
With Maximum Oversize Rods

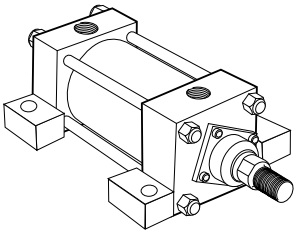


Retainer Held Bushing

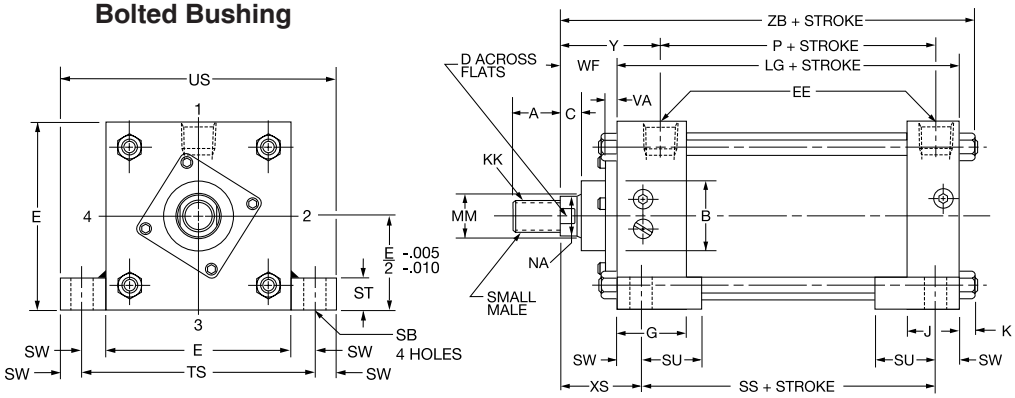


Before determining dimensions: See chart on page 3 for cylinder rod combinations that have removable bushings.

Side Lug Mount
Model 72
1 1/2" - 6" Bore



Bolted Bushing



Miller JV Series
Medium-Duty Hydraulic Cylinders

Side Lug Mount –
1" to 6" Bore Sizes

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF⊖	EE SAE★	F	G	J	K	LG	P	(Bolt) SB•	SS	ST	SU	SW	TS	US
1‡	■	1/4	6#	3/8	1 1/2	1	3/16	3 1/2	2 1/8	1/4	2 7/8	5/16	3/4	5/16	2 1/8	2 3/4
1 1/2	2	3/8†	6#	3/8	1 1/2	1	1/4	3 5/8	2 1/4	3/8	2 7/8	1/2	15/16	3/8	2 3/4	3 1/2
2	2 1/2	3/8†	6	3/8	1 1/2	1	5/16	3 5/8	2 1/4	3/8	2 7/8	1/2	15/16	3/8	3 1/4	4
2 1/2	3	3/8†	6	3/8	1 1/2	1	5/16	3 3/4	2 3/8	3/8	3	1/2	15/16	3/8	3 3/4	4 1/2
3 1/4	3 3/4	1/2	10	—	1 3/4	1 1/4	3/8	4 1/4	2 5/8	1/2	3 1/4	3/4	1 1/4	1/2	4 3/4	5 3/4
4	4 1/2	1/2	10	—	1 3/4	1 1/4	3/8	4 1/4	2 5/8	1/2	3 1/4	3/4	1 1/4	1/2	5 1/2	6 1/2
5	5 1/2	1/2	10	5/8	1 3/4	1 1/4	7/16	4 1/2	2 7/8	3/4	3 1/8	1	1 9/16	11/16	6 7/8	8 1/4
6	6 1/2	3/4	12	3/4	2	1 1/2	7/16	5	3 1/8	3/4	3 5/8	1	1 9/16	11/16	7 7/8	9 1/4

⊖ NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

★ SAE straight thread ports are indicated by port number.

†On 1 1/2", 2" and 2 1/2" bore sizes the head end (only) pipe thread is not full depth on cylinders with maximum oversize rods. Minimum of 3 full threads available.

■ 1" bore head is 1 3/4" x 1 1/2".

Straight thread ports. On 1 1/2" bore size an adapter fitting is required on cap end and on head end with maximum oversize rod. (See "Straight Thread Port Adapter" drawing.) Adapters are furnished as standard.

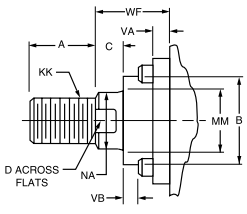
•Mounting holes are 1/16" larger than bolt size listed.

‡Cushion adjusting needle valve for 1" bore projects beyond sides of head and cap.

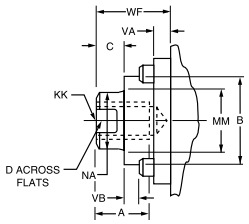
Bore	Rod Dia. MM	Thread Style 5 IM	Thread Style 2 & 4 KK	A	+.000 -.002 B	C	D	NA	V	VA	VB	W	WF	XS	Y	ZB
1	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	7/16	1/4	—	—	5/8	—	1 5/16	1 15/16	4 11/16
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4	—	—	5/8	—	1 5/16	1 15/16	4 11/16
1 1/2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	1 3/8	1 15/16	4 7/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2	—	—	1	—	1 3/4	2 5/16	5 1/4
2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	1 3/8	1 15/16	4 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2	2 9/16	5 9/16
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	1 3/4	2 5/16	5 5/16
2 1/2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	1 3/4	2 5/16	5 7/16
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	3/4	—	—	1 1/2	—	2 1/4	2 13/16	5 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2	2 9/16	5 11/16
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	1 3/8	1 15/16	5 1/16
3 1/4	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	1 7/8	2 7/16	6
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	2 1/2	3 1/16	6 5/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 1/8	2 11/16	6 1/4
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 3/8	2 15/16	6 1/2
4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 1/8	2 11/16	6 1/4
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	2 3/4	3 5/16	6 7/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 3/8	2 15/16	6 1/2
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	2 1/2	3 1/16	6 5/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	1 7/8	2 7/16	6
5	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 9/16	2 15/16	6 13/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	5/8	—	—	1 5/8	—	2 15/16	3 5/16	7 3/16
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	2 11/16	3 1/16	6 15/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	2 15/16	3 5/16	7 3/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	5/8	—	—	1 5/8	—	2 15/16	3 5/16	7 3/16
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 1/16	2 7/16	6 5/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 5/16	2 11/16	6 9/16
6	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 9/16	3 1/16	7 5/16
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	3 7/8	1/2	—	—	1 1/2	—	2 15/16	3 7/16	7 11/16
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	2 11/16	3 3/16	7 7/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	2 15/16	3 7/16	7 11/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	1/2	—	—	1 1/2	—	2 15/16	3 7/16	7 11/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	1/2	—	—	1 1/2	—	2 15/16	3 7/16	7 11/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	7/16	—	1 5/8	2 5/16	2 13/16	7 1/16

Rod End Dimensions — see table 2

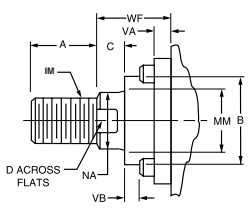
Thread Style 2
Small Male



Thread Style 4
Short Female



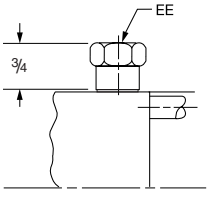
Thread Style 5
Intermediate Male



"Special" Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

Straight Thread Port Adapters
Used on 1 1/2" bore size only.

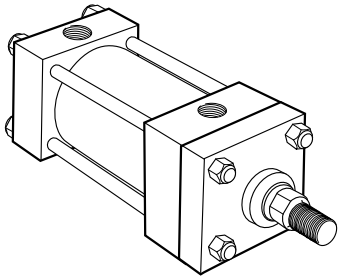


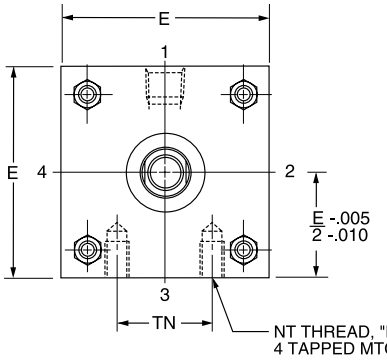
A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

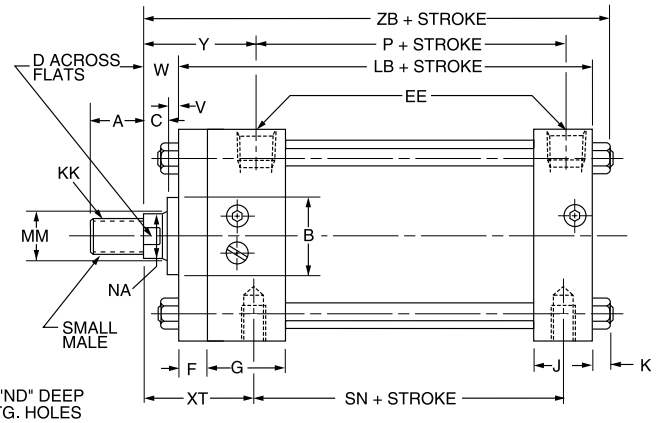
Miller JV Series
Medium-Duty Hydraulic Cylinders

Side Tap Mount
Model 74
1, 1 1/2", 2", 2 1/2", 5" and 6" Bore
With Maximum Oversize Rods

Retainer Held Bushing



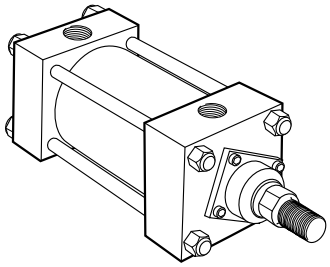


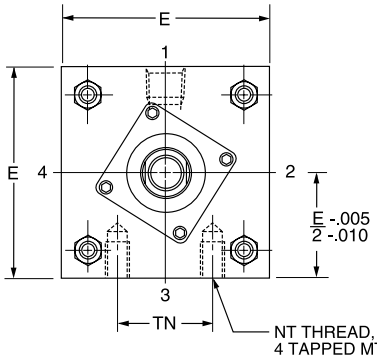


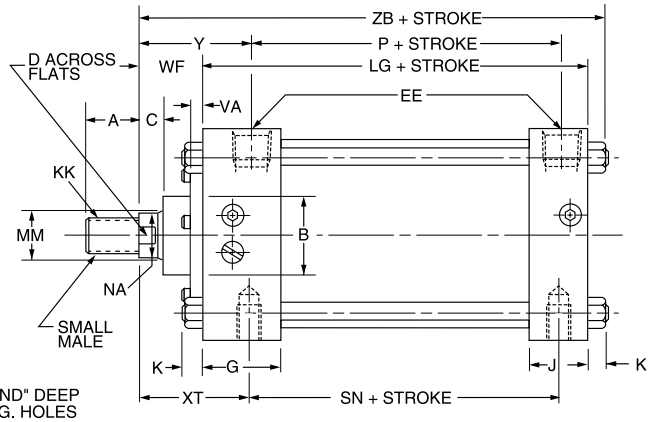
Before determining dimensions: See chart on page 3 for cylinder rod combinations that have removable bushings.

Side Tap Mount
Model 74
1 1/2" - 6" Bore

Bolted Bushing

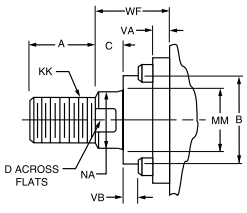




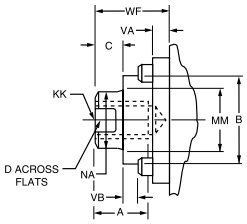


Rod End Dimensions — see table 2

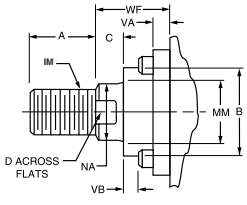
Thread Style 2
Small Male



Thread Style 4
Short Female



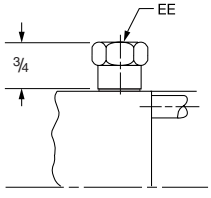
Thread Style 5
Intermediate Male



"Special" Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

Straight Thread Port Adapters
Used on 1 1/2" bore size only.



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Side Tap Mount
1" to 6" Bore Sizes

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF⊖	EE SAE*	F	G	J	K	LB	LG	NT	P	SN	TN
1‡	■	1/4	6#	3/8	1 1/2	1	3/16	3 7/8	—	10-24	2 1/8	2 1/8	9/16
1 1/2	2	3/8†	6#	3/8	1 1/2	1	1/4	4	3 5/8	1/4-20	2 1/4	2 1/4	5/8
2	2 1/2	3/8†	6	3/8	1 1/2	1	5/16	4	3 5/8	5/16-18	2 1/4	2 1/4	7/8
2 1/2	3	3/8†	6	3/8	1 1/2	1	5/16	4 1/8	3 3/4	3/8-16	2 3/8	2 3/8	1 1/4
3 1/4	3 3/4	1/2	10	–	1 3/4	1 1/4	3/8	–	4 1/4	1/2-13	2 5/8	2 5/8	1 1/2
4	4 1/2	1/2	10	–	1 3/4	1 1/4	3/8	–	4 1/4	1/2-13	2 5/8	2 5/8	2 1/16
5	5 1/2	1/2	10	5/8	1 3/4	1 1/4	7/16	5 1/8	4 1/2	5/8-11	2 7/8	2 7/8	2 11/16
6	6 1/2	3/4	12	3/4	2	1 1/2	7/16	–	5	3/4-10	3 1/8	3 1/8	3 1/4

⊖ NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

* SAE straight thread ports are indicated by port number.

‡Cushion adjusting needle valve for 1" bore projects beyond sides of head and cap.

■ 1" bore head is 1 3/4" x 1 1/2".

†On 1 1/2", 2" and 2 1/2" bore sizes the head end (only) pipe thread is not full depth on cylinders with maximum oversize rods. Minimum of 3 full threads available.

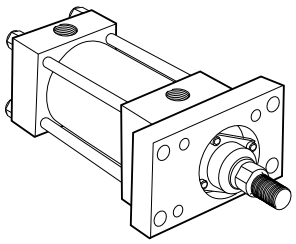
Straight thread ports. On 1 1/2" bore size an adapter fitting is required on cap end and on head end with maximum oversize rod. (See "Straight Thread Port Adapter" drawing.) Adapters are furnished as standard.

Table 2—Rod End Dimensions and Envelope Dimensions Affected by Rod Size

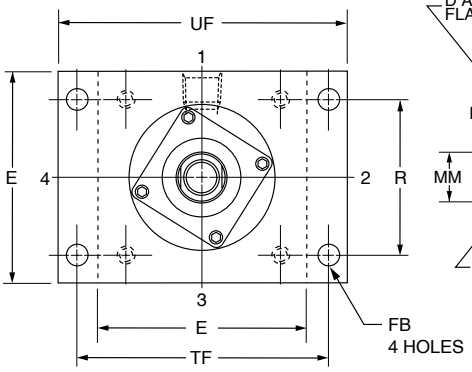
Bore	Rod Dia. MM	Thread Style 5 IM	Thread Style 2 & 4 KK	Rod End Dimensions and Envelope Dimensions Affected by Rod Size: A	+.000 -.002 B	C	D	NA	V	VA	VB	W	WF	XT	Y	ZB	ND
1	1/2	7/16-20	5/16-20	5/8	.999	3/8	3/8	7/16	1/4	—	—	5/8	—	1 15/16	1 15/16	4 11/16	1/4
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4	—	—	5/8	—	1 15/16	1 15/16	4 11/16	1/4
1 1/2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	1 15/16	1 15/16	4 7/8	3/16
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2	—	—	1	—	2 5/16	2 5/16	5 1/4	3/16
2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	1 15/16	1 5/16	4 15/16	11/32
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2 9/16	2 9/16	5 9/16	11/32
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 5/16	2 5/16	5 5/16	11/32
2 1/2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 5/16	2 5/16	5 7/16	7/16
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	3/4	—	—	1 1/2	—	2 13/16	2 13/16	5 15/16	7/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2 9/16	2 9/16	5 11/16	7/16
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	1 15/16	1 15/16	5 1/16	7/16
3 1/4	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 7/16	2 7/16	6	1/2
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3 1/16	3 1/16	6 5/8	1/2
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 11/16	2 11/16	6 1/4	1/2
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 15/16	2 15/16	6 1/2	1/2
4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 11/16	2 11/16	6 1/4	5/8
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	3 5/16	3 5/16	6 7/8	5/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 15/16	2 15/16	6 1/2	5/8
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3 1/16	3 1/16	6 5/8	5/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 7/16	2 7/16	6	5/8
5	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 15/16	2 15/16	6 13/16	3/4
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	5/8	—	—	1 5/8	—	3 5/16	3 5/16	7 3/16	3/4
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3 1/16	3 1/16	6 15/16	3/4
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	3 5/16	3 5/16	7 3/16	3/4
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	5/8	—	—	1 5/8	—	3 5/16	3 5/16	7 3/16	3/4
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 7/16	2 7/16	6 5/16	3/4
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 11/16	2 11/16	6 9/16	3/4
6	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	3 1/16	3 1/16	7 5/16	7/8
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	3 7/8	1/2	—	—	1 1/2	—	3 7/16	3 7/16	7 11/16	7/8
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3 3/16	3 3/16	7 7/16	7/8
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	3 7/16	3 7/16	7 11/16	7/8
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	1/2	—	—	1 1/2	—	3 7/16	3 7/16	7 11/16	7/8
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	1/2	—	—	1 1/2	—	3 7/16	3 7/16	7 11/16	7/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	7/16	—	1 5/8	2 13/16	2 13/16	7 1/16	7/8

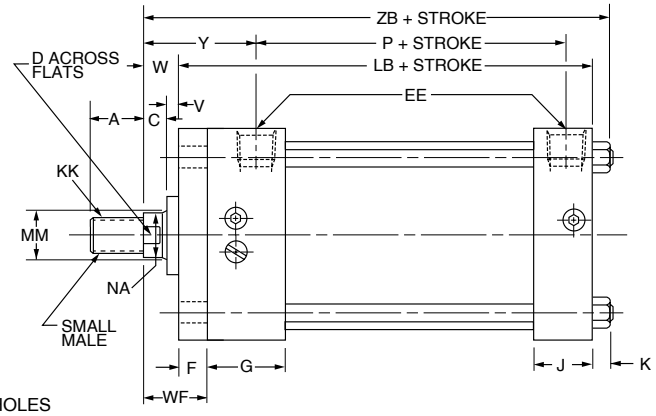
Miller JV Series
Medium-Duty Hydraulic Cylinders

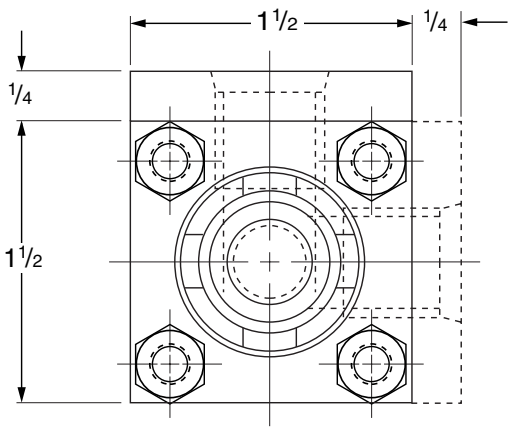
Head Rectangular Flange Mount
Model 61
1" - 6" Bore



Bolted Bushing







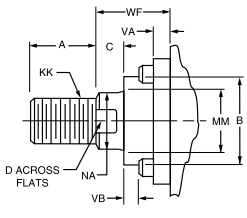
1" Bore Cylinder Only

Maximum Pressure Ratings
Push Application (Model 61 only)

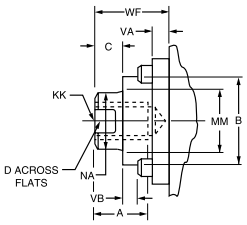
Bore Dia.	Rod Dia.	PSI	Bore Dia.	Rod Dia.	PSI
1	1/2	1900	4	1	900
	5/8	1500		1 3/8	750
1 1/2	5/8	1200		1 3/4	500
	1	700		2	500
2	5/8	450		2 1/2	600
	1	700	5	1	600
	1 3/8	400		1 3/8	600
2 1/2	5/8	500		1 3/4	500
	1	300		2	450
	1 3/8	500		2 1/2	600
	1 3/4	300		3	450
3 1/4	1	1000		3 1/2	400
	1 3/8	650	6	1 3/8	700
	1 3/4	1000		1 3/4	700
	2	800		2	700
				2 1/2	600
				3	600
				3 1/2	600
				4	450

Rod End Dimensions — see table 2

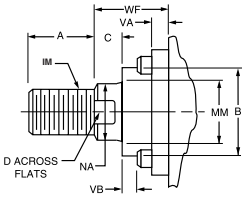
Thread Style 2
Small Male



Thread Style 4
Short Female



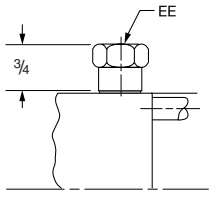
Thread Style 5
Intermediate Male



"Special" Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

Straight Thread Port Adapters
Used on 1 1/2" bore size only.



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Head Rectangular
Flange Mount
1" to 6" Bore Sizes

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF⊖	EE SAE★	F	(Bolt) FB	G	J	K	LB	P	R	TF	UF
1‡	1 1/2	1/4	6#	3/8	#10	1 1/2	1	3/16	3 7/8	2 1/8	1.08	2	2 1/2
1 1/2	2	3/8†	6#	3/8	1/4	1 1/2	1	1/4	4	2 1/4	1.43	2 3/4	3 3/8
2	2 1/2	3/8†	6	3/8	5/16	1 1/2	1	5/16	4	2 1/4	1.84	3 3/8	4 1/8
2 1/2	3	3/8†	6	3/8	5/16	1 1/2	1	5/16	4 1/8	2 3/8	2.19	3 7/8	4 5/8
3 1/4	3 3/4	1/2	10	5/8	3/8	1 3/4	1 1/4	3/8	4 7/8	2 5/8	2.76	4 11/16	5 1/2
4	4 1/2	1/2	10	5/8	3/8	1 3/4	1 1/4	3/8	4 7/8	2 5/8	3.32	5 7/16	6 1/4
5	5 1/2	1/2	10	5/8	1/2	1 3/4	1 1/4	7/16	5 1/8	2 7/8	4.10	6 5/8	7 5/8
6	6 1/2	3/4	12	3/4	1/2	2	1 1/2	7/16	5 3/4	3 1/8	4.88	7 5/8	8 5/8

⊖ NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

* SAE straight thread ports are indicated by port number.

‡Cushion adjusting needle valve for 1" bore projects beyond sides of head and cap.

■ 1" bore head is 1 3/4" x 1 1/2".

†On 1 1/2", 2" and 2 1/2" bore sizes the head end (only) pipe thread is not full depth on cylinders with maximum oversize rods. Minimum of 3 full threads available.

Straight thread ports on 1" bore size require an adapter fitting on the head end only. On 1 1/2" bore size an adapter fitting is required on cap end and on head end with maximum oversize rod. (See "Straight Thread Port Adapter" drawing.) Adapters are furnished as standard.

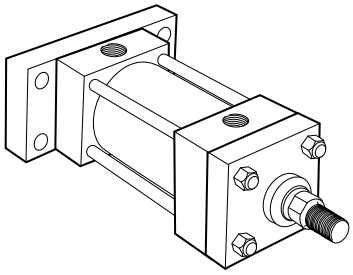
Note: Mounting holes are 1/16" larger than bolt size listed.

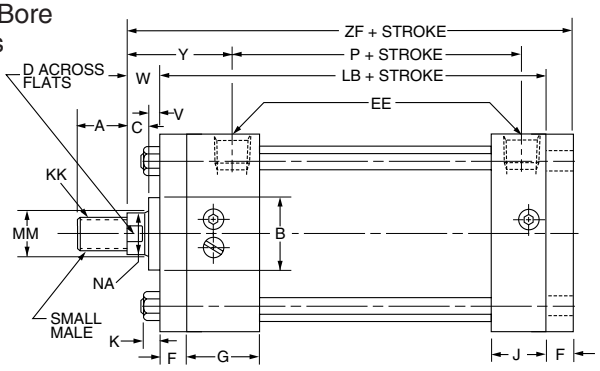
Table 2—Rod End Dimensions and Envelope Dimensions Affected by Rod Size

Bore	Rod Dia. MM	Thread Style 5 IM	Thread Style 2 & 4 KK	Rod Extensions and Envelope Dimensions Affected by Rod Size A	+.000 -.002 B	C	D	NA	V	W	Y	ZB
1	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	7/16	1/4	5/8	1 15/16	4 11/16
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4	5/8	1 15/16	4 11/16
1 1/2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4	5/8	1 15/16	4 7/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2	1	2 5/16	5 1/4
2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4	5/8	1 15/16	4 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	1 1/4	2 9/16	5 9/16
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2	1	2 5/16	5 5/16
2 1/2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2	1	2 5/16	5 7/16
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	3/4	1 1/2	2 13/16	5 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	1 1/4	2 9/16	5 11/16
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4	5/8	1 15/16	5 1/16
3 1/4	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/4	3/4	2 7/16	6
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	1/2	1 3/8	3 1/16	6 5/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	3/8	1	2 11/16	6 1/4
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	1/2	1 1/4	2 15/16	6 1/2
4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	3/8	1	2 11/16	6 1/4
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	5/8	1 5/8	3 5/16	6 7/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	1/2	1 1/4	2 15/16	6 1/2
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	1/2	1 3/8	3 1/16	6 5/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/4	3/4	2 7/16	6
5	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	1/2	1 1/4	2 15/16	6 13/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	5/8	1 5/8	3 5/16	7 3/16
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	1/2	1 3/8	3 1/16	6 15/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	5/8	1 5/8	3 5/16	7 3/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	5/8	1 5/8	3 5/16	7 3/16
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/4	3/4	2 7/16	6 5/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	3/8	1	2 11/16	6 9/16
6	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	3/8	1 1/8	3 1/16	7 5/16
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	3 7/8	1/2	1 1/2	3 7/16	7 11/16
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	3/8	1 1/4	3 3/16	7 7/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	1/2	1 1/2	3 7/16	7 11/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	1/2	1 1/2	3 7/16	7 11/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	1/2	1 1/2	3 7/16	7 11/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	1/4	7/8	2 13/16	7 1/16

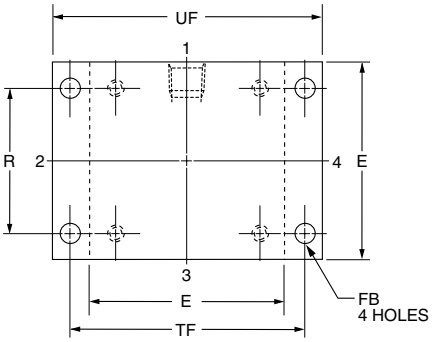
Miller JV Series
Medium-Duty Hydraulic Cylinders

Cap Rectangular Flange Mount
Model 62
1, 1 1/2", 2", 2 1/2", 5" and 6" Bore
With Maximum Oversize Rods



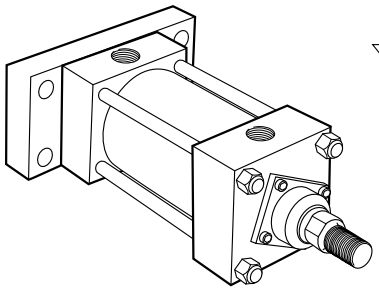


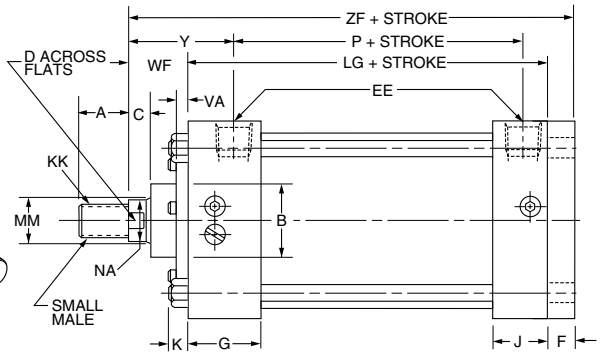
Retainer Held Bushing



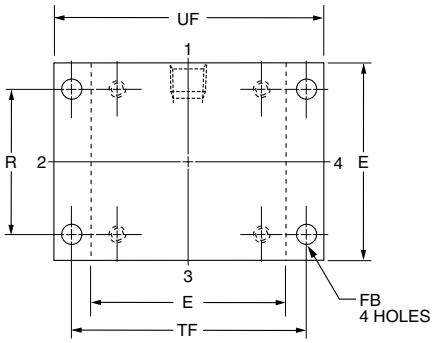
Before determining dimensions: See chart on page 3 for cylinder rod combinations that have removable bushings.

Cap Rectangular Flange Mount
Model 62
1 1/2" - 6" Bore



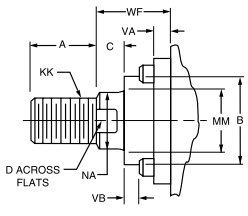


Bolted Bushing

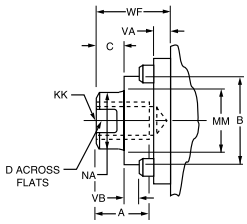


Rod End Dimensions — see table 2

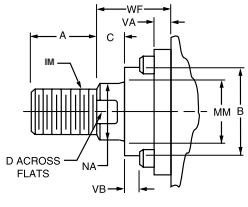
Thread Style 2
Small Male



Thread Style 4
Short Female



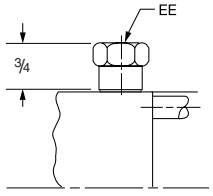
Thread Style 5
Intermediate Male



"Special" Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

Straight Thread Port Adapters
Used on 1 1/2" bore size only.



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Cap Rectangular
Flange Mount
1" to 6" Bore Sizes

Table 1—Envelope and Mounting Dimensions

Bore	E	EE		F	(Bolt) FB	G	J	K	LB	LG	P	R	TF	UF
		NPTF⊖	SAE*											
1‡	■	1/4	6#	3/8	#10	1 1/2	1	3/16	3 7/8	–	2 1/8	1.08	2	2 1/2
1 1/2	2	3/8†	6#	3/8	1/4	1 1/2	1	1/4	4	3 5/8	2 1/4	1.43	2 3/4	3 3/8
2	2 1/2	3/8†	6	3/8	5/16	1 1/2	1	5/16	4	3 5/8	2 1/4	1.84	3 3/8	4 1/8
2 1/2	3	3/8†	6	3/8	5/16	1 1/2	1	5/16	4 1/8	3 3/4	2 3/8	2.19	3 7/8	4 5/8
3 1/4	3 3/4	1/2	10	5/8	3/8	1 3/4	1 1/4	3/8	–	4 1/4	2 5/8	2.76	4 11/16	5 1/2
4	4	1/2	10	5/8	3/8	1 3/4	1 1/4	3/8	–	4 1/4	2 5/8	3.32	5 7/16	6 1/4
5	5 1/2	1/2	10	5/8	1/2	1 3/4	1 1/4	7/16	5 1/8	4 1/2	2 7/8	4.10	6 5/8	7 5/8
6	6 1/2	3/4	12	3/4	1/2	2	1 1/2	7/16	5 3/4	5	3 1/8	4.88	7 5/8	8 5/8

⊖ NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

* SAE straight thread ports are indicated by port number.

■ 1" bore heads and caps are 1 3/4" x 1 1/2".

†On 1", 1 1/2", 2" and 2 1/2" bore sizes the head end (only) pipe thread is not full depth on cylinders with maximum oversize rods. Minimum of 3 full threads available.

‡Cushion adjusting needle valve for 1" bore projects beyond sides of head and cap.

Straight thread ports. On 1 1/2" bore size an adapter fitting is required on cap end and on head end with maximum oversize rod. (See "Straight Thread Port Adapter" drawing.) Adapters are furnished as standard.

Note: Mounting holes are 1/16" larger than bolt size listed.

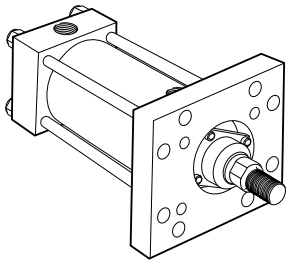
Table 2—Rod End Dimensions and Envelope Dimensions Affected by Rod Size

Bore	Rod Dia. MM	Thread		Rod End Dimensions and Envelope Dimensions Affected by Rod Size											
		Style 5 IM	Style 2 & 4 KK	A	+.000 -.002 B	C	D	NA	V	VA	VB	W	WF	Y	ZF
1	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	7/16	1/4	—	—	5/8	—	1 15/16	4 7/8
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4	—	—	5/8	—	1 15/16	4 7/8
1 1/2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	1 15/16	5
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2	—	—	1	—	2 5/16	5 3/8
2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	1 15/16	5
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2 9/16	5 5/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 5/16	5 3/8
2 1/2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 5/16	5 1/2
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	3/4	—	—	1 1/2	—	2 13/16	6
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2 9/16	5 3/4
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	1 15/16	5 1/8
3 1/4	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 7/16	6 1/4
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3 1/16	6 7/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 11/16	6 1/2
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 15/16	6 3/4
4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 11/16	6 1/2
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	3 5/16	7 1/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 15/16	6 3/4
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3 1/16	6 7/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 7/16	6 1/4
5	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 15/16	7
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	5/8	—	—	1 5/8	—	3 5/16	7 3/8
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3 1/16	7 1/8
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	3 5/16	7 3/8
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	5/8	—	—	1 5/8	—	3 5/16	7 3/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 7/16	6 1/2
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 11/16	6 3/4
6	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	3 1/16	7 5/8
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	3 7/8	1/2	—	—	1 1/2	—	3 7/16	8
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3 3/16	7 3/4
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	3 7/16	8
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	1/2	—	—	1 1/2	—	3 7/16	8
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	1/2	—	—	1 1/2	—	3 7/16	8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	7/16	—	1 5/8	2 13/16	7 3/8

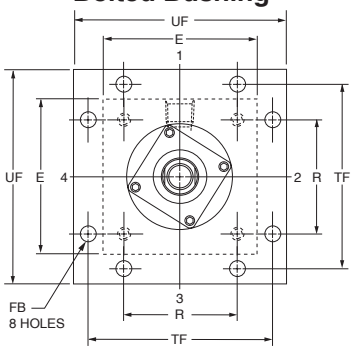
Miller JV Series
Medium-Duty Hydraulic Cylinders

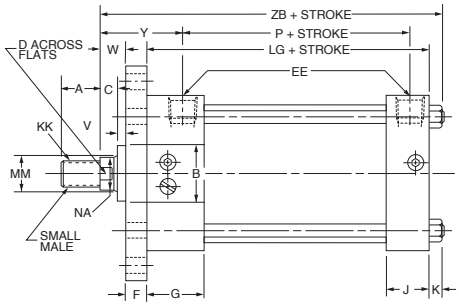
Head Square Flange Mount
Cap Square Flange Mount
1" to 6" Bore Sizes

Head Square Flange Mount
Model 65
1" - 6" Bore



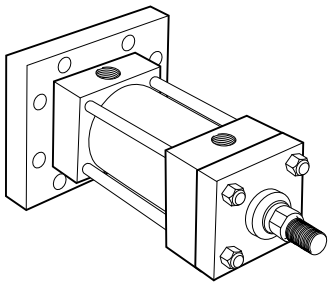
Bolted Bushing

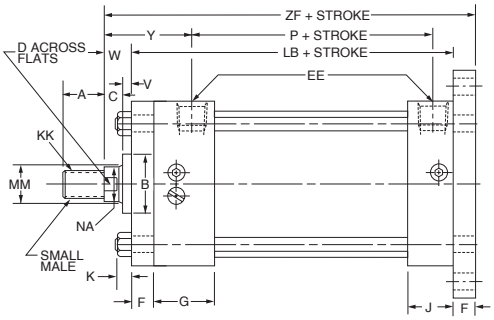




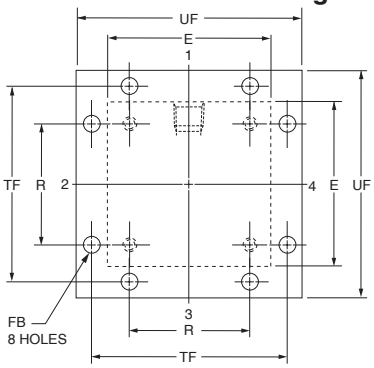
Before determining dimensions: See chart on page 3 for cylinder rod combinations that have removable bushings.

Cap Square Flange Mount
Model 66
1", 1 1/2", 2", 2 1/2", 5" and 6" Bore
With Maximum Oversize Rods

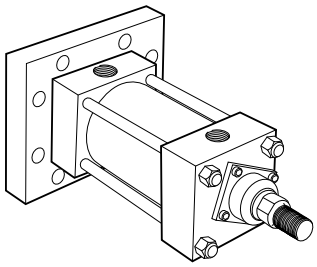


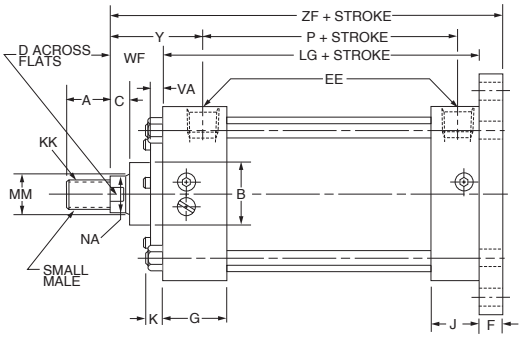


Retainer Held Bushing

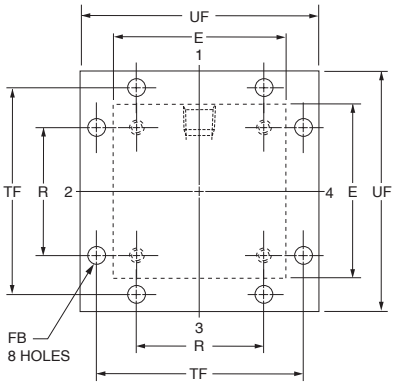


Cap Square Flange Mount
Model 66
1 1/2" - 6" Bore



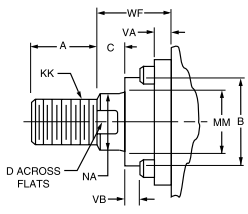


Bolted Bushing

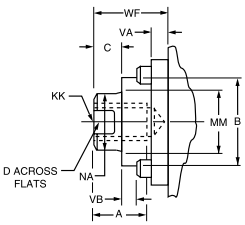


Rod End Dimensions — see table 2

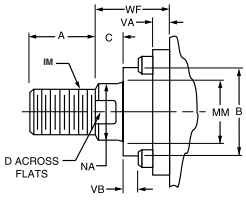
Thread Style 2
Small Male



Thread Style 4
Short Female



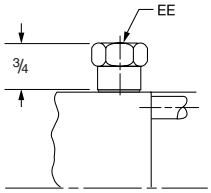
Thread Style 5
Intermediate Male



"Special" Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

Straight Thread Port Adapters
Used on 1 1/2" bore size only.



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Head Square Flange Mount
Cap Square Flange Mount
1" to 6" Bore Sizes

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF⊖	EE SAE*	F	(Bolt) FB	G	J	K	LB	LG	P	R	TF	UF
1‡	■	1/4	6#	3/8	#10	1 1/2	1	3/16	3 7/8	–	2 1/8	1.08	2	2 1/2
1 1/2	2	3/8†	6#	3/8	1/4	1 1/2	1	1/4	4	3 5/8	2 1/4	1.43	2 3/4	3 3/8
2	2 1/2	3/8†	6	3/8	5/16	1 1/2	1	5/16	4	3 5/8	2 1/4	1.84	3 3/8	4 1/8
2 1/2	3	3/8†	6	3/8	5/16	1 1/2	1	5/16	4 1/8	3 3/4	2 3/8	2.19	3 7/8	4 5/8
3 1/4	3 3/4	1/2	10	5/8	3/8	1 3/4	1 1/4	3/8	4 7/8	4 1/4	2 5/8	2.76	4 11/16	5 1/2
4	4 1/2	1/2	10	5/8	3/8	1 3/4	1 1/4	3/8	4 7/8	4 1/4	2 5/8	3.32	5 7/16	6 1/4
5	5 1/2	1/2	10	5/8	1/2	1 3/4	1 1/4	7/16	5 1/8	4 1/2	2 7/8	4.10	6 5/8	7 5/8
6	6 1/2	3/4	12	3/4	1/2	2	1 1/2	7/16	5 3/4	5	3 1/8	4.88	7 5/8	8 5/8

⊖ NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

* SAE straight thread ports are indicated by port number.

■ 1" bore head is 1 3/4" x 1 1/2".

†On 1 1/2", 2" and 2 1/2" bore sizes the head end (only) pipe thread is not full depth on cylinders with maximum oversize rods. Minimum of 3 full threads available.

‡Cushion adjusting needle valve for 1" bore projects beyond sides of head and cap.

Straight thread ports. On 1 1/2" bore size an adapter fitting is required on cap end and on head end with maximum oversize rod. (See "Straight Thread Port Adapter" drawing.) Adapters are furnished as standard.

Note: Mounting holes are 1/16" larger than bolt size listed.

Table 2—Rod End Dimensions and Envelope Dimensions Affected by Rod Size

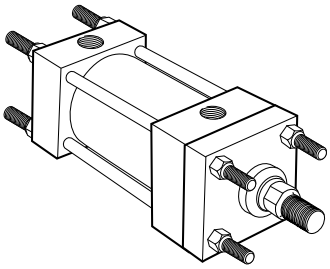
Bore	Rod Dia. MM	Thread Style 5 IM	Thread Style 2 & 4 KK	A	+.000 -.002 B	C	D	NA	V	VA	VB	W	WF	Y	ZB	ZF
1	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	7/16	1/4	—	—	5/8	—	1 15/16	4 11/16	4 7/8
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4	—	—	5/8	—	1 15/16	4 11/16	4 7/8
1 1/2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4*	1/4	3/16	5/8	1	1 15/16	4 7/8	5
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2	—	—	1	—	2 5/16	5 1/4	5 3/8
2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4*	1/4	3/16	5/8	1	1 15/16	4 15/16	5
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2 9/16	5 9/16	5 5/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2*	1/4	3/8	1	1 3/8	2 5/16	5 5/16	5 3/8
2 1/2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2*	1/4	3/8	1	1 3/8	2 5/16	5 7/16	5 1/2
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	3/4	—	—	1 1/2	—	2 13/16	5 15/16	6
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2 9/16	5 11/16	5 3/4
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4*	1/4	3/16	5/8	1	1 15/16	5 1/16	5 1/8
3 1/4	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/4*	1/4	3/8	3/4	1 3/8	2 7/16	6	6 1/4
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	1/2*	1/4	9/16	1 3/8	2	3 1/16	6 5/8	6 7/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	3/8*	1/4	1/2	1	1 5/8	2 11/16	6 1/4	6 1/2
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	1/2*	1/4	9/16	1 1/4	1 7/8	2 15/16	6 1/2	6 3/4
4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	3/8*	1/4	1/2	1	1 5/8	2 11/16	6 1/4	6 1/2
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	5/8*	1/4	11/16	1 5/8	2 1/4	3 5/16	6 7/8	7 1/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	1/2*	1/4	9/16	1 1/4	1 7/8	2 15/16	6 1/2	6 3/4
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	1/2*	1/4	9/16	1 3/8	2	3 1/16	6 5/8	6 7/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/4*	1/4	3/8	3/4	1 3/8	2 7/16	6	6 1/4
5	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	1/2*	1/4	9/16	1 1/4	1 7/8	2 15/16	6 13/16	7
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	5/8	—	—	1 5/8	—	3 5/16	7 3/16	7 3/8
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	1/2*	1/4	9/16	1 3/8	2	3 1/16	6 15/16	7 1/8
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	5/8*	1/4	11/16	1 5/8	2 1/4	3 5/16	7 3/16	7 3/8
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	5/8	—	—	1 5/8	—	3 5/16	7 3/16	7 3/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/4*	1/4	3/8	3/4	1 3/8	2 7/16	6 5/16	6 1/2
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	3/8*	1/4	1/2	1	1 5/8	2 11/16	6 9/16	6 3/4
6	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	3/8*	1/4	9/16	1 1/8	1 7/8	3 1/16	7 5/16	7 5/8
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	3 7/8	3/8	—	—	1 1/2	—	3 7/16	7 11/16	8
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	1/2*	1/4	9/16	1 1/4	2	3 3/16	7 7/16	7 3/4
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	1/2*	1/4	11/16	1 1/2	2 1/4	3 7/16	7 11/16	8
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	1/2	—	—	1 1/2	—	3 7/16	7 11/16	8
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	1/2	—	—	1 1/2	—	3 7/16	7 11/16	8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	1/4*	1/4	7/16	7/8	1 5/8	2 13/16	7 1/16	7 3/8

*For all Model 65 and Model 66 with max. oversized rods.

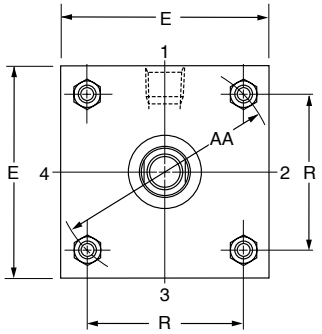
Miller JV Series
Medium-Duty Hydraulic Cylinders

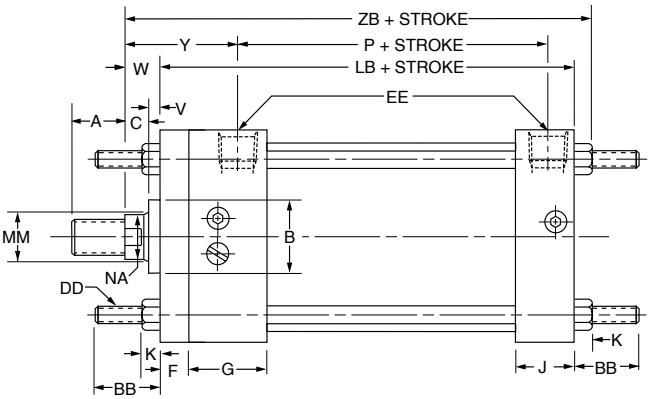
Tie Rods Extended Both Ends Mount

Model 51
1", 1 1/2", 2", 2 1/2", 5" and 6" Bore
With Maximum Oversize Rods



Retainer Held Bushing



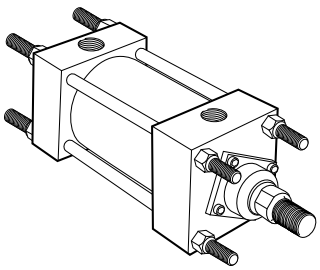


Tie rods can be extended:
Both Ends — Model 51
Cap End — Model 52
Head End — Model 53
All tie rod models can be dimensioned from Model 51 drawings shown.

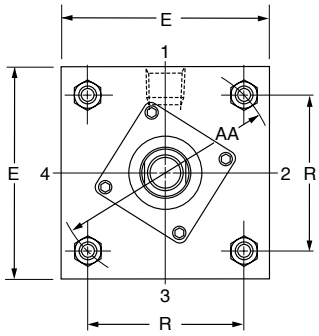
Before determining dimensions: See chart on page 3 for cylinder rod combinations that have removable bushings.

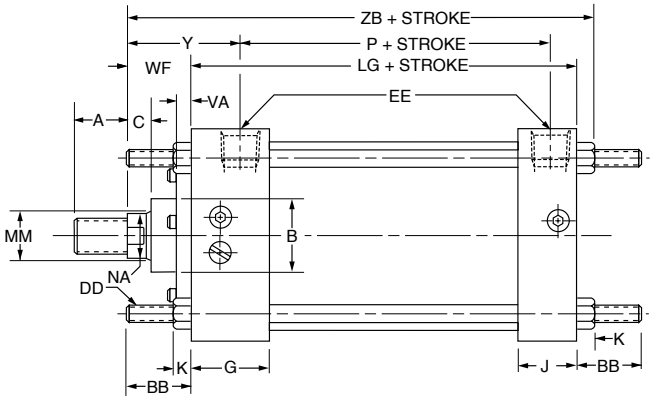
Tie Rods Extended Both Ends Mount

Model 51
1 1/2" - 6" Bore



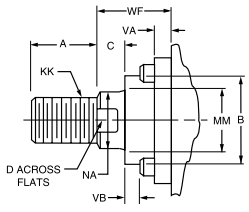
Bolted Bushing



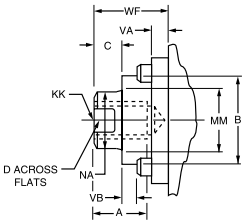


Rod End Dimensions — see table 2

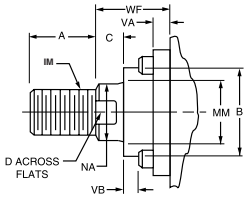
Thread Style 2
Small Male



Thread Style 4
Short Female



Thread Style 5
Intermediate Male



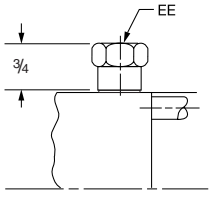
"Special" Thread Style X

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

Straight Thread Port Adapters

Used on 1 1/2" bore size only.



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Tie Rods Extended Mountings
1" to 6" Bore Sizes

Table 1—Envelope and Mounting Dimensions

Bore	AA	BB	DD	E	EE NPTF⊖	EE SAE*	F	G	J	K	LB	LG	P	R
1‡	1.53	3/4	10-24	■	1/4	6#	3/8	1 1/2	1	3/16	3 7/8	3 1/2	2 1/8	1.08
1 1/2	2.02	1	1/4-28	2	3/8†	6#	3/8	1 1/2	1	1/4	4	3 5/8	2 1/4	1.43
2	2.6	1 1/8	5/16-24	2 1/2	3/8†	6	3/8	1 1/2	1	5/16	4	3 5/8	2 1/4	1.84
2 1/2	3.1	1 1/8	5/16-24	3	3/8†	6	3/8	1 1/2	1	5/16	4 1/8	3 3/4	2 3/8	2.19
3 1/4	3.9	1 3/8	3/8-24	3 3/4	1/2	10	—	1 3/4	1 1/4	3/8	4 7/8	4 1/4	2 5/8	2.76
4	4.7	1 3/8	3/8-24	4 1/2	1/2	10	—	1 3/4	1 1/4	3/8	4 7/8	4 1/4	2 5/8	3.32
5	5.8	1 13/16	1/2-20	5 1/2	1/2	10	5/8	1 3/4	1 1/4	7/16	5 1/8	4 1/2	2 7/8	4.10
6	6.9	1 13/16	1/2-20	6 1/2	3/4	12	3/4	2	1 1/2	7/16	5 3/4	5	3 1/8	4.88

⊖ NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

* SAE straight thread ports are indicated by port number.

■ 1" bore head is 1 3/4" x 1 1/2".

†On 1", 1 1/2", 2" and 2 1/2" bore sizes the head end (only) pipe thread is not full depth on cylinders with maximum oversize rods. Minimum of 3 full threads available.

‡Cushion adjusting needle valve for 1" bore projects beyond sides of head and cap.

Straight thread ports. On 1 1/2" bore size an adapter fitting is required on cap end and on head end with maximum oversize rod. (See "Straight Thread Port Adapter" drawing.) Adapters are furnished as standard.

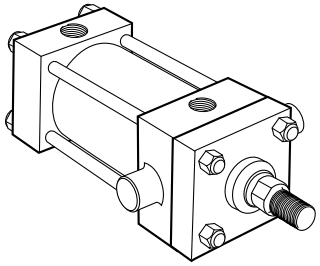
Table 2—Rod End Dimensions and Envelope Dimensions Affected by Rod Size

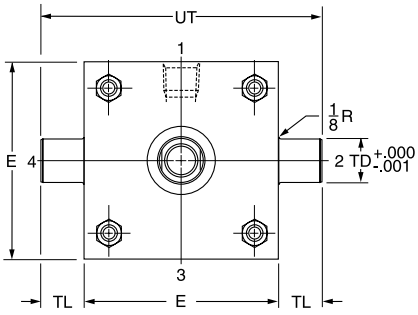
Bore	Rod Dia. MM	Thread Style 5 IM	Thread Style 2 & 4 KK	A	+.000 -.002 B	BF	C	D	NA	V	VA	VB	W	WF	Y	ZB
1	1/2	7/16-20	5/16-24	5/8	.999	—	3/8	3/8	7/16	1/4	—	—	5/8	—	1 15/16	4 11/16
	5/8	1/2-20	7/16-20	3/4	1.124	—	3/8	1/2	9/16	1/4	—	—	5/8	—	1 15/16	4 11/16
1 1/2	5/8	1/2-20	7/16-20	3/4	1.124	1.968	3/8	1/2	9/16	—	1/4	3/16	—	1	1 15/16	4 7/8
	1	7/8-14	3/4-16	1 1/8	1.499	—	1/2	7/8	15/16	1/2	—	—	1	—	2 5/16	5 1/4
2	5/8	1/2-20	7/16-20	3/4	1.124	1.968	3/8	1/2	9/16	—	1/4	3/16	—	1	1 15/16	4 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	—	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2 9/16	5 9/16
	1	7/8-14	3/4-16	1 1/8	1.499	2.468	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 5/16	5 5/16
2 1/2	1	7/8-14	3/4-16	1 1/8	1.499	2.468	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 5/16	5 7/16
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	—	3/4	1 1/2	1 11/16	3/4	—	—	1 1/2	—	2 13/16	5 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	2.968	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2 9/16	5 11/16
	5/8	1/2-20	7/16-20	3/4	1.124	2.468	3/8	1/2	9/16	—	1/4	3/16	—	1	1 5/16	5 1/16
3 1/4	1	7/8-14	3/4-16	1 1/8	1.499	2.968	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 7/16	6
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	3.735	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3 1/16	6 5/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	2.968	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 11/16	6 1/4
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3.735	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 15/16	6 1/2
4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	2.968	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 11/16	6 1/4
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	4.312	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	3 5/16	6 7/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3.735	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 15/16	6 1/2
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	3.735	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3 1/16	6 5/8
	1	7/8-14	3/4-16	1 1/8	1.499	2.968	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 7/16	6
5	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3.735	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 15/16	6 13/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	5.562	1	3	3 3/8	5/8	—	—	1 5/8	—	3 5/16	7 3/16
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	3.735	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3 1/16	6 15/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	5.000	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	3 5/16	7 3/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	5.000	1	2 5/8	2 7/8	5/8	—	—	1 5/8	—	3 5/16	7 3/16
	1	7/8-14	3/4-16	1 1/8	1.499	2.968	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 7/16	6 5/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	2.968	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 11/16	6 9/16
6	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3.625	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	3 1/16	7 5/16
	4	3 3/4-12	3-12	4	4.749	6.062	1	3 3/8	3 7/8	1/2	—	—	1 1/2	—	3 7/16	7 11/16
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	4.312	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3 3/16	7 7/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	4.312	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	3 7/16	7 11/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	5.562	1	2 5/8	2 7/8	1/2	—	—	1 1/2	—	3 7/16	7 11/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	5.562	1	3	3 3/8	1/2	—	—	1 1/2	—	3 7/16	7 11/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	3.625	5/8	1 1/8	1 5/16	—	1/4	7/16	—	1 5/8	2 13/16	7 1/16

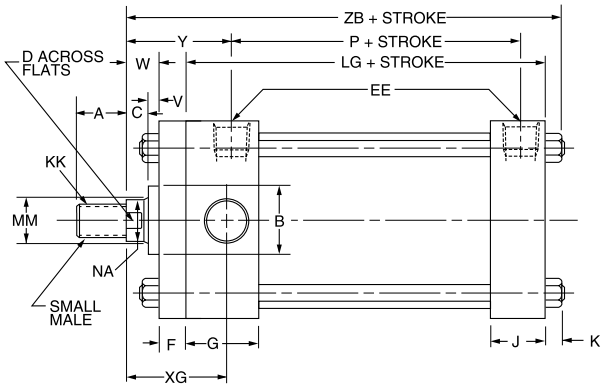
Miller JV Series
Medium-Duty Hydraulic Cylinders

Head Trunnion Mount
Model 81
1", 1 1/2", 2", 2 1/2", 5" and 6" Bore
With Maximum Oversize Rods

Retainer Held Bushing



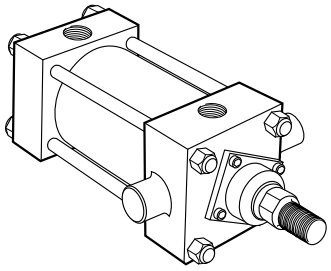


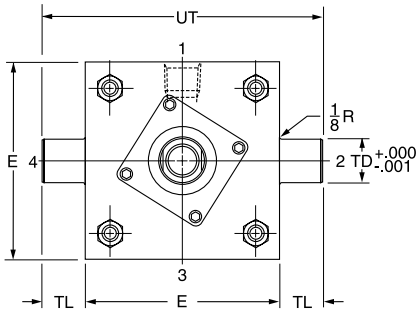


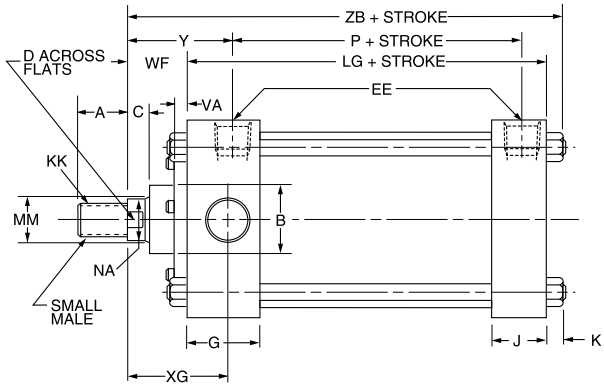
Before determining dimensions: See chart on page 3 for cylinder rod combinations that have removable bushings.

Head Trunnion Mount
Model 81
1 1/2" - 6" Bore

Bolted Bushing

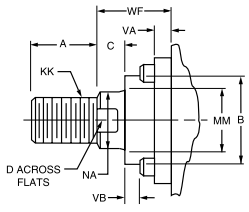




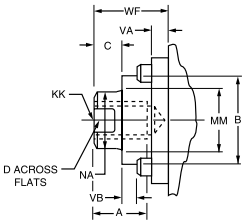


Rod End Dimensions — see table 2

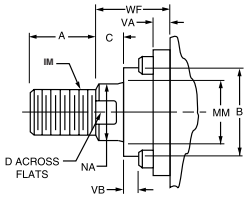
Thread Style 2
Small Male



Thread Style 4
Short Female



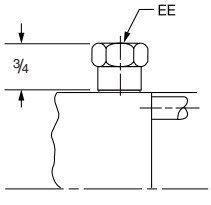
Thread Style 5
Intermediate Male



"Special" Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

Straight Thread Port Adapters
Used on 1 1/2" bore size only.



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Head Trunnion Mount
1" to 6" Bore Sizes

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF⊖	EE SAE*	F	G	J	K	LG	P	+.000 TD -.001	TL	UT
1‡	■	1/4	6#	3/8	1 1/2	1	3/16	3 1/2	2 1/8	.750	3/4	3
1 1/2	2	3/8†	6#	3/8	1 1/2	1	1/4	3 5/8	2 1/4	1.000	1	4
2	2 1/2	3/8†	6	3/8	1 1/2	1	5/16	3 5/8	2 1/4	1.000	1	4 1/2
2 1/2	3	3/8†	6	3/8	1 1/2	1	5/16	3 3/4	2 3/8	1.000	1	5
3 1/4	3 3/4	1/2	10	–	1 3/4	1 1/4	3/8	4 1/4	2 5/8	1.000	1	5 3/4
4	4 1/2	1/2	10	–	1 3/4	1 1/4	3/8	4 1/4	2 5/8	1.000	1	6 1/2
5	5 1/2	1/2	10	5/8	1 3/4	1 1/4	7/16	4 1/2	2 7/8	1.000	1	7 1/2
6	6 1/2	3/4	12	3/4	2	1 1/2	7/16	5	3 1/8	1.375	1 3/8	9 1/4

⊖ NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

* SAE straight thread ports are indicated by port number.

■1" bore head is 1 3/4" x 1 1/2".

†On 1 1/2", 2" and 2 1/2" bore sizes the head end (only) pipe thread is not full depth on cylinders with maximum oversize rods. Minimum of 3 full threads available.

‡Cushion adjusting needle valve for 1" bore projects beyond sides of head and cap.

Straight thread ports. On 1 1/2" bore size an adapter fitting is required on cap end and on head end with maximum oversize rod. (See "Straight Thread Port Adapter" drawing.) Adapters are furnished as standard.

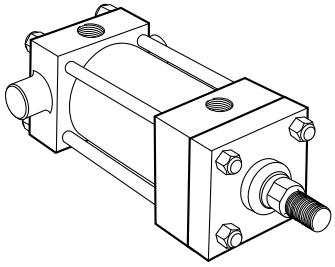
Table 2—Rod End Dimensions and Envelope Dimensions Affected by Rod Size

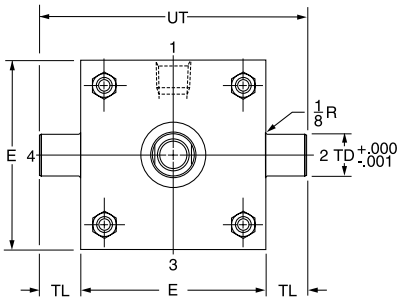
Bore	Rod Dia. MM	Thread Style 5 IM	Thread Style 2 & 4 KK	A	+.000 -.002 B	C	D	NA	V	VA	VB	W	WF	XG	Y	ZB
1	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	7/16	1/4	—	—	5/8	—	1 3/4	1 15/16	4 11/16
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4	—	—	5/8	—	1 3/4	1 15/16	4 11/16
1 1/2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	1 3/4	1 15/16	4 7/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2	—	—	1	—	2 1/8	2 5/16	5 1/4
2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	1 3/4	1 15/16	4 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2 3/8	2 9/16	5 9/16
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 1/8	2 5/16	5 5/16
2 1/2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 1/8	2 5/16	5 7/16
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	3/4	—	—	1 1/2	—	2 5/8	2 13/16	5 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2 3/8	2 9/16	5 11/16
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	1 3/4	1 15/16	5 1/16
3 1/4	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 1/4	2 7/16	6
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	2 7/8	3 1/16	6 5/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 1/2	2 11/16	6 1/4
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 3/4	2 15/16	6 1/2
4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 1/2	2 11/16	6 1/4
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	3 1/8	3 5/16	6 7/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 3/4	2 15/16	6 1/2
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	2 7/8	3 1/16	6 5/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 1/4	2 7/16	6
5	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 3/4	2 15/16	6 13/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	5/8	—	—	1 5/8	—	3 1/8	3 5/16	7 3/16
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	2 7/8	3 1/16	6 15/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	3 1/8	3 5/16	7 3/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	5/8	—	—	1 5/8	—	3 1/8	3 5/16	7 3/16
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	2 1/4	2 7/16	6 5/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	2 1/2	2 11/16	6 9/16
6	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	2 7/8	3 1/16	7 5/16
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	3 7/8	1/2	—	—	1 1/2	—	3 1/4	3 7/16	7 11/16
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	3	3 3/16	7 7/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	3 1/4	3 7/16	7 11/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	1/2	—	—	1 1/2	—	3 1/4	3 7/16	7 11/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	1/2	—	—	1 1/2	—	3 1/4	3 7/16	7 11/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	7/16	—	1 5/8	2 5/8	2 13/16	7 1/16

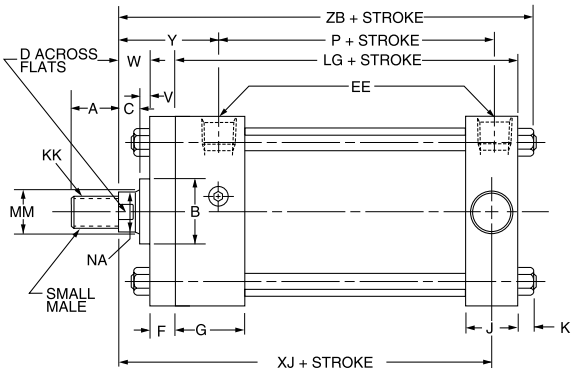
Miller JV Series
Medium-Duty Hydraulic Cylinders

Cap Trunnion Mount
Model 82
1", 1 1/2", 2", 2 1/2", 5" and 6" Bore
With Maximum Oversize Rods

Retainer Held Bushing



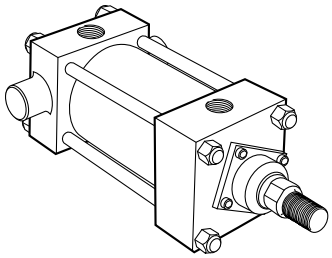


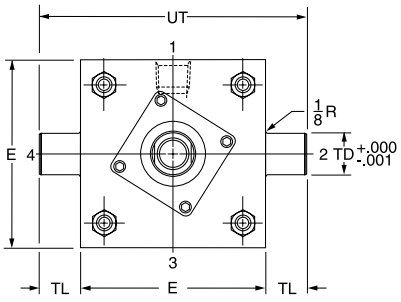


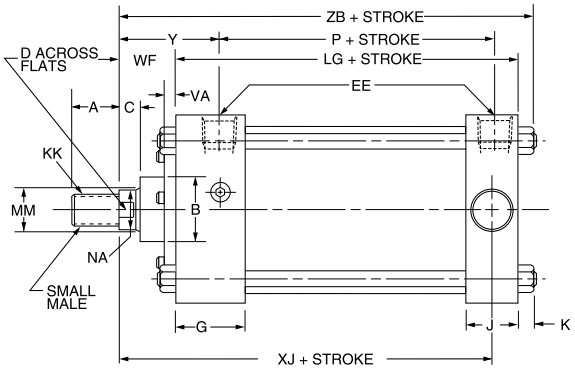
Before determining dimensions: See chart on page 3 for cylinder rod combinations that have removable bushings.

Cap Trunnion Mount
Model 82
1 1/2" - 6" Bore

Bolted Bushing

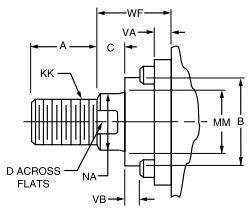




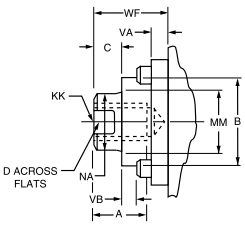


Rod End Dimensions — see table 2

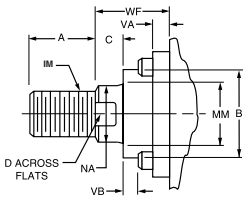
Thread Style 2
Small Male



Thread Style 4
Short Female



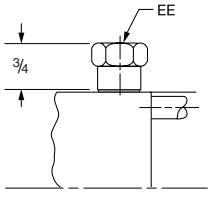
Thread Style 5
Intermediate Male



"Special" Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

Straight Thread Port Adapters
Used on 1 1/2" bore size only.



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Cap Trunnion Mount
1" to 6" Bore Sizes

Table 1—Envelope and Mounting Dimensions

Bore	E	EE NPTF⊖	EE SAE*	F	G	J	K	LG	P	+.000 TD -.001	TL	UT
1‡	■	1/4	6#	3/8	1 1/2	1	3/16	3 1/2	2 1/8	.750	3/4	3
1 1/2	2	3/8†	6#	3/8	1 1/2	1	1/4	3 5/8	2 1/4	1.000	1	4
2	2 1/2	3/8†	6	3/8	1 1/2	1	5/16	3 5/8	2 1/4	1.000	1	4 1/2
2 1/2	3	3/8†	6	3/8	1 1/2	1	5/16	3 3/4	2 3/8	1.000	1	5
3 1/4	3 3/4	1/2	10	–	1 3/4	1 1/4	3/8	4 1/4	2 5/8	1.000	1	5 3/4
4	4 1/2	1/2	10	–	1 3/4	1 1/4	3/8	4 1/4	2 5/8	1.000	1	6 1/2
5	5 1/2	1/2	10	5/8	1 3/4	1 1/4	7/16	4 1/2	2 7/8	1.000	1	7 1/2
6	6 1/2	3/4	12	3/4	2	1 1/2	7/16	5	3 1/8	1.375	1 3/8	9 1/4

⊖ NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

* SAE straight thread ports are indicated by port number.

■ 1" bore head is 1 3/4" x 1 1/2".

†On 1 1/2", 2" and 2 1/2" bore sizes the head end (only) pipe thread is not full depth on cylinders with maximum oversize rods. Minimum of 3 full threads available.

‡Cushion adjusting needle valve for 1" bore projects beyond sides of head and cap.

Straight thread ports. On 1 1/2" bore size an adapter fitting is required on cap end and on head end with maximum oversize rod. (See "Straight Thread Port Adapter" drawing.) Adapters are furnished as standard.

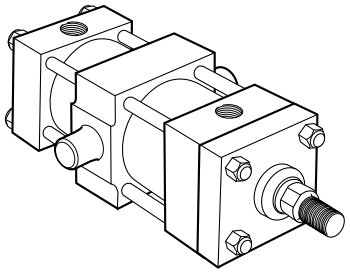
Table 2—Rod End Dimensions and Envelope Dimensions Affected by Rod Size

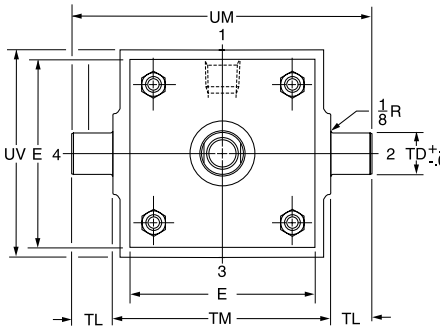
Bore	Rod Dia. MM	Thread Style 5 IM	Thread Style 2 & 4 KK	A	+.000 -.002 B	C	D	NA	V	VA	VB	W	WF	XJ	Y	ZB
1	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	7/16	1/4	—	—	5/8	—	4	1 15/16	4 11/16
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4	—	—	5/8	—	4	1 15/16	4 11/16
1 1/2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	4 1/8	1 15/16	4 7/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2	—	—	1	—	4 1/2	2 5/16	5 1/4
2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	4 1/8	1 15/16	4 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	4 3/4	2 9/16	5 9/16
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	4 1/2	2 5/16	5 5/16
2 1/2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	4 5/8	2 5/16	5 7/16
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	3/4	—	—	1 1/2	—	5 1/8	2 13/16	5 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	4 7/8	2 9/16	5 11/16
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	4 1/4	1 15/16	5 1/16
3 1/4	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	5	2 7/16	6
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	5 5/8	3 1/16	6 5/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	5 1/4	2 11/16	6 1/4
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	5 1/2	2 15/16	6 1/2
4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	5 1/4	2 11/16	6 1/4
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	5 7/8	3 5/16	6 7/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	5 1/2	2 15/16	6 1/2
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	5 5/8	3 1/16	6 5/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	5	2 7/16	6
5	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	5 3/4	2 15/16	6 13/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	5/8	—	—	1 5/8	—	6 1/8	3 5/16	7 3/16
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	5 7/8	3 1/16	6 15/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	6 1/8	3 5/16	7 3/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	5/8	—	—	1 5/8	—	6 1/8	3 5/16	7 3/16
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	5 1/4	2 7/16	6 5/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	5 1/2	2 11/16	6 9/16
6	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	6 1/8	3 1/16	7 5/16
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	3 7/8	1/2	—	—	1 1/2	—	6 1/2	3 7/16	7 11/16
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	6 1/4	3 3/16	7 7/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	6 1/2	3 7/16	7 11/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	1/2	—	—	1 1/2	—	6 1/2	3 7/16	7 11/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	1/2	—	—	1 1/2	—	6 1/2	3 7/16	7 11/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	7/16	—	1 5/8	5 7/8	2 13/16	7 1/16

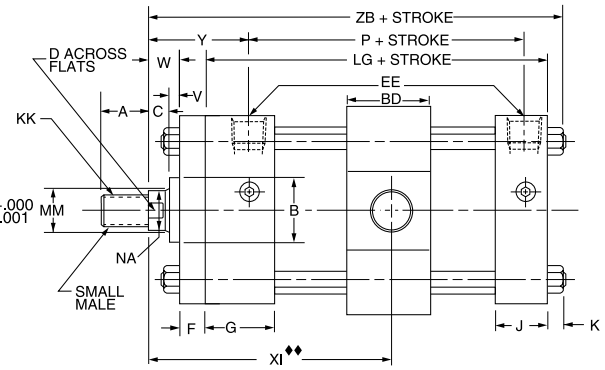
Miller JV Series
Medium-Duty Hydraulic Cylinders

Intermediate Trunnion Mount
Model 89
1 1/2", 2", 2 1/2", 5" and 6" Bore
With Maximum Oversize Rods

Retainer Held Bushing





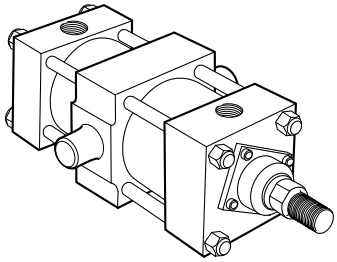


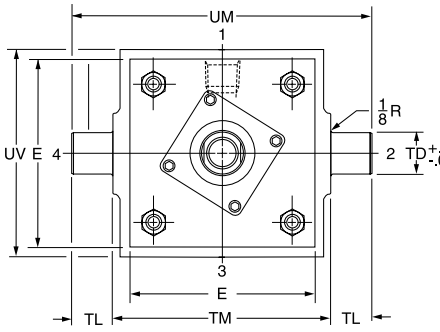
◆◆Dimension "XI" to be specified by customer.

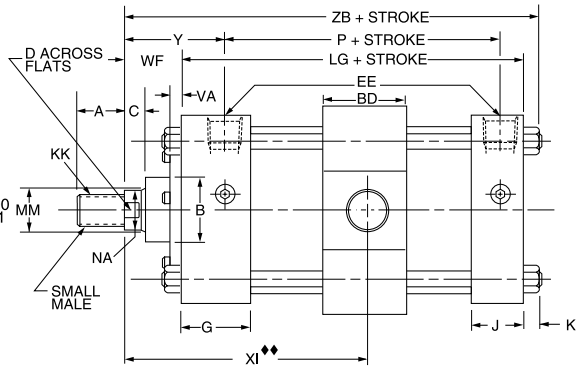
Before determining dimensions: See chart on page 3 for cylinder rod combinations that have removable bushings.

Intermediate Trunnion Mount
Model 89
1 1/2" - 6" Bore

Bolted Bushing



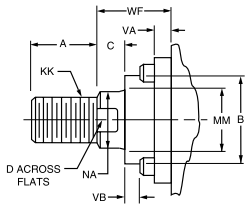




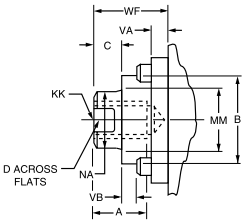
◆◆Dimension "XI" to be specified by customer.

Rod End Dimensions — see table 2

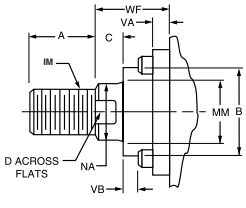
Thread Style 2
Small Male



Thread Style 4
Short Female



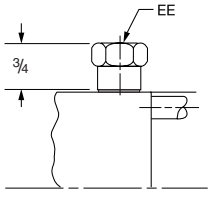
Thread Style 5
Intermediate Male



"Special" Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

Straight Thread Port Adapters
Used on 1 1/2" bore size only.



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Intermediate Trunnion Mount
1 1/2" to 6" Bore Sizes

Table 1—Envelope and Mounting Dimensions

Bore	BD	E	EE NPTF⊖	EE SAE*	F	G	J	K	LG	P	+.000 TD -.001	TL	TM	UM	UV	Min. Stroke
1 1/2	1 1/4	2	3/8†	6#	3/8	1 1/2	1	1/4	3 5/8	2 1/4	1.000	1	2 1/2	4 1/2	2 1/2	1/4
2	1 1/2	2 1/2	3/8†	6#	3/8	1 1/2	1	5/16	3 5/8	2 1/4	1.000	1	3	5	3	1/2
2 1/2	1 1/2	3	3/8†	6	3/8	1 1/2	1	5/16	3 3/4	2 3/8	1.000	1	3 1/2	5 1/2	3 1/2	3/8
3 1/4	2	3 3/4	1/2	10	—	1 3/4	1 1/4	3/8	4 1/4	2 5/8	1.000	1	4 1/2	6 1/2	4 1/4	7/8
4	2	4 1/2	1/2	10	—	1 3/4	1 1/4	3/8	4 1/4	2 5/8	1.000	1	5 1/4	7 1/4	5	7/8
5	2	5 1/2	1/2	10	5/8	1 3/4	1 1/4	7/16	4 1/2	2 7/8	1.000	1	6 1/4	8 1/4	6	5/8
6	2 1/2	6 1/2	3/4	12	3/4	2	1 1/2	7/16	5	3 1/8	1.375	1 3/8	7 5/8	10 3/8	7	1 1/8

⊖ NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

* SAE straight thread ports are indicated by port number.

†On 1", 1 1/2", 2" and 2 1/2" bore sizes the head end (only) pipe thread is not full depth on cylinders with maximum oversize rods. Minimum of 3 full threads available.

Straight thread ports on 1" bore size require an adapter fitting on the head end only. On 1 1/2" bore size an adapter fitting is required on cap end and on head end with maximum oversize rod. (See "Straight Thread Port Adapter" drawing.) Adapters are furnished as standard.

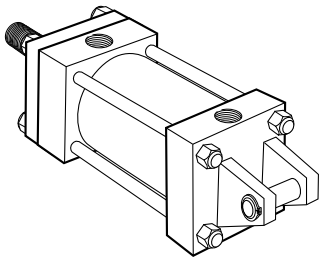
Table 2—Rod End Dimensions and Envelope Dimensions Affected by Rod Size

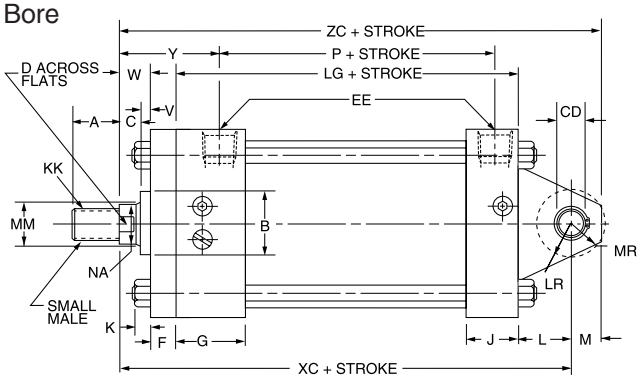
Bore	Rod Dia. MM	Thread Style 5 IM	Thread Style 2 & 4 KK	A	+.000 -.002 B	C	D	NA	V	VA	VB	W	WF	Min◆◆ XI	Y	ZB
1 1/2•	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	3 3/16	1 15/16	4 7/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2	—	—	1	—	3 9/16	2 5/16	5 1/4
2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	3 5/16	1 15/16	4 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	3 15/16	2 9/16	5 9/16
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	3 11/16	2 5/16	5 5/16
2 1/2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	3 11/16	2 5/16	5 7/16
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	3/4	—	—	1 1/2	—	4 3/16	2 13/16	5 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	3 15/16	2 9/16	5 11/16
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	3 5/16	1 15/16	5 1/16
3 1/4	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	4 3/16	2 7/16	6
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	4 13/16	3 1/16	6 5/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	4 7/16	2 11/16	6 1/4
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	4 11/16	2 15/16	6 1/2
4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	4 7/16	2 11/16	6 1/4
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	5 1/16	3 5/16	6 7/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	4 11/16	2 15/16	6 1/2
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	4 13/16	3 1/16	6 5/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	4 3/16	2 7/16	6
5	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	4 11/16	2 15/16	6 13/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	5/8	—	—	1 5/8	—	5 1/16	3 5/16	7 3/16
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	4 13/16	3 1/16	6 15/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	5 1/16	3 5/16	7 3/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	5/8	—	—	1 5/8	—	5 1/16	3 5/16	7 3/16
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	4 3/16	2 7/16	6 5/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	4 7/16	2 11/16	6 9/16
6	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	5 3/16	3 1/16	7 5/16
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	3 7/8	1/2	—	—	1 1/2	—	5 9/16	3 7/16	7 11/16
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	5 5/16	3 3/16	7 7/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	5 9/16	3 7/16	7 11/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	1/2	—	—	1 1/2	—	5 9/16	3 7/16	7 11/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	1/2	—	—	1 1/2	—	5 9/16	3 7/16	7 11/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	7/16	—	1 5/8	4 15/16	2 13/16	7 1/16

◆◆ Dimension XI to be specified by customer.

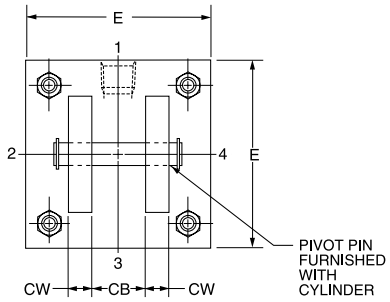
Miller JV Series
Medium-Duty Hydraulic Cylinders

Cap Fixed Clevis Mount
Model 84
1", 1 1/2", 2", 2 1/2", 5" and 6" Bore
With Maximum Oversize Rods





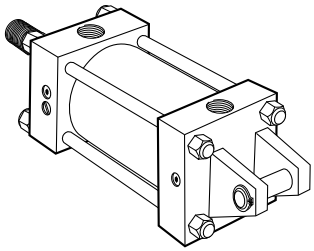
Retainer Held Bushing

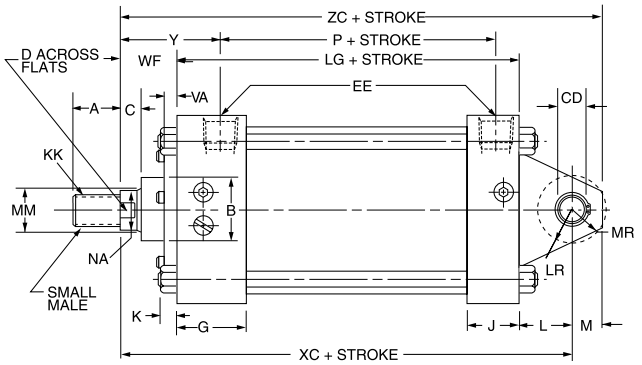


Note: Cap tie rod nuts not on 1 1/2", 2", 2 1/2" and 3 1/4" bores.

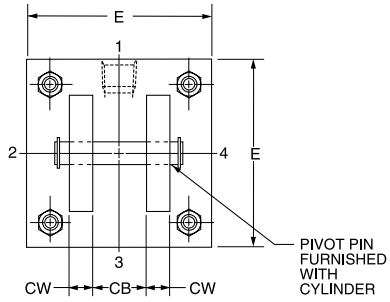
Before determining dimensions: See chart on page 3 for cylinder rod combinations that have removable bushings.

Cap Fixed Clevis Mount
Model 84
1 1/2" - 6" Bore





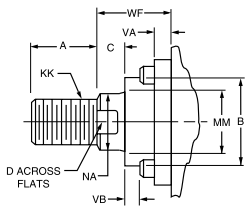
Bolted Bushing



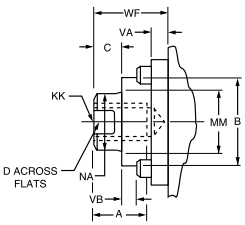
Note: Cap tie rod nuts not on 1 1/2", 2", 2 1/2" and 3 1/4" bores.

Rod End Dimensions — see table 2

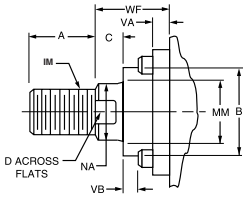
Thread Style 2
Small Male



Thread Style 4
Short Female



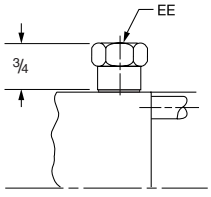
Thread Style 5
Intermediate Male



"Special" Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

Straight Thread Port Adapters
Used on 1 1/2" bore size only.



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Cap Fixed Clevis Mount
1" to 6" Bore Sizes

Table 1—Envelope and Mounting Dimensions

Bore	CB	+.000 CD▲ -.002	CW	E	EE NPTFϴ	EE SAE*	F	G	J	K	L	LG	LR	M	MR	P
1‡	•	.441•	•	■	1/4	6#	3/8	1 1/2	1	3/16	1/2•	3 1/2•	1/2•	7/16•	1/2•	2 1/8
1 1/2	3/4	.501	1/2	2	3/8†	6#	3/8	1 1/2	1	1/4	3/4	3 5/8	3/4	1/2	5/8	2 1/4
2	3/4	.501	1/2	2 1/2	3/8†	6	3/8	1 1/2	1	5/16	3/4	3 5/8	3/4	1/2	5/8	2 1/4
2 1/2	3/4	.501	1/2	3	3/8†	6	3/8	1 1/2	1	5/16	3/4	3 3/4	3/4	1/2	5/8	2 3/8
3 1/4	1 1/4	.751	5/8	3 3/4	1/2	10	—	1 3/4	1 1/4	3/8	1 1/4	4 1/4	1	3/4	15/16	2 5/8
4	1 1/4	.751	5/8	4 1/2	1/2	10	—	1 3/4	1 1/4	3/8	1 1/4	4 1/4	1	3/4	15/16	2 5/8
5	1 1/4	.751	5/8	5 1/2	1/2	10	5/8	1 3/4	1 1/4	7/16	1 1/4	4 1/2	1	3/4	15/16	2 7/8
6	1 1/2	1.001	3/4	6 1/2	3/4	12	3/4	2	1 1/2	7/16	1 1/2	5	1 1/4	1	1 3/16	3 1/8

ϴ NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

* SAE straight thread ports are indicated by port number.

■ 1" bore head is 1 3/4" x 1 1/2".

†On 1 1/2", 2" and 2 1/2" bore sizes the head end (only) pipe thread is not full depth on cylinders with maximum oversize rods. Minimum of 3 full threads available.

▲ Dimension CD is pin diameter except in 1" bore.

Straight thread ports. On 1 1/2" bore size an adapter fitting is required on cap end and on head end with maximum oversize rod. (See "Straight Thread Port Adapter" drawing.) Adapters are furnished as standard.

• In 1" bore size only, a single fixed eye mounting 7/16" thick is used. Dimension CD (.441") is hole diameter — pin not supplied.

‡Cushion adjusting needle valve for 1" bore projects beyond sides of head and cap.

Table 2—Rod End Dimensions and Envelope Dimensions Affected by Rod Size

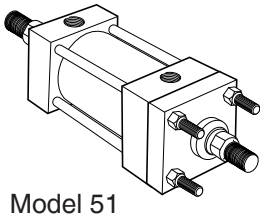
Bore	Rod Dia. MM	Thread Style 5 IM	Thread Style 2 & 4 KK	A	+.000 -.002 B	C	D	NA	V	VA	VB	W	WF	XC	Y	ZC
1	1/2	7/16-20	5/16-24	5/8	.999	3/8	3/8	7/16	1/4	—	—	5/8	—	5	1 15/16	5 7/16
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	1/4	—	—	5/8	—	5	1 15/16	5 7/16
1 1/2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	5 3/8	1 15/16	5 7/8
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	1/2	—	—	1	—	5 3/4	2 5/16	6 1/4
2	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	5 3/8	1 15/16	5 7/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	6	2 9/16	6 1/2
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	5 3/4	2 5/16	6 1/4
2 1/2	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	5 7/8	2 5/16	6 3/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	3/4	—	—	1 1/2	—	6 3/8	2 13/16	6 7/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	6 1/8	2 9/16	6 5/8
	5/8	1/2-20	7/16-20	3/4	1.124	3/8	1/2	9/16	—	1/4	3/16	—	1	5 1/2	1 15/16	6
3 1/4	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	6 7/8	2 7/16	7 5/8
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	7 1/2	3 1/16	8 1/4
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	7 1/8	2 11/16	7 7/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	7 3/8	2 15/16	8 1/8
4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	7 1/8	2 11/16	7 7/8
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	7 3/4	3 5/16	8 1/2
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	7 3/8	2 15/16	8 1/8
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	7 1/2	3 1/16	8 1/4
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	6 7/8	2 7/16	7 5/8
5	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	7 5/8	2 15/16	8 3/8
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	5/8	—	—	1 5/8	—	8	3 5/16	8 3/4
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	7 3/4	3 1/16	8 1/2
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	8	3 5/16	8 3/4
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	5/8	—	—	1 5/8	—	8	3 5/16	8 3/4
	1	7/8-14	3/4-16	1 1/8	1.499	1/2	7/8	15/16	—	1/4	3/8	—	1 3/8	7 1/8	2 7/16	7 7/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	1/2	—	1 5/8	7 3/8	2 11/16	8 1/8
6	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	—	1/4	9/16	—	1 7/8	8 3/8	3 1/16	9 3/8
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	3 7/8	1/2	—	—	1 1/2	—	8 3/4	3 7/16	9 3/4
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	—	1/4	9/16	—	2	8 1/2	3 3/16	9 1/2
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	—	1/4	11/16	—	2 1/4	8 3/4	3 7/16	9 3/4
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	1/2	—	—	1 1/2	—	8 3/4	3 7/16	9 3/4
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	1/2	—	—	1 1/2	—	8 3/4	3 7/16	9 3/4
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	—	1/4	7/16	—	1 5/8	8 1/8	2 13/16	9 1/8

NOTES

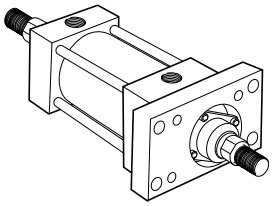
NOTES

Miller JV Series
Medium-Duty Hydraulic Cylinders

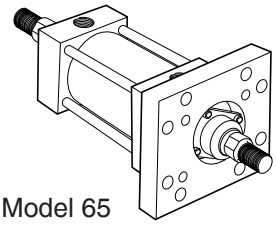
Double Rod End Cylinders



Model 51
& 53

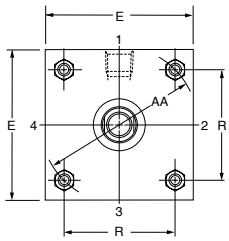


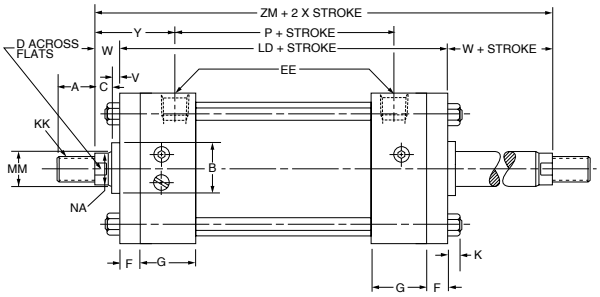
Model 61



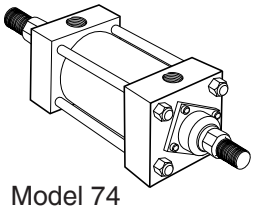
Model 65

Retainer Held Bushing

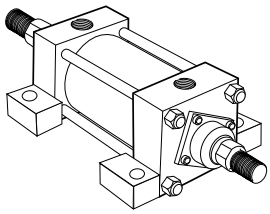




Note: The basic double rod cylinder dimensions are shown on this and facing page. For specific mounting dimensions, refer to pages for single rod cylinder. Exception: Model 72 "SS".

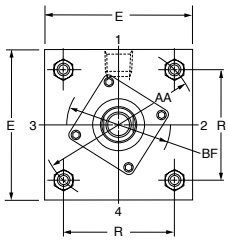


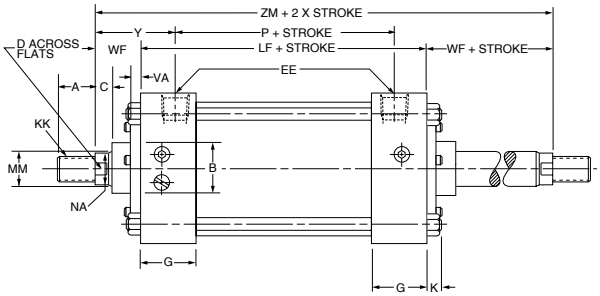
Model 74

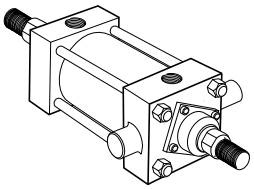


Model 72

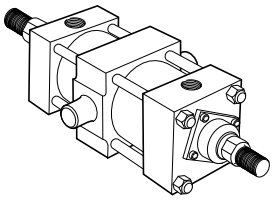
Bolted Bushing







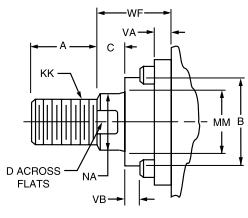
Model 81



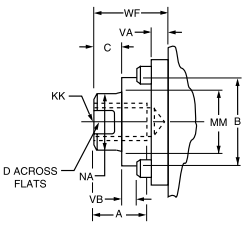
Model 89

Rod End Dimensions — see table 2

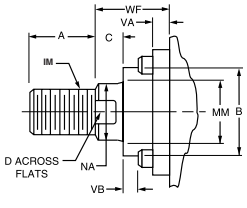
Thread Style 2
Small Male



Thread Style 4
Short Female



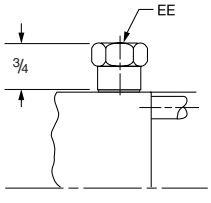
Thread Style 5
Intermediate Male



"Special" Thread Style X
Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

Straight Thread Port Adapters
Used on 1 1/2" bore size only.



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Bore	E	EE NPTF⊖	EE SAE*	F	G	K	LD	LF	P	SA	SS
1‡	■	1/4†	6#	3/8	1 1/2	3/16	4 3/4	—	2 1/8	6 3/8	3 3/8
1 1/2	2	3/8†	6#	3/8	1 1/2	1/4	4 7/8	4 1/8	2 1/4	6 1/2	3 3/8
2	2 1/2	3/8†	6	3/8	1 1/2	5/16	4 7/8	4 1/8	2 1/4	6 1/2	3 3/8
2 1/2	3	3/8†	6	3/8	1 1/2	5/16	5	4 1/4	2 3/8	6 5/8	3 1/2
3 1/4	3 3/4	1/2	10	5/8	1 3/4	3/8	6	4 3/4	2 5/8	7 7/8	3 3/4
4	4 1/2	1/2	10	5/8	1 3/4	3/8	6	4 3/4	2 5/8	7 7/8	3 3/4
5	5 1/2	1/2	10	5/8	1 3/4	7/16	6 1/4	5	2 7/8	8 3/8	3 5/8
6	6 1/2	3/4	12	3/4	2	7/16	7	5 1/2	3 1/8	9	4 1/8

⊖ NPTF ports will be furnished as standard unless SAE straight thread ports are specified.

* SAE straight thread ports are indicated by port number.

■ 1" bore head is 1 3/4" x 1 1/2".

†On 1 1/2", 2" and 2 1/2" bore sizes the head end (only) pipe thread is not full depth on cylinders with maximum oversize rods. Minimum of 3 full threads available.

Straight thread ports. On 1 1/2" bore size an adapter fitting is required on cap end and on head end with maximum oversize rod. (See "Straight Thread Port Adapter" drawing.) Adapters are furnished as standard.

‡Cushion adjusting needle valve for 1" bore projects beyond sides of head and cap.

How to Use Double Rod Cylinder Dimension Drawings

To determine dimensions for a double rod cylinder, first refer to the desired single rod mounting style cylinder shown on preceding pages of this catalog. After selecting necessary dimensions from that drawing, return to this page and supplement the single rod dimensions with those shown below. Note that double rod cylinders have a head (Dim. G) at both ends and that dimension LD replaces LB. The double rod dimensions differ from, or are in addition to those for single rod cylinders shown on preceding pages and provide the information needed to completely dimension a double rod cylinder. On a double rod cylinder where the two ends are different, be sure to clearly state which rod end is to be assembled at which end.

Port position 1 is standard. If other than standard, specify position 2, 3 or 4 when viewed from one end only.

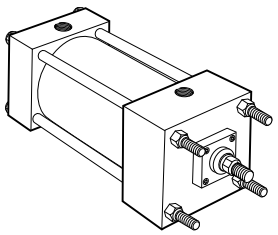
Table 2—Rod End Dimensions and Envelope Dimensions Affected by Rod Size

Bore	Rod Dia. MM	Thread Style 5 IM	Thread Style 2 & 4 KK	A	+.000 -.002 B	BF	C	D	NA	V	VA	VB	W	WF	Y	ZM
1	1/2	7/16-20	5/16-24	5/8	.999	—	3/8	3/8	7/16	1/4	—	—	5/8	—	1 15/16	5 3/8
	5/8	1/2-20	7/16-20	3/4	1.124	—	3/8	1/2	9/16	1/4	—	—	5/8	—	1 15/16	6
1 1/2	5/8	1/2-20	7/16-20	3/4	1.124	1.968	3/8	1/2	9/16	—	1/4	3/16	5/8	1	1 15/16	6 1/8
	1	7/8-14	3/4-16	1 1/8	1.499	—	1/2	7/8	15/16	1/2	—	—	1	—	2 5/16	6 7/8
2	5/8	1/2-20	7/16-20	3/4	1.124	1.968	3/8	1/2	9/16	—	1/4	3/16	5/8	1	1 15/16	6 1/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	—	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2 9/16	7 3/8
	1	7/8-14	3/4-16	1 1/8	1.499	2.468	1/2	7/8	15/16	—	1/4	3/8	1	1 3/8	2 5/16	6 7/8
2 1/2	1	7/8-14	3/4-16	1 1/8	1.499	2.468	1/2	7/8	15/16	—	1/4	3/8	1	1 3/8	2 5/16	7
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	—	3/4	1 1/2	1 11/16	3/4	—	—	1 1/2	—	2 13/16	8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	2.968	5/8	1 1/8	1 5/16	5/8	—	—	1 1/4	—	2 9/16	7 1/2
	5/8	1/2-20	7/16-20	3/4	1.124	1.968	3/8	1/2	9/16	—	1/4	3/16	5/8	1	1 15/16	6 1/4
3 1/4	1	7/8-14	3/4-16	1 1/8	1.499	2.468	1/2	7/8	15/16	—	1/4	3/8	3/4	1 3/8	2 7/16	7 1/2
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	3.735	7/8	1 11/16	1 15/16	—	1/4	9/16	1 3/8	2	3 1/16	8 3/4
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	2.968	5/8	1 1/8	1 5/16	—	1/4	1/2	1	1 5/8	2 11/16	8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3.625	3/4	1 1/2	1 11/16	—	1/4	9/16	1 1/4	1 7/8	2 15/16	8 1/2
4	1 3/8	1 1/4-12	1-14	1 5/8	1.999	2.968	5/8	1 1/8	1 5/16	—	1/4	1/2	1	1 5/8	2 11/16	8
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	4.312	1	2 1/16	2 3/8	—	1/4	11/16	1 5/8	2 1/4	3 5/16	9 1/4
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3.625	3/4	1 1/2	1 11/16	—	1/4	9/16	1 1/4	1 7/8	2 15/16	8 1/2
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	3.735	7/8	1 11/16	1 15/16	—	1/4	9/16	1 3/8	2	3 1/16	8 3/4
	1	7/8-14	3/4-16	1 1/8	1.499	2.468	1/2	7/8	15/16	—	1/4	3/8	3/4	1 3/8	2 7/16	7 1/2
5	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3.625	3/4	1 1/2	1 11/16	—	1/4	9/16	1 1/4	1 7/8	2 15/16	8 3/4
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	—	1	3	3 3/8	5/8	—	—	1 5/8	—	3 5/16	9 1/2
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	3.735	7/8	1 11/16	1 15/16	—	1/4	9/16	1 3/8	2	3 1/16	9
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	4.312	1	2 1/16	2 3/8	—	1/4	11/16	1 5/8	2 1/4	3 5/16	9 1/2
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	—	1	2 5/8	2 7/8	5/8	—	—	1 5/8	—	3 5/16	9 1/2
	1	7/8-14	3/4-16	1 1/8	1.499	2.468	1/2	7/8	15/16	—	1/4	3/8	3/4	1 3/8	2 7/16	7 3/4
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	2.968	5/8	1 1/8	1 5/16	—	1/4	1/2	1	1 5/8	2 11/16	8 1/4
6	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3.625	3/4	1 1/2	1 11/16	—	1/4	9/16	1 1/8	1 7/8	3 1/16	9 1/4
	4	3 3/4-12	3-12	4	4.749	—	1	3 3/8	3 7/8	1/2	—	—	1 1/2	—	3 7/16	10
	2	1 3/4-12	1 1/2-12	2 1/4	2.624	3.735	7/8	1 11/16	1 15/16	—	1/4	9/16	1 1/4	2	3 3/16	9 1/2
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	4.312	1	2 1/16	2 3/8	—	1/4	11/16	1 1/2	2 1/4	3 7/16	10
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	—	1	2 5/8	2 7/8	1/2	—	—	1 1/2	—	3 7/16	10
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	—	1	3	3 3/8	1/2	—	—	1 1/2	—	3 7/16	10
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	2.968	5/8	1 1/8	1 5/16	—	1/4	7/16	7/8	1 5/8	2 13/16	8 3/4

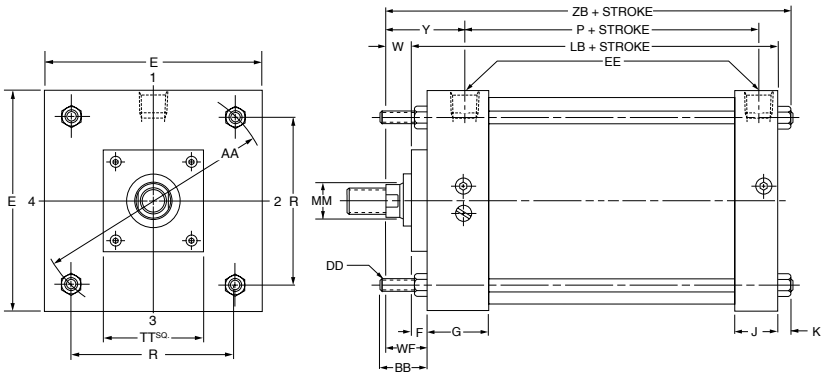
Miller JV Series
Medium-Duty Hydraulic Cylinders

Tie Rods Extended Mountings
Head Square Mount
Cap Square Mount
8" Bore Size

Tie Rods Extended Mount
Model 53

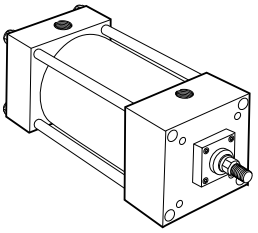


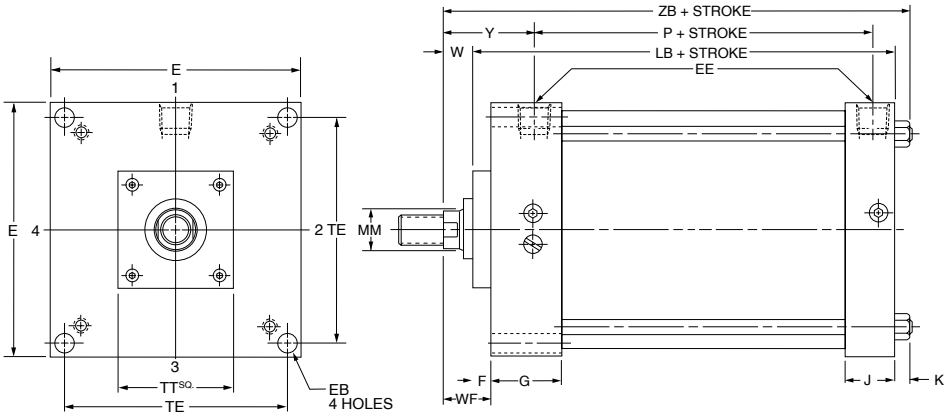
Model 53, Head Tie Rods Extended, illustrated: Model 52 Cap Tie Rods Extended; and Model 51. Both Ends Tie Rods Extended are also available. All Extended Tie Rods can be dimensioned from Model 53 drawing at right.



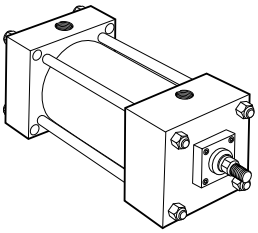
Model 53 and Model 51 not offered in 8" bore size, rod diameter 4 1/2", 5",and 5 1/2".

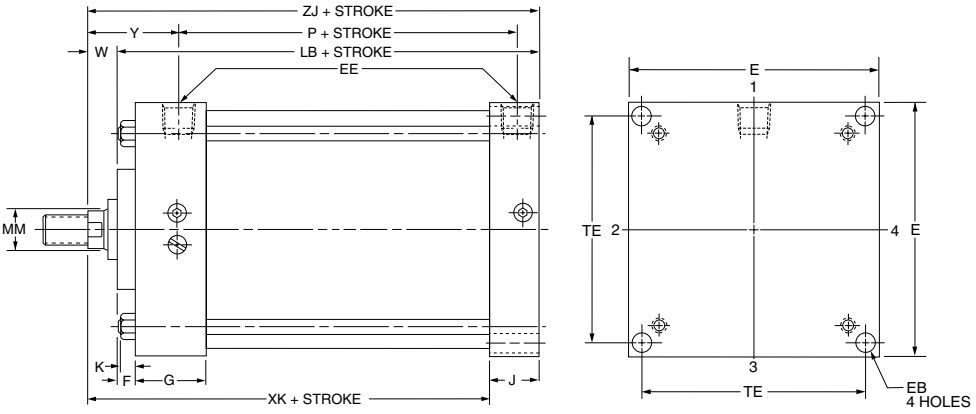
Head Square Mount
Model 63





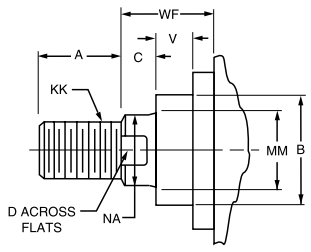
Cap Square Mount
Model 64



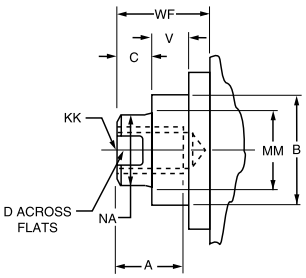


Rod End Dimensions — see tables 2 & 5

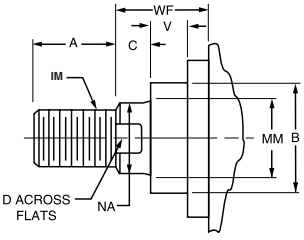
Thread Style 2
Small Male



Thread Style 4
Short Female



Thread Style 5
Intermediate Male



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

"Special" Thread Style X

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W or WF. If otherwise special, furnish dimensioned sketch.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Tie Rods Extended Mountings
Head Square Mount
Cap Square Mount
8" Bore Size

Table 1—Envelope and Mounting Dimensions—Model 53

Bore	AA	BB	DD	E	EE		F	G	J	K	R	Add Stroke	
					NPTF[e]	SAE*						LB	P
8	9.1	2 5/16	5/8-18	8 1/2	3/4	12	3/4	2	1 1/2	9/16	6.44	5 7/8	3 1/4

[e] NPTF ports will be furnished as standard unless SAE straight thread ports are specified.
* SAE straight thread ports are indicated by port number.

Table 2—Rod End Dimensions—Model 53

Bore	Rod Dia. MM	Thread		Rod Extensions and Pilot Dimensions							
		Style 5 IM	Style 2 & 4 KK	A	+.000 -.002 B	C	D	LA	NA	V	W
8	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2

Table 3 — Envelope and Mounting Dimensions

Bore	TT	WF	Y	Add Stroke
				ZB
8	4	2	3 3/16	7 11/16
	7	2 1/4	3 7/16	7 15/16
	4	2 1/4	3 7/16	7 15/16
	5 1/2	2 1/4	3 7/16	7 15/16
	5 1/2	2 1/4	3 7/16	7 15/16
	5 1/2	2 1/4	3 7/16	7 15/16
	4	1 5/8	2 13/16	7 5/16
	4	1 7/8	3 1/16	7 9/16
	7	2 1/4	3 7/16	7 15/16
	7	2 1/4	3 7/16	7 15/16

Table 4—Envelope and Mounting Dimensions—Model 63 and Model 64

Bore	E	EB**	EE		F	G	J	K	TE	Add Stroke	
		(BOLT)	NPTF[e]	SAE*						LB	P
8	8 1/2	5/8	3/4	12	3/4	2	1 1/2	9/16	7.57	5 7/8	3 1/4

[e] NPTF ports will be furnished as standard unless SAE straight thread ports are specified.
* SAE straight thread ports are indicated by port number.
**Mounting hole is 1/16" larger than bolt size listed.

Table 5—Rod End Dimensions—Model 63 and Model 64

Bore	Rod Dia. MM	Thread		Rod Extensions and Pilot Dimensions							
		Style 5 IM	Style 2 & 4 KK	A	+.000 -.002 B	C	D	LA	NA	V	W
8	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2

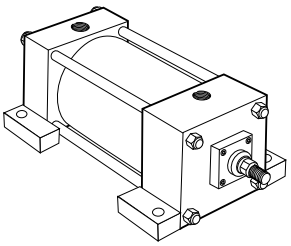
Table 6 — Envelope and Mounting Dimensions

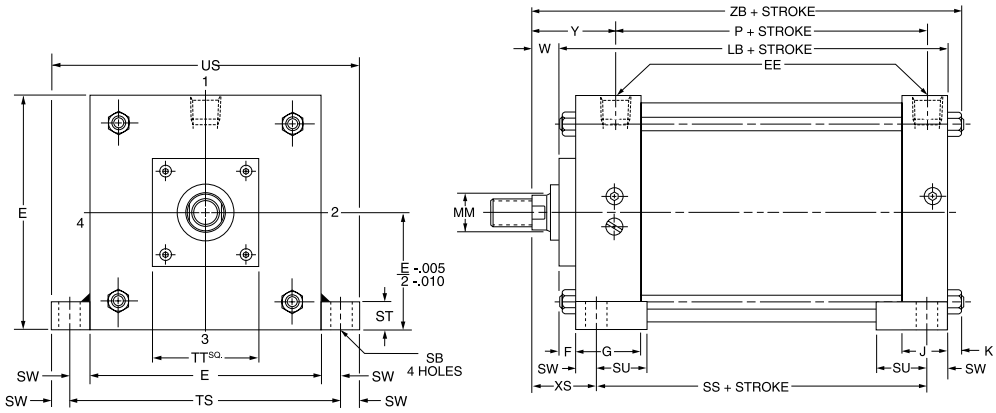
Bore	TT	WF	Y	Add Stroke		
				XK	ZB	ZJ
8	4	2	3 3/16	5 5/8	7 11/16	7 1/8
	7	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	4	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	5 1/2	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	5 1/2	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	5 1/2	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	4	1 5/8	2 13/16	5 1/4	7 5/16	6 3/4
	4	1 7/8	3 1/16	5 1/2	7 9/16	7
	7	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8
	7	2 1/4	3 7/16	5 7/8	7 15/16	7 3/8

Miller JV Series
Medium-Duty Hydraulic Cylinders

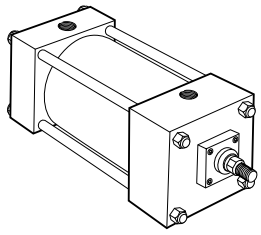
Side Lug Mount
Side Tap Mount
8" Bore Size

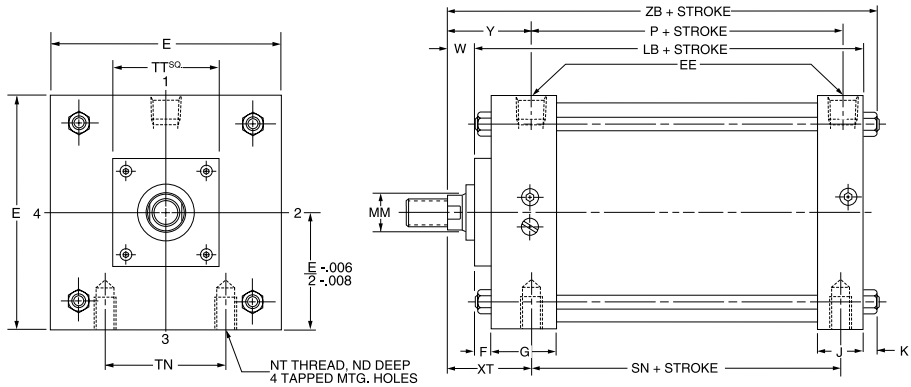
Side Lug Mount
Model 72





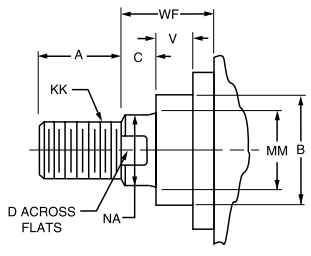
Side Tap Mount
Model 74



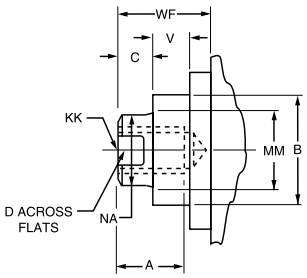


Rod End Dimensions — see tables 2 & 5

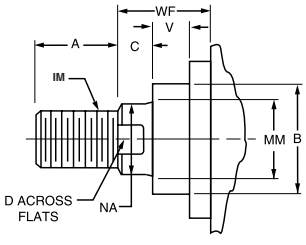
Thread Style 2
Small Male



Thread Style 4
Short Female



Thread Style 5
Intermediate Male



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

"Special" Thread Style X

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W. If otherwise special, furnish dimensioned sketch.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Side Lug Mount
Side Tap Mount
8" Bore Size

Table 1—Envelope and Mounting Dimensions—Model 72

Bore	E	EE		F	G	J	K	SB•	ST	SU	SW	TS	US	Add Stroke		
		NPTF[e]	SAE*					(BOLT)						LB	P	SS
8	8 1/2	3/4	12	3/4	2	1 1/2	9/16	3/4	1	1 9/16	11/16	9 7/8	11 1/4	5 7/8	3 1/4	3 3/4

[e] NPTF ports will be furnished as standard unless SAE straight thread ports are specified.
* SAE straight thread ports are indicated by port number.
• Mounting hole is 1/16" larger than bolt size listed.

Table 2—Rod End Dimensions—Model 72

Bore	Rod Dia. MM	Thread		Rod Extensions and Pilot Dimensions								Add Stroke
		Style 5 IM	Style 2 & 4 KK	A	+.000 -.002 B	C	D	LA	NA	V	W	ZB
8	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4	7 11/16
	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2	7 15/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2	7 15/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2	7 15/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2	7 15/16
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2	7 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8	7 5/16
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8	7 9/16
	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2	7 15/16
	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2	7 15/16

Table 3 — Envelope and Mounting Dimensions

Bore	TT	XS	Y
8	4	2 11/16	3 3/16
	7	2 15/16	3 7/16
	4	2 15/16	3 7/16
	5 1/2	2 15/16	3 7/16
	5 1/2	2 15/16	3 7/16
	5 1/2	2 15/16	3 7/16
	4	2 5/16	2 13/16
	4	2 9/16	3 1/16
	7	2 15/16	3 7/16
	7	2 15/16	3 7/16

Table 4—Envelope and Mounting Dimensions—Model 74

Bore	E	EE		F	G	J	K	ND	NT	TN	Add Stroke		
		NPTF[e]	SAE*								LB	P	SN
8	8 1/2	3/4	12	3/4	2	1 1/2	9/16	1 1/8	3/4-10	4 1/2	5 7/8	3 1/4	3 1/4

[e] NPTF ports will be furnished as standard unless SAE straight thread ports are specified.
* SAE straight thread ports are indicated by port number.

Table 5—Rod End Dimensions—Model 74

Bore	Rod Dia. MM	Thread		Rod Extensions and Pilot Dimensions								Add Stroke
		Style 5 IM	Style 2 & 4 KK	A	+.000 -.002 B	C	D	LA	NA	V	W	ZB
8	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4	7 11/16
	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2	7 15/16
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2	7 15/16
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2	7 15/16
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2	7 15/16
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2	7 15/16
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8	7 5/16
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8	7 9/16
	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2	7 15/16
	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2	7 15/16

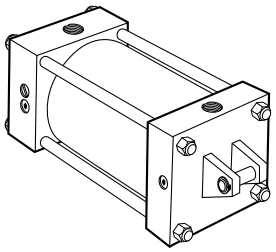
Table 6 — Envelope and Mounting Dimensions

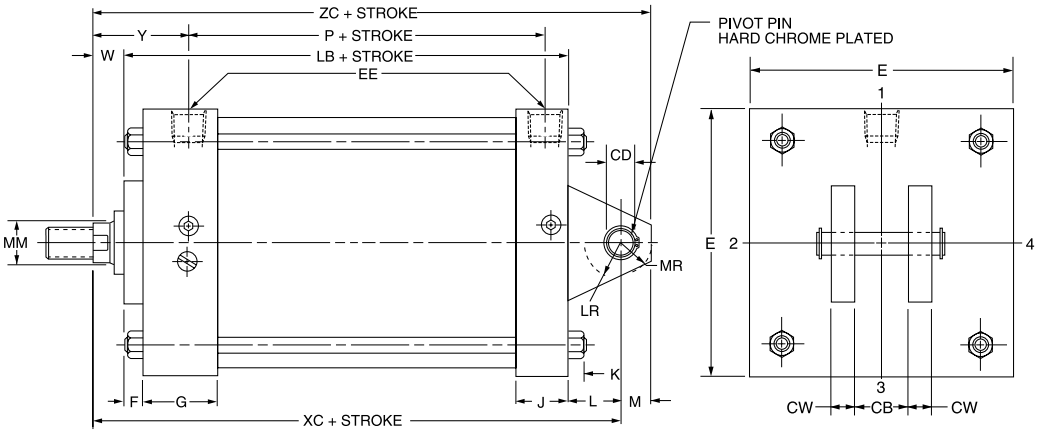
Bore	TT	XT	Y
8	4	3 3/16	3 3/16
	7	3 7/16	3 7/16
	4	3 7/16	3 7/16
	5 1/2	3 7/16	3 7/16
	5 1/2	3 7/16	3 7/16
	5 1/2	3 7/16	3 7/16
	4	2 13/16	2 13/16
	4	3 1/16	3 1/16
	7	3 7/16	3 7/16
	7	3 7/16	3 7/16

Miller JV Series
Medium-Duty Hydraulic Cylinders

Cap Fixed Clevis Mount
8" Bore Size

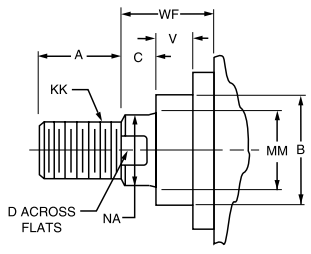
Cap Fixed Clevis Mount
Model 84



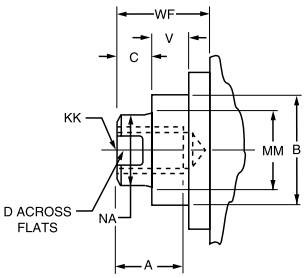


Rod End Dimensions — see table 2

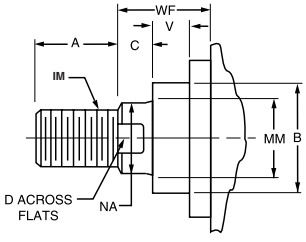
Thread Style 2
Small Male



Thread Style 4
Short Female



Thread Style 5
Intermediate Male



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

"Special" Thread Style X

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W. If otherwise special, furnish dimensioned sketch.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Cap Fixed Clevis Mount
8" Bore Size

Table 1—Envelope and Mounting Dimensions—Model 84

Bore	CB	+.000 -.002 CD•	CW	E	EE NPTF[e]	EE SAE*	F	G	J	K	L	LR	M	MR	Add Stroke LB	Add Stroke P
8	1 1/2	1.001	3/4	8 1/2	3/4	12	3/4	2	1 1/2	9/16	1 1/2	1 1/4	1	1 3/16	5 7/8	3 1/4

[e] NPTF ports will be furnished as standard unless SAE straight thread ports are specified.
* SAE straight thread ports are indicated by port number.
• Dimension CD is pin diameter.

Table 2—Rod End Dimensions—Model 84

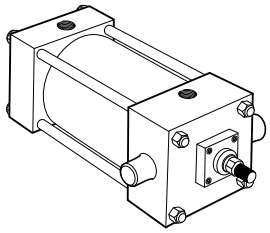
Bore	Rod Dia. MM	Thread CC	Thread KK	Rod Extensions and Pilot Dimensions A	+.000 -.002 B	C	D	LA	NA	V	W	Y	Add Stroke XC	Add Stroke ZC
8	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4	3 3/16	8 5/8	9 5/8
	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2	3 7/16	8 7/8	9 7/8
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2	3 7/16	8 7/8	9 7/8
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2	3 7/16	8 7/8	9 7/8
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2	3 7/16	8 7/8	9 7/8
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2	3 7/16	8 7/8	9 7/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8	2 13/16	8 1/4	9 1/4
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8	3 1/16	8 1/2	9 1/2
	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2	3 7/16	8 7/8	9 7/8
	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2	3 7/16	8 7/8	9 7/8

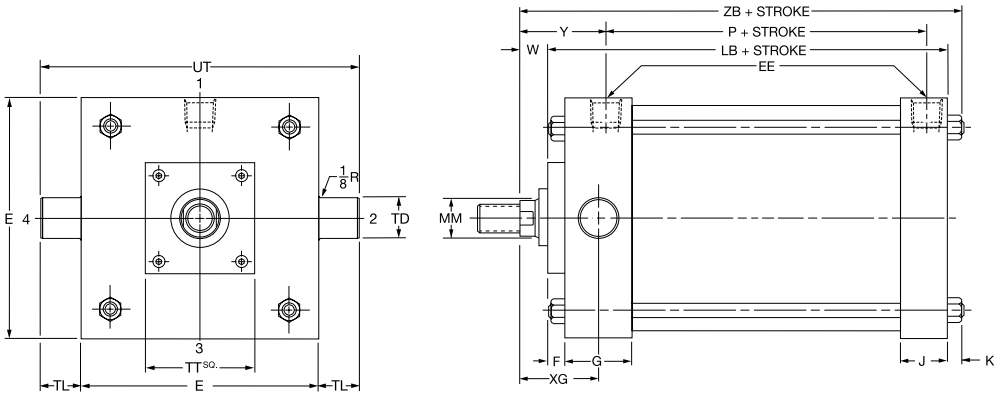
Table 3 — Envelope and Mounting Dimensions

Miller JV Series
Medium-Duty Hydraulic Cylinders

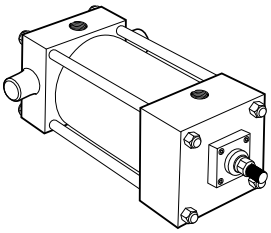
Head Trunnion Mount
Cap Trunnion Mount
Intermediate Trunnion Mount
8" Bore Size

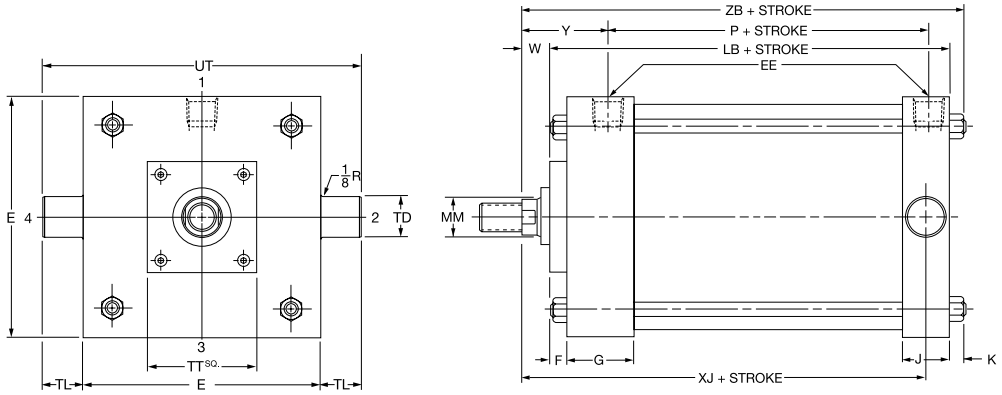
Head Trunnion Mount
Model 81



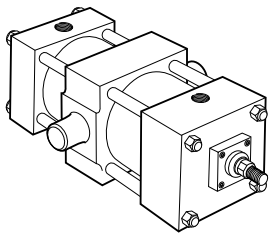


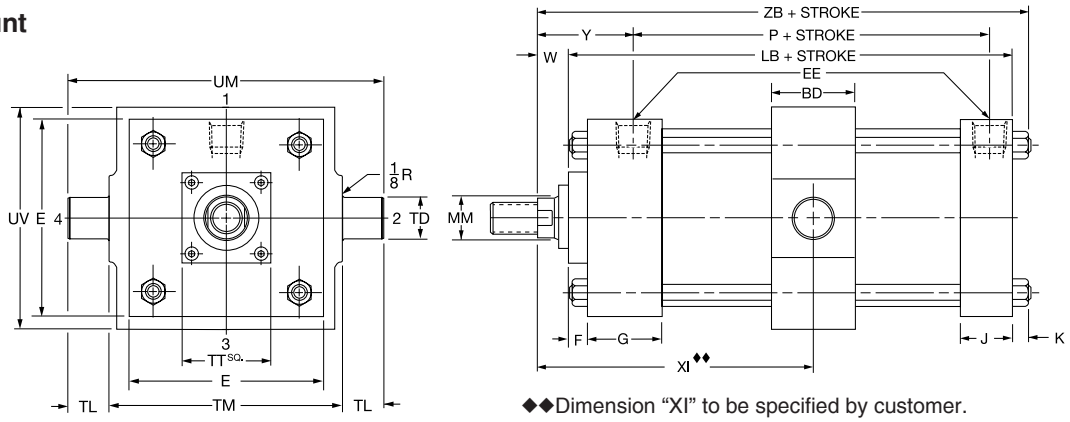
Cap Trunnion Mount
Model 82





Intermediate Trunnion Mount
Model 89

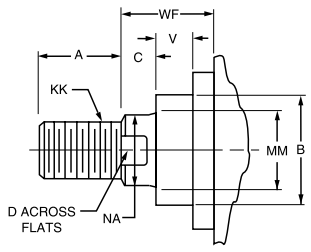




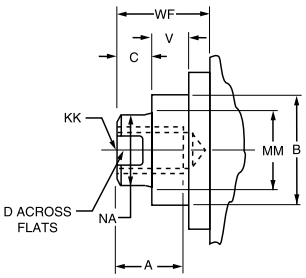
◆◆Dimension "XI" to be specified by customer.

Rod End Dimensions — see table 2

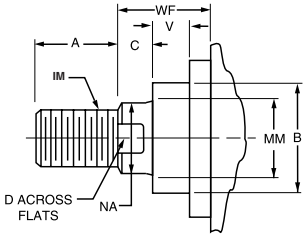
Thread Style 2
Small Male



Thread Style 4
Short Female



Thread Style 5
Intermediate Male



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

"Special" Thread Style X

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W. If otherwise special, furnish dimensioned sketch.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Head Trunnion Mount
Cap Trunnion Mount
Intermediate Trunnion Mount
8" Bore Size

Table 1—Envelope and Mounting Dimensions—Model 81 and Model 82

Bore	E	EE		F	G	J	K	+.000 -.001 TD	TL	UT	Add Stroke	
		NPTF[e]	SAE*								LB	P
8	8 1/2	3/4	12	3/4	2	1 1/2	9/16	1.375	1 3/8	11 1/4	5 7/8	3 1/4

[e] NPTF ports will be furnished as standard unless SAE straight thread ports are specified.
* SAE straight thread ports are indicated by port number.

Table 2—Rod End Dimensions—Model 81 and Model 82

Bore	Rod Dia. MM	Thread		Rod Extensions and Pilot Dimensions							
		Style 5 IM	Style 2 & 4 KK	A	+.000 -.002 B	C	D	LA	NA	V	W
8	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2

Table 3—Envelope and Mounting Dimensions

Bore	TT	XG	Y	Add Stroke	
				XJ	ZB
8	4	3	3 3/16	6 3/8	7 11/16
	7	3 1/4	3 7/16	6 5/8	7 15/16
	4	3 1/4	3 7/16	6 5/8	7 15/16
	5 1/2	3 1/4	3 7/16	6 5/8	7 15/16
	5 1/2	3 1/4	3 7/16	6 5/8	7 15/16
	5 1/2	3 1/4	3 7/16	6 5/8	7 15/16
	4	2 5/8	2 13/16	6	7 5/16
	4	2 7/8	3 1/16	6 1/4	7 9/16
	7	3 1/4	3 7/16	6 5/8	7 15/16
	7	3 1/4	3 7/16	6 5/8	7 15/16

Table 4—Envelope and Mounting Dimensions—Model 89

Bore	BD	E	EE		F	G	J	K	+.000 -.001 TD	TL	TM	UM	UV	Add Stroke		Style DD Min. Stroke
			NPTF[e]	SAE*										LB	P	
8	2 1/2	8 1/2	3/4	12	3/4	2	1 1/2	9/16	1.375	1 3/8	9 3/4	12 1/2	9 1/2	5 7/8	3 1/4	7/8

[e] NPTF ports will be furnished as standard unless SAE straight thread ports are specified.
* SAE straight thread ports are indicated by port number.

Table 5—Rod End Dimensions—Model 89

Bore	Rod Dia. MM	Thread		Rod Extensions and Pilot Dimensions							
		Style 5 IM	Style 2 & 4 KK	A	+.000 -.002 B	C	D	LA	NA	V	W
8	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	3 1/2	1 15/16	3/8	1 1/4
	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	7	5 3/8	1/2	1 1/2
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	4 1/2	2 3/8	1/2	1 1/2
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	5	2 7/8	1/2	1 1/2
	3 1/2	3 1/4-12	2 1/4-12	3 1/2	4.249	1	3	5	3 3/8	1/2	1 1/2
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	5 1/2	3 7/8	1/2	1 1/2
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	2 1/2	1 5/16	1/4	7/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	3 1/8	1 11/16	3/8	1 1/8
	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	6	4 3/8	1/2	1 1/2
	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	6 1/2	4 7/8	1/2	1 1/2

Table 6—Envelope and Mounting Dimensions

Bore	TT	Min.◆◆ XI	Y	Add Stroke
				ZB
8	4	5 5/16	3 3/16	7 11/16
	7	5 9/16	3 7/16	7 15/16
	4	5 9/16	3 7/16	7 15/16
	5 1/2	5 9/16	3 7/16	7 15/16
	5 1/2	5 9/16	3 7/16	7 15/16
	5 1/2	5 9/16	3 7/16	7 15/16
	4	4 15/16	2 13/16	7 5/16
	4	5 3/16	3 1/16	7 9/16
	7	5 9/16	3 7/16	7 15/16
	7	5 9/16	3 7/16	7 15/16

◆◆ Dimension XI to be specified by customer.

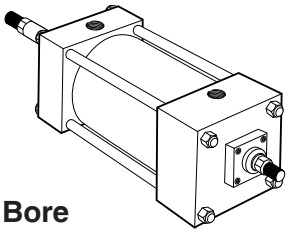
Miller JV Series
Medium-Duty Hydraulic Cylinders

How to Use Double Rod Cylinder Dimension Drawings

To determine dimensions for a double rod cylinder, first refer to the desired single rod mounting style cylinder shown on preceding pages of this catalog. After selecting necessary dimensions from that drawing, return to this page, supplement the single rod dimensions with those shown on the drawing and dimension table. Note that double rod cylinders have a head (Dim. G) at both ends and that dimension LD replaces LB. The double rod dimensions differ from, or are in addition to, those for single rod cylinders shown on preceding pages and provide the information needed to completely dimension a double rod cylinder.

On a double rod cylinder where the two rod ends are different, be sure to clearly state which rod end is to be assembled at which end.

Port position 1 is standard. If other than standard, specify pos. 2, 3, or 4 when viewed from one end only.



8" Bore

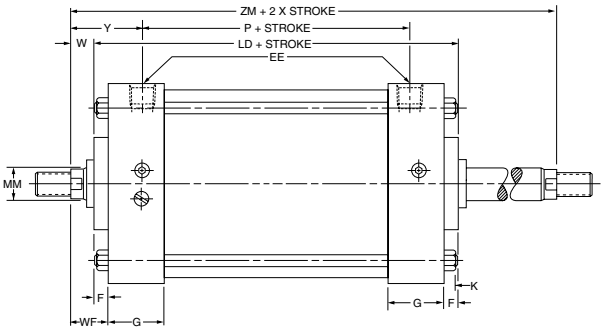


Table 1—Envelope and Mounting Dimensions

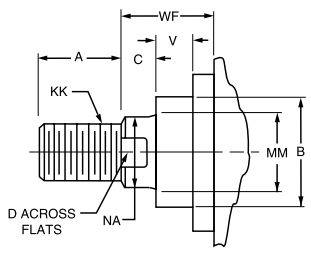
Bore	E	EE (NPTF)	F	G	K	LD	P	SA	SS
8	8 1/2	3/4	3/4	2	9/16	7 1/8	3 1/4	9 1/4	4 1/4

Table 2—Rod End Dimensions

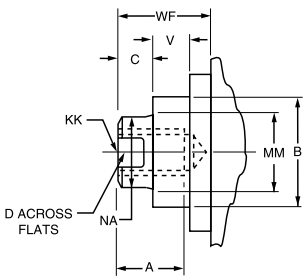
Bore	Rod Dia. MM	Thread		Rod Extensions and Pilot Dimensions									
		Style 5 IM	Style 2 & 4 KK	A	+.000 -.002 B	C	D	NA	V	W	WF	Y	ZM
8	2	1 3/4-12	1 1/2-12	2 1/4	2.624	7/8	1 11/16	1 15/16	3/8	1 1/4	2	3 3/16	9 5/8
	5 1/2	5 1/4-12	4-12	5 1/2	6.249	1	4 5/8	5 3/8	1/2	1 1/2	2 1/4	3 7/16	10 1/8
	2 1/2	2 1/4-12	1 7/8-12	3	3.124	1	2 1/16	2 3/8	1/2	1 1/2	2 1/4	3 7/16	10 1/8
	3	2 3/4-12	2 1/4-12	3 1/2	3.749	1	2 5/8	2 7/8	1/2	1 1/2	2 1/4	3 7/16	10 1/8
	3 1/2	3 1/4-12	2 1/2-12	3 1/2	4.249	1	3	3 3/8	1/2	1 1/2	2 1/4	3 7/16	10 1/8
	4	3 3/4-12	3-12	4	4.749	1	3 3/8	3 7/8	1/2	1 1/2	2 1/4	3 7/16	10 1/8
	1 3/8	1 1/4-12	1-14	1 5/8	1.999	5/8	1 1/8	1 5/16	1/4	7/8	1 5/8	2 13/16	8 7/8
	1 3/4	1 1/2-12	1 1/4-12	2	2.374	3/4	1 1/2	1 11/16	3/8	1 1/8	1 7/8	3 1/16	9 3/8
	4 1/2	4 1/4-12	3 1/4-12	4 1/2	5.249	1	3 7/8	4 3/8	1/2	1 1/2	2 1/4	3 7/16	10 1/8
	5	4 3/4-12	3 1/2-12	5	5.749	1	4 1/4	4 7/8	1/2	1 1/2	2 1/4	3 7/16	10 1/8

Rod End Dimensions — see table 2

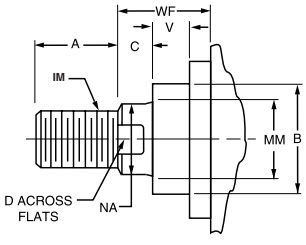
Thread Style 2
Small Male



Thread Style 4
Short Female



Thread Style 5
Intermediate Male



A high strength rod end stud is supplied on thread style 2 through 2" diameter rods and on thread style 5 through 1 3/8" diameter rods. Larger sizes or special rod ends are cut threads. Style 2 rod ends are recommended where the workpiece is secured against the rod shoulder. When the workpiece is not shouldered, style 2 rod ends are recommended through 2" piston rod diameters and style 5 rod ends are recommended on larger diameters. Use style 4 for applications where female rod end threads are required. If rod end is not specified, style 2 will be supplied.

"Special" Thread Style X

Special thread, extension, rod eye, blank, etc., are also available.

To order, specify "Style X" and give desired dimensions for KK, A, W. If otherwise special, furnish dimensioned sketch.

Linear Alignment Couplers are available in 13 standard thread sizes...

Cost Saving Features and Benefits Include...

- Maximum reliability for trouble-free operation, long life and lower operating costs
- Increased cylinder life by reducing wear on piston and rod bearings
- Simplifying cylinder installation and reducing assembly costs
- Increase rod bearing and rod seal life for lower maintenance costs

Alignment Coupler

See Table 1 for Part Numbers and Dimensions

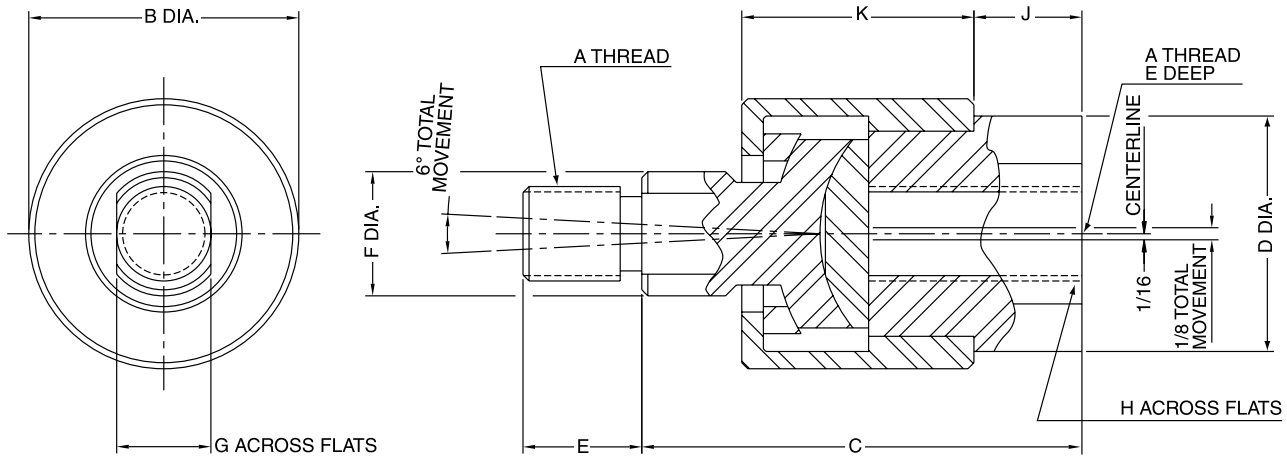


Table 1 — Part Numbers and Dimensions

Part No.	A	B	C	D	E	F	G	H	J	K	Max. Pull Load (lbs.)	Approx. Weight (lbs.)
1347570031	5/16-24	1 1/8	1 3/4	15/16	1/2	1/2	3/8	3/4	3/8	15/16	1200	.35
1347570038	3/8-24	1 1/8	1 3/4	15/16	1/2	1/2	3/8	3/4	3/8	15/16	2425	.35
1347570044	7/16-20	1 3/8	2	1 1/8	3/4	5/8	1/2	7/8	3/8	1 3/32	3250	.55
1347570050	1/2-20	1 3/8	2	1 1/8	3/4	5/8	1/2	7/8	3/8	1 3/32	4450	.55
1347570063	5/8-18	1 3/8	2	1 1/8	3/4	5/8	1/2	7/8	3/8	1 3/32	6800	.55
1347570075	3/4-16	2	2 5/16	1 5/8	1 1/8	15/16	3/4	1 5/16	7/16	1 9/32	9050	1.4
1347570088	7/8-14	2	2 5/16	1 5/8	1 1/8	15/16	3/4	1 5/16	7/16	1 9/32	14450	1.4
1347570100	1-14	3 1/8	3	2 3/8	1 5/8	1 7/16	1 1/4	1 7/8	3/4	1 25/32	19425	4.8
1347570125	1 1/4-12	3 1/8	3	2 3/8	1 5/8	1 7/16	1 1/4	1 7/8	3/4	1 25/32	30500	4.8
1337390125	1 1/4-12	3 1/2	4	2	2	1 1/2	1 1/4	1 11/16	3/4	2 1/2	30500	6.9
1337390150	1 1/2-12	4	4 3/8	2 1/4	2 1/4	1 3/4	1 1/2	1 15/16	7/8	2 3/4	45750	9.8
1337390175	1 3/4-12	4	4 3/8	2 1/4	2 1/4	1 3/4	1 1/2	1 15/16	7/8	2 3/4	58350	9.8
1337390188	1 7/8-12	5	5 5/8	3	3	2 1/4	1 15/16	2 5/8	1 3/8	3 3/8	67550	19.8

How to Order Linear Alignment Couplers — When ordering a cylinder with a threaded male rod end, specify the coupler of equal thread size by part number as listed in Table 1, i.e.; Piston Rod "KK" dimension is 3/4" - 16", specify coupler part number 1347570075.

Miller JV Series
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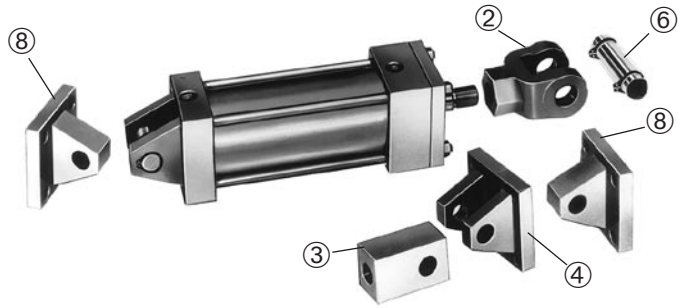


Cylinder Accessories

Miller Fluid Power offers a complete range of cylinder accessories to assure you of greatest versatility in present or future cylinder applications.

Rod End Accessories

Accessories offered for the rod end of the cylinder include Rod Clevis, Eye Bracket, Rod Eye, Clevis Bracket and Pivot Pin. To select the proper part number for any desired accessory, refer to Chart A below and look opposite the thread size of the rod end as indicated in the first column. The Pivot Pins, Eye Brackets and Clevis Brackets are listed opposite the thread size which their mating Rod Eyes or Clevises fit.

Chart A

Thread Size	Mating Parts			Mating Parts			Alignment Coupler
	Rod Clevis	Eye Bracket	Pin	Rod Eye	Clevis Bracket	Pin	
5/16-24	51221	74077	—	74075	74076	74078	1347570031
7/16-20	50940	69195	68368	69089	69205	68368	1347570044
1/2-20	50941	69195	68368	69090	69205	68368	1347570050
3/4-16	50942	69196	68369	69091	69206	68369	1347570075
3/4-16	133284	69196	68369	69091	69206	68369	1347570075
7/8-14	50943	*85361	68370	69092	69207	68370	1347570088
1-14	50944	*85361	68370	69093	69207	68370	1347570100
1-14	133285	*85361	68370	69093	69207	68370	1347570100
1 1/4-12	50945	69198	68371	69094	69208	68371	1347570125
1 1/4-12	133286	69198	68371	69094	69208	68371	1347570125
1 1/2-12	50946	*85362	68372	69095	69209	68372	1337390150
1 3/4-12	50947	*85363	68373	69096	69210	69215	1337390175
1 7/8-12	50948	*85363	68373	69097	69210	69215	1337390188
2 1/4-12	50949	*85364	68374	69098	69211	68374	Consult Factory
2 1/2-12	50950	*85365	68375	69099	69212	68375	
2 3/4-12	50951	*85365	68375	69100	69213	69216	
3 1/4-12	50952	73538	73545	73536	73542	73545	
3 1/2-12	50953	73539	73547	73537	73542	73545	
4-12	50954	73539	73547	73538	73543	82181	
4 1/2-12	–	–	–	73439	73544	73547	

*Cylinder accessory dimensions conform to NFPA recommended standard NFPA/T3.6.8 R1-1984, NFPA recommended standard fluid power systems — cylinder — dimensions for accessories for cataloged square head industrial types.

Note: For economical accessory selection, it is recommended that rod end style 2 be specified on your cylinder order.

Accessory Load Capacity

The various accessories on these pages have been load rated for your convenience. The load capacity in lbs. shown, is the recommended maximum load for that accessory based on a 4:1 design factor in tension. (Pivot Pin is rated in shear.) Before specifying, compare the actual load or the tension (pull) force at maximum operating pressure of the cylinder with the load capacity of the accessory you plan to use. If load or pull force of cylinder exceeds load capacity of accessory, consult factory.

Chart B

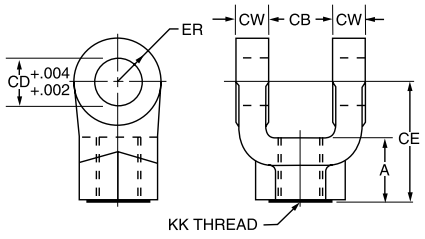
Eye Bracket Part No.	JV Series Bore Size
74076‡	1"
69195	1 1/2", 2", 2 1/2"
69196	3 1/4", 4", 5"
*85361	6", 8"

‡Use Clevis Bracket P/N 74076 for 1" bore single lug Model 84.

Eye Brackets

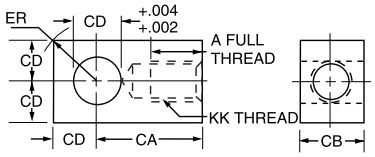
Eye Brackets for Model 84 (clevis mounted) cylinders are offered. To select proper part number for your application, refer to Chart B.

② Rod Clevis



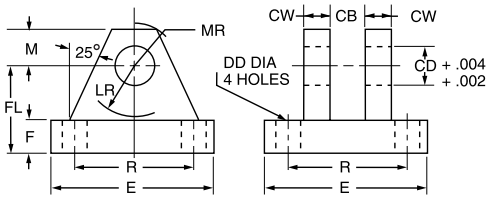
Order to fit thread size.

③ Rod Eye



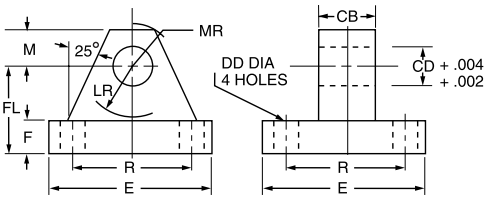
Order to fit thread size.

④ Clevis Bracket



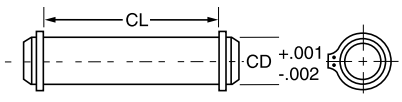
Order to fit Rod Eye.

⑧ Eye Bracket



1. When used to mate with the Rod Clevis, select from Chart A.
2. When used to mount the Model 84 cylinders, select from Chart B at lower left.

⑥ Pivot Pin



1. Pivot Pins are furnished with Clevis Mounted Cylinders as standard.
2. Pivot Pins are furnished with (2) Retainer Rings.
3. Pivot Pins must be ordered as a separate item if to be used with Rod Eyes, Rod Clevises, or Clevis Brackets.

Miller JV Series
Medium-Duty Hydraulic Cylinders

	Rod Clevis Part Number																		
	51221†	50940	50941	50942	133284	50943	50944	133285	50945	133286	50946	50947	50948	50949	50950	50951	50952	50953	50954
A	13/16	3/4	3/4	1 1/8	1 1/8	1 5/8	1 5/8	1 5/8	1 7/8	2	2 1/4	3	3	3 1/2	3 1/2	3 1/2	3 1/2	4	4
CB	11/32	3/4	3/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	2	2	2 1/2	2 1/2	2 1/2	3	3	3	4	4 1/2	4 1/2
CD	5/16	1/2	1/2	3/4	3/4	1	1	1	1 3/8	1 3/8	1 3/4	2	2	2 1/2	3	3	3 1/2	4	4
CE	2 1/4	1 1/2	1 1/2	2 1/8	2 3/8	2 15/16	2 15/16	3 1/8	3 3/4	4 1/8	4 1/2	5 1/2	5 1/2	6 1/2	6 3/4	6 3/4	7 3/4	8 13/16	8 13/16
CW	13/64	1/2	1/2	5/8	5/8	3/4	3/4	3/4	1	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	2	2 1/4	2 1/4
ER	19/64	1/2	1/2	3/4	3/4	1	1	1	1 3/8	1 3/8	1 3/4	2	2	2 1/2	2 3/4	2 3/4	3 1/2	4	4
KK	5/16-24	7/16-20	1/2-20	3/4-16	3/4-16	7/8-14	1-14	1-14	1 1/4-12	1 1/4-12	1 1/2-12	1 3/4-12	1 7/8-12	2 1/4-12	2 1/2-12	2 3/4-12	3 1/4-12	3 1/2-12	4-12
Load Capacity Lbs. ⊖	2600	4250	4900	11200	11200	18800	19500	19500	33500	33500	45600	65600	65600	98200	98200	98200	156700	193200	221200

	Rod Eye Part Number																
	74075	69089	69090	69091	69092	69093	69094	69095	69096	69097	69098	69099	69100	73536	73437	73438	73439
A	3/4	3/4	3/4	1 1/8	1 1/8	1 5/8	2	2 1/4	2 1/4	3	3 1/2	3 1/2	3 5/8	4 1/2	5	5 1/2	5 1/2
CA	1 1/2	1 1/2	1 1/2	2 1/16	2 3/8	2 13/16	3 7/16	4	4 3/8	5	5 13/16	6 1/8	6 1/2	7 5/8	7 5/8	9 1/8	9 1/8
CB	7/16	3/4	3/4	1 1/4	1 1/2	1 1/2	2	2 1/2	2 1/2	2 1/2	3	3	3 1/2	4	4	4 1/2	5
CD	7/16	1/2	1/2	3/4	1	1	1 3/8	1 3/4	2	2	2 1/2	3	3	3 1/2	3 1/2	4	4
ER	19/32	23/32	23/32	1 1/16	1 7/16	1 7/16	1 31/32	2 1/2	2 27/32	2 27/32	3 9/16	4 1/4	4 1/4	4 31/32	4 31/32	5 11/16	5 11/16
KK	5/16-24	7/16-20	1/2-20	3/4-16	7/8-14	1-14	1 1/4-12	1 1/2-12	1 3/4-12	1 7/8-12	2 1/4-12	2 1/2-12	2 3/4-12	3 1/4-12	3 1/2-12	4-12	4 1/2-12
Load Capacity Lbs.⊖	3300	5000	5700	12100	13000	21700	33500	45000	53500	75000	98700	110000	123300	161300	217300	273800	308500

	Clevis Bracket Part Number												
	74076	69205	69206	69207	69208	69209	69210	69211	69212	69213	73542	73543	73544
CB	15/32	3/4	1 1/4	1 1/2	2	2 1/2	2 1/2	3	3	3 1/2	4	4 1/2	5
CD	7/16	1/2	3/4	1	1 3/8	1 3/4	2	2 1/2	3	3	3 1/2	4	4
CW	3/8	1/2	5/8	3/4	1	1 1/4	1 1/2	1 1/2	1 1/2	1 1/2	2	2	2
DD	17/64	13/32	17/32	21/32	21/32	29/32	1 1/16	1 3/16	1 5/16	1 5/16	1 13/16	2 1/16	2 1/16
E	2 1/4	3 1/2	5	6 1/2	7 1/2	9 1/2	12 3/4	12 3/4	12 3/4	12 3/4	15 1/2	17 1/2	17 1/2
F	3/8	1/2	5/8	3/4	7/8	7/8	1	1	1	1	1 11/16	1 15/16	1 15/16
FL	1	1 1/2	1 7/8	2 1/4	3	3 5/8	4 1/4	4 1/2	6	6	6 11/16	7 11/16	7 11/16
LR	5/8	3/4	1 3/16	1 1/2	2	2 3/4	3 3/16	3 1/2	4 1/4	4 1/4	5	5 3/4	5 3/4
M	3/8	1/2	3/4	1	1 3/8	1 3/4	2 1/4	2 1/2	3	3	3 1/2	4	4
MR	1/2	5/8	29/32	1 1/4	1 21/32	2 7/32	2 25/32	3 1/8	3 19/32	3 19/32	4 1/8	4 7/8	4 7/8
R	1.75	2.55	3.82	4.95	5.73	7.50	9.40	9.40	9.40	9.40	12.00	13.75	13.75
Load Capacity Lbs.⊖	3600	7300	14000	19200	36900	34000	33000	34900	33800	36900	83500	102600	108400

	Eye Bracket Part Number										
	74077	69195	69196	85361*	69198	85362*	85363*	85364*	85365*	73538	73539
CB	5/16	3/4	1 1/4	1 1/2	2	2 1/2	2 1/2	3	3	4	4 1/2
CD	5/16	1/2	3/4	1	1 3/8	1 3/4	2	2 1/2	3	3 1/2	4
DD	17/64	13/32	17/32	21/32	21/32	29/32	1 1/16	1 3/16	1 5/16	1 13/16	2 1/16
E	2 1/4	2 1/2	3 1/2	4 1/2	5	6 1/2	7 1/2	8 1/2	9 1/2	12 5/8	14 7/8
F	3/8	3/8	5/8	7/8	7/8	1 1/8	1 1/2	1 3/4	2	1 11/16	1 15/16
FL	1	1 1/8	1 7/8	2 3/8	3	3 3/8	4	4 3/4	5 1/4	5 11/16	6 7/16
LR	5/8	3/4	1 1/4	1 1/2	2 1/8	2 1/4	2 1/2	3	3 1/4	4	4 1/2
M	3/8	1/2	3/4	1	1 3/8	1 3/4	2	2 1/2	2 3/4	3 1/2	4
MR	1/2	9/16	7/8	1 1/4	1 5/8	2 1/8	2 7/16	3	3 1/4	4 1/8	5 1/4
R	1.75	1.63	2.55	3.25	3.82	4.95	5.73	6.58	7.50	9.62	11.45
Load Capacity Lbs.⊖	1700	4100	10500	20400	21200	49480	70000	94200	121900	57400	75000

	Pivot Pin Part Number													
	74078	68368	68369	68370	68371	68372	68373	69215	68374	68375	69216	73545	82181	73547•
CD	7/16	1/2	3/4	1	1 3/8	1 3/4	2	2	2 1/2	3	3	3 1/2	4	4
CL	1 5/16	1 7/8	2 5/8	3 1/8	4 1/8	5 3/16	5 3/16	5 11/16	6 3/16	6 1/4	6 3/4	8 1/4	8 5/8	9
Shear Capacity Lbs.⊖	6600	8600	19300	34300	65000	105200	137400	137400	214700	309200	309200	420900	565800	565800

*Cylinder accessory dimensions conform to NFPA recommended standard NFPA/T3.6.8 R1-1984, NFPA recommended standard fluid power systems — cylinder — dimensions for accessories for cataloged square head industrial types.

⊖ See Accessory Load Capacity note on opposite page.

•This size supplied with cotter pins.

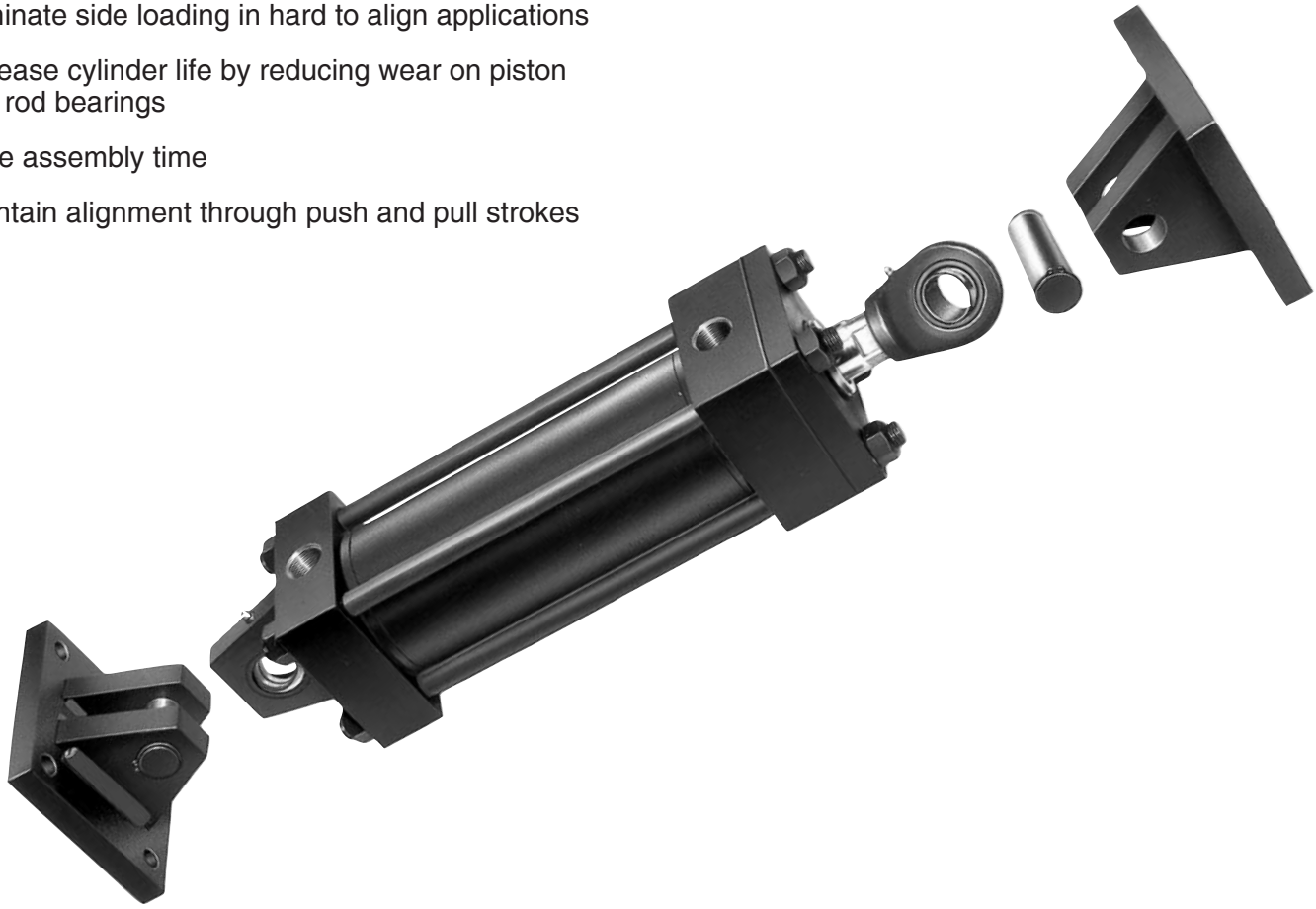
†Includes Pivot Pin.

Spherical Bearings For JV Series Cylinders

Spherical Bearing Mount That Maintains Alignment Through Push and Pull Strokes.

Benefits Are...

- Simplify installation of cylinder
- Reduce cylinder friction
- Eliminate side loading in hard to align applications
- Increase cylinder life by reducing wear on piston and rod bearings
- Save assembly time
- Maintain alignment through push and pull strokes
- Increase rod bearing and rod seal life
- Simplify machine design problems



JV Series hydraulic cylinders are available with spherical bearing mounts at both ends or head and cap end only. The bearing at the cap end is housed in a single stud ear welded to the cap to form an integral structure. At the head end the bearing is mounted in a steel rod eye threaded to the piston rod. Grease fittings are provided for lubrication.

The spherical bearing mount provides swivel connections at both ends of the cylinder to reduce misalignment problems and to maintain alignment through push and pull strokes.

The bearing races are designed primarily for radial loads and moderate misalignment not to exceed angle “a” as shown in Table 1 on the next page.

The accessories, rod eye, pivot pin and clevis brackets are all designed to take maximum loading of the cylinder.

Application and Design Data

The spherical bearing life is influenced by many factors, i.e., bearing pressure, load direction oscillating angle and lubrication. The maximum operating pressure ratings of the spherical bearing mountings are based on standard commercial bearing ratings. The 4:1 design factor rating is based on the tensile strength of the material.

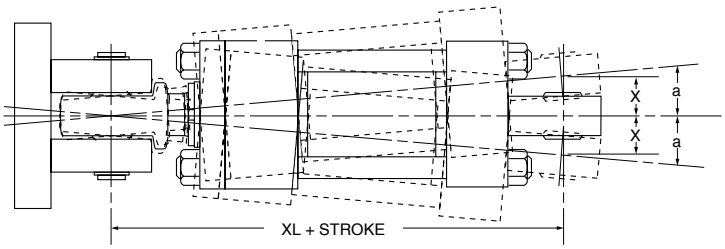
The spherical bearings are dimensioned to ensure a satisfactory bearing life under normal operating conditions. The bearing races are made of through-hardened steel and are precision ground. They are phosphate treated and coated with dry film lubricant to minimize friction of contacting surfaces. In the case of a permanent unidirectional load to the bearing, or other unusual operating conditions, the use of a larger bearing may be required.

For longer bearing life, regular lubrication will protect the spherical plain bearing from premature wear and corrosion. Rust-inhibiting EP greases of lithium/lead base, preferably with molybdenum disulphide additives are particularly suited. The radial bearings have lubricating holes and grooves in the races permitting lubrication. The bearing housings at the cap and rod end are provided with grease fittings for lubrication.

Maximum angle of swivel in relation to the center line of the pivot pin is shown as angle **a** in the table below. It is recommended that this angle is not exceeded when mounting the cylinder.

Mounting Information

Head End Mounting



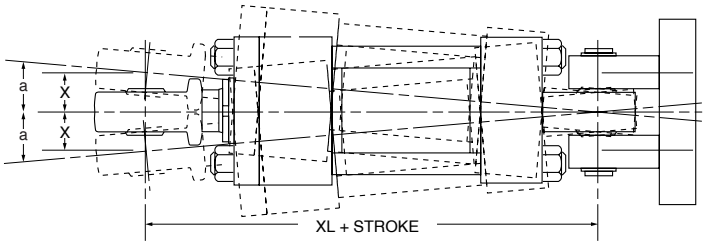
Recommended maximum swivel angle on each side of the cylinder centerline.

Table 1

	Head End Mounted		Cap End Mounted	
Bore	**Angle a**	**Tan. of a**	**Angle a**	**Tan. of a**
1 1/2	2°	.035	2°	.035
2	2 1/2°	.044	4 1/2°	.079
2 1/2	2 1/2°	.044	4 1/2°	.079
3 1/4	3°	.052	3°	.052
4	2 1/2°	.044	3°	.052
5 - 8	3°	.052	3°	.052

Note: Dimension X is the maximum off center mounting of the cylinder. To determine dimension X for various stroke lengths multiply distance between pivot pin holes by tangent of angle **a**. For extended position use X = XL + 2X stroke.

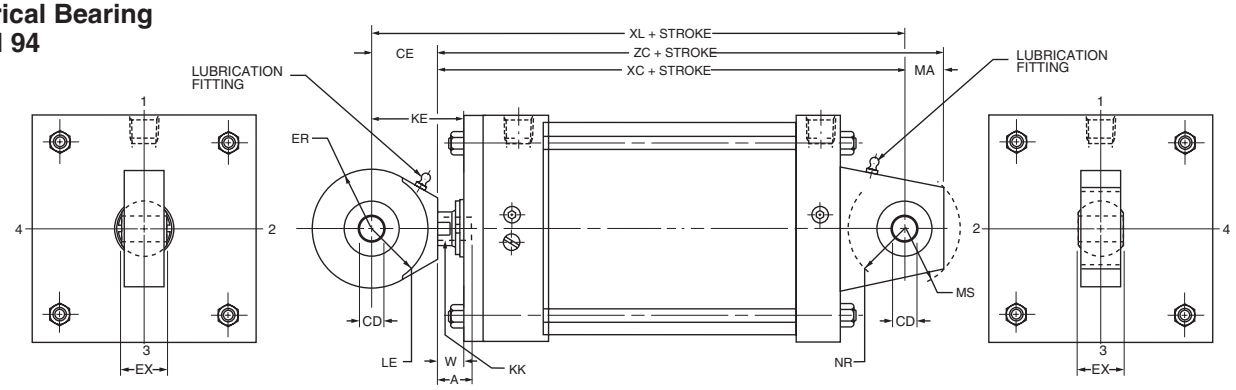
Cap End Mounting



Miller JV Series
Medium-Duty Hydraulic Cylinders

Spherical Bearing Mount
1½" to 8" Bore Sizes

Cap Fixed Eye Mount with Spherical Bearing Model 94



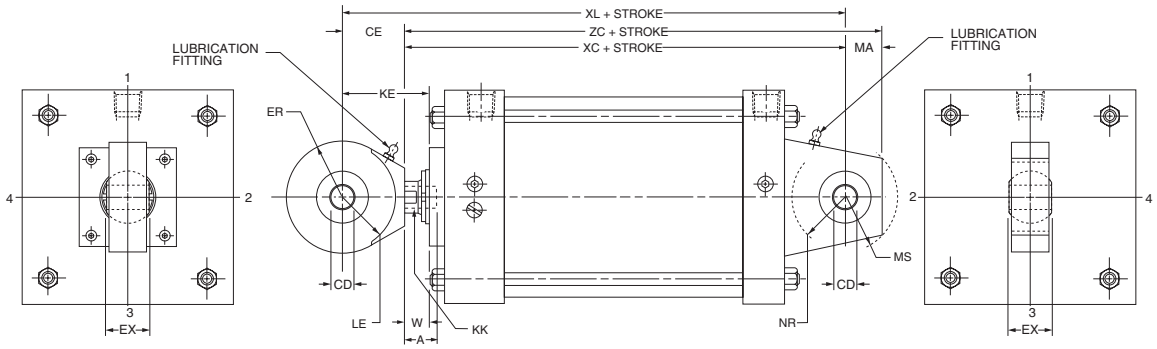
Bore	Rod Dia. MM	** Thread Style 4 KK	A	W	Add Stroke XC	Add Stroke XL	Add Stroke ZC	KE	CD*	CE	ER	EX	LE	MA	MS	NR	Max. Oper. PSI†
1½	5/8	7/16-20	3/4	5/8	5 3/8	6 1/4	6 1/8	1 1/2	-.0005 .5000	7/8	13/16	7/16	3/4	3/4	15/16	5/8	1500
	1	3/4-16	1 1/8	1	5 3/4	6 5/8	6 1/2	1 7/8									
2	5/8	7/16-20	3/4	5/8	5 3/8	6 1/4	6 1/8	1 1/2	-.0005 .5000	7/8	13/16	7/16	3/4	3/4	15/16	5/8	980
	1 3/8	1-14	1 5/8	1 1/4	6	6 7/8	6 3/4	2 1/8									
	1	3/4-16	1 1/8	1	5 3/4	6 5/8	6 1/2	1 7/8									
2½	5/8	7/16-20	3/4	5/8	5 1/2	6 3/8	6 1/4	1 1/2	-.0005 .5000	7/8	13/16	7/16	3/4	3/4	15/16	5/8	630
	1 3/4	1 1/4-12	2	1 1/2	6 3/8	7 1/4	7 1/8	2 3/8									
	1	3/4-16	1 1/8	1	5 7/8	6 3/4	6 5/8	1 7/8									
	1 3/8	1-14	1 5/8	1 1/4	6 1/8	7	6 7/8	2 1/8									
3 1/4	1	3/4-16	1 1/8	3/4	6 7/8	8 1/8	7 7/8	2	-.0005 .7500	1 1/4	1 1/8	21/32	1 1/16	1	1 3/8	1	830
	2	1 1/2-12	2 1/4	1 3/8	7 1/2	8 3/4	8 1/2	2 5/8									
	1 3/8	1-14	1 5/8	1	7 1/8	8 3/8	8 1/8	2 1/4									
	1 3/4	1 1/4-12	2	1 1/4	7 3/8	8 5/8	8 3/8	2 1/2									
4	1	3/4-16	1 1/8	3/4	6 7/8	8 1/8	7 7/8	2	-.0005 .7500	1 1/4	1 1/8	21/32	1 1/16	1	1 3/8	1	550
	2 1/2	1 7/8-12	3	1 5/8	7 3/4	9	8 3/4	2 7/8									
	1 3/8	1-14	1 5/8	1	7 1/8	8 3/8	8 1/8	2 1/4									
	1 3/4	1 1/4-12	2	1 1/4	7 3/8	8 5/8	8 3/8	2 1/2									
	2	1 1/2-12	2 1/4	1 3/8	7 1/2	8 3/4	8 1/2	2 5/8									
5	1	3/4-16	1 1/8	3/4	7 1/8	8 3/8	8 1/8	2	-.0005 .7500	1 1/4	1 1/8	21/32	1 1/16	1	1 3/8	1	350
	3 1/2	2 1/2-12	3 1/2	1 5/8	8	9 1/4	9	2 7/8									
	1 3/8	1-14	1 5/8	1	7 3/8	8 5/8	8 3/8	2 1/4									
	1 3/4	1 1/4-12	2	1 1/4	7 5/8	8 7/8	8 5/8	2 1/2									
	2	1 1/2-12	2 1/4	1 3/8	7 3/4	9	8 3/4	2 5/8									
	2 1/2	1 7/8-12	3	1 5/8	8	9 1/4	9	2 7/8									
	3	2 1/4-12	3 1/2	1 5/8	8	9 1/4	9	2 7/8									
6	1 3/8	1-14	1 5/8	7/8	8 1/8	10	9 3/8	2 3/4	-.0005 1.0000	1 7/8	1 1/4	7/8	1 7/16	1 1/4	1 11/16	1 1/4	440
	4	3-12	4	1 1/2	8 3/4	10 5/8	10	3 3/8									
	1 3/4	1 1/4-12	2	1 1/8	8 3/8	10 1/4	9 5/8	3									
	2	1 1/2-12	2 1/4	1 1/4	8 1/2	10 3/8	9 3/4	3 1/8									
	2 1/2	1 7/8-12	3	1 1/2	8 3/4	10 5/8	10	3 3/8									
	3	2 1/4-12	3 1/2	1 1/2	8 3/4	10 5/8	10	3 3/8									
	3 1/2	2 1/2-12	3 1/2	1 1/2	8 3/4	10 5/8	10	3 3/8									

Maximum operating pressure at 4:1 design factor is based on tensile strength of material. Pressure ratings are based on standard commercial bearing ratings.
* Dimension CD is hole diameter.
** To match pin diameter in rod eye and cap, when an oversize rod is required, specify rod end style 'X', 'KK' thread and 'A' thread length for the standard rod diameter (first rod listed for the bore), and 'W' for the oversize rod. Order the rod eye and clevis bracket for the required bore size from the tables on the Spherical Bearings Accessory page.
† Maximum operating pressure at 4:1 design factor is based on tensile strength of material.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Spherical Bearing Mount
1½" to 8" Bore Sizes

Cap Fixed Eye Mount with Spherical Bearing Model 94



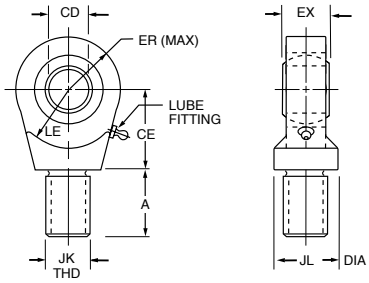
Bore	Rod Dia. MM	** Thread Style 4 KK	A	W	Add Stroke XC	Add Stroke XL	Add Stroke ZC	KE	CD*	CE	ER	EX	LE	MA	MS	NR	Max. Oper. PSI†
8	1 3/8	1-14	1 5/8	7/8	8 1/4	10 1/8	9 1/2	2 3/4	-.0005 1.0000	1 7/8	1 1/4	7/8	1 7/16	1 1/4	1 11/16	1 1/4	250
	5 1/2	4-12	5 1/2	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
	1 3/4	1 1/4-12	2	1 1/8	8 1/2	10 3/8	9 3/4	3									
	2	1 1/2-12	2 1/4	1 1/4	8 5/8	10 1/2	9 7/8	3 1/8									
	2 1/2	1 7/8-12	3	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
	3	2 1/4-12	3 1/2	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
	3 1/2	2 1/2-12	3 1/2	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
	4	3-12	4	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
	4 1/2	3 1/4-12	4 1/2	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									
	5	3 1/2-12	5	1 1/2	8 7/8	10 3/4	10 1/8	3 3/8									

Maximum operating pressure at 4:1 design factor is based on tensile strength of material. Pressure ratings are based on standard commercial bearing ratings.
* Dimension CD is hole diameter.
** To match pin diameter in rod eye and cap, when an oversize rod is required, specify rod end style 'X', 'KK' thread and 'A' thread length for the standard rod diameter (first rod listed for the bore), and 'W' for the oversize rod. Order the rod eye and clevis bracket for the required bore size from the tables on the Spherical Bearings Accessory page.
† Maximum operating pressure at 4:1 design factor is based on tensile strength of material.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Miller offers a complete range of Cylinder Accessories to assure you of the greatest versatility in present or future cylinder applications. Accessories offered for the respective cylinder include the Rod Eye, Pivot Pin and Clevis Bracket. To select the proper part number for any desired accessory refer to the charts below.

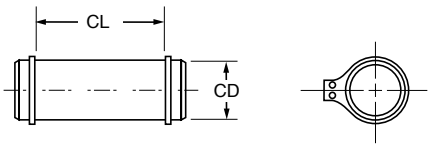
Spherical Rod Eye



Order to fit Piston Rod Thread Size.

Bore Sizes	1 1/2, 2 & 2 1/2	3 1/4, 4 & 5	6 & 8
Part No.	132290	132291	132292
CD	.5000-0005	.7500-0005	1.0000-0005
A	11/16	1	1 1/2
CE	7/8	1 1/4	1 7/8
EX	7/16	21/32	7/8
ER	7/8	1 1/4	1 3/8
LE	3/4	1 1/16	1 7/16
JK	7/16-20	3/4-16	1-14
JL	7/8	1 5/16	1 1/2
LOAD CAPACITY LBS.	2644	9441	16860

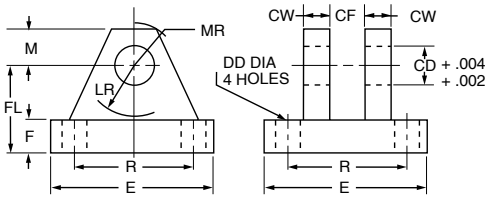
Pivot Pin



Pivot Pins are furnished with (2) Retainer Rings.

Bore Sizes	1 1/2, 2 & 2 1/2	3 1/4, 4 & 5	6 & 8
Part No.	83962	83963	83964
CD	.4997-0004	.7497-0005	.9997-0005
CL	1 9/16	2 1/32	2 1/2
LOAD CAPACITY LBS.	8600	19300	34300

Clevis Bracket



Order to fit Cap or Rod Eye.

Bore Sizes	1 1/2, 2 & 2 1/2	3 1/4, 4 & 5	6 & 8
Part No.	83947	83948	83949
CD	1/2	3/4	1
CF	7/16	21/32	7/8
CW	1/2	5/8	3/4
DD	13/32	13/32	17/32
E	3	3 3/4	5 1/2
F	1/2	5/8	3/4
FL	1 1/2	2	2 1/2
LR	15/16	1 3/8	1 11/16
M	1/2	7/8	1
MR	5/8	1	1 3/16
R	2.05	2.76	4.10
LOAD CAPACITY LBS.	5770	9450	14300

NOTES

Theoretical Push and Pull Forces

Push Force and Displacement

Cyl. Bore Size (Inches)	Piston Area (Sq. In.)	Cylinder Push Stroke Force In Pounds At Various Pressures										Displacement Per Inch Of Stroke (Gallons)
		25	50	65	80	100	250	500	1000	2000	3000	
1	.785	20	39	51	65	79	196	392	785	1570	2355	.0034
1 1/2	1.767	44	88	115	142	177	443	885	1770	3540	5310	.00765
2	3.14	79	157	204	251	314	785	1570	3140	6280	9420	.0136
2 1/2	4.91	123	245	319	393	491	1228	2455	4910	9820	14730	.0213
3 1/4	8.30	208	415	540	664	830	2075	4150	8300	16600	24900	.0359
4	12.57	314	628	817	1006	1257	3143	6285	12570	25140	37710	.0544
5	19.64	491	982	1277	1571	1964	4910	9820	19640	39280	58920	.0850
6	28.27	707	1414	1838	2262	2827	7068	14135	28270	56540	84810	.1224
7	38.49	962	1924	2502	3079	3849	9623	19245	38490	76980	115470	.1666
8	50.27	1257	2513	3268	4022	5027	12568	25135	50270	100540	150810	.2176

Deductions for Pull Force and Displacement

Piston Rod Dia. (Inches)	Piston Area (Sq. In.)	Piston Rod Diameter Force In Pounds At Various Pressures To determine Cylinder Pull Force or Displacement, deduct the following Force or Displacement corresponding to Rod Size, from selected Push Stroke Force or Displacement corresponding to Bore Size in table above.										Displacement Per Inch Of Stroke (Gallons)
		25	50	65	80	100	250	500	1000	2000	3000	
1/2	.196	5	10	13	16	20	49	98	196	392	588	.0009
5/8	.307	8	15	20	25	31	77	154	307	614	921	.0013
1	.785	20	39	51	65	79	196	392	785	1570	2355	.0034
1 3/8	1.49	37	75	97	119	149	373	745	1490	2980	4470	.0065
1 3/4	2.41	60	121	157	193	241	603	1205	2410	4820	7230	.0104
2	3.14	79	157	204	251	314	785	1570	3140	6280	9420	.0136
2 1/2	4.91	123	245	319	393	491	1228	2455	4910	9820	14730	.0213
3	7.07	177	354	460	566	707	1767	3535	7070	14140	21210	.0306
3 1/2	9.62	241	481	625	770	962	2405	4810	9620	19240	28860	.0416
4	12.57	314	628	817	1006	1257	3143	6285	12570	25140	37710	.0544
4 1/2	15.90	398	795	1033	1272	1590	3975	7950	15900	31800	47708	.0688
5	19.64	491	982	1277	1571	1964	4910	9820	19640	39280	58920	.0850
5 1/2	23.76	594	1188	1544	1901	2376	5940	11880	23760	47520	71280	.1028

General Formula

The cylinder output forces are derived from the formula:

$$F = P \times A$$

Where F = Force in pounds.
P = Pressure at the cylinder in pounds per square inch, gauge.
A = Effective area of cylinder piston in square inches.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Operating Fluids and Temperature Range
Fluidpower cylinders are designed for use with pressurized air, hydraulic oil and fire resistant fluids, in some cases special seals are required.

Class 1 Seals
Class 1 seals are the standard seals provided in a cylinder assembly. They are intended for use with fluids such as: air, nitrogen, mineral base hydraulic oil or MIL-H-5606 within the temperature range of -10°F (-23°C) to +165°F (+74°C). The individual seals may be nitrile (Buna-N), enhanced polyurethane, polymyte, PTFE or filled PTFE.

Class 2 (Nitrile) Seals
Class 2 seals are intended for use with water base fluids within the temperature of -10°F (-23°C) to +165°F (+74°C) except for High Water Content Fluids (HWCF) in which case Class 6 seals should be used. Typical water base fluids compatible with Class 2 seals are: Water, Water-Glycol, Water-in Emulsion, Houghto-Safe 27, 620 5040, Mobil Pyrogard D, Shell Irus 905, Ucon Hydrolube J-4. Class 2 seals are nitrile. Lipseal will have polymyte or PTFE back-up washer when required. O-rings will have nitrile back-up washers when required.

Class 3 Seals — Ethylene Propylene (E.P.R.) Seals
Class 3 seals are intended for use with some Phosphate Ester Fluids between the temperatures of -10°F (-23°C) to +130°F (+54°C). Typical fluids compatible with Class 3 seals are Skydrol 500 and 700. Class 3 seals are Ethylene Propylene. Lipseals will have a PTFE back-up washer when required. O-rings will have EPR back-up washers when required. Note: Class 3 seals are not compatible with mineral base hydraulic oil or greases. Even limited exposure to these fluids will cause severe swelling. PTFE back-up washer may not be suitable when used in a radiation environment.

Class 4 Seals — Nitrile Seals
Class 4 seals are intended for low temperature service with the same type of fluids as used with Class 1 seals within the temperature range of -50°F (-46°C) to +150°F (+66°C). Class 4 seals are nitrile seals. Lipseals will have leather, polymyte or PTFE back-up washers when required. O-rings will have nitrile back-up washers when required.

Note: Certain fluids may react adversely with Class 4 seals compared to Class 1 seals.

Class 5 Seals — Fluorocarbon Seals
Class 5 seals are intended for elevated temperature service or for some Phosphate Ester Fluids such as Houghto-Safe 1010, 1055, 1120; Fyrquel 150, 220, 300, 350; Mobil Pyrogard 42, 43, 53, and 55. Note: In addition, Class 5 seals can be used with fluids listed below under Class 1 or Class 2 service. However, they are not compatible with Phosphate Ester Fluids such as Skydrols. Class 5 seals can operate with a temperature range of -10°F (-23°C) to +250°F (+121°C). Fluorocarbon seals may be operated to +400°F (+204°C) with limited service life. For temperatures above +250°F (-121°C) the cylinder must be manufactured with non-studded piston rod thread and a pinned piston to rod connection. Class 5 seals are fluorocarbon seals. Lipseals will have PTFE back-up washers. O-rings will have fluorocarbon back-up when required.

Class 6 Seals
Class 6 seals are intended for High Water Content Fluids (HWCF) such as Houghton Hydrolubric 120B and Sonsol Lubrizol within the temperature range of +40°F (+4°C) to +120°F (+49°C). Class 6 seals are special nitrile compound dynamic seals. Lipseals will have PTFE and or polymyte back-up washers when required. O-rings will have nitrile back-up washers when required. Because of the viscosity of these fluids, cylinders specified with Class 6 seals, will also be modified to have lipseal piston seals and straight cushions.

Lipseal Pistons
Lipseals with a back-up washers are standard in JV cylinders and are often used for hydraulic applications when virtually zero static leakage is required. Lipseals will function properly in these applications when used in conjunction with moderate hydraulic pressures.

Warning!
The piston rod stud and the piston rod to piston threaded connections are secured with an anaerobic adhesive which is temperature sensitive. Cylinders specified with fluorocarbon seals are assembled with anaerobic adhesive having a maximum temperature rating of +250°F (+121°C). Cylinders specified with all other seal compounds are assembled with anaerobic adhesive have a maximum operating temperature rating +165°F (+74°C). These temperature limitations are necessary to prevent the possible loosening of the threaded connections. Cylinders originally manufactured with Class 1 seals (Nitrile) that will be exposed to ambient temperatures above +165°F (+74°C) must be modified for higher temperature service. Contact the factory immediately and arrange for the piston to rod and the stud to piston rod connections to be properly reassembled to withstand the higher temperature service.

Low Friction Hydraulic Seals
Low Friction hydraulic seals are available as an option for both piston and piston rod seals for JV Series cylinders. They are sometimes used when a cylinder is controlled by servo or proportional valve. The seal assembly itself is a two piece assembly consisting of a filled PTFE dynamic seal with an elastomer expander. A piston seal assembly consists of one seal assembly in the middle of the piston with a filled PTFE wear ring on each side of the piston. The piston rod seal assembly consists of two seal assemblies and an elastomer wiper seal. The filled PTFE seals are compatible with Class 1, 2, 3, 4 & 5 fluids and provide virtually leak free sealing. The expanders and rod wiper will be nitrile unless Class 3 or 5 seals are specified. In those cases the expanders and wiper will be EPR and fluorocarbon respectively. When specifying low friction seals specify if piston, piston rod seals or both are required. Note: It may be necessary to cycle these seals 40 or 50 times before achieving leakage free performance.

Cast Iron Piston Rings
Cast iron rings optional piston seals for JV Series cylinders. They offer the widest operating conditions by tolerating high operating pressures, wide temperature range and are compatible with most fluids. The only drawback of cast iron rings is that they allow a small amount of leakage. The leakage for a 4" bore cylinder, operating at 2000 psi, with mineral base hydraulic fluid will be less than 10in/²min. Leakage will increase as pressure, bore size and viscosity of the operating hydraulic fluid increases. For these reasons cast iron rings are not recommended when using water or Class 6 fluids.

Water Service
JV Series hydraulic cylinders can also be modified for water operation and supplied with chrome-plated cylinder bore; electroless nickel-plated head, cap and piston; chrome-plated precipitation hardened stainless steel piston rod, chrome-plated cushion plungers. When high water base fluids are the operating medium, hydraulic cylinders are usually supplied with high water base rod wiper and seals. Water and high water base fluid operated cylinders are best used on short stroke applications or where high pressure is applied only to clamp the load.

Warranty
Miller will warrant cylinders modified for water or high water content fluid service to be free of defects in materials or workmanship, but cannot accept responsibility for premature failure due to excessive wear resulting from lack of lubricity or where failure is caused by corrosion, electrolysis or mineral deposits within the cylinder.

Class No.	Typical Fluids	Temperature Range
1 Standard Nitrile Polyurethane	Air, Nitrogen Hydraulic Oil, Mil-H-5606 Oil	-10°F (-23°C) to +165°F (+74°C)
2* Optional Water base fluid seal Nitrile	Water, Water-Glycol, HWCF — See Class 6 below. Water-in-Oil Emulsion Houghto-Safe, 271, 620, 5040 Mobil Pyrogard D, Shell Irus 905 Ucon Hydrolube J-4	-10°F (-23°C) to +165°F (+74°C)
3 Special (EPR) (At extra cost) Note: Class 3 seals are not compatible with hydraulic oil.	Some Phosphate Ester Fluids Skydrol 500, 7000	-10°F (-23°C) to +130°F (+54°C)
4 Special (Nitrile) (At extra cost)	Low Temperature Air or Hydraulic Oil	-50°F (-46°C) to +150°F (+66°C)
5 Optional (At extra cost) (Fluorocarbon Seals) Note: Class 5 seals are not suitable for use with Skydrol fluid, but can be used with hydraulic oil if desired	High Temperature Houghto-Safe 1010, 1055, 1120 Fryquel 150, 220, 300, 550 Mobil Pyrogard 42,43,53,55	See above paragraph on Fluorocarbon seals for recommended temperature range.
6 Optional (HWCF) (At extra cost)	Houghton, Hydrolubric 120B Sonsol Lubrizol, for other HWCF — consult factory.	+40°F (+4°C) to +120°F (+49°C)

Miller JV Series
Medium-Duty Hydraulic Cylinders

Application Data

The proper application of a fluid power cylinder requires consideration of the operating pressure, the fluid medium, the mounting style, the length of stroke, the type of piston rod connection to the load, thrust or tension loading on the rod, mounting attitude, the speed of stroke, and how the load in motion will be stopped. Information given here provides pressure rating data for pneumatic and hydraulic cylinders.

Hydraulic Cylinders (Medium-Duty)

Pressure ratings for JV Series hydraulic cylinders vary by bore size and rod size as shown in table below. For pressures higher than those indicated, H Series or HV2 Series heavy-duty cylinders should be used.

JV Series Hydraulic Cylinders
Maximum Pressure Rating

Bore Size (Inches)	Rod Diameters (Inches)	Pressure Rating At 4:1 Design* Factor (On Tensile)
1	1/2	1900
	5/8	1900
1 1/2	5/8	2000
	1	2300
2	5/8	1100
	1	2000
	1 3/8	2000
2 1/2	5/8	700
	1	1400
	1 3/8	1400
	1 3/4	1400
3 1/4	1	1300
	1 3/8	1300
	1 3/4	1300
	2	1300
4	1	900
	1 3/8	900
	1 3/4	900
	2	900
	2 1/2	900
5	1	600
	1 3/8	950
	1 3/4	950
	2	950
	2 1/2	950
	3	950
	3 1/2	950
6	1 3/8	700
	1 3/4	700
	2	700
	2 1/2	700
	3	700
	3 1/2	700
	4	700
8	1 3/8	400
	1 3/4	650
	2	650
	2 1/2	650
	3	650
	3 1/2	650
	4	650
	4 1/2	650
	5	650
	5 1/2	650

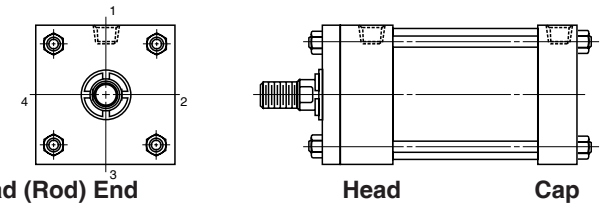
*Applies to all mountings except Model 61.

Ports

Miller JV Series cylinders can be supplied with SAE straight O-ring ports or NPTF pipe thread ports. If specified on your order, extra ports can be provided on the sides of heads or caps that are not occupied by mountings or cushion valve.

Standard port location is position 1 as shown on line drawings in product catalog and Figure 1 below. Cushion adjustment needle and check valves are at positions 2 and 4 (or 3), depending on mounting style. Heads or caps which do not have an integral mounting can be rotated and assembled with ports at 90° or 180° from standard position. Mounting styles on which head or cap can be rotated at no extra charge are shown in Table A below. To order, specify by position number. In such assemblies the cushion adjustment needle and check valve rotate accordingly since their relationship with port position does not change.

Figure 1



Head (Rod) End **Head** **Cap**

Table A

Model	Port Position Available	
	Head End	Cap End
51, 52, 53, 61, 62, 63, 64, 65, 66, 89	1, 2, 3 or 4	1, 2, 3 or 4
82, 84	1,2, 3 or 4	1 or 3
81	1 or 3	1, 2, 3 or 4
72, 74	1	1

Ports can be supplied at positions other than those shown in Table A at an extra charge. To order, specify port position as shown in Figure 1.

Straight Thread Ports

The SAE straight thread O-ring port is recommended for hydraulic applications. Miller will furnish this port configuration at positions shown in Table A. This port can also be provided at positions other than those shown in Table A at an extra charge. SAE port size numbers are listed next to the NPTF pipe thread counterparts for each bore size in the respective product catalogs. Size number, tube, O.D. and port thread size for SAE ports are listed in Table B.

Table B

SAE Straight Thread O-Ring Ports

Size No.	Tube O.D. (In.)	Thread Size	Size No.	Tube O.D. (In.)	Thread Size
2	1/8	5/16 - 24	12	3/4	1 1/16 - 12
3	3/16	3/8 - 24	—	—	—
4	1/4	7/16 - 20	16	1	1 5/16 - 12
5	5/16	1/2 - 20	20	1 1/4	1 5/8 - 12
6	3/8	9/16 - 18	24	1 1/2	1 7/8 - 12
8	1/2	3/4 - 16	32	2	2 1/2 - 12
10	5/8	7/8 - 14	—	—	—

Note: For the pressure ratings of individual connectors, contact your connector supplier. Hydraulic cylinders applied with meter out or deceleration circuits are subject to intensified pressure at the cylinder piston rod end. The rod end pressure is approximately equal to:

$$\frac{\text{Effective Cap End Piston Area}}{\text{Effective Rod End Piston Area}} \times \text{Operating Pressure}$$

International Ports

Other port configurations to meet international requirements are available at extra cost. Miller JV Series cylinders can be supplied, on request, with British standard taper port (BSPT). Such port has a taper of 1 in 16 measured on the diameter (1/16" per inch). The thread form is Whitworth System, and size and number of threads per inch are as follows:

Table C

British Standard Pipe Threads

Nominal Pipe Size	No. Threads Per Inch	Pipe O.D.
1/8	28	.383
1/4	19	.518
3/8	19	.656
1/2	14	.825
3/4	14	1.041
1	11	1.309
1 1/4	11	1.650
1 1/2	11	1.882
2	11	2.347

British standard parallel internal threads are designated as BSPP and have the same thread form and number of threads per inch as the BSPT type and can be supplied, on request, at extra cost. Unless otherwise specified, the BSPP or BSPT port size supplied will be the same nominal pipe size as the NPTF port for a given bore size cylinder.

Metric ports can also be supplied to order at extra cost. Consult factory.

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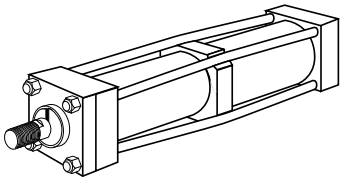
Stroke Data

Miller cylinders are available in any practical stroke length. The following information should prove helpful to you in selecting the proper stroke for your cylinder application.

Stroke Tolerances Stroke length tolerances are required due to buildup of tolerances of piston, head, cap and cylinder body. Standard production stroke tolerances run +1/32" to -1/64" up to 20" stroke, +1/32" to -.20" for 21" to 60" and +1/32" to -1/32" for greater than 60" stroke. For closer tolerances on stroke length, it is necessary to specify the required tolerance plus the operating pressure and temperature at which the cylinder will operate. Stroke tolerances smaller than .015" are not generally practical due to elasticity of cylinders. If machine design requires such close tolerances, use of a stroke adjuster (below) may achieve the desired result.

Tie Rod Supports



Rigidity of Envelope The prestressed tie rod construction of cylinders has advantages in rigidity within the limits of the cylinder tube to resist buckling. For long stroke cylinders within practical limits. Tie rod supports (see table below) which move the tie rod centerlines radially outward are used.

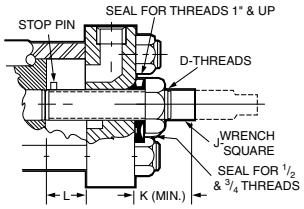
Standard tie rod supports are kept within the envelope dimensions of the head and cap, and generally do not interfere with mounting a long cylinder.

Number of Supports Required	Stroke (Inches)												
Bore	36	48	60	72	84	96	108	120	132	144	156	168
1	—	1	1	1	2	Consult Factory						
1 1/2	—	—	1	1	1	2	2	2	3	3	3	4
2	—	—	—	1	1	1	1	2	2	2	2	3
2 1/2	—	—	—	—	—	1	1	1	1	1	2	2
3 1/4	—	—	—	—	—	—	—	1	1	1	1	1
4	—	—	—	—	—	—	—	—	—	1	1	1

Note: 5" through 8" bore sizes — no supports required.

Stroke Adjusters

Stroke Adjusters For the requirement where adjusting the stroke is specified. Miller has several designs to offer, one of which is illustrated below. This is suitable for infrequent* adjustment and is economical.



Here a "retracting stroke adjuster" must be called for in specifications, and the length of the adjustment must be specified.

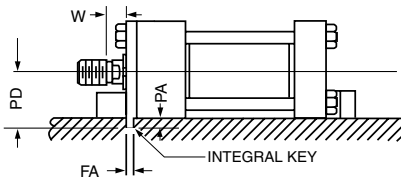
Where frequent adjustment or cushions at the cap end are required, other designs are available according to application needs.

Bore Size JV & AV Series	D	J	K	L (Max.)
1 1/2, 2	1/2 - 20	5/16	15/16	5
2 1/2, 3 1/4, 4	3/4 - 16	7/16	1 1/4	8
5, 6	1 - 14	5/8	1 11/16	9
8	1 1/2 - 12	15/16	2 1/8	18
10	2-12	1 5/16	2 11/16	20
12, 14	2 1/2 - 12	1 11/16	3 1/8	20
—	3-12	2	3 1/4	20
—	3 1/2 - 12	2 3/8	3 1/2	20

*Infrequent is defined by positioning the retract stroke in a couple of attempts at original machine set-up. The frequent stroke adjuster is recommended when adjustments may be required by the end user.

Thrust Key Mountings

Thrust key mountings eliminate the need of using fitted bolts or external keys on side mounted cylinders. Cylinder Models 72 and 74 can be provided with the bushing retainer plate extended below the mounting side of the cylinder (see illustration below). This extended retainer plate can then be fitted into a keyway milled into the mounting surface of the machine member.



Bore	Dim. FA	Dim. PA	Dim. PD Mtg. Styles 72, 74
1	.312 +.000 -.002	3/16	15/16
1 1/2			1 3/16
2			1 7/16
2 1/2			1 11/16
3 1/4	.562 +.000 -.002	5/16	2 3/16
4			2 9/16
5			3 1/16
6	.687 +.000 -.002	3/8	3 5/8

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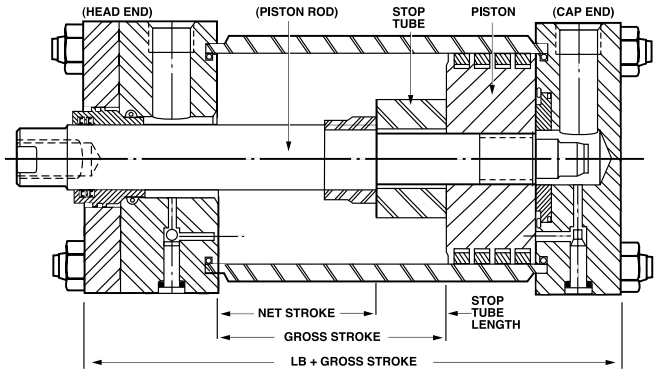
Stop Tubing

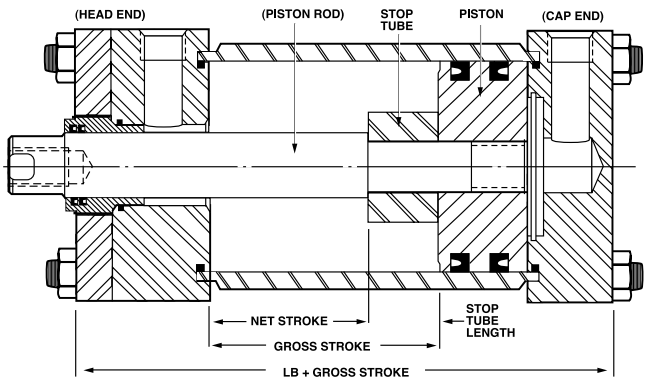
Stop tube is recommended to lengthen the distance between the bushing and piston to reduce bearing loads when the cylinder is fully extended. This is especially true of horizontally mounted and long stroke cylinders. Long stroke cylinders achieve additional stability through the use of a stop tube.

Drawing A



When specifying cylinders with long stroke and stop tube, be sure to call out the net stroke and the length of the stop tube. Machine design can be continued without delay by laying in a cylinder equivalent in length to the NET STROKE PLUS STOP TUBE LENGTH, which is referred to as GROSS STROKE.

Drawing B



This design is supplied on all non-cushion cylinders.

Mounting Classes

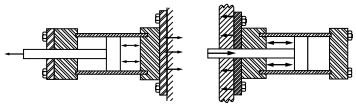
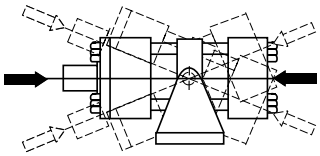
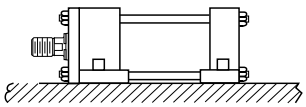
Standard mountings for fluid power cylinders fall into three basic groups. The groups can be summarized as follows:

Group 1 Straight Line Force Transfer with fixed mounts which absorb force on cylinder centerline.

Group 2 Pivot Force Transfer. Pivot mountings permit a cylinder to change its alignment in one plane.

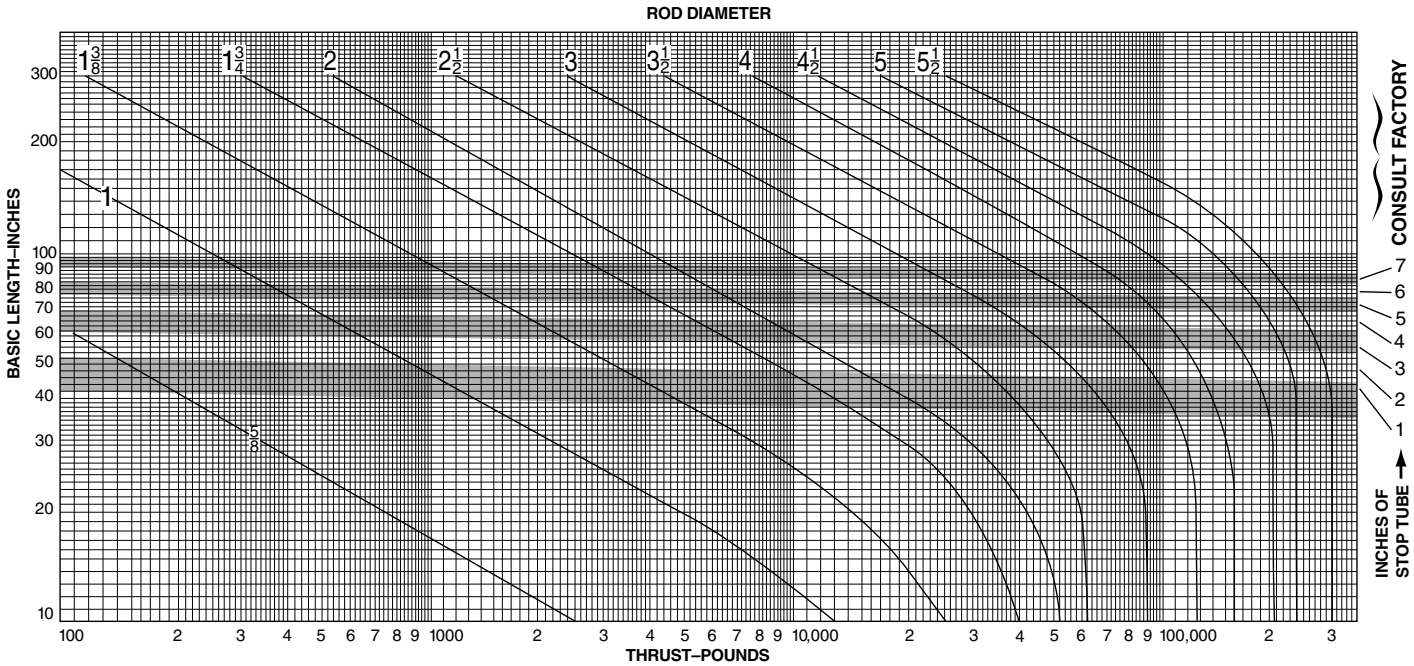
Group 3 Straight Line Force Transfer with fixed mounts which do not absorb force on cylinder centerline.

Because a cylinder's mounting directly affects the maximum pressure at which the cylinder can be used, the chart below should be helpful in selection of the proper mounting combination for your application. Stroke length, piston rod connection to load, extra piston rod length over standard, etc., should be considered for thrust loads. Alloy steel mounting bolts are recommended for all mounting styles, and thrust keys are recommended for Group 3.

Group 1 FIXED MOUNTS which absorb force on cylinder centerline.	
	
Heavy-Duty Service For Thrust Loads For Tension Loads	 Models 52 Models 53
Medium-Duty Service For Thrust Loads For Tension Loads	 Models 62, 66 Models 61, 65
Light-Duty Service For Thrust Loads For Tension Loads	 Model 62 Model 61
Group 2 PIVOT MOUNTS which absorb force on cylinder centerline.	
	
Heavy-Duty Service For Thrust Loads For Tension Loads	 Models 81, 89 Models 81, 82, 84, 89
Medium-Duty Service For Thrust Loads For Tension Loads	 Model 84 Model 84
Group 3 FIXED MOUNTS which do not absorb force on the centerline.	
	
Heavy-Duty Service For Thrust Loads For Tension Loads	 Model 72 Model 72
Medium-Duty Service For Thrust Loads For Tension Loads	 Model 74 Model 74

Miller JV Series
Medium-Duty Hydraulic Cylinders

Piston Rod — Stroke Selection Chart



How to Use the Chart

The selection of a piston rod for thrust (push) conditions requires the following steps:

1. Determine the type of cylinder mounting style and rod end connection to be used. Then consult the chart below and find the "stroke factor" that corresponds to the conditions used.

2. Using this stroke factor, determine the "basic length" from the equation:

$$\text{Basic Length} = \text{Actual Stroke} \times \text{Stroke Factor}$$

The graph is prepared for standard rod extensions beyond the face of the bushing retainers. For rod extensions greater than standard, add the increase to the stroke in arriving at the "basic length."

3. Find the load imposed for the thrust application by multiplying the full bore area of the cylinder by the system pressure.

4. Enter the graph along the values of "basic length" and "thrust" as found above and note the point of intersection:

A) The correct piston rod size is read from the diagonally curved line labeled "Rod Diameter" next *above* the point of intersection.

B) The required length of stop tube is read from the right of the graph by following the shaded band in which the point of intersection lies.

C) If required length of stop tube is in the region labeled "consult factory," submit the following information for an individual analysis:

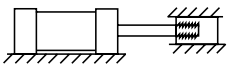
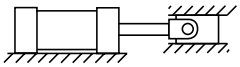
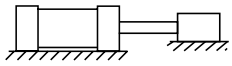
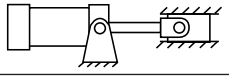
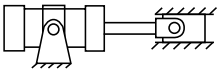
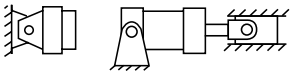
1) Cylinder mounting style.

2) Rod end connection and method of guiding load.

3) Bore, required stroke, length of rod extension (Dim. "LA") if greater than standard, and series of cylinder used.

4) Mounting position of cylinder. (Note: If at an angle or vertical, specify direction of piston rod.)

5) Operating pressure of cylinder if limited to less than standard pressure for cylinder selected.

Recommended Mounting Styles for Maximum Stroke and Thrust Loads	Rod End Connection	Case	Stroke Factor
Groups 1 or 3 Long stroke cylinders for thrust loads should be mounted using a heavy-duty mounting style at one end, firmly fixed and aligned to take the principal force. Additional mounting should be specified at the opposite end, which should be used for alignment and support. An intermediate support may also be desirable for long stroke cylinders mounted horizontally. See "Tie Rod Supports — Rigidity of Envelope" for a guide. Machine mounting pads can be adjustable for support mountings to achieve proper alignment.	Fixed and Rigidly Guided	I 	.50
	Pivoted and Rigidly Guided	II 	.70
	Supported but not Rigidly Guided	III 	2.00
Group 2 Model 81 — Trunnion on Head	Pivoted and Rigidly Guided	IV 	1.00
Model 89 — Intermediate Trunnion	Pivoted and Rigidly Guided	V 	1.50
Model 82 — Trunnion on Cap or Model 84 — Clevis on Cap	Pivoted and Rigidly Guided	VI 	2.00

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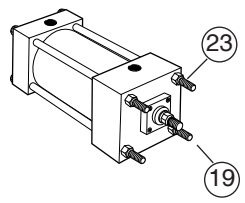
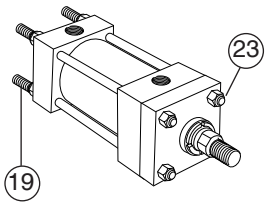
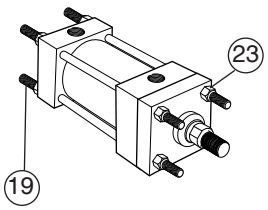
Model 53



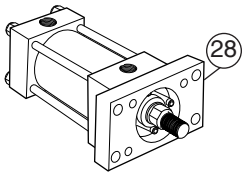
Model 52



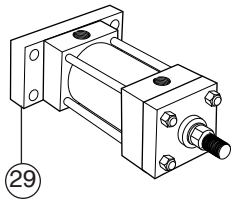
Model 51



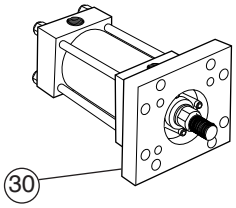
Model 61



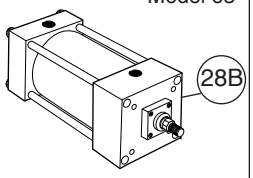
Model 62



Model 65

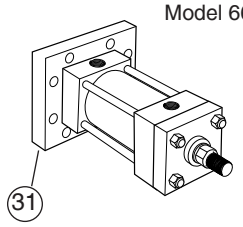


Model 63

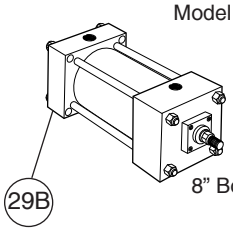


8" Bore

Model 66

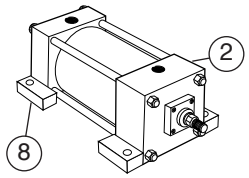


Model 64

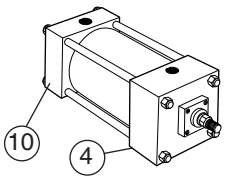


8" Bore

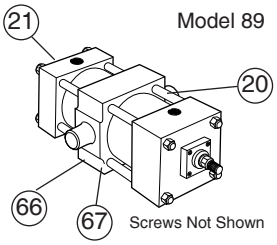
Model 72



Model 74

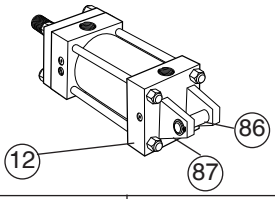


Model 89

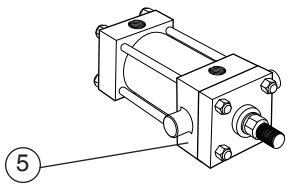


Screws Not Shown

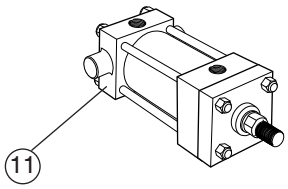
Model 84



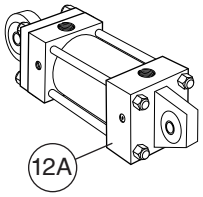
Model 81



Model 82



Model 94



Replacement Mountings & Hardware

Symbol	Description
2	Head, side lug mount
3	Head, centerline lug mount
4	Head, side tap mount
5	Head, trunnion mount
8	Cap, side lug mount
9	Cap, centerline lug mount
10	Cap, side tap mount
11	Cap, trunnion mount
12	Cap, fixed clevis mount
12A	Cap, eye, w/spherical bearing mount
19	Tie rod
20	Tie rod, head end mount
21	Tie rod, cap end mount
23	Tie rod nut
25	Detachable clevis, mount
28	Flange, rectangular, head mount
28B	Head, square mount
29	Flange, rectangular, cap mount
29B	Cap, square mount
30	Flange, square, head mount
31	Flange, square, cap mount
66	Intermediate trunnion
67	Screws, intermediate trunnion
87	Retaining ring mount

How to Order

Give cylinder model number, bore, stroke, serial number and symbol number shown above to insure proper replacement.

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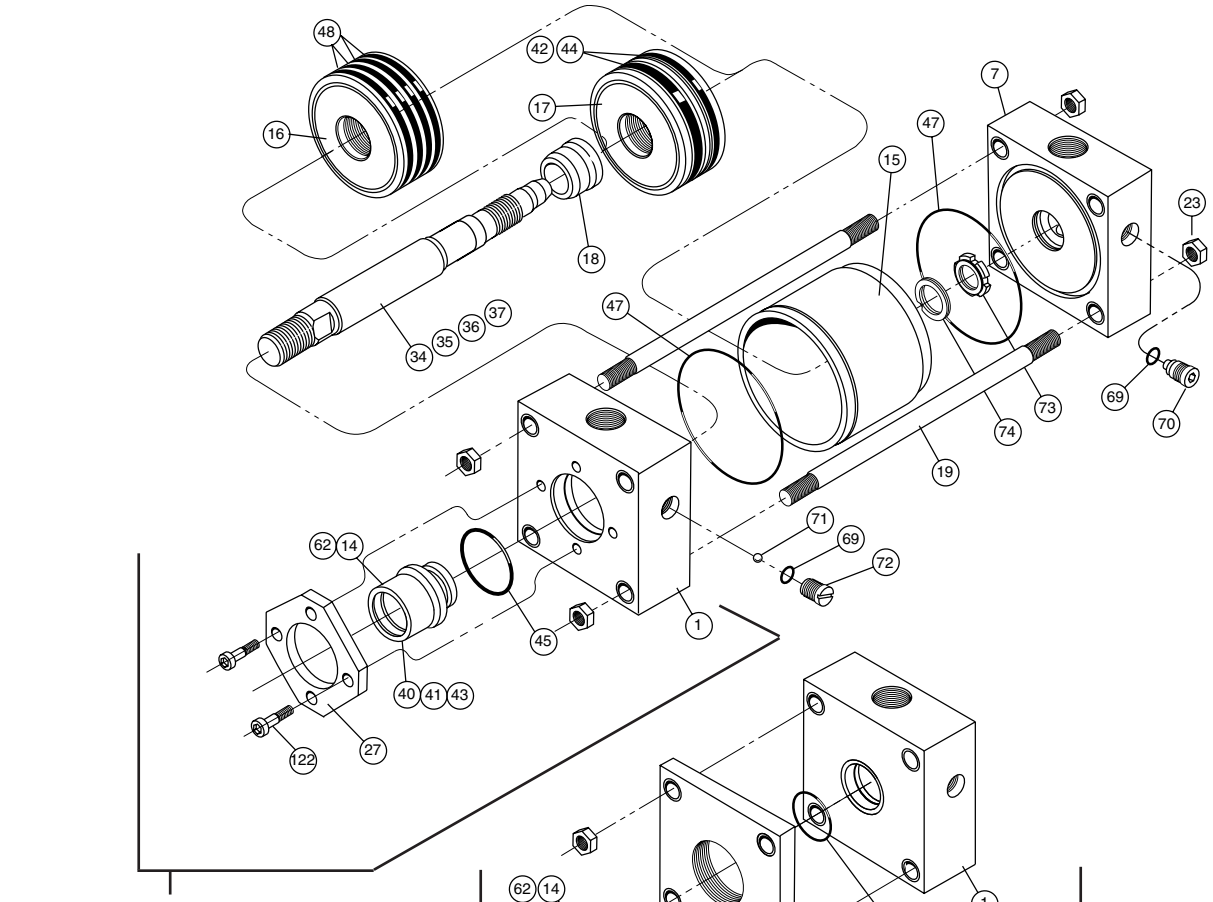
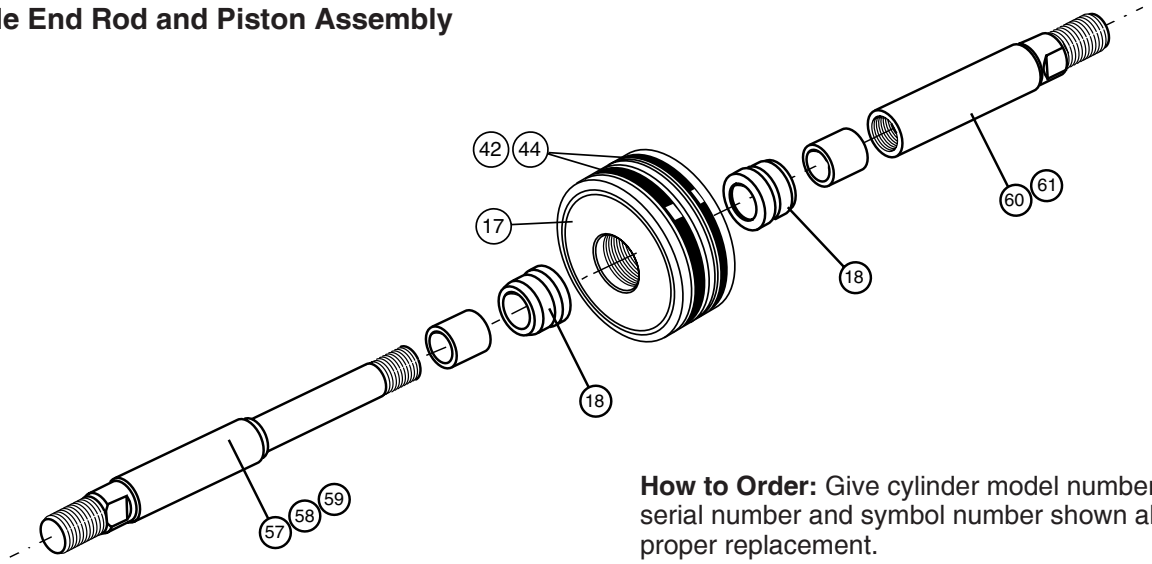


Up to and including 2-1/2" diameter rods

3" diameter rods and over

Double End Rod and Piston Assembly



How to Order: Give cylinder model number, bore, stroke, serial number and symbol number shown above to insure proper replacement.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Parts		Assemblies (Includes Symbol Numbers Shown)			
Symbol	Description	Symbol	Description	Ring Type Piston	Lipseal Type Piston
1	Head, ported, non-cushioned	C1SA	Head, ported, cushioned		1, 69, 70, 71 & 72
7	Cap, ported, non-cushioned	C7SA	Cap, ported, cushioned		7, 69, 70, 73 & 74
14	Bushing	62	Bushing kit		14, 40, 41, 43 & 45
15	Cylinder tube	–	–		–
16	Piston, ring type	–	–		–
17	Piston, lipseal type	–	–		–
18	Cushion plunger, cushioned cylinder only	–	–		–
19	Tie rod	–	–		–
23	Tie rod nut	–	–		–
27	Retainer	–	–		–
34	Piston rod, single rod type, non-cushioned	34SA	Piston & rod assembly, single rod type — non-cushioned	16, 34 & 48	17, 34, 42 & 44
35	Piston rod, single rod type, cushioned head end	35SA	Piston & rod assembly, single rod type — cush. head end	16, 18, 35 & 48	17, 18, 35, 42 & 44
36	Piston rod, single rod type, cushioned cap end	36SA	Piston & rod assembly, single rod type — cush. cap end	16, 36 & 48	17, 36, 42 & 44
37	Piston rod, single rod type, cushioned both ends	37SA	Piston & rod assembly, single rod type — cush. both ends	16, 18, 37 & 48	17, 18, 37, 42 & 44
40	Rod wiper	–	Seal Kits		–
41	Rod seal	–			–
42	Lipseal, piston	–			–
43	Back-up washer, bushing	–			–
44	Back-up washer, piston	–			–
45	O-ring, bushing to head seal	–			–
47	O-ring, cylinder tube end seal	–			–
48	Piston ring	–			–
57	Piston rod, double rod type, non-cushioned	57SA	Piston & Rod assembly, double rod type — non-cush.	16, 48, 57 & 60	17, 42, 44, 57 & 60
58	Piston rod, double rod type, cushioned one end	58SA	Piston & rod assembly, double rod type — cush. one end	16, 18, 48, 58 & 60	17, 18, 42, 44, 58 & 60
59	Piston rod, double rod type, cushioned both ends	59SA	Piston & rod assembly, double rod type — cush. both ends	16, 18, 48, 58 & 61	17, 18, 42, 44, 58 & 61
60	Piston rod extension, double rod type—non-cushioned	–	–		–
61	Piston rod extension, double rod type — cushioned	–	–		–
69	O-ring, cushion adjustment & check valve screw	–	Cushion Kits		–
70	Needle valve, cushion adjustment	–			–
71	Ball, check valve	–			–
72	Plug screw, check valve	–			–
73	Cushion bushing, cap end floating check valve	–			–
74	Retaining ring, floating cushion bushing	–			–
122	Socket cap screws	–	Seal Kits		–

Standard Cushion Hardware Kits

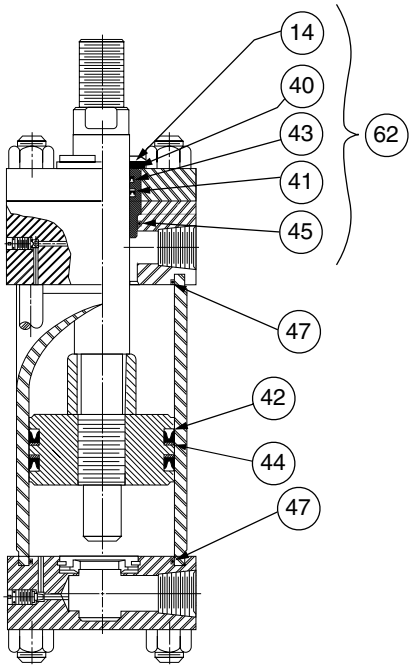
Bore Size	Rod Diameter	For Head Assemblies Order Kits By Number Below: (Kits include Symbols 69, 70, 71 & 72 for One Head) Series JV	For Cap Assemblies Order Kits By Number Below: (Kits include Symbols 69, 70, 73 & 74 for One Cap) Series JV
1	All	JV-CUKH1-9	JV-CUKC1-13
1 1/2	5/8	JV-CUKH1-10	JV-CUKC1-14
	1	JV-CUKH1-10M	
2	5/8, 1	JV-CUKH1-10	JV-CUKC1-14
	1 3/8	JV-CUKH1-10M	
2 1/2	5/8, 1, 1 3/8	JV-CUKH1-10	JV-CUKC1-14
	1 3/4	JV-CUKH1-10M	
3 1/4	All	JV-CUKH1-11	JV-CUKC1-15
4	All	JV-CUKH1-11	JV-CUKC1-15
5	All	JV-CUKH1-11A	JV-CUKC1-15A
6	1 3/8 - 3 1/2	JV-CUKH1-12	JV-CUKC1-16
6	4	JV-CUKH1-11	JV-CUKC1-16A
8	All	JV-CUKH1-12	JV-CUKC1-17

Fluorocarbon Cushion Hardware Kits

Bore Size	Rod Diameter	For Head Assemblies Order Kits By Number Below: (Kits include Symbols 69, 70, 71 & 72) Series JV	For Cap Assemblies Order Kits By Number Below: (Kits include Symbols 69, 70, 73 & 74) Series JV
1	All	JV-CUKH5-28	JV-CUKC5-32
1 1/2	5/8	JV-CUKH5-29	JV-CUKC5-33
	1	JV-CUKH5-29M	
2	5/8, 1	JV-CUKH5-29	JV-CUKC5-33
	1 3/8	JV-CUKH5-29M	
2 1/2	5/8, 1, 1 3/8	JV-CUKH5-29	JV-CUKC5-33
	1 3/4	JV-CUKH5-29M	
3 1/4	All	JV-CUKH5-30	JV-CUKC5-34
4	All	JV-CUKH5-30	JV-CUKC5-34
5	All	JV-CUKH5-30A	JV-CUKC5-34A
6	1 3/8 - 3 1/2	JV-CUKH5-31	JV-CUKC5-35
6	4	JVCUKH5-30	JV-CUKC5-35A
8	All	JV-CUKH5-31	JV-CUKC5-36

Miller JV Series
Medium-Duty Hydraulic Cylinders

Symbol	Description
14	Bushing
40	Rod Wiper
41	Rod Seal
42	Piston lipseal
43	Bushing back-up washer
44	Piston back-up washer
45	Bushing to head o-ring
47	End seal o-ring
48	Piston ring
62	Bushing kit



Seal Kits for Class 1 & 2 Service

Material: Buna-N (Nitrile)

For operating temperature and fluid compatibility, see “Operating Fluids and Temperature Range” page.

Bushing wrenches are available to ease (rod) seal or bushing removal without disassembly of the cylinder. **(For rod diameters over 2 1/2".)**

For detailed seal replacement instructions see service bulletin M0995-M1, M2 and M3.

Rod Dia.	Bushing (Symbol 62) Kits Contains Symbols 14, 40, 41, 43 & 45	Rod Seal Kits Contains Symbols 40, 41, 43 & 45	Bushing Wrench	Spanner Wrench
1/2	JV-KR100-50	JV-KR300-50	Not Required	Not Required
5/8	JV-KR100-63	JV-KR300-63		
1	JV-KR100-100	JV-KR300-100		
1 3/8	JV-KR100-138	JV-KR300-138		
1 3/4	JV-KR100-175	JV-KR300-175		
2	JV-KR100-200	JV-KR300-200		
2 1/2	JV-KR100-250	JV-KR300-250		
3	JV-KR100-300	JV-KR300-300	069596 0000	011677 0000
3 1/2	JV-KR100-350	JV-KR300-350	069597 0000	011677 0000
4	JV-KR100-400	JV-KR300-400	069598 0000	011678 0000
4 1/2	JV-KR100-450	JV-KR300-450	083877 0000	011678 0000
5	JV-KR100-500	JV-KR300-500	069599 0000	011678 0000
5 1/2	JV-KR100-550	JV-KR300-550	069600 0000	011678 0000

Bore Size	Piston Seal Kits JV Series Contains 2 Each Symbols: 42, 44 & 47	Piston Ring Kits JV Series Contains 2 Each Symbols 47 & 4 Each Symbol 48
1	JV-KB100-100	JV-KB300-100
1 1/2	JV-KB100-150	JV-KB300-150
2	JV-KB100-200	JV-KB300-200
2 1/2	JV-KB100-250	JV-KB300-250
3 1/4	JV-KB100-325	JV-KB300-325
4	JV-KB100-400	JV-KB300-400
5	JV-KB100-500	JV-KB300-500
6	JV-KB100-600	JV-KB300-600
8	JV-KB100-800	JV-KB300-800

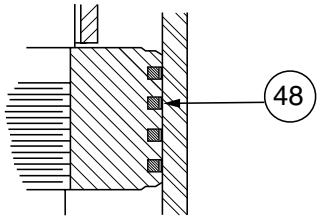
Piston Seal Options

Lipseal Type Piston

(as shown above)

Supplied as standard on JV Series hydraulic cylinders.

Ring Type Piston



Optional for JV Series hydraulic cylinders.

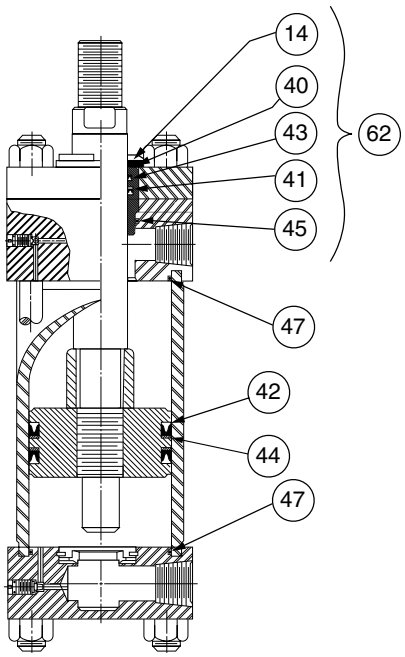
Bore Size	Tube Seal Kits Contains 2 Each Symbol 47	Tie Rod Torque Specifications (Ft. Lbs.)
1	JV-ES100-100	2
1 1/2	JV-ES100-150	5
2	JV-ES100-200	11
2 1/2	JV-ES100-250	11
3 1/4	JV-ES100-325	25
4	JV-ES100-400	25
5	JV-ES100-500	60
6	JV-ES100-600	60
8	JV-ES100-800	110

How to Order

Individual seals contained in the kits are available separately; however, we recommend purchasing complete kits because of convenience and lower replacement cost. When ordering seal kits, give part number listed above. To be sure of exact replacement, give serial number of cylinder when ordering replacement kits or seals.

Miller JV Series
Medium-Duty Hydraulic Cylinders

Symbol	Description
14	Bushing
40	Rod Wiper
41	Rod Seal
42	Piston lipseal
43	Bushing back-up washer
44	Piston back-up washer
45	Bushing to head o-ring
47	End seal o-ring
48	Piston ring
62	Bushing kit



Seal Kits for Class 5 Service

Material: Fluorocarbon

For operating temperature and fluid compatibility, see “Operating Fluids and Temperature Range” page.

Bushing wrenches are available to ease (rod) seal or bushing removal without disassembly of the cylinder. **(For rod diameters over 2 1/2".)**

For detailed seal replacement instructions see service bulletin M0995-M1, M3 and M5.

Rod Dia.	Bushing (Symbol 62) Kits Contains Symbols 14, 40, 41, 43 & 45	Rod Seal Kits Contains Symbols 40, 41, 43 & 45	Bushing Wrench	Spanner Wrench
1/2	JV-KR200-50	JV-KR400-50	Not Required	Not Required
5/8	JV-KR200-63	JV-KR400-63		
1	JV-KR200-100	JV-KR400-100		
1 3/8	JV-KR200-138	JV-KR400-138		
1 3/4	JV-KR200-175	JV-KR400-175		
2	JV-KR200-200	JV-KR400-200		
2 1/2	JV-KR200-250	JV-KR400-250		
3	JV-KR200-300	JV-KR400-300	069596 0000	011677 0000
3 1/2	JV-KR200-350	JV-KR400-350	069597 0000	011677 0000
4	JV-KR200-400	JV-KR400-400	069598 0000	011678 0000
4 1/2	JV-KR200-450	JV-KR400-450	083877 0000	011678 0000
5	JV-KR200-500	JV-KR400-500	069599 0000	011678 0000
5 1/2	JV-KR200-550	JV-KR400-550	069600 0000	011678 0000

Bore Size	Piston Seal Kits Contains 2 Each Symbols: 42, 44 & 47	Piston Ring Kits Contains 2 Each Symbols 47 & 4 Each Symbol 48
1	JV-KB200-100	JV-KB400-100
1 1/2	JV-KB200-150	JV-KB400-150
2	JV-KB200-200	JV-KB400-200
2 1/2	JV-KB200-250	JV-KB400-250
3 1/4	JV-KB200-325	JV-KB400-325
4	JV-KB200-400	JV-KB400-400
5	JV-KB200-500	JV-KB400-500
6	JV-KB200-600	JV-KB400-600
8	JV-KB200-800	JV-KB400-800

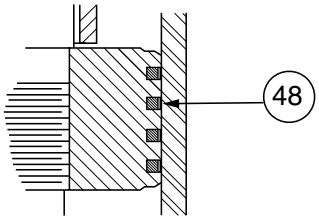
Piston Seal Options

Lipseal Type Piston

(as shown above)

Supplied as standard on JV Series hydraulic cylinders.

Ring Type Piston



Optional for JV Series hydraulic cylinders.

Bore Size	Tube Seal Kits Contains 2 Each Symbol 47	Tie Rod Torque Specifications (Ft. Lbs.)
1	JV-ES200-100	2
1 1/2	JV-ES200-150	5
2	JV-ES200-200	11
2 1/2	JV-ES200-250	11
3 1/4	JV-ES200-325	25
4	JV-ES200-400	25
5	JV-ES200-500	60
6	JV-ES200-600	60
8	JV-ES200-800	110

How to Order

Individual seals contained in the kits are available separately; however, we recommend purchasing complete kits because of convenience and lower replacement cost. When ordering seal kits, give part number listed above. To be sure of exact replacement, give serial number of cylinder when ordering replacement kits or seals.

How to Order JV Series Cylinders

Data Required On All Cylinder Orders

When ordering JV Series cylinders, be sure to specify each of the following requirements:

(**NOTE:** – Duplicate cylinders can be ordered by giving the SERIAL NUMBER from the original cylinder. Factory records supply a quick, positive identification.)

a) Series Designation ("JV")

b) Mounting Model
Specify your choice of mounting – as shown and dimensioned in this catalog.

c) Bushing Style ("B" or "R")

d) Piston Rod End Thread Style
Call out thread style number.
Thread style 2 will be furnished if not otherwise supplied. For special rod ends specify style "X" as indicated below.

e) Cushions (if required)
Specify "Cushion-head end," "Cushion-cap end" or "Cushion-both ends" as required. If cylinder is to have a double rod and only one cushion is required, be sure to specify clearly which end of the cylinder is to be cushioned.

f) Bore Size

g) Length of Stroke

h) Piston Rod Diameter
Call out rod diameter. In JV Series cylinders, standard rod diameters will be furnished if not otherwise specified, unless length of stroke makes the application questionable.

i) Ports
NPTF is standard.

j) Port Locations

k) Modifications
Any modifications that are not identified in the cylinder number shown on the following page should be added to the specifications. These can include special fluids, special seals, air bleeds, double rod cylinder with different rod end styles and diameters. For further information consult factory.

Style X Rod End

A style X rod end indicates a special rod end configuration. All special rod ends must be described by at least **all three**: KK; A; or W/WF specified with the rod fully retracted. A sketch or drawing should be submitted for rod ends requiring special machining such as snap ring grooves, keyways, tapers, multiple diameters, etc. It is good design practice to have this machining done on a diameter at least 0.065 inches smaller than the piston rod diameter. This allows the piston rod to have a chamfer preventing rod seal damage during assembly or maintenance.

Service Policy

When cylinders are returned to the factory for repairs, it is standard policy for Miller Fluid Power to make such part replacements as will put the cylinder in as good as new condition. Should the condition of the returned cylinder be such that expenses for repair exceed the cost of a new one, you will be notified.

Certified Dimensions

Miller Fluid Power guarantees that all cylinders ordered from this catalog will be built to dimensions shown. All dimensions are certified to be correct, and thus it is not necessary to request certified drawings.

Miller JV Series
Medium-Duty Hydraulic Cylinders

How to Order – Example: JV-72B2N-00400-00800-0138 N11-0

JV	72	B	2	N -	004.00 -	008.00 -	01.38	N	1	1 -	0
Series	**Mounting Style**	**Bushing**	**Rod End Style**	**Cushions**	**Bore Dia.**	**Stroke**	**Rod Dia.**	**Port Type**	**Port Location**		**Modified**
JV DJV (D = Dbl. Rod End)		B = Bolted Bushing R = Retainer Held Bushing	2 (Standard) 4 5 X (Special)	R = Rod End Cushioned C = Cap End Cushioned B = Both Ends Cushioned N = Non-Cushioned				N = NPTF S = SAE	Head End 1 (Std.) 2 3 4	Cap End 1 2 3 4	0 = Standard 9* = Modified

9* The number 9 refers to special options or modifications that deviate from the standard product offering.
Non-standard modifications and options not identified in the cylinder model number should be added in the notes when placing an order.

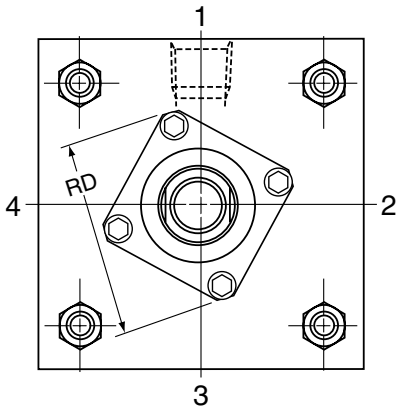
Modifications which can be placed under the designator "9" are as follows:

- Fluorocarbon Seals – for applications which experience operating temperatures up to and including 250°F
- Multiple Ports
- Special Port Threads
- Cushion Location
- Special Mounts

Note: The standard #1 port location is at the top of the cylinder, and the standard cushion adjustment screw is in position #2 when facing the rod end of the cylinder. If multiple ports are required, the last number of the part number should be "9", indicating modified and the desired port location specified in the notes.

Cushions not available on 1" bore.

Rod Dia.	RD Across Corners
5/8"	1 63/64
1"	2 31/64
1 3/8"	2 63/64
1 3/4"	3 41/64
2"	3 3/4
2 1/2"	4 21/64



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:

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

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.

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 piston rod gland and loosen it from the cylinder head. Confirm that this condition is not occurring. If it does, re-tighten the piston rod gland firmly against the cylinder head.

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. The standard tie rod extension is shown as BB in dimension tables. Longer or shorter extensions can be supplied. 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 gland wear. If clearance is excessive, replace rod bushing 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 loose tie rods. Torque the tie rods 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 tie rods 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 tie rods 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 gland 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 Industrial 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, tie rod, 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.

NOTES

Offer of Sale

The items described in this document and other documents and descriptions provided by Parker Hannifin Corporation, Hydraulics Group, and its authorized distributors ("Seller") are hereby offered for sale at prices to be established by Seller. This offer and its acceptance by any customer ("Buyer") shall be governed by all of the following Terms and Conditions. Buyer's order for any item described in its document, when communicated to Seller verbally, or in writing, shall constitute acceptance of this offer. All goods or work described will be referred to as "Products".

1. Terms and Conditions. Seller's willingness to offer Products, or accept an order for Products, to or from Buyer is expressly conditioned on Buyer's assent to these Terms and Conditions and to the terms and conditions found on-line at www.parker.com/saleterms/. Seller objects to any contrary or additional term or condition of Buyer's order or any other document issued by Buyer.

2. Price Adjustments; Payments. Prices stated on the reverse side or preceding pages of this document are valid for 30 days. After 30 days, Seller may change prices to reflect any increase in its costs resulting from state, federal or local legislation, price increases from its suppliers, or any change in the rate, charge, or classification of any carrier. The prices stated on the reverse or preceding pages of this document do not include any sales, use, or other taxes unless so stated specifically. Unless otherwise specified by Seller, all prices are F.O.B. Seller's facility, and payment is due 30 days from the date of invoice. After 30 days, Buyer shall pay interest on any unpaid invoices at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. Delivery Dates; Title and Risk; Shipment. All delivery dates are approximate and Seller shall not be responsible for any damages resulting from any delay. Regardless of the manner of shipment, title to any products and risk of loss or damage shall pass to Buyer upon tender to the carrier at Seller's facility (i.e., when it's on the truck, it's yours). Unless otherwise stated, Seller may exercise its judgment in choosing the carrier and means of delivery. No deferment of shipment at Buyers' request beyond the respective dates indicated will be made except on terms that will indemnify, defend and hold Seller harmless against all loss and additional expense. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's changes in shipping, product specifications or in accordance with Section 13, herein.

4. Warranty. Seller warrants that the Products sold hereunder shall be free from defects in material or workmanship for a period of eighteen months from the date of delivery to Buyer. The prices charged for Seller's products are based upon the exclusive limited warranty stated above, and upon the following disclaimer: DISCLAIMER OF WARRANTY: THIS WARRANTY COMPRISES THE SOLE AND ENTIRE WARRANTY PERTAINING TO PRODUCTS PROVIDED HEREUNDER. SELLER DISCLAIMS ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, INCLUDING MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon delivery. No claims for shortages will be allowed unless reported to the Seller within 10 days of delivery. No other claims against Seller will be allowed unless asserted in writing within 60 days after delivery or, in the case of an alleged breach of warranty, within 30 days after the date within the warranty period on which the defect is or should have been discovered by Buyer. Any action based upon breach of this agreement or upon any other claim arising out of this sale (other than an action by Seller for any amount due to Seller from Buyer) must be commenced within thirteen months from the date of tender of delivery by Seller or, for a cause of action based upon an alleged breach of warranty, within thirteen months from the date within the warranty period on which the defect is or should have been discovered by Buyer.

6. LIMITATION OF LIABILITY. UPON NOTIFICATION, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE A DEFECTIVE PRODUCT, OR REFUND THE PURCHASE PRICE. IN NO EVENT SHALL SELLER BE LIABLE TO BUYER FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF, OR AS THE RESULT OF, THE SALE, DELIVERY, NON-DELIVERY, SERVICING, USE OR LOSS OF USE OF THE PRODUCTS OR ANY PART THEREOF, OR FOR ANY CHARGES OR EXPENSES OF ANY NATURE INCURRED WITHOUT SELLER'S WRITTEN CONSENT, EVEN IF SELLER HAS BEEN NEGLIGENT, WHETHER IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE OF THE PRODUCTS.

7. Contingencies. Seller shall not be liable for any default or delay in performance if caused by circumstances beyond the reasonable control of Seller.

8. User Responsibility. The user, through its own analysis and testing, is solely responsible for making the final selection of the system and Product and assuring that all performance, endurance, maintenance, safety and warning requirements of the application are met. The user must analyze all aspects of the application and follow applicable industry standards and Product information. If Seller provides Product or system options, the user is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products or systems.

9. Loss to Buyer's Property. Any designs, tools, patterns, materials, drawings, confidential information or equipment furnished by Buyer or any other items which become Buyer's property, may be considered obsolete and may be destroyed by Seller after two consecutive years have elapsed without Buyer placing an order for the items which are manufactured using such property. Seller shall not be responsible for any loss or damage to such property while it is in Seller's possession or control.

10. Special Tooling. A tooling charge may be imposed for any special tooling, including without limitation, dies, fixtures, molds and patterns, acquired to manufacture Products. Such special tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in apparatus belonging to Seller which is utilized in the manufacture of the Products, even if such apparatus has been specially converted or adapted for such manufacture and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller shall have the right to alter, discard or otherwise dispose of any special tooling or other property in its sole discretion at any time.

11. Buyer's Obligation; Rights of Seller. To secure payment of all sums due or otherwise, Seller shall retain a security interest in the goods delivered and this agreement shall be deemed a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect its security interest. Seller shall have a security interest in, and lien upon, any property of Buyer in Seller's possession as security for the payment of any amounts owed to Seller by Buyer.

12. Improper Use and Indemnity. Buyer shall indemnify, defend, and hold Seller harmless from any claim, liability, damages, lawsuits, and costs (including attorney fees), whether for personal injury, property damage, patent, trademark or copyright infringement or any other claim, brought by or incurred by Buyer, Buyer's employees, or any other person, arising out of: (a) improper selection, improper application or other misuse of Products purchased by Buyer from Seller; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, plans, drawings, or specifications furnished by Buyer to manufacture Product; or (d) Buyer's failure to comply with these terms and conditions. Seller shall not indemnify Buyer under any circumstance except as otherwise provided.

13. Cancellations and Changes. Orders shall not be subject to cancellation or change by Buyer for any reason, except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage. Seller may change product features, specifications, designs and availability with notice to Buyer.

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

15. Entire Agreement. This agreement contains the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of the agreement. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter are herein merged.

16. Waiver and Severability. Failure to enforce any provision of this agreement will not waive that provision nor will any such failure prejudice Seller's right to enforce that provision in the future. Invalidation of any provision of this agreement by legislation or other rule of law shall not invalidate any other provision herein. The remaining provisions of this agreement will remain in full force and effect.

17. Termination. This agreement may be terminated by Seller for any reason and at any time by giving Buyer thirty (30) days written notice of termination. In addition, Seller may by written notice immediately terminate this agreement for the following: (a) Buyer commits a breach of any provision of this agreement (b) the appointment of a trustee, receiver or custodian for all or any part of Buyer's property (c) the filing of a petition for relief in bankruptcy of the other Party on its own behalf, or by a third party (d) an assignment for the benefit of creditors, or (e) the dissolution or liquidation of the Buyer.

18. Governing Law. This agreement and the sale and delivery of all Products hereunder shall be deemed to have taken place in and shall be governed and construed in accordance with the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to this agreement. Disputes between the parties shall not be settled by arbitration unless, after a dispute has arisen, both parties expressly agree in writing to arbitrate the dispute.

19. Indemnity for Infringement of Intellectual Property Rights. Seller shall have no liability for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights except as provided in this Section. Seller will defend and indemnify Buyer against allegations of infringement of U.S. patents, U.S. trademarks, copyrights, trade dress and trade secrets ("Intellectual Property Rights"). Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on an allegation that a Product sold pursuant to this Agreement infringes the Intellectual Property Rights of a third party. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of such allegations of infringement, and Seller having sole control over the defense of any allegations or actions including all negotiations for settlement or compromise. If a Product is subject to a claim that it infringes the Intellectual Property Rights of a third party, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Product, replace or modify the Product so as to make it noninfringing, or offer to accept return of the Product and return the purchase price less a reasonable allowance for depreciation. Notwithstanding the foregoing, Seller shall have no liability for claims of infringement based on information provided by Buyer, or directed to Products delivered hereunder for which the designs are specified in whole or part by Buyer, or infringements resulting from the modification, combination or use in a system of any Product sold hereunder. The foregoing provisions of this Section shall constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for infringement of Intellectual Property Rights.

20. Taxes. Unless otherwise indicated, all prices and charges are exclusive of excise, sales, use, property, occupational or like taxes which may be imposed by any taxing authority upon the manufacture, sale or delivery of Products.

21. Equal Opportunity Clause. For the performance of government contracts and where dollar value of the Products exceed $10,000, the equal employment opportunity clauses in Executive Order 11246, VEVRAA, and 41 C.F.R. §§ 60-1.4(a), 60-741.5(a), and 60-250.4, are hereby incorporated.

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