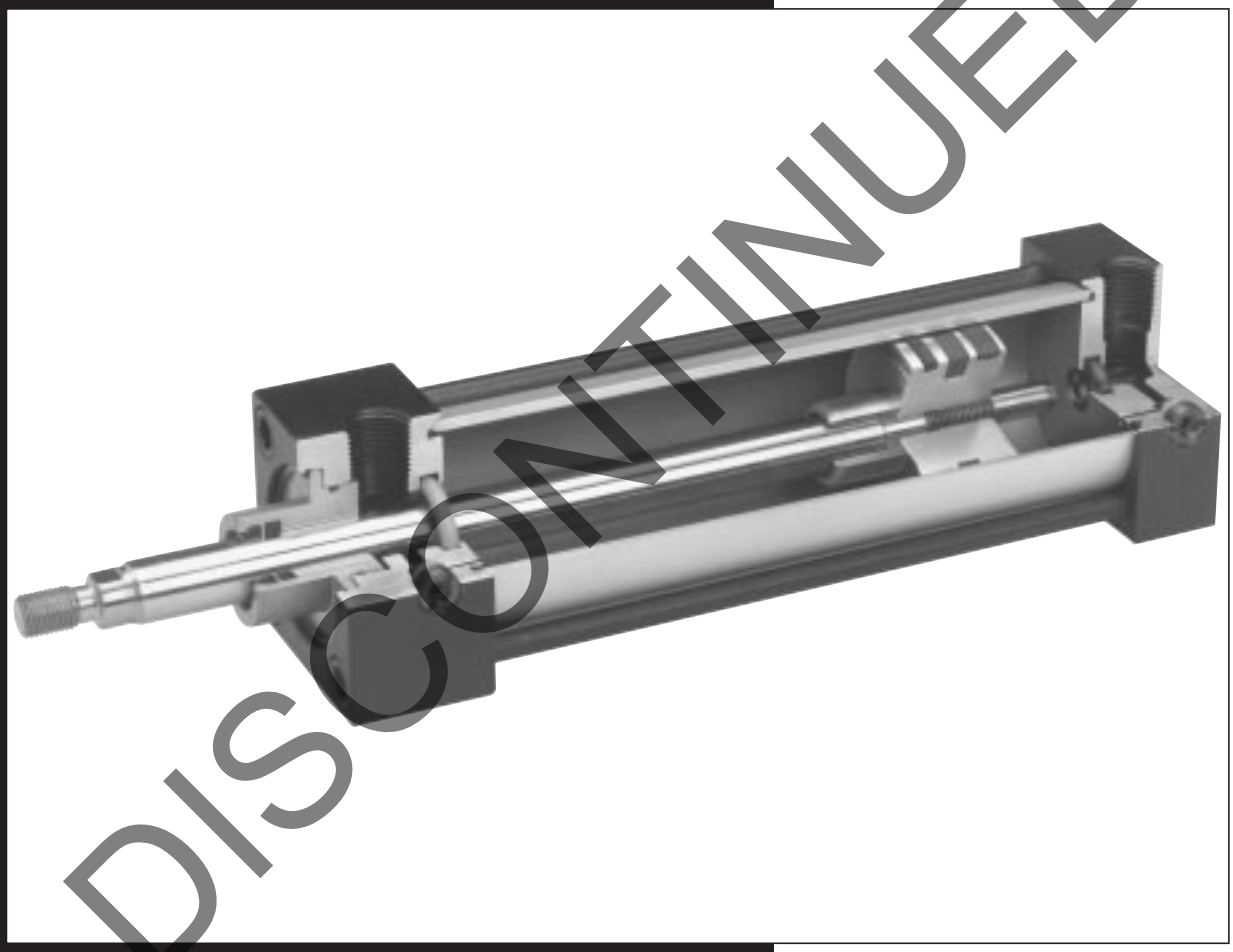
AL Series
Air Cylinder



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Up to 200 PSI
Bore Sizes 1-1/2" through 8"
NFPA Interchangeable

Miller FLUID POWER

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Miller Warranty

Subject to the conditions below, Miller Fluid Power corporation (“Miller”) warrants to the first end user (the “buyer”) that Miller's products are free from defects in material and workmanship.

Miller will either repair or replace a defective product, including lowest transportation costs but not including installation or any other similar charges, provided that (1) the Buyer notifies Miller in writing of the claimed defect within two years from shipment from Miller's factory (2) provides a complete explanation of the defect, the application of the product, and such other information concerning use of the product as Miller may request, and (3) returns the product to Miller in accordance with Miller's specific written instructions and authorization obtained from Miller prior to return of the product, and Miller's inspection confirms that the product was defective.

This warranty applies only if the product was used and applied correctly under normal operating conditions and good engineering practice; was installed, operated and maintained in accordance with all instructions issued or published by Miller; was used within stated pressure, media and operating limitations published by Miller and in effect on the date of shipment; and was not subject to abuse, misuse or unauthorized modification.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, not withstanding any disclosure to Miller of the use to which the product is to be put. The Buyer's SOLE AND EXCLUSIVE REMEDY on any claim of any kind for any loss or damage arising out of the manufacturer, sale, delivery or use of Miller's products shall be for the repair or replacement of any defective products as provided herein.

IN NO EVENT SHALL MILLER BE LIABLE FOR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES. There are no warranties, expressed or implied, made by Miller other than the warranty against defects in material and workmanship set forth above, and Miller neither assumes nor authorizes any other person or firm to assume for it any other obligations or liability.

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Miller AL Series
Air Cylinder

How to Select a Miller Cylinder

Miller cylinders are available based on air or hydraulic operating pressure. The many styles, sizes and optional features available assure that your application needs are precisely met. To select a Miller cylinder, follow these simple steps:

Step 1 — Determine the correct cylinder bore size necessary to achieve required force using the available operating pressure.

Step 2 — Based on operating pressure, determine the series cylinder to use.

Step 3 — Turn to the appropriate cylinder selection section. Select the mounting style (Model No.) which fits your installation needs. Determine the bore and rod sizes available for the model you select. Then complete model selection.

- Choose a rod end style and the desired rod end accessories.
- Size the cylinder to meet your application requirements.

Step 4 — Consider the following conditions which may require further modifications to the cylinder you have selected. Additional information on each subject is given in the Engineering Aids section.

Application Condition	Check the Following
Quick Starts or Stops	Confirm that determined thrust is sufficient to accelerate or decelerate cylinder and load within prescribed distance. Optional cushions should be used to reduce shock during deceleration, check that peak pressures will be within tolerable limits.
Long Push Stroke	Check whether stop tube is required to prevent excessive bearing loads and wear.
High Column Loading-Long Push Stroke	Determine if standard-size piston rod is strong enough to accommodate intended load.
Long Horizontal Stroke	Determine if standard-size piston rod is strong enough to accommodate intended load.
High Operating Temperatures	For temperatures between 200° F. and 300° F. use Series AL cylinder with high temperature seals. For 300° F. to 450° F. use Series A cylinder with high temperature seals.
Options and Modifications	• Adjustable cushions • Extra heavy chrome plated piston rods • Adjustable switches —Weld immune available • Stainless steel piston rods (Type 316) • Piston bumpers (1½" through 6" bore) • Port and cushion adjust relocation • Stop tube • Spring return cylinders • Mixed mountings • Rod end modifications • Double rod end • Metallic rod scraper • Multiple ports • Alignment coupler • Adjustable stroke (cap end only) • Rod boots

Other Miller Air and Hydraulic Cylinders. Order Catalog by File No.

A Series Cylinders
Up to 250 PSI Permanently lubricated

Series A air cylinders are available in bore sizes from 1½" through 20" and up to 250 PSI operating pressure. Standard NFPA dimensions and proven Miller design features. (File 7619)

BT & BTM Series Cylinders
Up to 250 PSI

Our new BT & BTM Series air cylinders are available in bore sizes from 7⁄16" through 2". Operating pressures up to 250 PSI. 21 available mounting styles.

J Series Cylinders
500-2500 PSI

Our popularly-priced line of medium pressure hydraulic cylinders, with bore sizes from 1½" to 20". (File 7620)

HV Series Cylinders
3000-5000 PSI

Miller's value designed heavy-duty cylinder line for most hydraulic applications. Bore sizes from 1½" to 8". Heavy-duty construction. (File 8641)

H Series Cylinders
3000-5000 PSI

Miller's heavy-duty cylinder line for the most demanding hydraulic applications. Bore sizes from 1½" to 20". Heavy-duty construction. (File 7622)

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Miller AL Series
Air Cylinder

Advanced Design

The Miller AL Series air cylinder has been designed and engineered for contemporary pneumatic cylinder applications. The advanced design characteristics have been rigorously tested under the most adverse of operating conditions to ensure years of trouble-free operation and long life for a wide range of applications. All AL Series cylinders are permanently lubricated with a water resistant, mechanically and chemically stable lubricant.

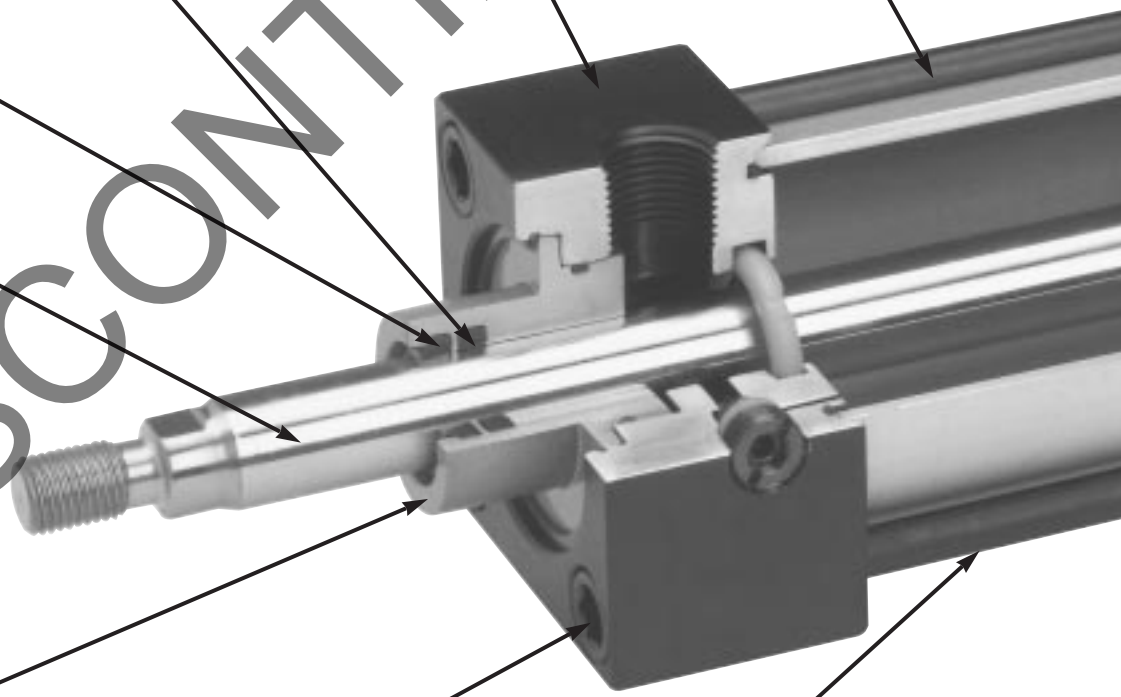
Rod Seal
The Nitrile rod seal is pressure energized, wear compensating and resists abrasion to ensure long life.

Head & Cap
High quality, precision machined from aluminum alloy bar stock and black anodized

Tube
Sturdy, hard coat aluminum, and precision machined for long packing life. The tube is piloted into the head and cap to ensure concentricity.

Rod Wiper
The Urethane wiper seal wipes away dirt that may have accumulated on the rod, reducing bushing wear.

Piston Rod
Chrome plated to provide corrosion and abrasion resistance.



Rod Bushing
Externally removable, high-density iron, tin plated rod bushing protects against side loads. The outboard placement of the rod seal ensures lubrication over the full bearing length.

Tie Rod Nuts
Threaded flush, black oxide, tie rod nuts for mounting configuration flexibility.

Tie Rods
E-Coated for corrosion resistance.

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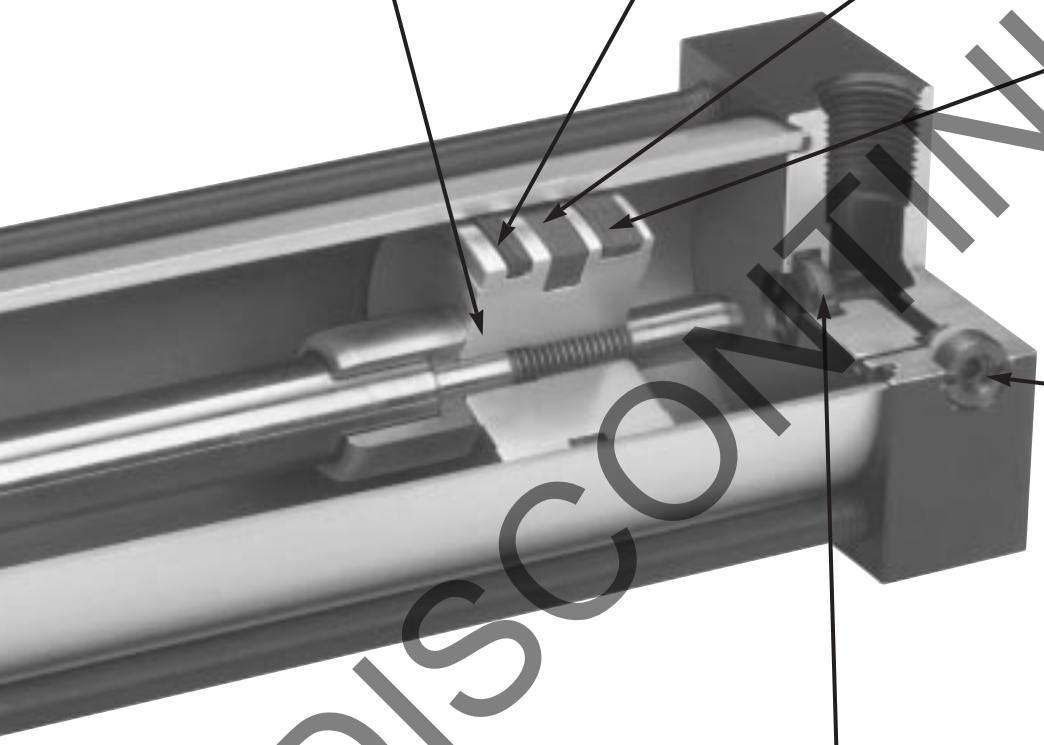
Miller AL Series
Air Cylinder

Piston
Piston is torqued to exacting specification, staked and secured with a high strength retaining compound.

Piston Seal
Rugged Nitrile quad ring seal for long life. Temperature range is -40 degrees to +200 degrees F.

Permanent Piston Magnet Option*
Permanent magnet installed for tie rod mounted adjustable position sensing switch installation. Maximum temperature rating on magnet is 175˚F. See pages 18, 19, 20 for switch information.



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Wear Band
Piston wear band reduces possibility of damaging piston which can score tubing.
Reduces need for piston replacement.

Cushion Adjusters
Anti-blowout, flush mounted cushion adjustment design is a must for today's safety requirements.

Cushions
The radial seal cushion is available in either or both ends. The AL design permits smooth deceleration and quick out-of-cushion starts. Bumpers are available and recommended when appropriate – consult your Miller Fluid Power representative for more information.

• Optional Urethane Bumpers
Available thru 8" bore. Stroke is reduced by approximately ⅛" per bumper. If bumpers are employed, cushions are ineffective and not recommended.

* Magnet option must be specified when placing order or piston will be equipped with wear ring and seal only.

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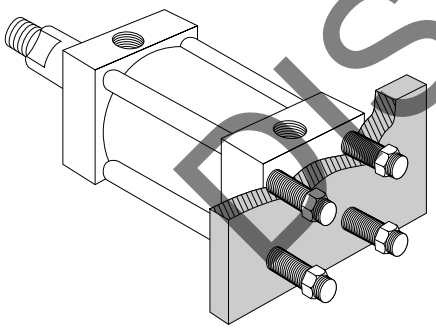
Mounting Styles That Fit Your Installation Requirement

Miller Series AL air cylinders operate at internal pressures up to 200 PSI, and incorporate proven Miller design characteristics to provide safe, reliable power for many heavy-duty industrial applications. Available in 15 standard mounting configurations to provide centerline, foot or pivot installations as explained below.

Centerline Mounting

The preferred cylinder installation method, centerline mounting places the mounting bolts in simple shear or simple tension so that the mounting mechanism is protected from compound forces. Centerline mounting is a rigid mounting style and this requires accurate cylinder alignment to prevent damage to the cylinder working parts.

Miller AL Series mounting configurations that provide centerline support are tie-rod mounts, or flange mounts with rectangular flanges fastened to the cylinder head or cap.

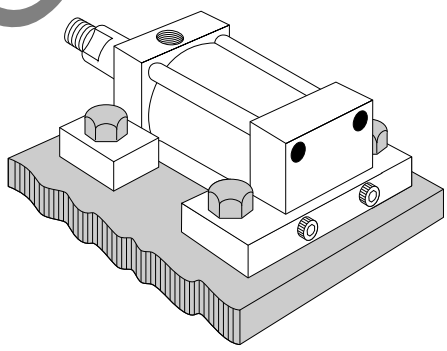


Centerline mounting is preferable since it prevents compound forces from acting on the mounting bolts (tie rod model shown).

Foot Mounting

Foot mounting secures the cylinder along its side. Since the mounting surface plane is thus not centered directly on the line of force, the mounting bolts are subjected to a significant amount of shear stress. Because foot mounts are rigid, they require accurate cylinder alignment.

Lugs attached to the ends of the cylinder, are the usual form of foot mounts. As an alternative to the use of lugs, flush mounting incorporates tapped mounting holes on the sides of the cylinder head and cap.

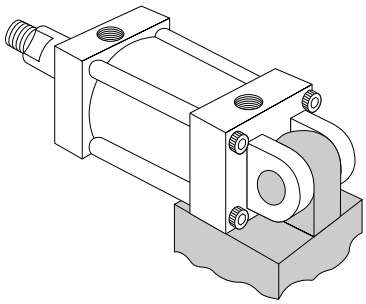


Foot mounting secures the cylinder on its side, but can subject the mounting bolts to compound stress (cylinder side lugs shown).

Pivot Mounting

Pivot mounting is used when the cylinder must pivot during piston motion. Clevis and trunnion mounts are the two methods used to allow this motion.

The clevis end design locates the pivot point at the cap end of the cylinder. Trunnion mounting uses the head or cap of the cylinder to allow it to pivot at any of two locations. Both clevis and trunnion mounting configurations allow the cylinder to pivot in one plane only.



Pivot mounting allows the cylinder to pivot during piston motion (clevis method shown).

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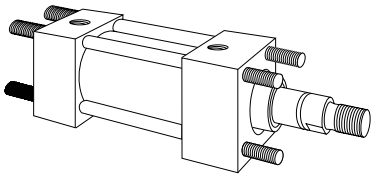
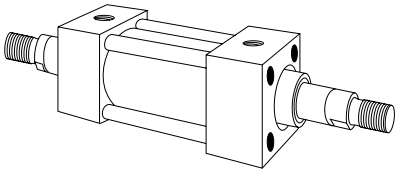
An Array Of Models In Each Mounting Style

Miller Series AL air cylinders are available in 15 models in your choice of centerline, foot and pivot installation methods. All models are sized to NFPA standards to permit complete interchangeability with corresponding NFPA-coded cylinders.

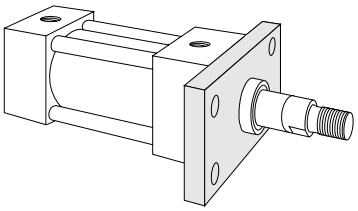
Centerline Mounts



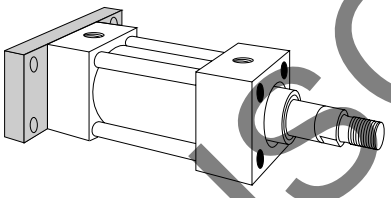
Tie Rod Models 50
51, (NFPA MX1), 52 (NFPA MX2),
53 (NFPA MX3), 54 (NFPA MX4)



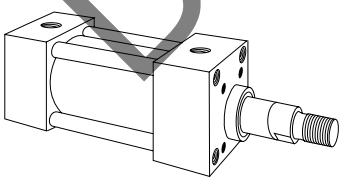
Double Rod End
Model D50



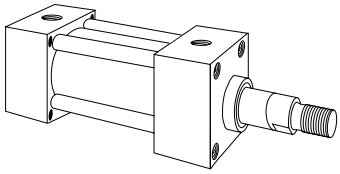
Rectangular Flange/Head End
Model 61 (NFPA MF1)



Rectangular Flange/Cap End
Model 62 (NFPA MF2)

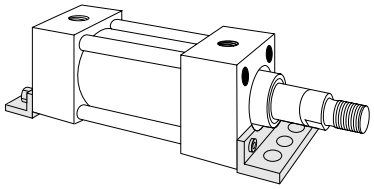


Square Head
Model 63 (NFPA ME3)
(8" Bore Only)

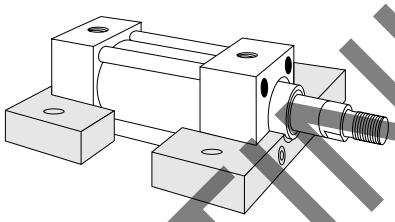


Square Cap
Model 64 (NFPA ME4)
(8" Bore Only)

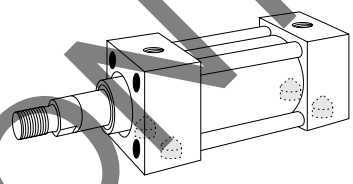
Foot Mounts



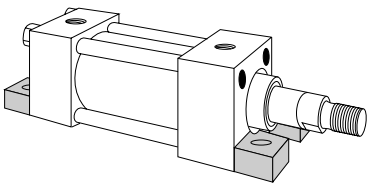
Side End Angle
Model 71 (NFPA MS1)



Side Lug
Model 72 (NFPA MS2)



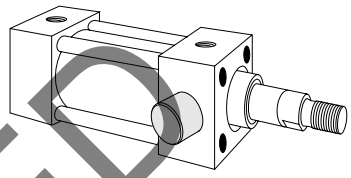
Side Tapped
Model 74 (NFPA MS4)



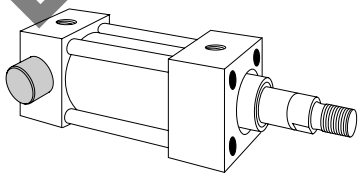
End Lug
Model 77 (NFPA MS7)

Note:
All mounts will be assembled unless ordered separately. See page 28 for mounting kits.

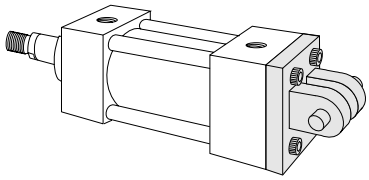
Pivot Mounts



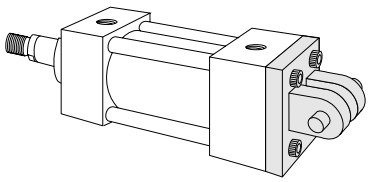
Trunnion/Head End
Model 81 (NFPA MT1)



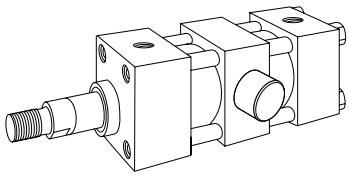
Trunnion/Cap End
Model 82 (NFPA MT2)



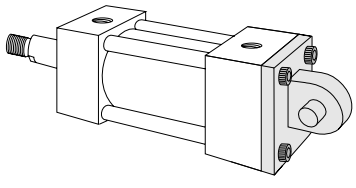
Detachable Clevis Interchange
Model 84 (NFPA MP1)



Detachable Clevis
Model 86 (NFPA MP2)



Intermediate Fixed Trunnion
Model 89 (NFPA MT4)



Rear Eye
Model 96 (NFPA MP4)

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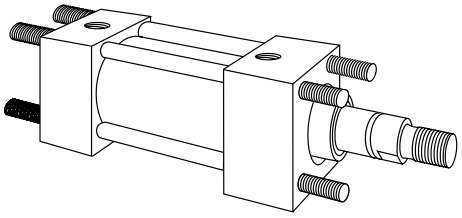
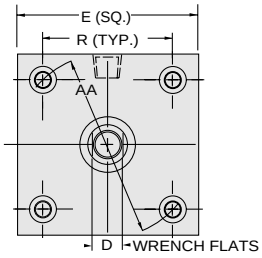
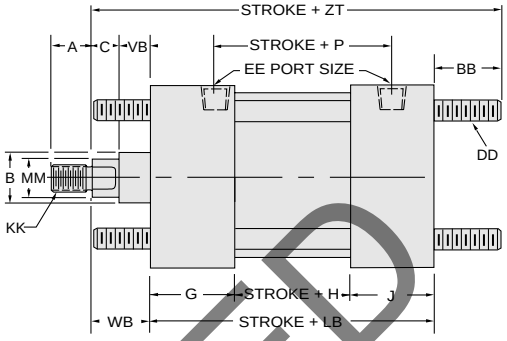
Tie Rod Mounts
Model 51 (NFPA MX1)



See tables on next page
for Dimensions

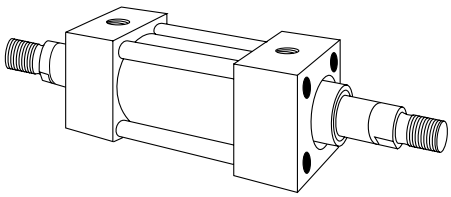




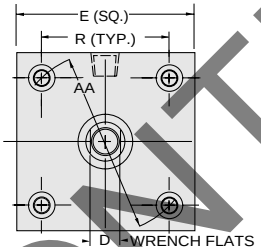
Also available: Model 52 (NFPA MX2) Tie Rods Extended cap end, Model 53 (NFPA MX3) Tie Rods Extended head end, Model 54 (NFPA MX4) two Tie Rods Extended both ends. All of the above models can be dimensioned from Model 51 drawing at right.
Note: Tie Rod extensions are from mounting kits.

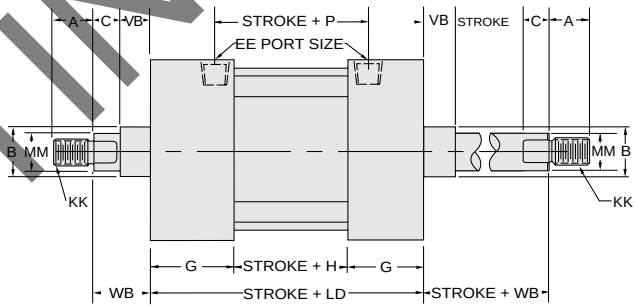
Double Rod End
Model D50

Add single rod model
mounting style dimensions



See tables on next page
for Dimensions





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Cylinder Body Dimensions

Bore Size	Dimensions					
	AA	E	EE	G	J	R
1½	2.02	2	3/8 - 18	1½	1	1.43
2	2.60	2½	3/8 - 18	1½	1	1.84
2½	3.10	3	3/8 - 18	1½	1	2.19
3¼	3.90	3¾	1/2 - 14	1¾	1¼	2.76
4	4.70	4½	1/2 - 14	1¾	1¼	3.32
5	5.80	5½	1/2 - 14	1¾	1¼	4.10
6	6.90	6½	3/4 - 14	2	1½	4.88
8	9.10	8½	3/4 - 14	2	1½	6.44

Mounting Dimensions

BB	DD
1	1/4-28
1⅛	5/16-24
1⅛	5/16-24
1⅜	3/8-24
1⅜	3/8-24
1 13/16	1/2-20
1 13/16	1/2-20
2 5/16	5/8-18

Rod End Dimensions

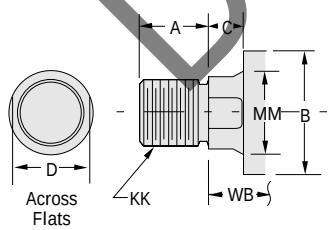
Bore Size	Rod Dia (MM)	A	B -.001 to -.003	C	D	IM Style 5	KK Styles 2,4&6	VB	WB
1½	5/8	¾	1.125	⅜	½	½-20	7/16-20	5/8	1
2	5/8	¾	1.125	⅜	½	½-20	7/16-20	5/8	1
	1	1⅛	1.500	½	⅞	⅞-14	¾ -16	⅞	1⅜
2½	5/8	¾	1.125	⅜	½	½-20	7/16-20	5/8	1
	1	1⅛	1.500	½	⅞	⅞-14	¾ -16	⅞	1⅜
3¼	1	1⅛	1.500	½	⅞	⅞-14	¾ -16	⅞	1⅜
	1⅜	1⅝	2.000	5/8	1⅛	1¼-12	1-14	1	1⅝
4	1	1⅛	1.500	½	⅞	⅞-14	¾ -16	⅞	1⅜
	1⅜	1⅝	2.000	5/8	1⅛	1¼-12	1-14	1	1⅝
5	1	1⅛	1.500	½	⅞	⅞-14	¾ -16	⅞	1⅜
	1⅜	1⅝	2.000	5/8	1⅛	1¼-12	1-14	1	1⅝
6	1⅜	1⅝	2.000	5/8	1⅛	1¼-12	1-14	1	1⅝
	1¾	2	2.375	¾	1½	1½-12	1¼-12	1⅛	1⅞
8	1⅜	1⅝	2.000	5/8	1⅛	1¼-12	1-14	1	1⅝
	1¾	2	2.375	¾	1½	1½-12	1¼-12	1⅛	1⅞

Add Stroke

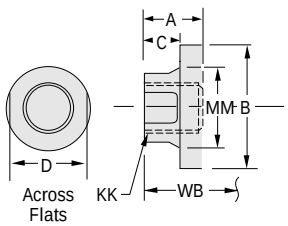
H	P	LB	LD	ZT
1⅛	2 5/16	3 5/8	4⅛	5⅜
1⅛	2 5/16	3 5/8	4⅛	5¾
1⅛	2 5/16	3 5/8	4⅛	6⅛
1¼	2 7/16	3¾	4¼	5⅞
1¼	2 7/16	3¾	4¼	6¼
1¼	2⅝	4¼	4¾	7
1¼	2⅝	4¼	4¾	7¼
1¼	2⅝	4¼	4¾	7
1¼	2⅝	4¼	4¾	7¼
1½	2⅞	4½	5	7 11/16
1½	2⅞	4½	5	7 15/16
1½	3⅛	5	5½	8 7/16
1½	3⅛	5	5½	8 11/16
1⅝	3¼	5⅛	5⅝	9 1/16
1⅝	3¼	5⅛	5⅝	9 5/16

Rod End Styles & Dimensions

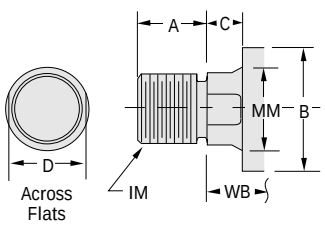
Style No. 2-Standard
Threaded on Turndown Section



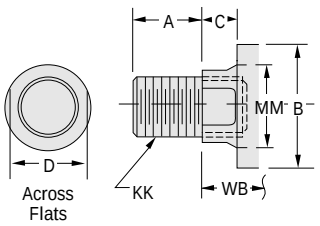
Style No. 4
Short Rod End-Internal Threads



Style No. 5
Threaded Intermediate Male



Style No. 6
Studded Rod End

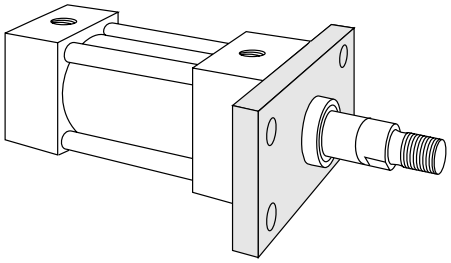


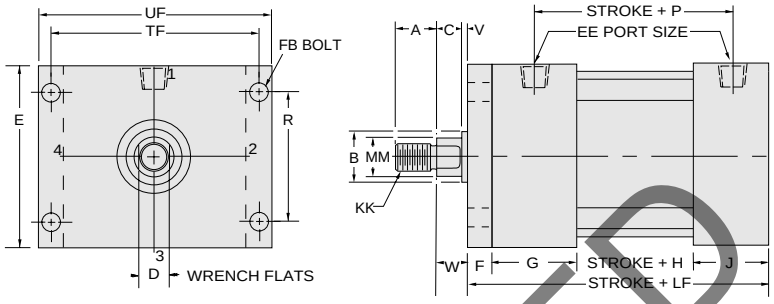
See page 17 for additional rod end styles.

DISCONTINUED

Rectangular Flange/Head End
Model 61 (NFPA MF1)

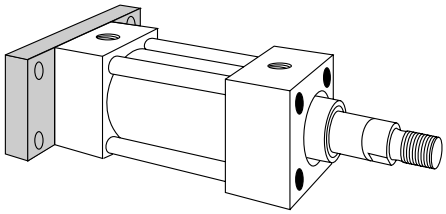
See tables on next page for Dimensions

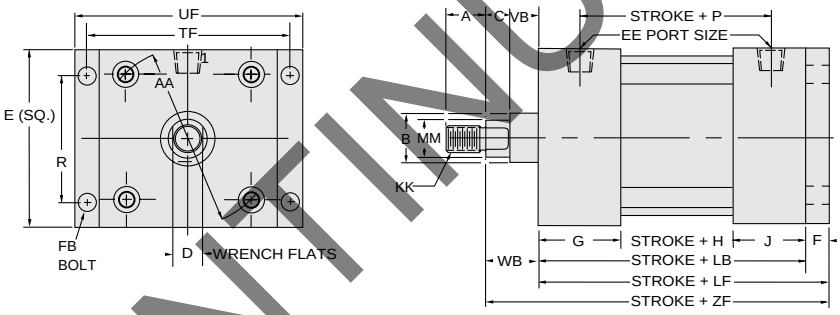




Rectangular Flange/Cap End
Model 62 (NFPA MF2)

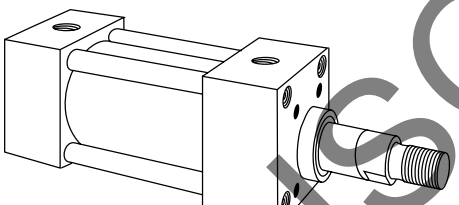
See tables on next page for Dimensions

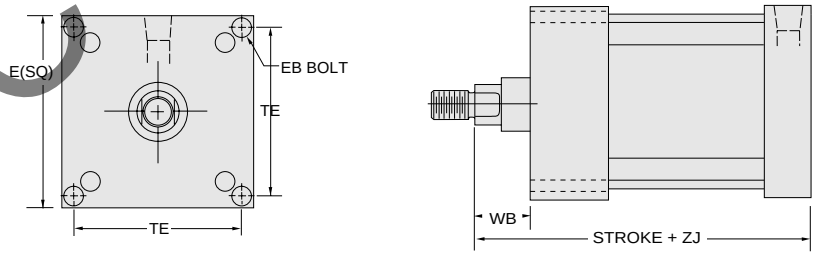




Square Head
Model 63-B (NFPA ME3)
8" Bore only

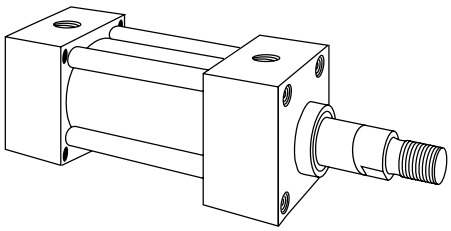
See tables on next page for Dimensions

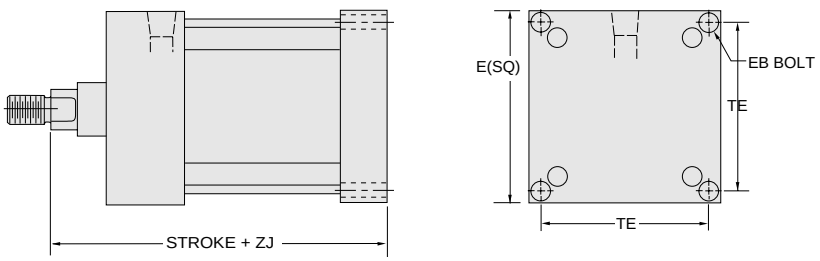




Square Cap
Model 64-B (NFPA ME4)
8" Bore only

See tables on next page for Dimensions





DISCONTINUED

Cylinder Body DImensions

Bore Size	Dimensions					
	AA	E	EE	G	J	R
1½	2.02	2	⅜-18	1½	1	1.43
2	2.60	2½	⅜-18	1½	1	1.84
2½	3.10	3	⅜-18	1½	1	2.19
3¼	3.90	3¾	½-14	1¾	1¼	2.76
4	4.70	4½	½-14	1¾	1¼	3.32
5	5.80	5½	½-14	1¾	1¼	4.10
6	6.90	6½	¾-14	2	1½	4.88
8	9.10	8½	¾-14	2	1½	6.44

Mounting Dimensions

F	EB	TE	FB	TF	UF
⅜	–	–	5/16	2¾	3⅜
⅜	–	–	⅜	3⅜	4⅛
⅜	–	–	⅜	3⅞	4⅝
⅝	–	–	7/16	4 11/16	5½
⅝	–	–	7/16	5 7/16	6¼
⅝	–	–	9/16	6⅝	7⅝
¾	–	–	9/16	7⅝	8⅝
–	⅝	7.57	–	–	–

Rod End Dimensions

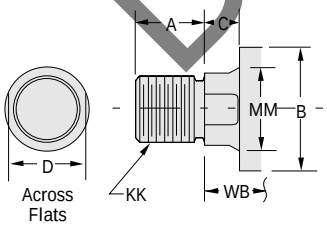
Bore Size	Rod Dia.	A	B -.001 -.003	C	D	IM Style 5	KK Styles 2,4&6	V	VB	W	WB
1½	⅝	¾	1.125	⅜	½	1/2-20	7/16-20	¼	⅝	⅝	1
2	⅝	¾	1.125	⅜	½	1/2-20	7/16-20	¼	⅝	⅝	1
	1	1⅛	1.500	½	⅞	⅞-14	¾-16	½	⅞	1	1⅜
2½	⅝	¾	1.125	⅜	½	1/2-20	7/16-20	¼	⅝	⅝	1
	1	1⅛	1.500	½	⅞	⅞-14	¾-16	½	⅞	1	1⅜
3¼	1	1⅛	1.500	½	⅞	⅞-14	¾-16	¼	⅞	¾	1⅜
	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	⅜	1	1	1⅝
4	1	1⅛	1.500	½	⅞	⅞-14	¾-16	¼	⅞	¾	1⅜
	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	⅜	1	1	1⅝
5	1	1⅛	1.500	½	⅞	⅞-14	¾-16	¼	⅞	¾	1⅜
	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	⅜	1	1	1⅝
6	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	¼	1	⅞	1⅝
	1¾	2	2.375	¾	1½	1½-12	1¼-12	⅜	1⅛	1⅛	1⅞
8	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	–	1	–	1⅝
	1¾	2	2.375	¾	1½	1½-12	1¼-12	–	1⅛	–	1⅞

Add Stroke

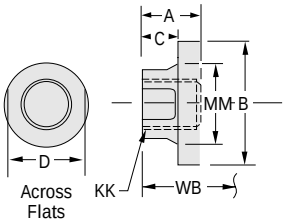
H	P	LB	LF	ZF	ZJ
1⅛	2 5/16	3⅝	4	5	–
1⅛	2 5/16	3⅝	4	5	–
1⅛	2 5/16	3⅝	4	5⅜	–
1¼	2 7/16	3¾	4⅛	5⅛	–
1¼	2 7/16	3¾	4⅛	5½	–
1¼	2⅝	4¼	4⅛	6¼	–
1¼	2⅝	4¼	4⅞	6½	–
1¼	2⅝	4¼	4⅞	6¼	–
1¼	2⅝	4¼	4⅞	6½	–
1½	2⅞	4½	5⅛	6½	–
1½	2⅞	4½	5⅛	6¾	–
1½	3⅛	5	5¾	7⅜	–
1½	3⅛	5	5¾	7⅝	–
1⅝	3¼	5⅛	–	–	6¾
1⅝	3¼	5⅛	–	–	7

Rod End Styles & Dimensions

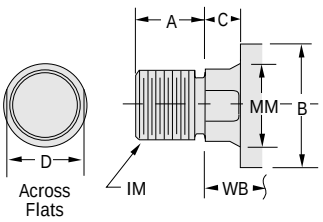
Style No. 2-Standard
Threaded on Turndown Section



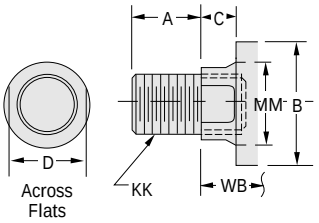
Style No. 4
Short Rod End-Internal Threads



Style No. 5
Threaded Intermediate Male



Style No. 6
Studded Rod End



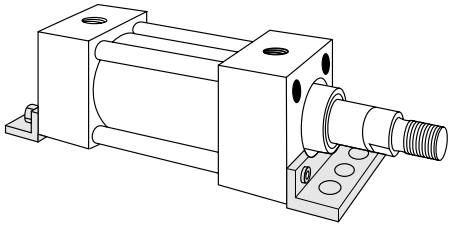
See page 17 for additional rod end styles.

Model 61 not available in 8" bore

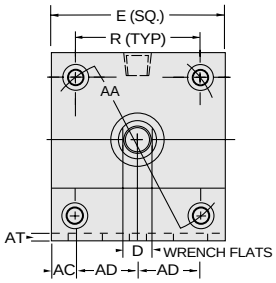
Model 62 not available in 8" bore

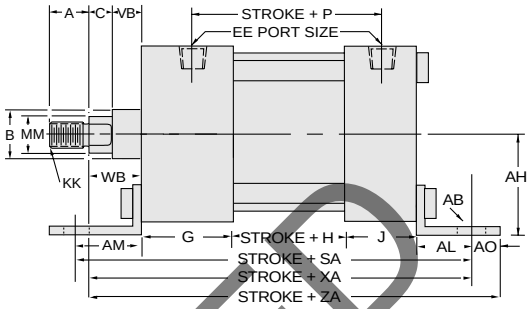
DISCONTINUED

End Angle
Model 71 (NFPA MS1)

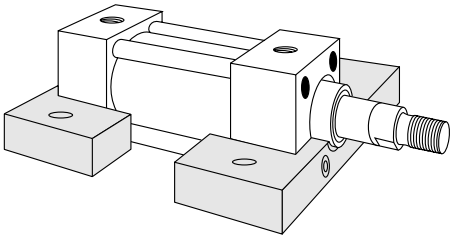


See tables on next page for Dimensions

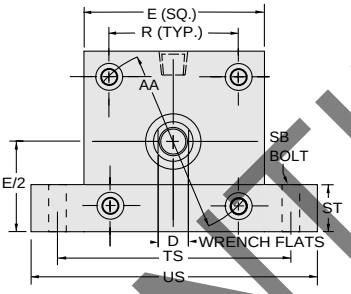


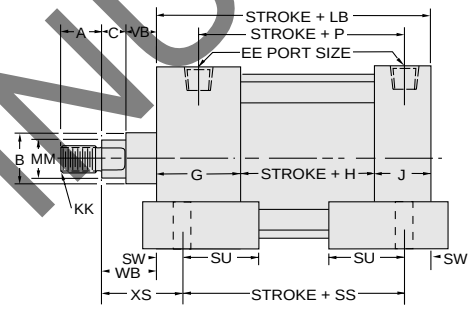


Side Lug Mount
Model 72 (NFPA MS2)

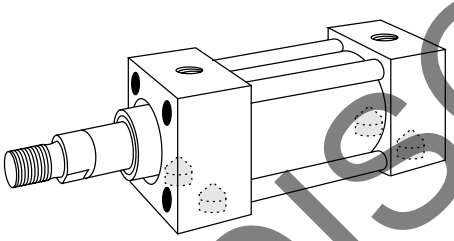


See tables on next page for Dimensions

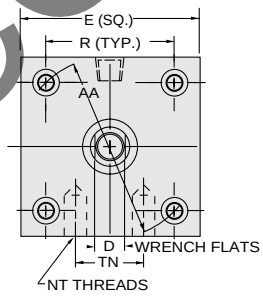


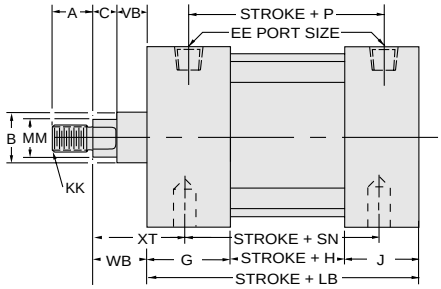


Side Tap Mount
Model 74 (NFPA MS4)

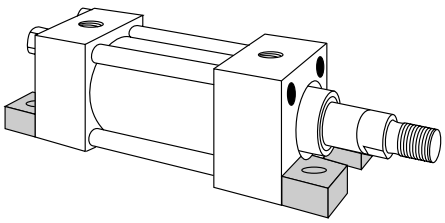


See tables on next page for Dimensions

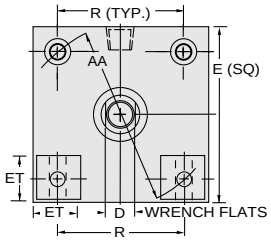


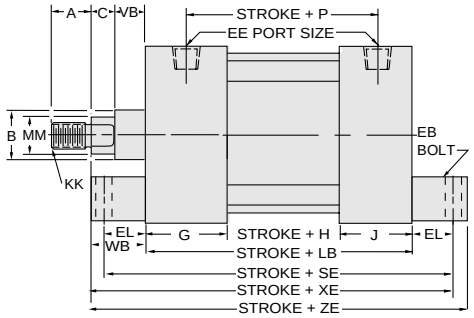


End Lug Mount
Model 77 (NFPA MS7)



See tables on next page for Dimensions





DISCONTINUED

Cylinder Body DImensions

Bore Size	Dimensions					
	AA	E	EE	G	J	R
1½	2.02	2	3/8-18	1½	1	1.43
2	2.60	2½	3/8-18	1½	1	1.84
2½	3.10	3	3/8-18	1½	1	2.19
3¼	3.90	3¾	½-14	1¾	1¼	2.76
4	4.70	4½	½-14	1¾	1¼	3.32
5	5.80	5½	½-14	1¾	1¼	4.10
6	6.90	6½	¾-14	2	1½	4.88
8	9.10	8½	¾-14	2	1½	6.44

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

Mounting Dimensions

Dimensions																		
AB*	AC	AD	AH	AL	AM	AO	AT	EB*	EL	ET	NT	SB*	ST	SU	SW	TN	TS	US
3/8	3/8	5/8	1 3/16	1	1 3/8	3/8	1/8	1/4	3/4	1/2	1/4-20	3/8	1/2	15/16	3/8	5/8	2 3/4	3 1/2
3/8	3/8	7/8	1 7/16	1	1 3/8	3/8	1/8	5/16	15/16	19/32	5/16-18	3/8	1/2	15/16	3/8	7/8	3 1/4	4
3/8	3/8	1 1/8	1 5/8	1	1 3/8	3/8	1/8	5/16	1 1/16	3/4	3/8-16	3/8	1/2	15/16	3/8	1 1/4	3 3/4	4 1/2
1/2	1/2	1 3/8	1 15/16	1 1/4	1 7/8	1/2	3/16	3/8	7/8	29/32	1/2-13	1/2	3/4	1 1/4	1/2	1 1/2	4 3/4	5 3/4
1/2	1/2	1 3/4	2 1/4	1 1/4	1 7/8	1/2	3/16	3/8	1	1 1/8	1/2-13	1/2	3/4	1 1/4	1/2	2 1/16	5 1/2	6 1/2
5/8	5/8	2 1/8	2 3/4	1 3/8	2	5/8	1/4	1/2	1 1/16	1 11/32	5/8-11	3/4	1	1 9/16	11/16	2 11/16	6 7/8	8 1/4
3/4	5/8	2 5/8	3 1/4	1 3/8	2 1/8	5/8	1/4	1/2	1	1 9/16	3/4-10	3/4	1	1 9/16	11/16	3 1/4	7 7/8	9 1/4
3/4	11/16	3 9/16	4 1/4	1 13/16	1 13/16	11/16	1/4	5/8	1 1/8	2	3/4-10	3/4	1	1 9/16	11/16	4 1/2	9 7/8	11 1/4

Rod End Dimensions

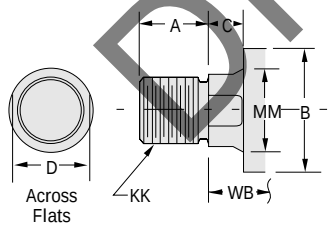
Bore Size	Rod Dia.	A	B -.001 -.003	C	D	IM Style 5	KK Styles 2,4&6	VB	WB	XS	XT
1½	5/8	3/4	1.125	3/8	1/2	1/2-20	7/16-20	5/8	1	1 3/8	1 15/16
2	5/8	3/4	1.125	3/8	1/2	1/2-20	7/16-20	5/8	1	1 3/8	1 15/16
	1	1 1/8	1.500	1/2	7/8	7/8-14	3/4-16	7/8	1 3/8	1 3/4	2 5/16
2½	5/8	3/4	1.125	3/8	1/2	1/2-20	7/16-20	5/8	1	1 3/8	1 15/16
	1	1 1/8	1.500	1/2	7/8	7/8-14	3/4-16	7/8	1 3/8	1 3/4	2 5/16
3¼	1	1 1/8	1.500	1/2	7/8	7/8-14	3/4-16	7/8	1 3/8	1 7/8	2 7/16
	1 3/8	1 5/8	2.000	5/8	1 1/8	1 1/4-12	1-14	1	1 5/8	2 1/8	2 11/16
4	1	1 1/8	1.500	1/2	7/8	7/8-14	3/4-16	7/8	1 3/8	1 7/8	2 7/16
	1 3/8	1 5/8	2.000	5/8	1 1/8	1 1/4-12	1-14	1	1 5/8	2 1/8	2 11/16
5	1	1 1/8	1.500	1/2	7/8	7/8-14	3/4-16	7/8	1 3/8	2 1/16	2 7/16
	1 3/8	1 5/8	2.000	5/8	1 1/8	1 1/4-12	1-14	1	1 5/8	2 5/16	2 11/16
6	1 3/8	1 5/8	2.000	5/8	1 1/8	1 1/4-12	1-14	1	1 5/8	2 5/16	2 13/16
	1 3/4	2	2.375	3/4	1 1/2	1 1/2-12	1 1/4-12	1 1/8	1 7/8	2 9/16	3 1/16
8	1 3/8	1 5/8	2.000	5/8	1 1/8	1 1/4-12	1-14	1	1 5/8	2 5/16	2 13/16
	1 3/4	2	2.375	3/4	1 1/2	1 1/2-12	1 1/4-12	1 1/8	1 7/8	2 9/16	3 1/16

Add to Stroke

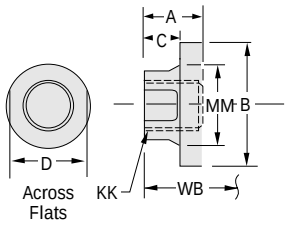
H	P	LB	SA	SE	SS	SN	XA	XE	ZA	ZE
1 1/8	2 5/16	3 5/8	6	5 1/8	2 7/8	2 1/4	5 5/8	5 3/8	6	5 5/8
1 1/8	2 5/16	3 5/8	6	5 1/2	2 7/8	2 1/4	5 5/8	5 9/16	6	5 7/8
1 1/8	2 5/16	3 5/8	6	5 1/2	2 7/8	2 1/4	6	5 15/16	6 3/8	6 1/4
1 1/4	2 7/16	3 3/4	6 1/8	5 7/8	3	2 3/8	5 3/4	5 13/16	6 1/8	6 1/8
1 1/4	2 7/16	3 3/4	6 1/8	5 7/8	3	2 3/8	6 1/8	6 3/16	6 1/2	6 1/2
1 1/4	2 5/8	4 1/4	7 3/8	6	3 1/4	2 5/8	6 7/8	6 1/2	7 3/8	6 7/8
1 1/4	2 5/8	4 1/4	7 3/8	6	3 1/4	2 5/8	7 1/8	6 3/4	7 5/8	7 1/8
1 1/4	2 5/8	4 1/4	7 3/8	6 1/4	3 1/4	2 5/8	6 7/8	6 5/8	7 3/8	7
1 1/4	2 5/8	4 1/4	7 3/8	6 1/4	3 1/4	2 5/8	7 1/8	6 7/8	7 5/8	7 1/4
1 1/2	2 7/8	4 1/2	7 7/8	6 5/8	3 1/8	2 7/8	7 1/4	6 15/16	7 7/8	7 7/16
1 1/2	2 7/8	4 1/2	7 7/8	6 5/8	3 1/8	2 7/8	7 1/2	7 3/16	8 1/8	7 11/16
1 1/2	3 1/8	5	8 1/2	7	3 5/8	3 1/8	8	7 5/8	8 5/8	8 1/8
1 1/2	3 1/8	5	8 1/2	7	3 5/8	3 1/8	8 1/4	7 7/8	8 7/8	8 3/8
1 5/8	3 1/4	5 1/8	8 3/4	7 3/8	3 3/4	3 1/4	8 9/16	7 7/8	9 1/4	8 1/2
1 5/8	3 1/4	5 1/8	8 3/4	7 3/8	3 3/4	3 1/4	8 13/16	8 1/8	9 1/2	8 3/4

Rod End Styles & Dimensions

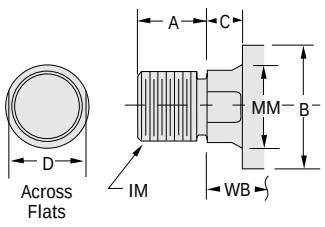
Style No. 2-Standard
Threaded on Turndown Section



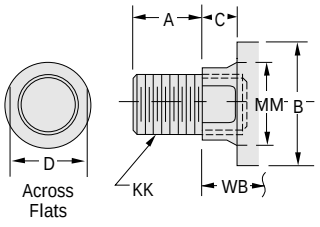
Style No. 4
Short Rod End-Internal Threads



Style No. 5
Threaded Intermediate Male



Style No. 6
Studded Rod End

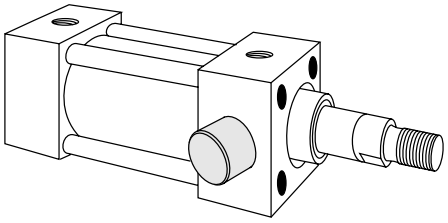


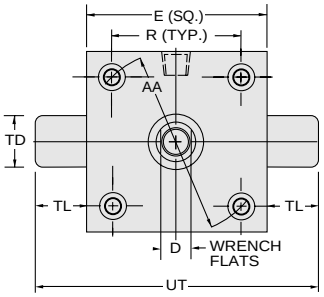
See page 17 for additional rod end styles.

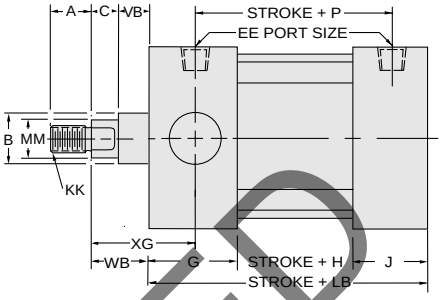
DISCONTINUED

Trunnion Head/End
Model 81 (NFPA MT1)

See tables on next page
for Dimensions

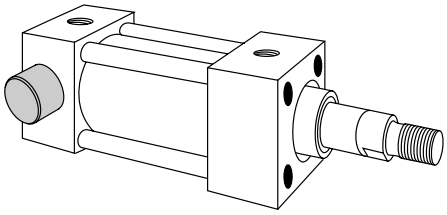


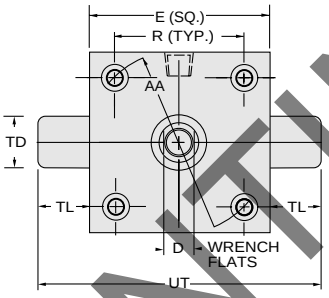


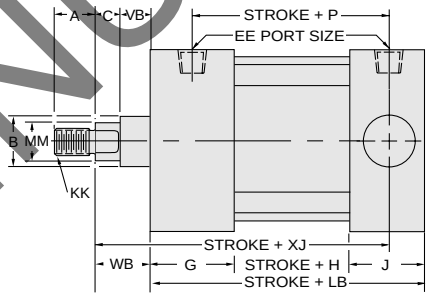


Trunnion Cap/End
Model 82 (NFPA MT2)

See tables on next page
for Dimensions

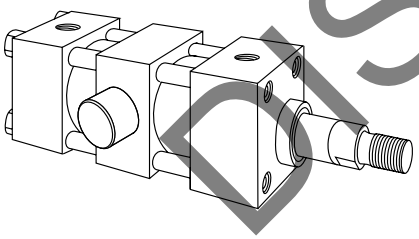


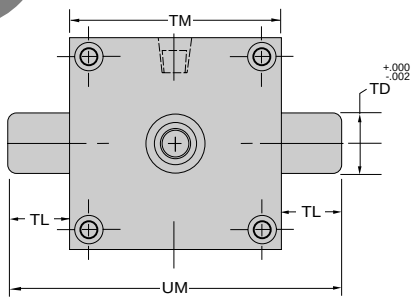


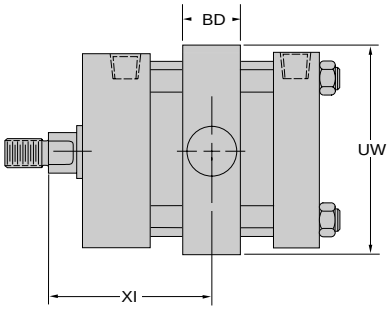


Intermediate Trunnion
**Model 89 (NFPA MT4)

See tables on next page
for Dimensions







Note: Customer to specify XI dimension.

DISCONTINUED

Cylinder Body Dimensions

Bore Size	Dimensions					
	AA	E	EE	G	J	R
1½	2.02	2	⅜-18	1½	1	1.43
2	2.60	2½	⅜-18	1½	1	1.84
2½	3.10	3	⅜-18	1½	1	2.19
3¼	3.90	3¾	½-14	1¾	1¼	2.76
4	4.70	4½	½-14	1¾	1¼	3.32
5	5.80	5½	½-14	1¾	1¼	4.10
6	6.90	6½	¾-14	2	1½	4.88
8	9.10	8½	¾-14	2	1½	6.44

Mounting Dimensions

Dimensions							
BD	TM	UM	UW	TD	TL	UT	Min. Strk.**
1½	2½	4½	2½	1	1	4	3¼
1½	3	5	3	1	1	4½	2¾
1½	3½	5½	3½	1	1	5	2⅝
2	4½	6½	4½	1	1	5¾	4½
2	5¼	7¼	5	1	1	6½	3
2	6¼	8¼	6½	1	1	7½	3
2¼	7⅝	10⅜	7½	1⅜	1⅜	9¼	2⅞
3	9¾	12½	9½	1⅜	1⅜	11¼	7

Rod End Dimensions

Bore Size	Rod Dia.	A	B -.001 -.003	C	D	IM Style 5	KK Styles 2,4&6	VB	XG	WB
1½	⅝	¾	1.125	⅜	½	1/2-20	7/16-20	⅝	1¾	1
2	⅝	¾	1.125	⅜	½	1/2-20	7/16-20	⅝	1¾	1
	1	1⅛	1.500	½	⅞	⅞-14	¾-16	⅞	2⅛	1⅜
2½	⅝	¾	1.125	⅜	½	1/2-20	7/16-20	⅝	1¾	1
	1	1⅛	1.500	½	⅞	⅞-14	¾-16	⅞	2⅛	1⅜
3¼	1	1⅛	1.500	½	⅞	⅞-14	¾-16	⅞	2¼	1⅜
	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	1	2½	1⅝
4	1	1⅛	1.500	½	⅞	⅞-14	¾-16	⅞	2¼	1⅜
	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	1	2½	1⅝
5	1	1⅛	1.500	½	⅞	⅞-14	¾-16	⅞	2¼	1⅜
	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	1	2½	1⅝
6	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	1	2⅝	1⅝
	1¾	2	2.375	¾	1½	1½-12	1¼-12	1⅛	2⅞	1⅞
8	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	1	2⅝	1⅝
	1¾	2	2.375	¾	1½	1½-12	1¼-12	1⅛	2⅞	1⅞

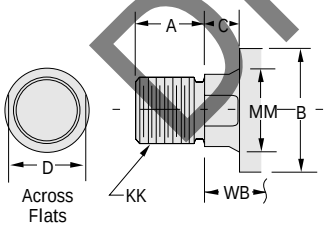
** Contact Miller Fluid Power if shorter stroke or X1 dimension.

Add to Stroke

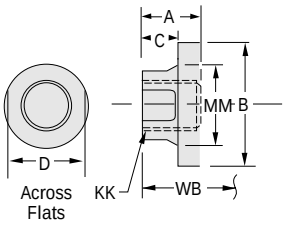
H	P	LB	XJ	Min. XI Dim.**
1⅛	2 5/16	3⅝	4⅛	4⅞
1⅛	2 5/16	3⅝	4⅛	4½
1⅛	2 5/16	3⅝	4½	4⅞
1¼	2 7/16	3¾	4¼	4½
1¼	2 7/16	3¾	4⅝	4⅞
1¼	2⅝	4¼	5	6⅜
1¼	2⅝	4¼	5¼	6⅝
1¼	2⅝	4¼	5	5⅜
1¼	2⅝	4¼	5¼	5⅝
1½	2⅞	4½	5¼	5½
1½	2⅞	4½	5½	5¾
1½	3⅛	5	5⅞	6¼
1½	3⅛	5	6⅛	6½
1⅝	3¼	5⅛	6	8⅜
1⅝	3¼	5⅛	6¼	8⅝

Rod End Styles & Dimensions

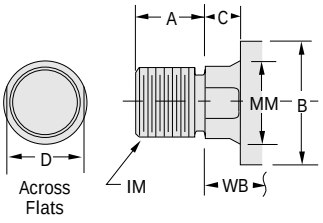
Style No. 2-Standard
Threaded on Turndown Section



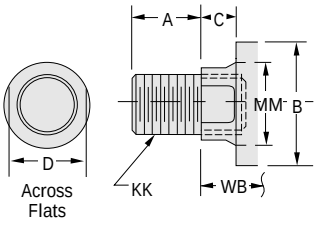
Style No. 4
Short Rod End-Internal Threads



Style No. 5
Threaded Intermediate Male



Style No. 6
Studded Rod End

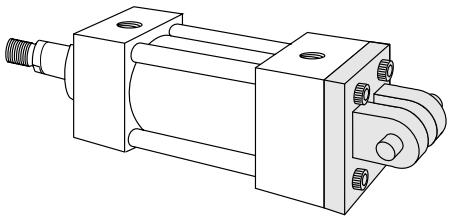


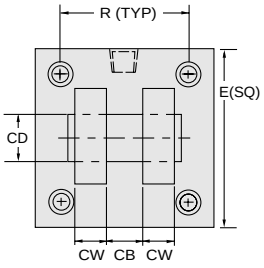
See page 17 for additional rod end styles.

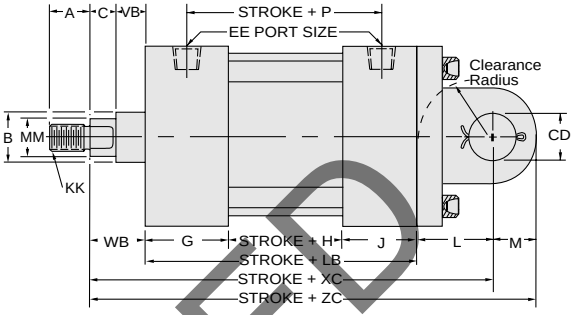
DISCONTINUED

Detachable Clevis
Model 84 (NFPA MP1)
Interchange

See tables on next page
for Dimensions

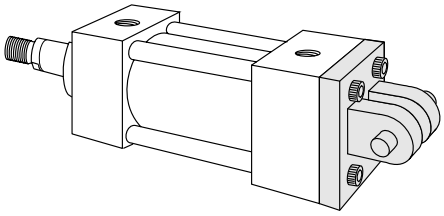


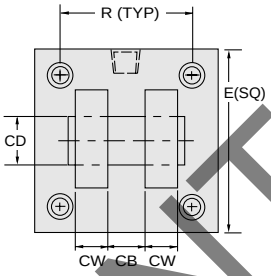


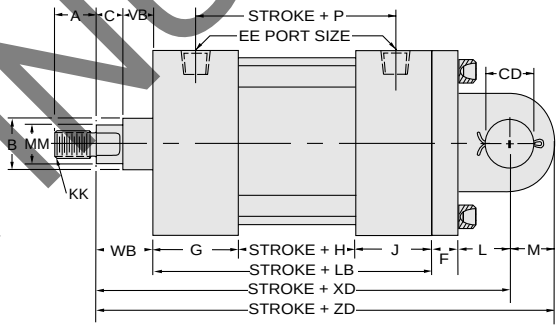


Detachable Clevis
Model 86 (NFPA MP2)

See tables on next page
for Dimensions

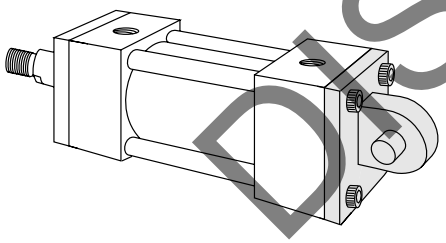


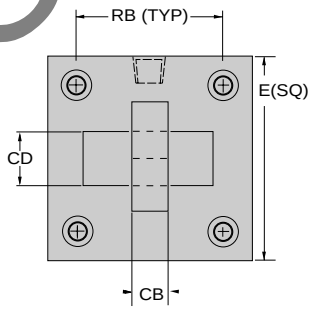


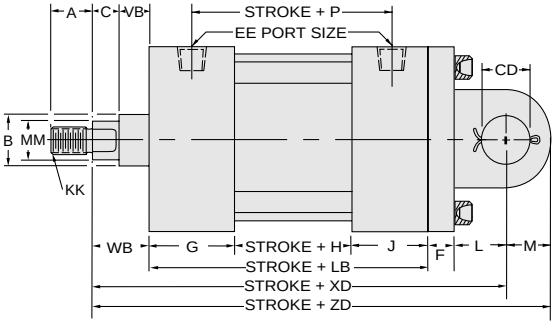


Detachable Clevis
Model 96 (NFPA MP4)

See tables on next page
for Dimensions







DISCONTINUED

Cylinder Body Dimensions

Bore Size	Dimensions				
	E	EE	G	J	R
1½	2	⅜-18	1½	1	1.43
2	2½	⅜-18	1½	1	1.84
2½	3	⅜-18	1½	1	2.19
3¼	3¾	½-14	1¾	1¼	2.76
4	4½	½-14	1¾	1¼	3.32
5	5½	½-14	1¾	1¼	4.10
6	6½	¾-14	2	1½	4.88
8	8½	¾-14	2	1½	6.44

Mounting Dimensions

Dimensions					
L	M	CB	CD	CW	F
¾	½	¾	½	½	⅜
¾	½	¾	½	½	⅜
¾	½	¾	½	½	⅜
1¼	¾	1¼	¾	⅝	⅝
1¼	¾	1¼	¾	⅝	⅝
1¼	¾	1¼	¾	⅝	⅝
1½	1	1½	1	¾	¾
1½	1	1½	1	¾	1

Rod End Dimensions

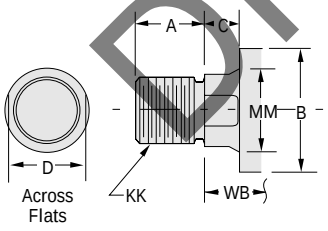
Bore Size	Rod Dia.	A	B -.001 -.003	C	D	IM Style 5	KK Styles 2,4&6	VB	WB
1½	⅝	¾	1.125	⅜	½	1/2-20	7/16-20	⅝	1
2	⅝	¾	1.125	⅜	½	1/2-20	7/16-20	⅝	1
	1	1⅛	1.500	½	⅞	⅞-14	¾-16	⅞	1⅜
2½	⅝	¾	1.125	⅜	½	1/2-20	7/16-20	⅝	1
	1	1⅛	1.500	½	⅞	⅞-14	¾-16	⅞	1⅜
3¼	1	1⅛	1.500	½	⅞	⅞-14	¾-16	⅞	1⅜
	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	1	1⅝
4	1	1⅛	1.500	½	⅞	⅞-14	¾-16	⅞	1⅜
	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	1	1⅝
5	1	1⅛	1.500	½	⅞	⅞-14	¾-16	⅞	1⅜
	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	1	1⅝
6	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	1	1⅝
	1¾	2	2.375	¾	1½	1½-12	1¼-12	1⅛	1⅞
8	1⅜	1⅝	2.000	⅝	1⅛	1¼-12	1-14	1	1⅝
	1¾	2	2.375	¾	1½	1½-12	1¼-12	1⅛	1⅞

Add to Stroke

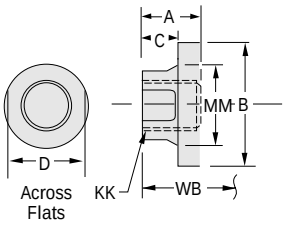
H	P	LB	XC	XD
1⅛	2 5/16	3⅝	5⅜	5¾
1⅛	2 5/16	3⅝	5⅜	5¾
1⅛	2 5/16	3⅝	5¾	6⅛
1¼	2 7/16	3¾	5½	5⅞
1¼	2 7/16	3¾	5⅞	6¼
1¼	2⅝	4¼	6⅞	7½
1¼	2⅝	4¼	7⅛	7¾
1¼	2⅝	4¼	6⅞	7½
1¼	2⅝	4¼	7⅛	7¾
1½	2⅞	4½	7⅛	7¾
1½	2⅞	4½	7⅜	8
1½	3⅛	5	8⅛	8⅞
1½	3⅛	5	8⅜	9⅛
1⅝	3¼	5⅛	8¼	9¼
1⅝	3¼	5⅛	8½	9½

Rod End Styles & Dimensions

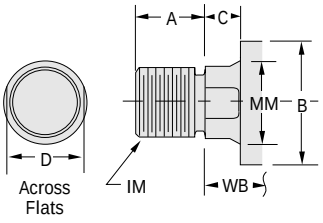
Style No. 2-Standard
Threaded on Turndown Section



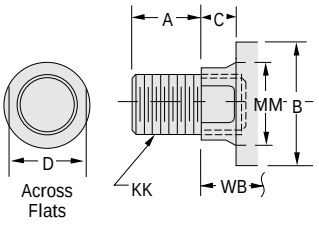
Style No. 4
Short Rod End-Internal Threads



Style No. 5
Threaded Intermediate Male



Style No. 6
Studded Rod End



See page 17 for additional rod end styles.

DISCONTINUED

Selecting Rod End Accessories

Cylinder rod end accessories are used to affix the piston rod to the load — most commonly when the cylinder pivots during piston motion. The use of a pivot pin is required. A dimension key is provided in Fig. A.

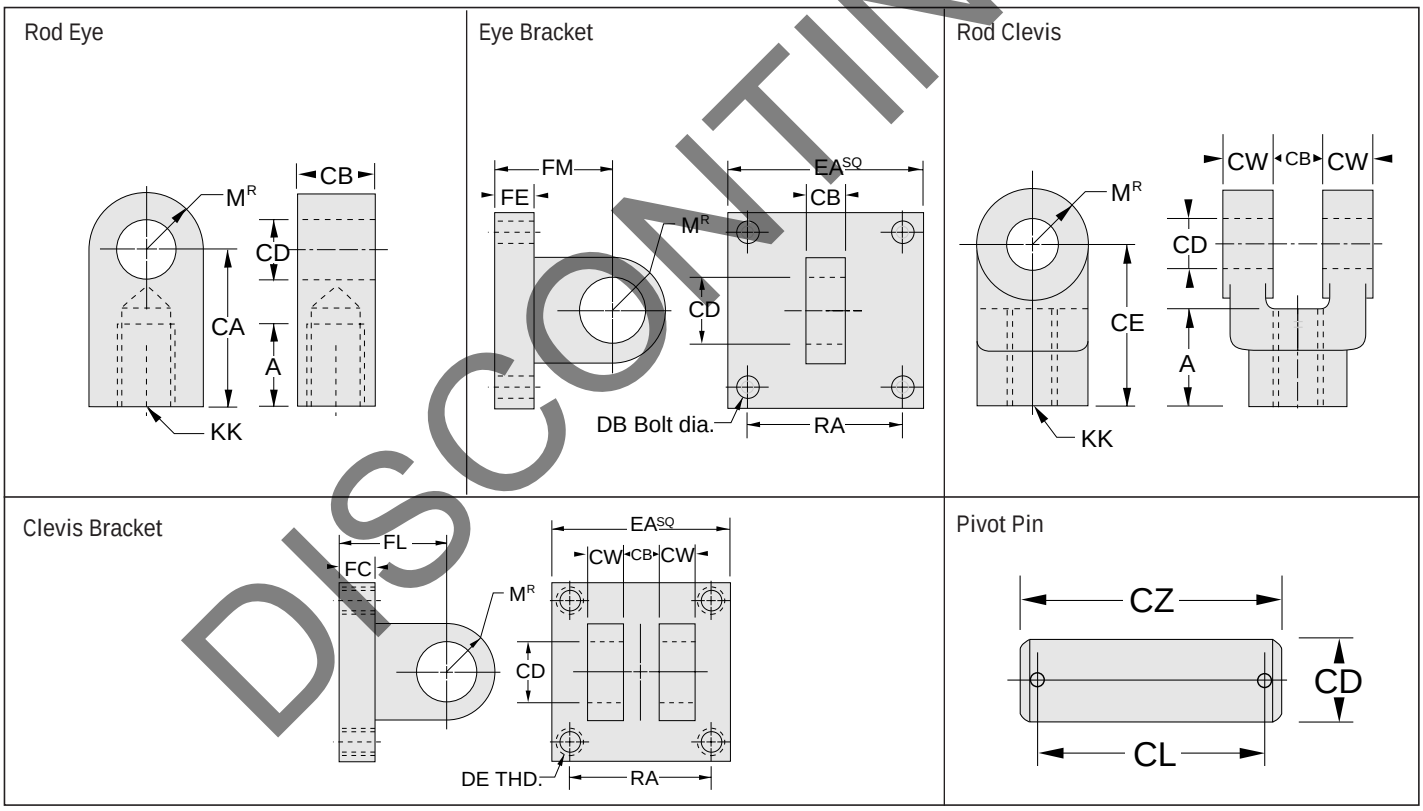
Piston Rod Attachments — In attaching machinery components or rod clevises, rod eyes, etc. to Miller Style 2 (Threaded on Turndown Section) or Style 4 (Internally Threaded) Piston Rods, the attachments should be tightened to the torques given in the Table at right. This torque or prestress triples the fatigue strength of the rod's threaded section and makes a stronger assembly than attaching the machinery component to a maximum diameter threaded rod (Style 5) and torquing it against a lock nut. Miller recommends the Style 2 (Threaded on Turndown Section) Rod for most applications. Its square shoulder design helps assure proper alignment of cylinder to mechanism, eliminates need for a jam nut, provides fixed point for more accurate cylinder positioning, simplifies piloting to full rod diameter into mating part, and permits easier assembly of seal over rod without damage.

Pre-Stress Table: Piston Rods		
Std. Rod	Thread Size	Torque ft lbs*
5/8	7/16-20	36
1	3/4-16	125
1 3/8	1-14	250
1 3/4	1 1/4-12	460

*Recommended Torques (ft. lbs.) with MoS2 Lubricant or Equivalent.

Torque Table: Tie Rods			
Bore size	Thread Size	Torque ft lbs*	Elongation in 36"
1.50	1/4-20	3	.022
2.00	5/16-24	4	.015
2.50	5/16-24	4	.015
3.25	3/8-24	6	.012
4.00	3/8-24	6	.012
5.00	1/2-20	12	.010
6.00	1/2-20	12	.010
8.00	5/8-18	25	.011

Figure A



See page 17 for accessory part numbers.

Rod End Accessories Dimension Chart

AL Series Cylinder Accessories and Dimensions

Stnd. Rod Dia.	A	CA	CB	CD	CE	CL	CW	CZ	DB	DE	EA	FC	FE	FL	FM	KK	M	RA
5/8	3/4	1 1/2	3/4	1/2	1 1/2	1.83	1/2	2.28	3/8	3/8-24	2 1/2	3/8	3/8	1 1/8	1 1/8	7/16-20	1/2	1.63
1	1 1/8	2 1/16	1 1/4	3/4	2 3/8	2.58	5/8	3.09	1/2	1/2-20	3 1/2	5/8	5/8	1 7/8	1 7/8	3/4-16	3/4	2.55
1 3/8	1 5/8	2 13/16	1 1/2	1	3 1/8	3.08	3/4	3.59	5/8	5/8-18	4 1/2	3/4	3/4	2 1/4	2 1/4	1-14	1	3.25
1 3/4	2	3 7/16	2	1 3/8	4 1/8	4.08	1	4.66	5/8	5/8-18	5	7/8	7/8	3	3	1 1/4-12	1 3/8	3.82

DISCONTINUED

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Additional Rod End Styles

Rod End Styles

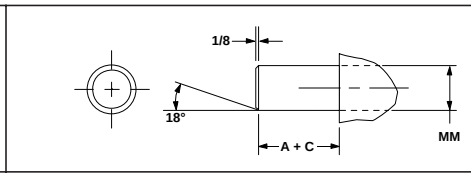
Rod End Style 2 is the standard rod end on Miller Fluid power cylinders and will be furnished unless otherwise specified.

The rod end styles shown on this page represent most of the more commonly used rod end connections. If a rod end is required other than any of those shown, it would be machined from the style "O" Rod end and identified as a style "O" modified.

Rod end modifications to your specifications can be readily made and could include a radius, a spherical radius, special thread size or length or both, keyway, special drilled holes and many other variations too numerous to mention. Furnish sketch for rod ends other than standard.

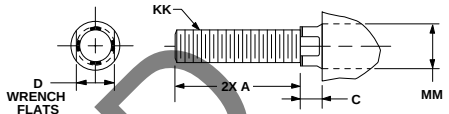
Style 0

Plain Rod
No Thread
No Flats



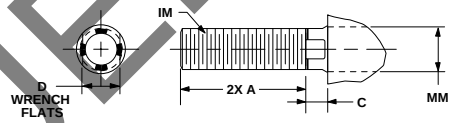
Style 7

Turndown
Male
Thread (2X A)



Style 8

Intermediate
Male Thread
(2X A)



Bore Size	Bore/Rod Size Availability	
	Standard Rod	Oversized Rod
1½"	⅝"	—
2"	⅝"	1"
2½"	⅝"	1"
3¼"	1"	1⅜"
4"	1"	1⅜"
5"	1"	1⅜"
6"	1⅜"	1¾"
8"	1⅜"	1¾"

Rod End Dimensions

Rod Dia. mm.	A	C	D	IM	KK
⅝	¾	⅜	½	½-20	7/16-20
1	1⅛	½	⅞	⅞-14	¾-16
1⅜	1⅝	⅝	1⅛	1¼-12	1-14
1¾	2	¾	1½	1½-12	1¼-12

DISCONTINUED

Accessory Part Numbers

To order accessories for your AL cylinder, use the part numbers listed below.

Pin Dia.	Rod Eye	Clevis Bracket	Pin	Rod Clevis	Eye Bracket
½	057-RE001-44-20	170-MB 86A-150-50	057-PP001-50	057-RC001-44-20	057-EB001-50
¾	057-RE001-75-16	170-MB 86A-250-75	057-PP001-75	057-RC001-75-16	057-EB001-75
1	057-RE001-100-14	170-MB 86A-325-100	057-PP001-100	057-RC001-100-14	057-EB001-100
1⅜	057-RE001-125-12	170-MB 86A-400-138	057-PP001-138	057-RC001-125-12	057-EB001-138

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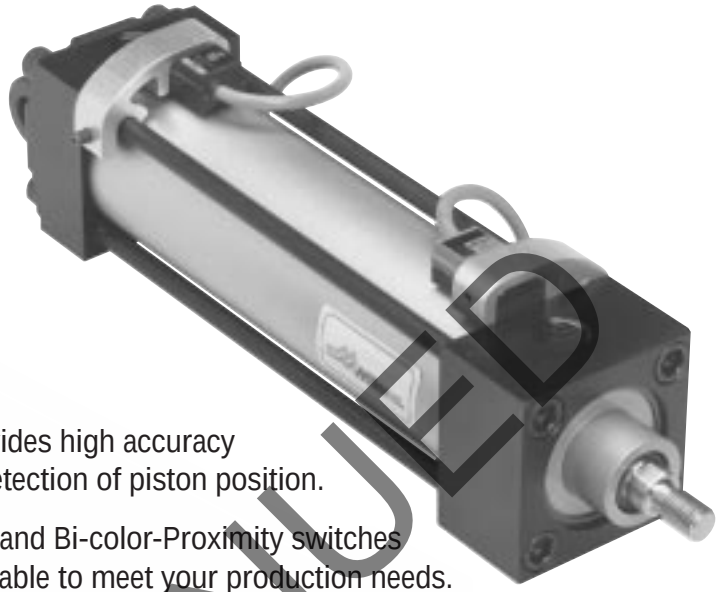
Limit Switches
Non-Contact, External, Adjustable Position

Miller limit switches are compact and reliable. Because of their low profile, and secure mounting brackets, the chances of being damaged by inadvertent physical abuse is remote. They have been thoroughly tested and proven for years of trouble-free service.

The piston contains a ring magnet which closes the switch when the piston passes underneath. These switches are hermetically sealed and all electrical components are epoxy encapsulated.

These limit switches may be used, in any number, with a Miller AL Series cylinder that is equipped with the magnetic piston. The switches are easily attached to the tie rods. Piston magnet must be specified when ordering the cylinder.

Minimum stroke on AL cylinder with switches is ½"



Provides high accuracy
in detection of piston position.

One and Bi-color-Proximity switches
available to meet your production needs.

DISCONTINUED

Switch Specifications ••

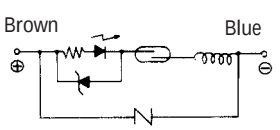
	Contactless Switches					Reed Switches			
	R15	R25	R2Y5	R35	R3Y5	R05	R45	R55	R65
Usage	Prog. cont. relay small solenoid valve	PC excl.		PC relay IC net solenoid valve		Relay, PC	High capacity relay solenoid valve	PC IC net (w/o lamp), serial connect	PC excl. (w/ self hold func.)
Supply voltage	—	—		4.5-28V DC		—	—	—	—
Lead voltage/ Current	85-265 VAC 5-100mA	10-30 VDC 5-30mA		Max 30 VDC; max 200mA	max 150 mA	24 VDC, 5-50mA; 100 VAC, 7-20mA; 200 VAC, 7-10mA;	100 VAC, 20-200mA; 200 VAC, 10-200mA;	24 VDC, max 50mA; 100 VAC, max 20mA; 200 VAC, max 10mA;	24 VDC, 5-50mA
Current consumption	—	—		10mA	16mA	—	—	—	—
				As switched on with 24 VDC					
Int. volt. drop	7V max.	4V max.		.5V max w/ 150 mA	.5V max	2.4V max	2V max	0V	5V max
Indicator lamp	LED (lights when switched on)	①		LED (lights when switched on	①	LED (lights when switched on)	Neon lamp (lights when switched off)	None	LED (lights when switched on)
Leak Current	Max 1mA for 100 VAC Max 2mA for 200 VAC	Max 1mA	Max 1.2mA	Max 10mA		0	Max 10mA	0	Max 0.1mA
Lead length	5M (oilproof 2-ply PVC tire cord. 0.3 sqr. mm)			5M oilproof 3-ply PVC tire cord. 0.15 sqr. mm)		5M (oilproof 2-ply PVC tire cord. 0.3 sqr. mm)			
Ambient temp.	-10° — +60° C (+14° —+140° F)								

① = Bi-Color (Lights when switched on)

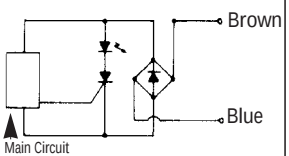
*:R2Y and R3Y are bi-color display.

Switch internal circuit

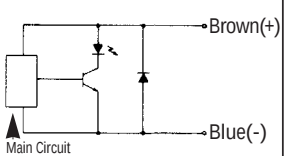
● RO5



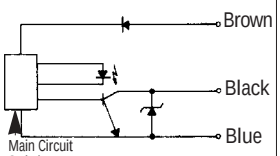
● R15



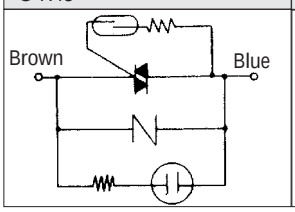
● R25 + R2Y5



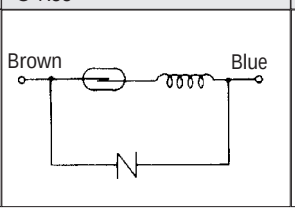
● R35 + R3Y5



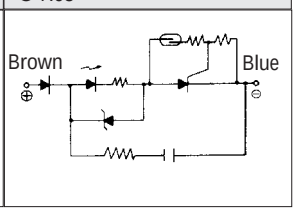
● R45



● R55



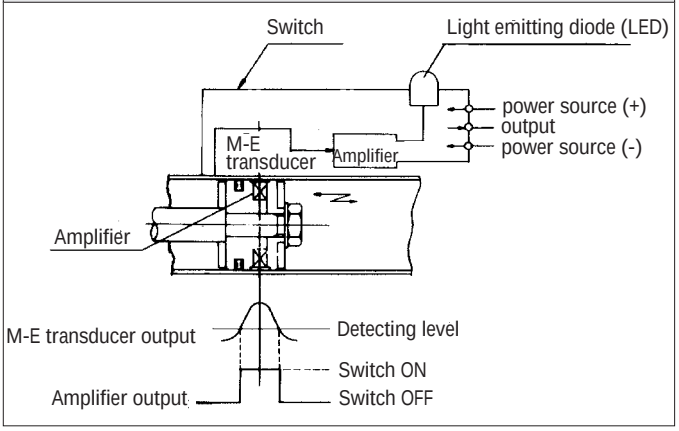
● R65



Operating Principle, Switch Mounting Position, Operating Range and Hysteresis

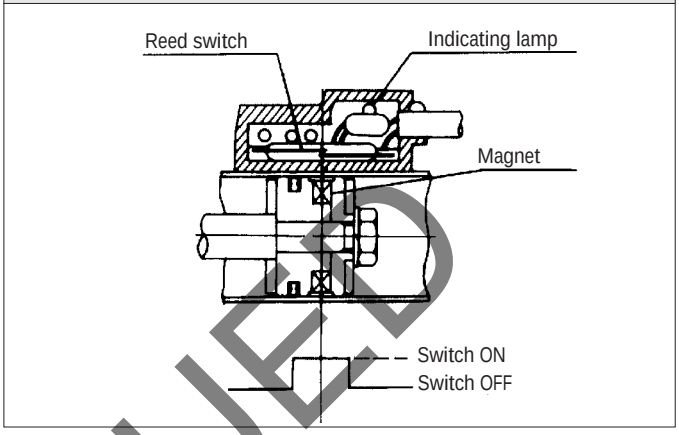
Operating principle

Proximity switch



An approaching piston magnet will cause a change in the magnetic field crossing the switch. Output voltage from the M-E (magneto-electrical) transducer will make a corresponding level change as shown above. The voltage signal is then amplified to produce the switching output pulse, as shown.

Reed switch



An approaching piston magnet will generate a magnetic field crossing the switch. The opposing contacts are then magnetized, mutually attracted and closed.

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Switch mounting position

● For End of Stroke Sensing

To obtain near end of stroke sensing, mount the switches on the tie rods at each end of the cylinder with the lead wires of the switches entending inward toward the center of the cylinder. Depending on bore size and switch model selected, piston stroke-to-go may be as much as 1/4" when the switch gives an output.

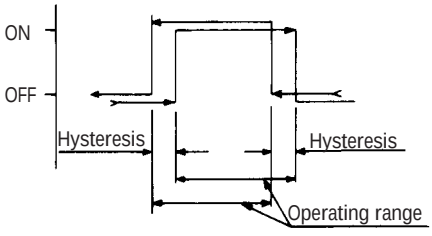
● For Mid-stroke Sensing

(1) For switches R05, R15, R25, R35, R45, R55, and R65: To sense piston movement in its mid-stroke position, move the piston to its desired stop position. Move the switch above the fixed piston to the location of initial switch actuation. The midpoint between the initial switch actuation and the center of the piston gives you the point of maximum sensitivity and the switch should be located at that position.

(2) For bi-color proximity switches R2Y5 and R3Y5: Move the switch to a position of initial lighting of the green indication lamp. This gives you the point of maximum sensitivity: the optimum point for switch installation.

Operating range

● As the cylinder moves through its stroke, the piston may move to turn on a switch and then move further in the same direction and turn the switch off again. The range between such on and off positions is called the operating range. The center of the operating range gives the exact point of maximum sensitivity. Setting a piston stop at this point will best stabilize the switching



action because the least external disturbance acts at this point. With the bi-color proximity switch, the operating range is signaled by the lighting of the red lamp, and the maximum sensitivity point (best mounting position) by the lighting of the green lamp.

Hysteresis

● In its travel cycle the piston may move to turn on the cylinder switch, then reverse its direction and move back to turn off the switch. The zone within such ON and OFF actions is called the "hysteresis". The hysteresis should be carefully noted because a piston stop in this area may harm the switching action due to increased external disturbance.

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Proximity switches

1 Connection of lead wires

Before beginning, power-off the electric circuit to be connected to. Make proper connection watching lead color coding.

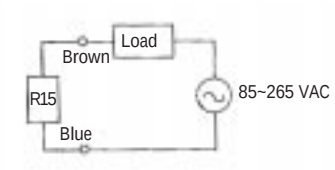


Fig. 1 Basic R15 circuit

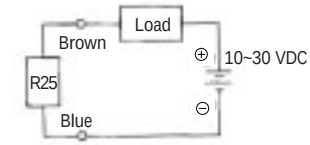


Fig. 2 Basic R25 (R2Y5) circuit

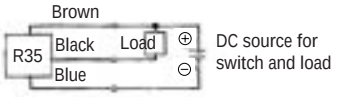


Fig. 3 Basic R35 (R3Y5) circuit (1) (with the same power source for switch and load), (sinking inputs)

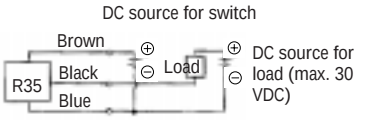
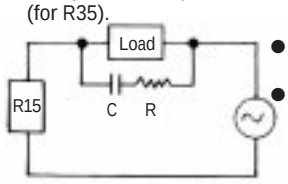


Fig. 4 Basic R35 (R3Y5) circuit (2) (with separate power sources (4.5-28) for switch), (sinking inputs)

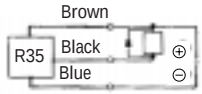
2 Output circuit protection

- Switch connection to an inductive load (such as a relay or solenoid valve) will give rise to surge voltage at the time of switching off. To get around this difficulty be sure to provide a protection circuit as shown in Figures 5A & 5B.
- With the switch connected to a capacitive load (i.e., capacitor), an inrush current will be introduced at the time of switching on. To avoid this difficulty be sure to provide a protection circuit as shown in Figure 6.
- If the lead wiring exceeds 10 meters, be sure to provide a protection circuit as shown in Figures 7, 8 (for R15/R25) or Figure 9 (for R35).



- Capacitor C=0.03~0.1μF
- Resistor R=1~3KΩ

Fig. 5A



- Diode (Hitachi V06C or equivalent)

Fig. 5B Protection circuit using surge absorbing diode for inductive load

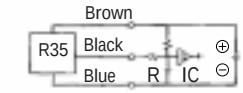


Fig. 6 Protection circuit using current limiting resistor R for capacitive load.
Find minimum ohmage from: V/0.15=R(Ω)

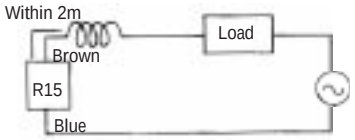


Fig. 7 ● Choke coil
L= Several hundred uH to several mH, of good high-frequency characteristic.
● Wire close to the switch (within 2m)

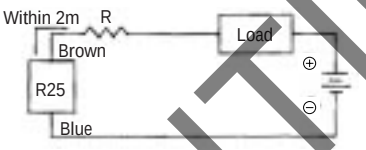


Fig. 8 ● Inrush current limiting resistor
R= Max. resistance allowed by load circuit
● Wire close to the switch (within 2m)

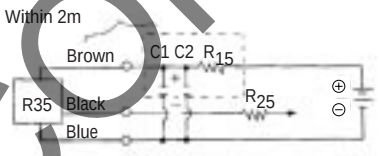


Fig. 9 ● Source noise absorbing circuit
C1 = 20~50μF
Electrolytic capacitor (withstand voltage: 50 V min.)
● C2 = 0.01~0.1μF
Ceramic capacitor
R15 = 20~30Ω
● Inrush current limiting resistor
R25 = Max. ohmage allowed by load circuit
● Wire close to the switch (within 2 m)

3 Connection to programmable controller (sequencer)

Pattern of connection varies with the type of programmable controller (PC). Follow wiring instructions shown in Figures 10 ~ 15.

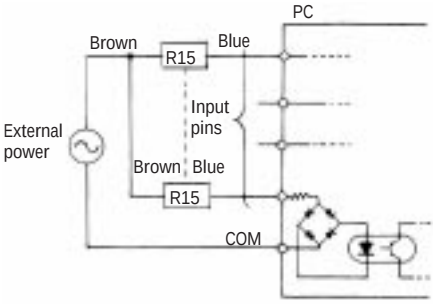


Fig. 10 R15 connection to AC-input PC

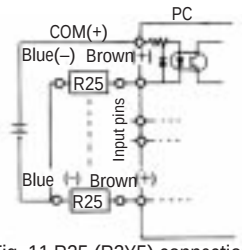


Fig. 11 R25 (R2Y5) connection to sinking input PC (externally powered)

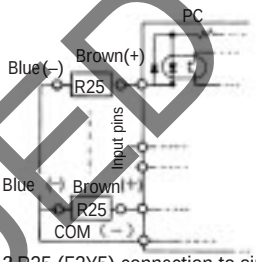


Fig. 12 R25 (E2Y5) connection to sinking input PC (internally powered)

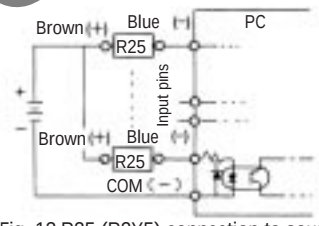


Fig. 13 R25 (R2Y5) connection to source-load-input PC

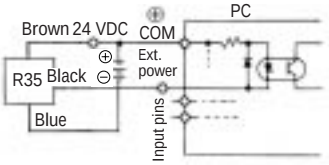


Fig. 14 R35 (R3Y5) connection to sinking input PC (externally powered)

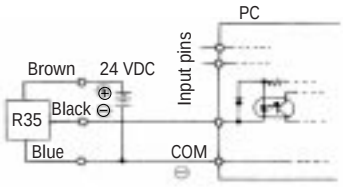


Fig. 15 R35 (R3Y5) connection to sinking input PC (internally powered)

4 Series connection

Total voltage drop across two or more R15/R25 switches connected in series is the sum of voltage drops across each of these switches. Consequently the load circuit will receive the source voltage minus the voltage drop across the series switches connection.
Before connection, analyze the load specifications and decide on the number of switches to be connected. Whenever two or more R35 switches are to be hooked in series, consult CKD or its dealers.

5 Parallel connection

When connecting to a PLC, R35 switches are recommended for parallel connections because of their small current leakage.

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Operating notes on cylinder switches – Reed switches

1 Connection of lead wires

Do not connect the switch leads directly to the power source. Instead be sure to insert a load in series between.

* When using the RO type for DC application, be sure to connect the brown lead to the (+) polarity, and the blue to the (-). The reverse connection will actuate the switch but fail to turn on the lamp.

2 Contact capacity

Avoid application of a heavier load than the maximum contact capacity of the switch being used. Also note that the lamp may stay dark if the rated amperage is not reached. Refer to switch specifications.

3 Contact protection

When using the switch with an inductive load such as relay, be certain that a contact protection circuit like in Figures 1 or 2 is provided.
A longer wiring length than shown below must have a contact protection circuit as shown in Figures 3 or 4.

Switch type	Voltage	Wiring length
RO5, R55, R65	DC	100m
RO5, R55	AC	10m
R45	AC	100m

Table 1

Fig. 1

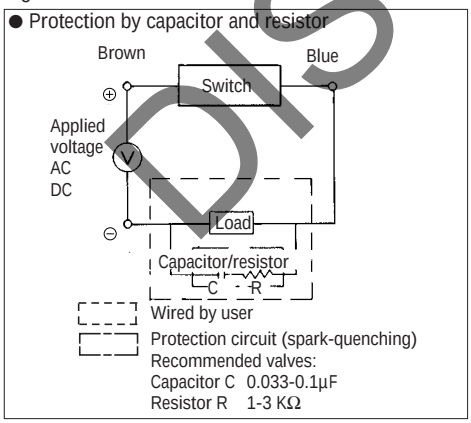


Fig. 2

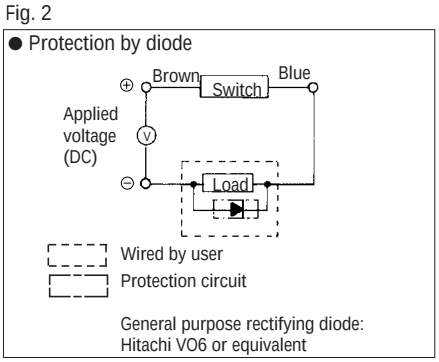


Fig. 3

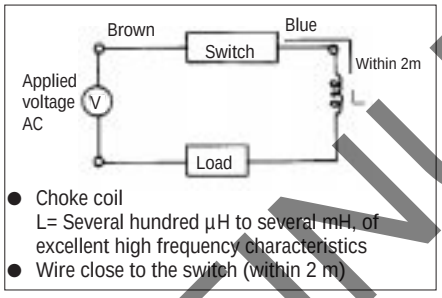
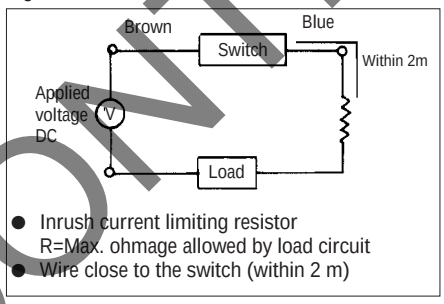


Fig. 4



4 Relays to be used

Use the following relays or equivalent:
- Omron . . . . . .MY type
- Fuji Electric . . . . . .HH5 type
- TEC . . . . . .MPM type
- Matsushita Electric Works, Ltd. . . . . .HC type

5 Series connection

Total voltage drop across two or more reed switches connected in series is the sum of voltage drops across each of these switches. However, suppose only one RO switch is used as the motion detector in series with some number of R5.
Then the resultant voltage drop would decrease almost to the level when a single RO switch is used: about 2.4 V. Note the lamp would light only when all switches are turned on. Refer to specification sheets for voltage drops.

General operating notes on proximity and reed switches

1 Parallel connection

When some number of switches are connected in parallel, leakage current will increase in proportion to the number of switches connected.
Before connection, carefully check the load specifications and decide on the number of switches to be connected. If the total sum of the leakage current approaches the available supply current, the lamp may dim or fail to turn on.

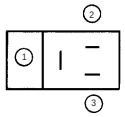
2 Magnetic environment

Cylinder switches should not be used in sites that are near large electric currents (large magnets, spot welding machines and such).

3 Lead wire protection

Take good wiring care to avoid application of repeated bending and tensile stresses to the lead wires. Moving parts must be connected by flexible wires such as used for robot systems.

4 Terminal box wiring



Switch \ Terminal	①	②	③
R05 (DC), R25, R2Y5, R65		+	–
R05 (AC), R15, R45, R55		±	±
R35, R3Y5	OUT	+	–

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Determining The Proper Bore Size

To find the proper bore size for your cylinder, follow these simple steps:

1. In the table below left, locate the column headed by the pressure at which you plan to operate the system.
2. Move down that column and find the force or thrust value which is the same as (or larger than but closest to) that which the cylinder will be required to deliver.
3. On the same line, move across the table to the first column. The number shown there is most likely the bore size best suited to delivering the push stroke forces you require. Later checks can confirm whether this bore size is, in fact, the one which best serves your particular application needs.

Thrusts for operating pressures not shown in the table may be calculated by multiplying the operatingpressures by the piston areas.

Bore Size Estimation Table

Cylinder Bores in inches	Piston Area Sq. In.	Push Stroke Forces in Pounds Air Pressures				
		50 PSI	60 PSI	80 PSI	100 PSI	200 PSI
1-1/2	1.767	88	106	141	177	353
2	3.142	157	189	251	314	628
2-1/2	4.909	245	295	393	491	982
3-1/4	8.296	415	498	664	830	1,659
4	12.566	628	754	1,005	1,257	2,513
5	19.635	982	1,178	1,571	1,964	3,927
6	28.274	1,414	1,696	2,262	2,827	5,657
7	38.485	1,924	2,309	3,079	3,849	7,697
8	50.265	2,513	3,016	4,021	5,027	10,053

Pull Stroke Force

To determine pull stroke force, deduct the rod area force below from the bore area force at left.

Piston Rod Diameters in inches	Piston Rod Area Sq. In.	Air Pressures				
		50 PSI	60 PSI	80 PSI	100 PSI	200 PSI
5/8	.307	15	18	25	31	61
1	.785	39	47	63	79	157
1-3/8	1.485	74	89	119	149	297
1-3/4	2.405	120	144	192	241	481

Pull force = (Bore Area - Rod Area) x Working Pressure

Calculating Free Air Consumption

To determine Free Air Consumption per inch of stroke, use the "Pressure Air" column for Cubic Feet Displaced for the bore size you are using and calculate the Free Air Consumption with the following formula:

Free Air Consumption Per Inch of Stroke = Cu. Ft. Displaced x (Pressure + 14.7) ÷ 14.7.

For convenience, the Free Air Consumption per inch at 80 PSI pressure has been pre-calculated as shown on the chart below. To determine the air consumption in cubic feet per minute, use the following formula:

Air Consumption Cu. Ft. Per Minute = Cu. Ft. per Inch x Inches Per Minute Piston Speed.

Free Air Consumption Chart

Push Stroke				Deduct the Rod size Consumption from push stroke figure to determine pull stroke consumption			
		Consumption Per Inch of Stroke in One Direction				Consumption Per Inch of Stroke in One Direction	
Cyl. Bore in in.	Piston Area Sq. in.	Pressure Air Cu. Ft. Displaced	Free Air Cu. Ft. At 80 PSI	Standard Piston Rod Diam. in in.	Piston Rod Area Sq. in.	Pressure Air Cu. Ft. Displaced	Free Air Cu. Ft. at 80 PSI
1 1/2	1.767	.00102	.00657	5/8	.307	.0001778	.00115
2	3.142	.00184	.01185	1	.785	.000454	.002925
2 1/2	4.909	.00289	.01863	1 3/8	1.485	.00086	.00554
3 1/4	8.296	.00481	.0310	1 3/4	2.405	.001393	.00897
4	12.566	.00726	.04675				
5	19.635	.01137	.0732				
6	28.274	.01638	.1056				
7	38.485	.02230	.1435				
8	50.265	.02910	.1873				

To determine the pipe size required for air consumption, use the Air Flow Chart at right. Find your initial pressure in the column on left. Read across to the right until you find the vertical column where the SCFM is the same as or larger than your requirement. Read to the top of that column and you will see the nominal standard pipe size required.

Air Flow Chart

Maximum Recommended Flow Through Standard Weight Pipe
To be used as a guide in determining size of equipment in compressed air circuits.

Initial Area of Pipe (Sq. In.)	Nominal Standard Pipe Size 1/8" .057	1/4" .104	3/8" .191	1/2" .304	3/4" .533	1" .864	1-1/4" 1.495	1-1/2" 2.036
Initial Pressure Psig.	Maximum Recommended Flow (SCFM – free air)							
10	5.5	9.2	18.6	30.2	51.1	84.	139.	186.
20	6.5	11.	22.	35.7	60.6	100.	165.	220.
30	7.4	12.5	25.	40.7	68.4	112.	187.	250.
40	8.2	13.3	27.6	44.9	76.	125.	207.	276.
50	8.9	15.0	30.	48.8	82.2	135.	226.	301.
60	9.6	16.1	32.2	52.3	89.0	146.	242.	323.
70	10.4	17.7	34.3	56.0	94.	154.	258.	345.
80	10.8	18.2	36.3	59.0	100.	165.	273.	364.
90	11.3	19.1	38.2	62.2	105.	172.	286.	382.
100	12.0	20.	40.	65.	110.	180.	300.	400.
110	12.5	20.8	41.8	67.7	114.	188.	312.	417.
120	12.8	21.6	43.4	70.4	119.	195.	325.	434.
130	13.3	22.4	45.	73.	123.	202.	337.	450.
140	13.8	23.2	46.5	75.5	127.	209.	348.	465.
150	14.2	23.9	48.	77.7	132.	218.	360.	479.
Pressure Drop in PSI Per 100 Feet of Pipe								
Press. Drop PSI/100	54.0	31.7	25.4	19.0	12.4	9.2	5.94	4.68

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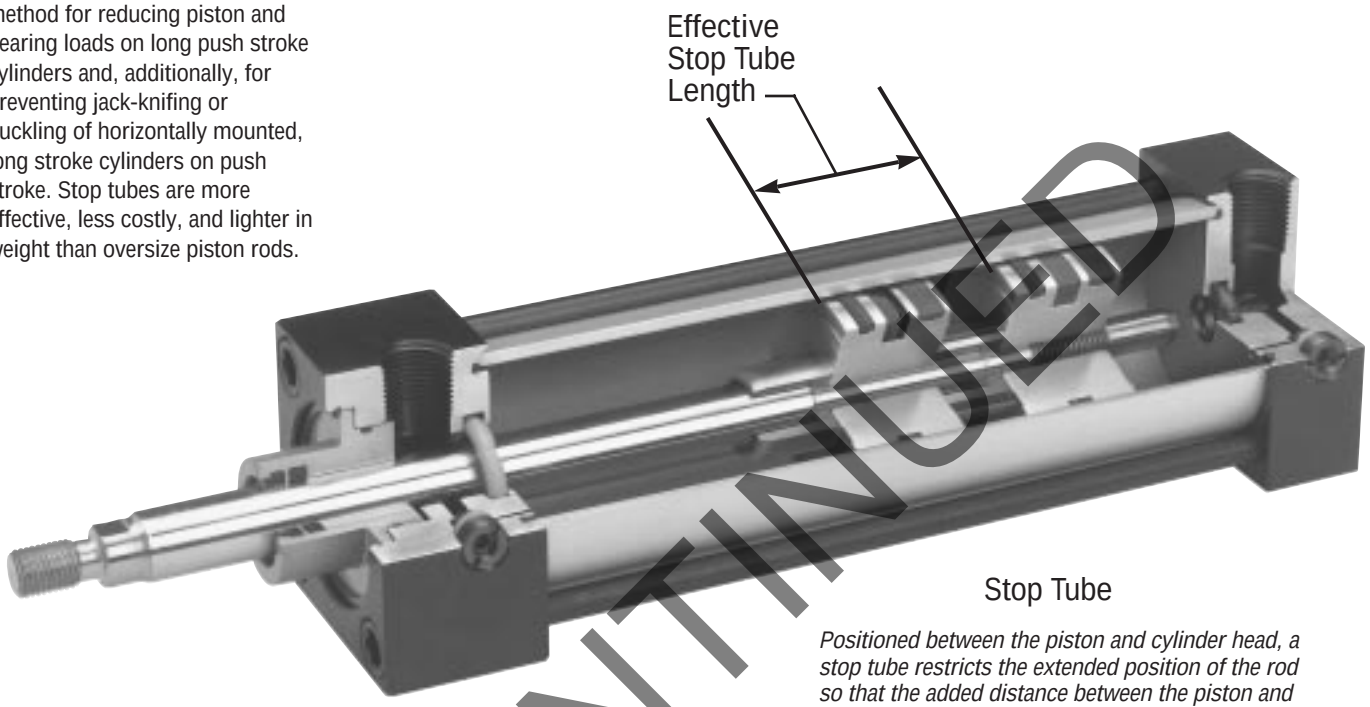
Stop Tubing for Long Push Stroke Cylinders

The use of stop tubing is a generally accepted and preferred method for reducing piston and bearing loads on long push stroke cylinders and, additionally, for preventing jack-knifing or buckling of horizontally mounted, long stroke cylinders on push stroke. Stop tubes are more effective, less costly, and lighter in weight than oversize piston rods.



Stop Tube

Positioned between the piston and cylinder head, a stop tube restricts the extended position of the rod so that the added distance between the piston and bushing results in less strain, wear, and bearing load.

Note: With the above stop tube design, cylinder can be furnished with cushions on both ends if requested.

DISCONTINUED

Determining The Length And Need For Stop Tubing

Follow these simple steps to determine whether your cylinder requires a stop tube, and, if so, how long it should be.

1. Examine the groups of cylinders illustrated on page 24 and determine which, if any, of the mounting configurations corresponds to your cylinder application and model number.

2. If your cylinder mounting style corresponds to any of those in Group A, then no stop tube is required. But, if cylinder operates on push stroke, an oversize rod may be required and you should check the following page. If your cylinder is like one of those in Group B, then a stop tube is recommended and you should proceed to Step 3. If your cylinder is similar to one of the Group C illustrations, then you should calculate the turning moments and loads between piston and rod bushing to insure that they are not excessive. Weight of fluid must be included on large diagram or long stroke cylinders. For assistance on this, contact Miller Fluid Power. Next, continue on to Step 3 to determine the length of stop tube needed.

Minimum Length of Stop Tube on AL Series Cylinder

Bore	Minimum Stop Tube Length	Next Avail. Stop Tube Length
1½	1.125	2
2	1.125	2
2½	1.250	2
3¼	1.250	2
4	1.250	2
5	1.500	2
6	1.500	2
8	1.625	2

Stop tubes available in 1" increments after 2" length

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Engineering Aids And Cylinder Modifications

3. Referring to the illustration which corresponds to your cylinder application, determine the value of "L". Be certain to include the thickness of the cylinder head, cap and piston assembly plus twice the length of the cylinder stroke. Then go down the first column of the Stop Tube Table and find the range which encompasses the value of "L". The number shown to the right in the second column is the length of the stop tube your cylinder requires.

4. Add the stop tube length to your "L" dimension to obtain an adjusted "Dimension". This dimension will be used in the procedures on the following page to determine whether your cylinder requires an oversize piston rod in addition to the tube except models 53, 61, 63, 81, & 89.

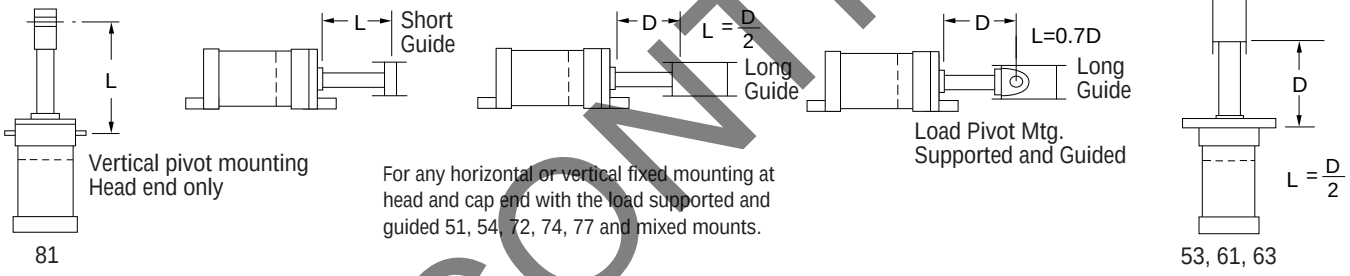
Stop Tube Table

"L" (inches)	Stop Tube Length (inches)	"L" (inches)	Stop Tube Length (inches)
0 - 40	0	171 - 180	14
41 - 50	1	181 - 190	15
51 - 60	2	191 - 200	16
61 - 70	3	201 - 210	17
71 - 80	4	211 - 220	18
81 - 90	5	221 - 230	19
91 - 100	6	231 - 240	20
101 - 110	7	241 - 250	21
111 - 120	8	251 - 260	22
121 - 130	9	261 - 270	23
131 - 140	10	271 - 280	24
141 - 150	11	281 - 290	25
151 - 160	12	291 - 300	26
161 - 170	13	301 - 310	27

Note: "L" or "D" are calculated from mounting point with rod extended.
See chart on Page 23 for minimum stop tube length.

Group A –

With piston rod extended. To be checked for diameter only. Stop tube not required.



Vertical pivot mounting Head end only

81

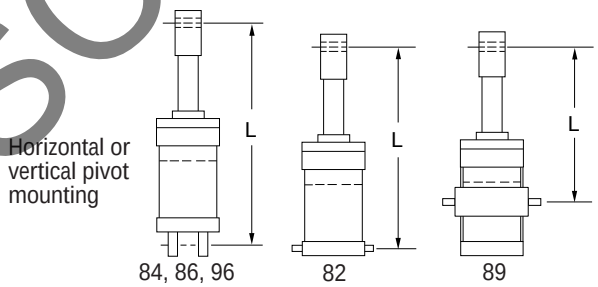
For any horizontal or vertical fixed mounting at head and cap end with the load supported and guided 51, 54, 72, 74, 77 and mixed mounts.

Load Pivot Mtg. Supported and Guided

53, 61, 63

Group B –

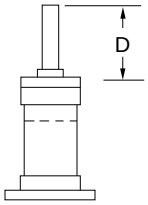
To avoid rod buckling or cylinder jackknifing, check for cylinder stop tube and rod diameter requirements with piston rod extended. Use cylinder dimensional charts. No stop tube required if cylinder operates on pull stroke only.



Horizontal or vertical pivot mounting

84, 86, 96 — 82 — 89

Piston rod guided: L=2D
Piston rod unguided: L=4D

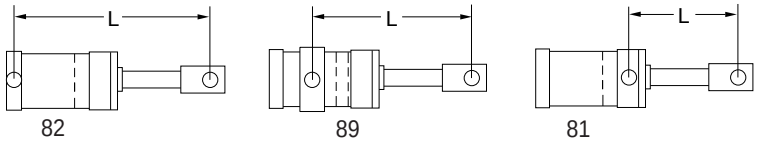


Cap or cap end flange vertical mount

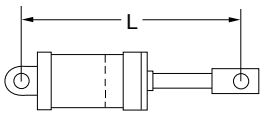
52, 62

Group C –

To be checked for Stop tube length and piston rod diameter to eliminate buckling or jackknifing with piston rod extended.

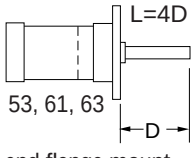


82 — 89 — 81



84, 86, 96

On long strokes support cap

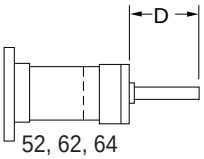


53, 61, 63

Head or head end flange mount

Piston rod guided: L=2D

Piston rod unguided L=4D



52, 62, 64

Cap or cap end flange mount

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Oversize Piston Rods for Column Strength On Long Push Stroke Cylinders

Cylinder applications requiring column strength or long cylinder push strokes may need oversize piston rods.

However, Miller Fluid Power cautions against depending upon the higher rigidity of oversize rods to absorb or reduce side loading. Actually, the greater flexibility of a smaller standard diameter rod transmits less side loading back to the piston rod bushing. It is important to use the correct rod diameter based on the various factors involved in your application. Oversize rods, when not needed, merely add to the cylinder price and require longer delivery.

Standard rod diameters are recommended for all pull stroke cylinders. To determine the correct rod diameter for a push stroke application, follow these simple steps:

1. Referring to the Group A through C illustrations on the previous page, determine the value of "L" for your cylinder, or use the "Adjusted L Dimension" calculated in Step 4 on that page.
2. In the Oversize Piston Rod Table, find in the first column your cylinder thrust value which was previously determined.
3. Move across the table to the right and in the same row locate your "L" or " Adjusted L Dimension". If the exact value is not shown, continue to the next larger number.
4. Go to the top of the column and you will find the correct rod diameter for your cylinder application.

Oversize Piston Rod Table

Thrust in lbs.	3/8"	1"	1-3/8"	1-3/4"
250	43	94	146	
400	37	83	134	186
700	30	68	118	168
1,000	27	60	105	155
1,400	24	53	92	142
1,800	23	48	82	127
2,400	19	45	75	114
3,200	16	41	67	103
4,000	13	38	63	94
5,000	9	34	60	87
6,000	5	30	56	82
8,000	5	26	50	76
10,000	4	21	45	70

DISCONTINUED

Available Options

AL cylinder options are available at extra cost. In some cases, options will not affect delivery time.The lists below identify the options which will or will not affect delivery.

Options Not Affecting Delivery

High Temperature Seals (to 300° F.)
Metallic Rod Scraper
Rod End Styles #2, #4, #5, #6, #7, #8
Double Rod End
316 Stainless Steel Piston Rod
Multiple Ports
4 Wrench Flats on Piston Rod
Longer Than Standard Tie Rod Studs
Alignment Coupler
Port and Cushion Adjustment Relocation
Oversize Piston Rod Diameters
Stop Tubing
Bumpers (Each bumper takes up 1/8" of stroke)
Modified Rod Ends
GO Switches

Options Requiring Additional Lead Time

Port and Cushion Adjustment Relocation
Extra Heavy Chrome Plated Piston Rod
Adjustable Stroke (Retract Stroke Only)
Rod Boots
Namco Switches
Limit Switches (Weld Immune Avail.)
Port in Center Rear Face of Cap (Cylinder Non Cushioned On Cap End)

Other options may be available on AL Series cylinders. Please check with Miller Fluid Power for availability of options you require.

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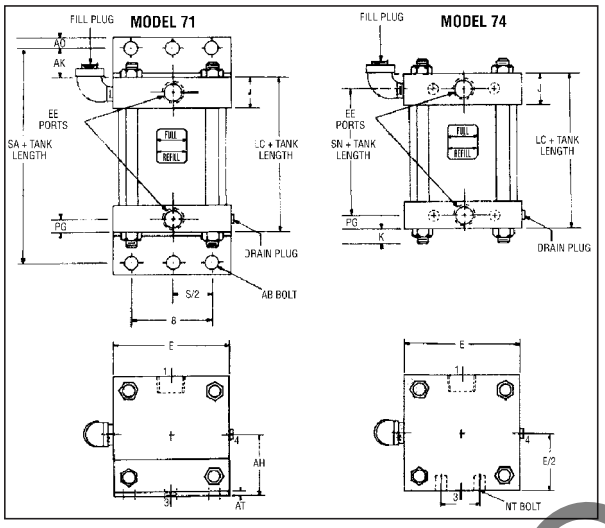
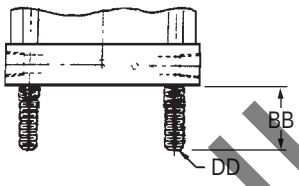
Miller AL Series
Air Cylinder

Value Engineered Air-Oil Tank For Up To 150 psi Operation

The new Miller AL Air-Oil Tanks provide smooth, precision hydraulic power and control from shop air in simple circuits requiring one or only a few cylinders. Thus, they offer the simplicity, low initial cost, and low maintenance cost of shop air input operation compared to using the conventional hydraulic power input source requiring pump, motor, filter, pressure relief valve, etc. The hydraulic cylinder driven by the simple air-oil system is controlled exactly as the cylinder driven by the pump installation using the same control valves. This new Fiberglass Tube Air Oil Tank is in addition to our tried and proven Steel Tube Oil Tank. We recommend the new AL Air Oil Tank for light duty applications and the standard Steel Tube Air Oil Tank for heavy duty applications.



*Model AL53 Tank



*All other dimensions are the same as for Tank shown at left.

Tank Dimensions				
Bore	3-1/4	4	5	6
AB	.50	.50	.63	.75
AH	1.93	2.25	2.75	3.25
AK	1.25	1.25	1.38	1.38
AO	.50	.50	.63	.63
AT	.19	.19	.19	.19
BB	1.38	1.38	1.81	1.81
DD	3/8-24	3/8-24	1/2-20	1/2-20
E	3.75	4.50	5.50	6.50
EE	1/2-14	1/2-14	1/2-14	3/4-14
J	1.02	1.02	.98	1.25
K	.38	.38	.44	.44
LC	2.60	2.60	2.52	3.06
NT	1/2-13	1/2-13	5/8-11	3/4-10
PG	.525	.525	.504	.641
S	2.75	3.50	4.25	5.25
SA	5.10	5.10	5.28	5.82
SN	1.45	1.45	1.36	1.65

Usable Tank Volume In Cubic Inches					
Tank Length	Tank Bore Diameters (Inches)				Fluid Working
(inches)	3-1/4	4	5	6	Height"
4	8.	12.	19.	28.	1
5	15.	23.	36.	53.	1-7/8
6	22.	34.	54.	77.	2-3/4
7	30.	45.	71.	102.	3-5/8
8	37.	56.	88.	127.	4-1/2
9	44.	67.	105.	152.	5-3/8
10	51.	78.	122.	176.	6-1/4
11	59.	89.	139.	201.	7-1/8
12	66.	100.	157.	226.	8
13	73.	111.	174.	250.	8-7/8
14	80.	122.	191.	275.	9-3/4
15	88.	133.	208.	300.	10-5/8
16	95.	144.	225.	325.	11-1/2
17	102.	155.	243.	349.	12-3/8
18	109.	166.	260.	374.	13-1/4
19	117.	177.	277.	399.	14-1/8
20	124.	188.	294.	424.	15
21	131.	199.	311.	448.	15-7/8
22	139.	210.	328.	473.	16-3/4
23	146.	221.	346.	498.	17-5/8
24	153.	232.	363.	523.	18-1/2

How to Select Proper Tank Size

The bore and stroke of the hydraulic cylinder are known. Then –

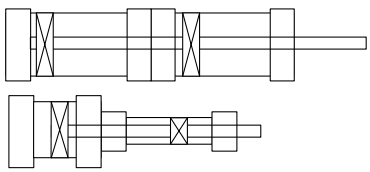
1. Determine the cubic inch oil displacement of the cylinder piston by multiplying the square inch area of the piston by the inches of stroke.
2. Locate, on selector chart at right, the volumes closest to the volume obtained and read up to tank diameters and to the left for tank lengths. In general, tanks of smaller diameters and greater lengths are less costly than larger diameter, shorter tanks of approximately equal volume.

DISCONTINUED

Tandem Cylinders and Duplex Cylinders

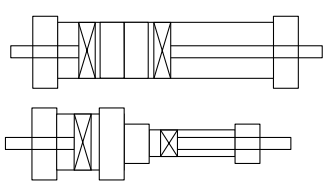
A Miller AL Tandem cylinder is a combination single rod end AL cylinder joined, in tandem, with an AL double rod end cylinder using a common piston rod between the two cylinder pistons. This arrangement allows for air pressure to be used on the full piston area of the rear single rod end cylinder along with air pressure to the net piston area of the double rod end forward cylinder providing higher thrust at the working end of the piston rod without increasing the cylinder bore size

Tandem Cylinder



An AL Duplex cylinder is a combination of two single rod end AL cylinders (usually with different stroke lengths) mounted back to back with the piston rods extending from opposite ends of the cylinder. By inserting air pressure in the different ports of the two cylinders or in combination with each other, up to four positive stop stroke positions can be obtained.

Duplex Cylinder



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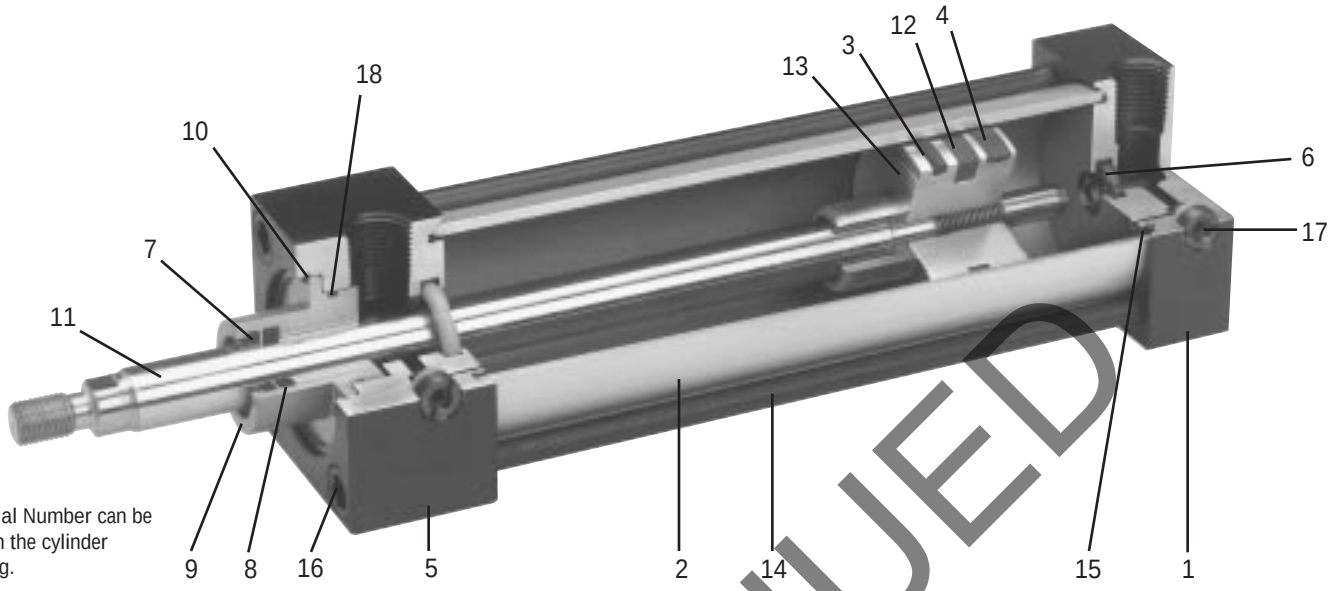
Parts List - Seal Kits for AL Cylinder



The Serial Number can be found on the cylinder Name tag.

1. Cap
2. Tube
3. Piston Seal
4. Wear Band
5. Head
6. Cushion Seal/Seals
7. Rod Wiper
8. Rod Seal
9. Bushing
10. Bushing Retainer Ring
11. Piston Rod
12. Magnet
13. Piston
14. Tie Rods (4 Required)
15. Tube End Seal (2 Required)
16. Tie Rod Nuts (4 Required)
17. Cushion Adjustment Assembly
18. Rod Bushing Static Seal

DISCONTINUED

AL Cylinder Repair Kit

To restore your AL cylinder to top performance, the single rod end cylinder will require a complete cylinder repair kit. If only the rod bushing or rod seals require replacement, a bushing repair kit may be ordered. Double rod end cylinders require one complete cylinder repair kit plus one rod bushing repair kit. If only the rod bushing or rod seals need replacement in a double rod cylinder, two rod bushing repair kits are necessary. Specify hi-temp. (Viton) seals when replacing same.

How To Order Seal Kits

Example: 2" bore, 1" rod dia. complete kit w/ standard seals and magnet
Kit Number #020-CRK02-200-100

Bore Size	Rod Dia.	Complete Cylinder Repair Kit* Order Number				
			Std. Seals No Magnet	Std. Seals With Magnet	Hi-Temp. Seals No Magnet	
1-1/2	5⁄8	020-	CRK01	CRK02	CRK03	-150-63
2	5⁄8	020-	CRK01	CRK02	CRK03	-200-63
	1	020-	CRK01	CRK02	CRK03	-200-100
2-1⁄2	5⁄8	020-	CRK01	CRK02	CRK03	-250-63
	1	020-	CRK01	CRK02	CRK03	-250-100
3-1⁄4	1	020-	CRK01	CRK02	CRK03	-325-100
	1-3⁄8	020-	CRK01	CRK02	CRK03	-325-138
4	1	020-	CRK01	CRK02	CRK03	-400-100
	1-3⁄8	020-	CRK01	CRK02	CRK03	-400-138
5	1	020-	CRK01	CRK02	CRK03	-500-100
	1-3⁄8	020-	CRK01	CRK02	CRK03	-500-138
6	1-3⁄8	020-	CRK01	CRK02	CRK03	-600-138
	1-3⁄4	020-	CRK01	CRK02	CRK03	-600-175
8	1-3⁄8	020-	CRK01	CRK02	CRK03	-800-138
	1-3⁄4	020-	CRK01	CRK02	CRK03	-800-175

Example: 2" bore, 1" rod dia. bushing kit w/ standard seals
Kit Number #020-BRK01-200-100

Bore Size	Rod Dia.	Bushing Repair Kit** Order Number			
			Std Seals	Hi-Temp. Seals	
1-1/2	5⁄8	020-	BRK01	BRK02	-150-63
2	5⁄8	020-	BRK01	BRK02	-200-63
	1	020-	BRK01	BRK02	-200-100
2-1⁄2	5⁄8	020-	BRK01	BRK02	-250-63
	1	020-	BRK01	BRK02	-250-100
3-1⁄4	1	020-	BRK01	BRK02	-325-100
	13⁄8	020-	BRK01	BRK02	-325-138
4	1	020-	BRK01	BRK02	-400-100
	13⁄8	020-	BRK01	BRK02	-400-138
5	1	020-	BRK01	BRK02	-500-100
	13⁄8	020-	BRK01	BRK02	-500-138
6	13⁄8	020-	BRK01	BRK02	-600-138
	13⁄4	020-	BRK01	BRK0	-600-175
8	13⁄8	020-	BRK01	BRK02	-800-138
	13⁄4	020-	BRK01	BRK02	-800-175

* Cylinder repair kit includes: piston seal, wear ring, tube seals, bushing kit and cushion seals.
** Bushing repair kit includes: bushing, rod seal rod wiper, and bushing seal assembled & lubricated, ready for easy cartridge style assembly.

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Mounting Conversion Options and Switches

AL Mounting Conversion Options

You can field convert many mounting styles of the same bore size to a different mounting style simply by removing the retaining screws and replacing the mount with the mounting style desired.
Caution: Different mounts may require different attaching screws!

AL Mounting Kits - 1 ½" Through 8" Bore (All mounting kits include attaching screws)

Bore Size	Model 51 Tie Rod Extension Both Ends	Model 52 53,54 Tie Rod Extensions	Model 61 Head Flange	Model 62* Cap Flange	Model 96* Detachable Eye
1-1⁄2"	020-MK51A-150	020-MK52A-150	020-MK61A-150	020-MK62A-150	020-MK96A-150
2"	020-MK51A-200	020-MK52A-200	020-MK61A-200	020-MK62A-200	020-MK96A-200
2-1⁄2"	020-MK51A-250	020-MK52A-250	020-MK61A-250	020-MK62A-250	020-MK96A-250
3-1⁄4"	020-MK51A-325	020-MK52A-325	020-MK61A-325	020-MK62A-325	020-MK96A-325
4"	020-MK51A-400	020-MK52A-400	020-MK61A-400	020-MK62A-400	020-MK96A-400
5"	020-MK51A-500	020-MK52A-500	020-MK61A-500	020-MK62A-500	020-MK96A-500
6"	020-MK51A-600	020-MK52A-600	020-MK61A-600	020-MK62A-600	020-MK96A-600
8"	020-MK51A-800	020-MK52A-800			020-MK96A-800

Bore Size	Model 71* End Angle	Model 72* Side Lug	Model 77 End Lug Mount	Model 84* Detachable Clevis	Model 86* Detachable Clevis
1-1⁄2"	020-MK71A-150	020-MK72A-150	020-MK77A-150	020-MK84A-150	020-MK86A-150
2"	020-MK71A-200	020-MK72A-200	020-MK77A-200	020-MK84A-200	020-MK86A-200
2-1⁄2"	020-MK71A-250	020-MK72A-250	020-MK77A-250	020-MK84A-250	020-MK86A-250
3-1⁄4"	020-MK71A-325	020-MK72A-325	020-MK77A-325	020-MK84A-325	020-MK86A-325
4"	020-MK71A-400	020-MK72A-400	020-MK77A-400	020-MK84A-400	020-MK86A-400
5"	020-MK71A-500	020-MK72A-500	020-MK77A-500	020-MK84A-500	020-MK86A-500
6"	020-MK71A-600	020-MK72A-600	020-MK77A-600	020-MK84A-600	020-MK86A-600
8"	020-MK71A-800	020-MK72A-800	020-MK77A-800	020-MK84A-800	020-MK86A-800

Models 63, 64, 81, 82 and 89 must be ordered as such - other models cannot be converted to these mountings.
* Single Rod Only

DISCONTINUED

How To Order

AL Switch Kits

Kits include switch with 5m lead, mounting bracket and screws.

Example: Switch for 2-1/2" Bore AL Cylinder

020-SWK01-200-R05

020-SWK01 - 200 - R05

Switch Series	Mtg. Bkt. Size	Switch Type
	1-1/2" Bore = 150	R05
	2- 2-1/2" Bore = 200	R15
	3-1/4 - 4" Bore = 325	R25
	5, 6, 8" Bore = 500	R2Y5
		R35
		R3Y5
		R45
		R55
		R65

AL Switches Only

(Switch has 5m lead)

Example: Switch only for 2-1/2" Bore AL Cylinder

415-SW-R05

415-SW - R05

Switch Series	Switch Type
	R05
	R15
	R25
	R2Y5
	R35
	R3Y5
	R45
	R55
	R65

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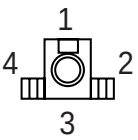
How To Order

Example: AL-72B2N-00400-00800-0138-N11C2-0

AL	72	B	2	N	-	004.00	-	008.00	-	01.38	N	1	1	C*	2	0
Series AL DAL (D= Dbl. Rod End)	**Mounting Style**	**Bushing** B= Externally Removeable Bushing	**Rod End Style** #0 #2 (Std) #4 #5 #6 #7 #8	**Cushions** ** R= Rod End Cushioned C= Cap End Cushioned B= Both Ends Cushioned N= Non-Cushioned		**Bore Dia.**		**Stroke**		**Rod Dia.**	**Port Type** N= NPT	**Port Location** Head End / Cap End 1 (Std.) / 1 2 / 2 3 / 3 4 / 4  		**Magnet and/or Switch Type** A=R05 B=R15 C=R25 D=R2Y5 E=R35 F=R3Y5 G=R45 H=R55 J=R65 M= Magnet Only O= No Magnet	**Switch Quantity**	**Modified** 0= Standard 9= Modified

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Note: The Standard (#1) port location is at the top of the cylinder in relation to the mountings as shown on the mounting dimensional pages in this catalog. These numbered locations are shown within the end views of the cylinders for each of the mountings indicated. If multiple ports are required, the last number of the part number above should be 9 indicating modified and location of multiple ports identified.

The standard cushion adjustment screw location is position #2.

The number 9 refers to any modifications from standard design. Non-Standard Modifications and options not identified in the part number identification above must be included on all orders.

* When using switches on the AL cylinder the minimum stroke is ½".

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All specifications and information subject to change without notice or prior obligation.

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