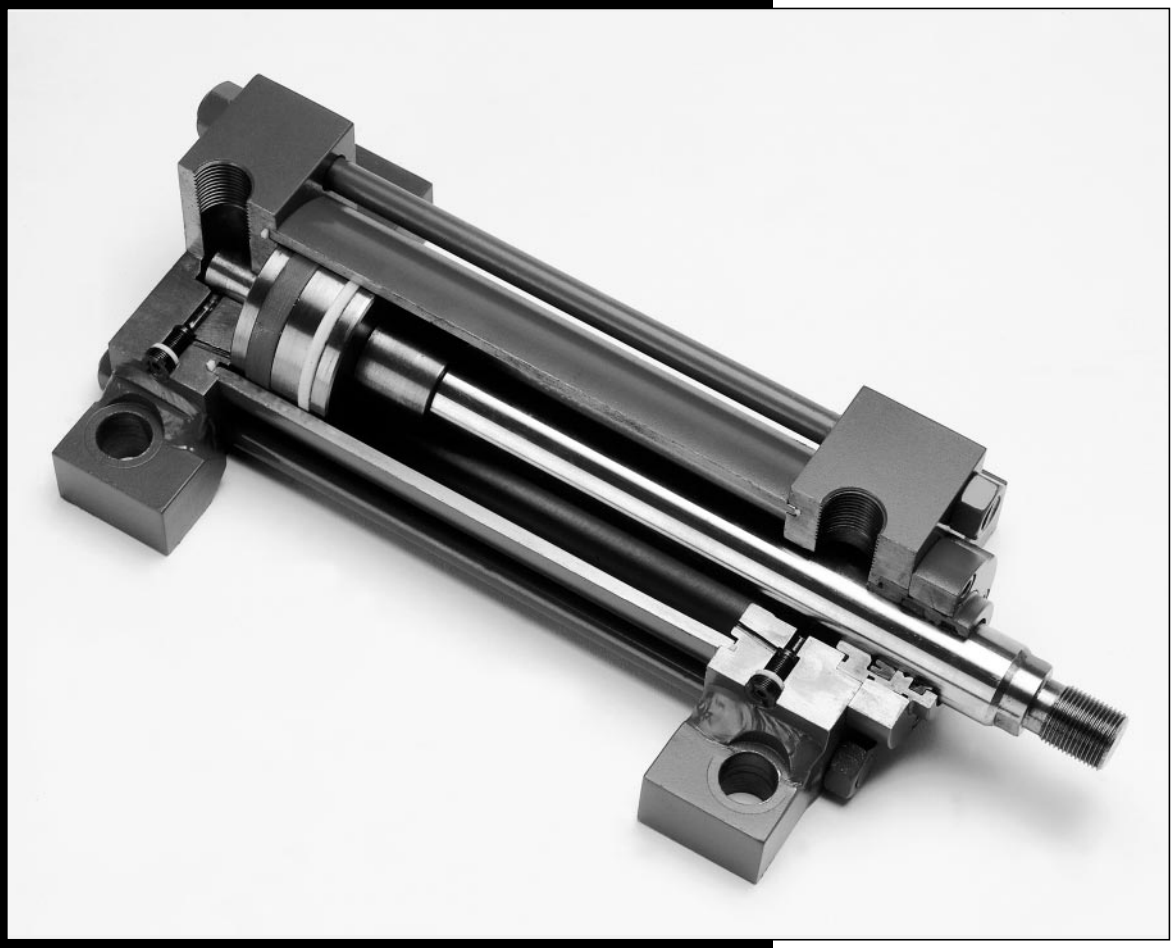
MH Series

Hydraulic Cylinder
ISO 6020-2



Up to 210 Bar
Bore Sizes 25 mm through 200 mm

Miller FLUID POWER

Miller MH Series
Hydraulic Cylinders

Table Of Contents

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

IP Series Cylinders
Up to 10 bar Permanently lubricated

Miller's ISO metric (6431) aluminum pneumatic cylinder line. Bore sizes from 32mm-200mm. (File 9817)

A Series Cylinders
Up to 250 PSI Permanently lubricated

Series A steel 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)

AL Series Cylinders
Up to 200 PSI Permanently lubricated

Our new aluminum AL Series air cylinders are available in bore sizes from 1½" through 8". Operating pressures up to 200 PSI. Dimensions are NFPA Standard. (File 8564)

J Series Cylinders
500-2500 PSI

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

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)

Miller MH Series
Hydraulic Cylinder Selection Guide

Selecting a Miller Hydraulic Cylinder

Miller hydraulic cylinders are selected and sized primarily based on force requirements and available operating pressure. The MH Series is a heavy-duty design intended for normal industrial service at internal operating pressures up to 210 bar. It is available in mounting styles and bore sizes from 25mm to 200 mm.

Steps in Selecting the Correct Cylinder

Detailed engineering information on bore size selection, oversize rods, stop tubes and the like is located in this catalog. See Table of Contents on previous page.

Step 1 — Determine the correct cylinder bore size required based upon operating pressure and thrust required (See page 30).

Step 2 — Select the mounting style which is required for your application (see pages 4 & 5).

Step 3 — On the appropriate catalog page for the mounting style selected, review bore and rod sizes available.

Step 4 — Choose a rod end style and, if desired, rod end accessories (pages 28 & 29), and optional cushions.

Step 5 — Consider the conditions listed below which may require further modifications to the cylinder you have selected. Application Engineering assistance is readily available by contacting any of the Miller facilities listed on the back cover of this catalog.

Step 6 — Refer to "How to Order" section on (page 36) to develop the part number and place your order.

Application Condition	Check the following
Rapid Starts or Stops	Use severe service pressure rating only. Confirm that sufficient thrust is available to accelerate or decelerate cylinder and load within prescribed distances. If optional cushions are selected and will be used to reduce shock during deceleration, check that peak pressures will be within acceptable limits.
Long Stroke	Check whether stop tube may be required to prevent excess bearing loads and wear.
High Column Loading-Long Push Stroke	Determine if standard size piston rod is strong enough to accommodate intended load without buckling.
Loads	When high side loads and similar severe or unusual operating conditions are anticipated, please consult a Miller application engineer for recommendations concerning optional bushing material and design.
Operating Temperatures	The standard operating temperature range of the Urethane seals used in the MH Series is -29˚C to 71˚C. For temperatures in excess of that range, optional high temperature seals will be required.
Sufficient Speed	Confirm that standard port size permits sufficient flow to accommodate speed requirements.
Fluid Compatibility	The standard MH seals are compatible with petroleum based fluids.

Fluid power cylinders are designed to be linear actuators. They are intended to provide motion and force along the centerline of the rod. Since they have limited capacity to withstand eccentric or radial loads, they should not be employed as linear bearings. Good machine design practice requires that proper alignment be maintained to avoid excessive bearing loads. Any premature failure resulting from side loading is not considered a warranty failure. If your design involves the possibility of side loading, please contact the Miller Fluid Power application engineering department.

Miller MH Series Hydraulic Cylinders

Standard Design Features to Maximize Performance and Uptime

Ports

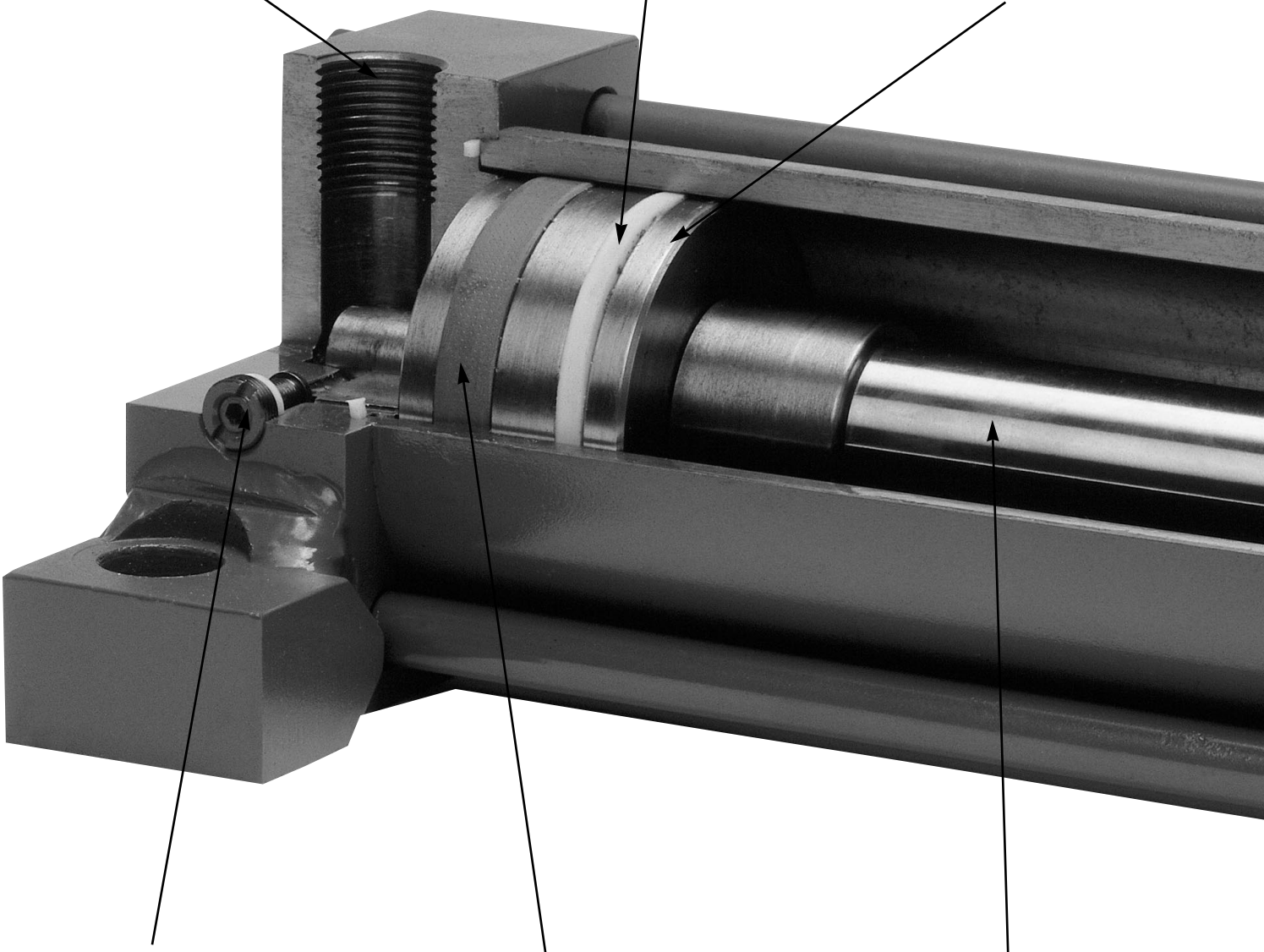
ISO 6149-1 ports are standard.

Piston Seals

Single, teflon bidirectional seal with viton pre-loaded expander is temperature and fluid resistant while providing low-friction service

Piston

One-piece piloted design provides maximum strength and protection against shock loads. When over-size rods are used, piston threads increase in size for added strength.



Cushions

Adjustable cushion design provides closer control of cushioning rate, while standard ball check provides greater reverse flow for faster out-of cushion starts. Flush mounted cushion adjustments are a captive design.

Piston Wear Band

Durable, non-metallic wear band prevents metal to metal contact and resultant scoring. Bearing point at rear of piston, combined with extra long rod bushing, provides maximum bearing span between piston and rod bushing to reduce bearing loads and increase cylinder rigidity.

Piston Rod

Piston rods are case-hardened and chrome-plated to resist mechanical damage and scratching; ground and polished to extend bushing and seal life. External rod diameter reduced slightly at flats for easy rod seal replacement.

Miller MH Series Hydraulic Cylinders

Standard Design Features to Maximize Performance and Uptime

Tube End Seal

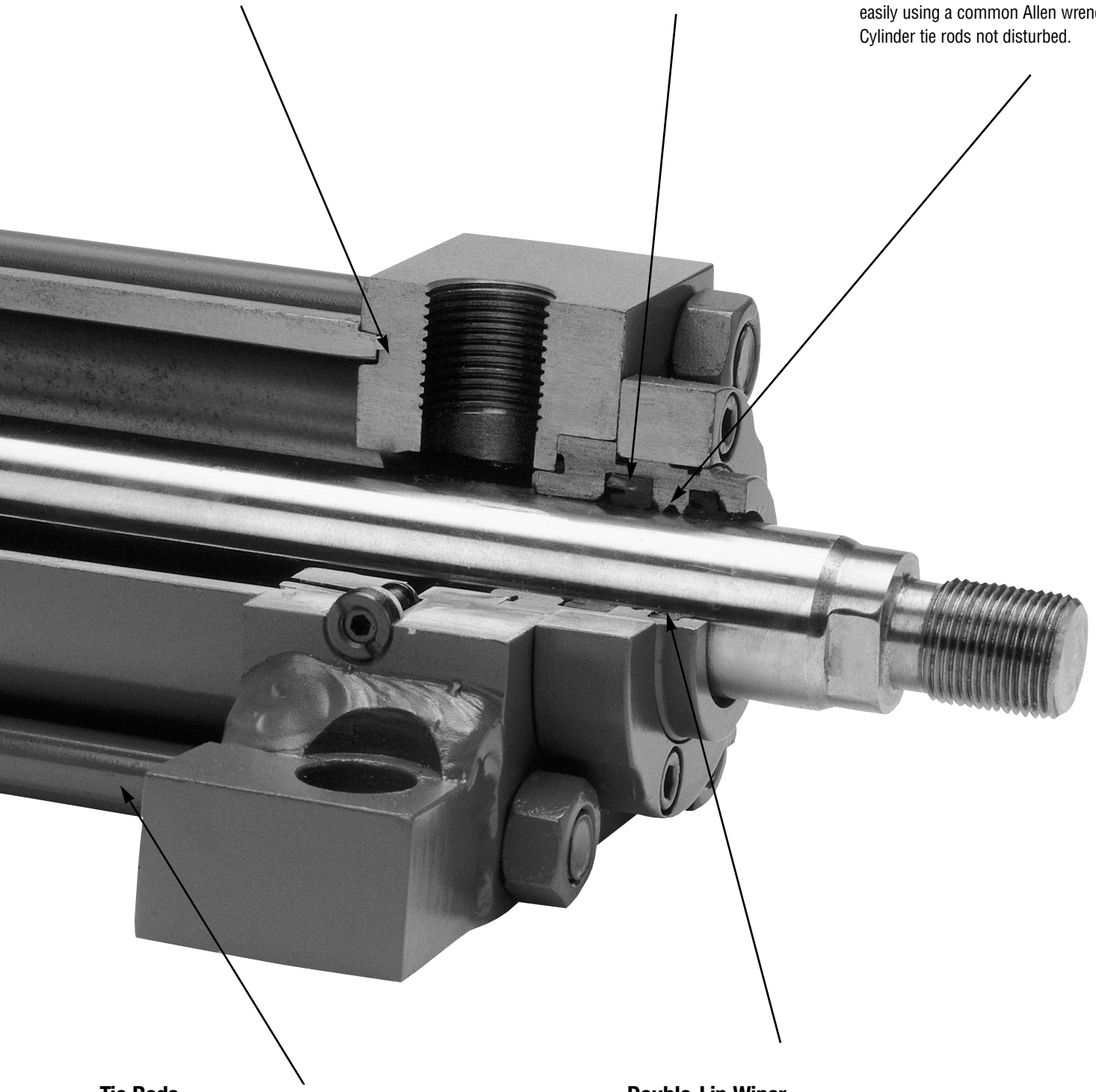
Teflon®* tube-end seal resists heat, extrusion, shearing, and hydraulic fluids.

Rod Seal

Durable urethane rod seal is pressure-energized and wear-compensating for long, leak-free service.

Bushing

Nodular iron bushing provides 400% longer bearing life than conventional bronze bushings. Protects against side loads. Removes easily using a common Allen wrench. Cylinder tie rods not disturbed.



Tie Rods

Rolled thread, high-strength tie rods (690,000 — 862,500 kPa minimum yield) provide protection against shock and fatigue.

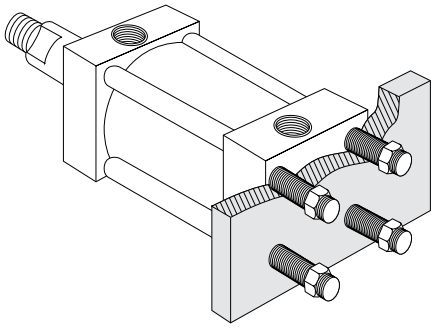
Double-Lip Wiper

Double-lip design rod wiper/seal protects piston rod and bushing from external contamination and provides a secondary back-up rod seal.

Centerline

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

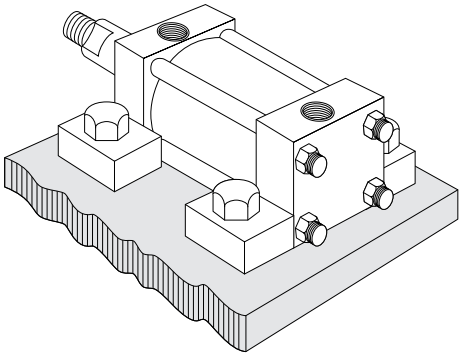
Miller Series MH mounting configurations that provide centerline support are tie-rod mounts, and rectangular head and cap cylinders.



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

Foot

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. The cylinder should be pinned or keyed to absorb the stress of shear loads and allow the mounting bolts to remain in simple tension. Because foot mounts are rigid, they require accurate cylinder alignment.



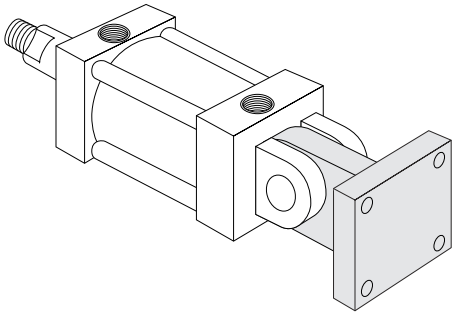
Foot mounting secures the cylinder on its side, but can subject the mounting bolts to compound stress (cylinder side lugs shown).

Pivot

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.

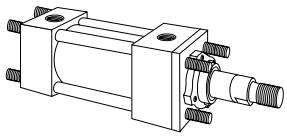
The clevis end design locates the pivot point at the cap end of the cylinder. Trunnion mounting uses trunnions on the head, cap or side of the cylinder to allow it to pivot at any of three locations. Both clevis and trunnion mounting configurations allow the cylinder to pivot in one plane only.

The rear eye cylinder is an additional pivot-mounted cylinder. Essentially a reversal of the fixed clevis assembly, the rear eye cylinder locates a clevis eye on the cylinder cap and mounts to a clevis bracket on the load surface.

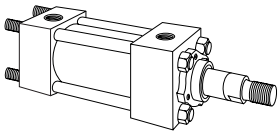


Pivot mounting allows the cylinder to pivot during piston motion (clevis method shown).

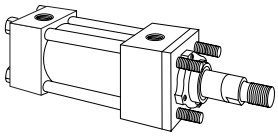
Centerline Mounts



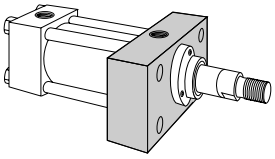
Model 51 - Tie Rods
Extended Head Cap (ISO MX1)



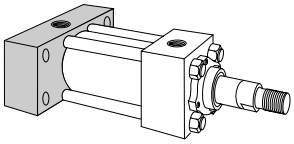
Model 52 - Tie Rods
Extended Cap End Only (ISO MX2)



Model 53 Tie Rods
Extended Head End Only (ISO MX3)

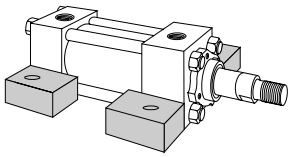


Rectangular Head
Model 67 (ISO ME5)



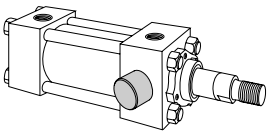
Rectangular Cap
Model 68 (ISO ME6)

Foot Mounts

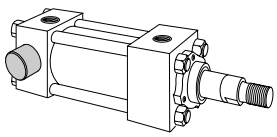


Side Lug
Model 72 (ISO MS2)

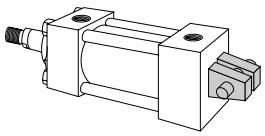
Pivot Mounts



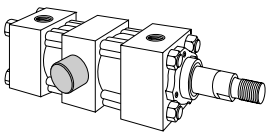
Trunnion/Head End
Model 81 (ISO MT1)



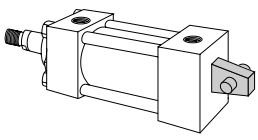
Trunnion/Cap End
Model 82 (ISO MT2)



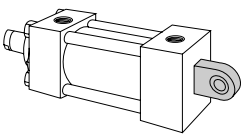
Fixed Clevis
Model 84 (ISO MP1)



Intermediate Trunnion
Model 89 (ISO MT4)



Rear Eye
Model 90 (ISO MP3)



Spherical Eye
Model 94 (ISO MP5)

Bushing Retainer Style

While the standard Miller cylinder design utilizes a bolted bushing, on certain combinations of bore size. rod size and/or mounting style a bolted bushing would interfere with the tie rod nuts. In those cases, a square retainer-held bushing is used.

The selection chart below lists all the possible combination, with a B indicating bolted type bushing and an R indicating use of the full square retainer method.

Please note that dimensional information is provided on the appropriate catalog pages for the two different styles.

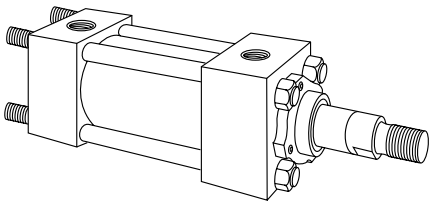
BORE	ROD	BUSHING CONSTRUCTION			
		ALL MODELS EXCEPT 51, 53, 67,72 WITH HEAD END "K" RETAINER	MODEL 51, 53	MODEL 67	MODEL 72 WITH HEAD END "K" RETAINER
25	12	R	R	B	R
32	14	R	R	B	R
40	18	B	R	B	R
	28	R	R	B	R
50	22	B	R	B	R
	36	R	R	B	R
	28	R	R	B	R
63	28	B	B	B	B
	45	B	R	B	R
	36	B	R	B	R
80	36	B	B	B	B
	56	B	R	B	R
	45	B	B	B	B
100	45	B	B	B	B
	70	B	R	B	R
	56	B	B	B	B
125	56	B	B	B	B
	90	B	R	B	R
	70	B	B	B	B
160	70	B	B	B	B
	110	B	B	B	B
	90	B	B	B	B
200	90	B	B	B	B
	140	B	B	B	B
	110	B	B	B	B

Cylinder Port Availability

	PORT						
BORE	"M" ISO 6149-1 STRAIGHT THREAD PORT (STD)	"S" SAE STRAIGHT THREAD PORT (OPT)	"N" NPT TAPERED THREAD PORT (OPT)	"B" BSPP PARALLEL THREAD PORT (OPT)	"J" BSPT TAPERED THREAD PORT (OPT)	"F" SAE 4-BOLT FLANGE PORT (OPT)	"G" METRIC STRAIGHT THREAD (OPT)
25	M14X1.5	#6	1/4	1/4	1/4	N/A	M14X1.5
32	M14X1.5	#6	1/4	1/4	1/4	N/A	M14X1.5
40	M18X1.5	#6	3/8	3/8	3/8	N/A	M18X1.5
50	M22X1.5	#10	1/2	1/2	1/2	N/A	M22X1.5
63	M22X1.5	#10	1/2	1/2	1/2	1/2*	M22X1.5
80	M27X2	#12	3/4	3/4	3/4	3/4**	M27X2
100	M27X2	#12	3/4	3/4	3/4	3/4**	M27X2
125	M33X2	#16	1	1	1	1**	M33X2
160	M33X2	#16	1	1	1	1**	M33X2
200	M42X2	#20	1-1/4	1-1/4	1-1/4	1-1/4	M42X2

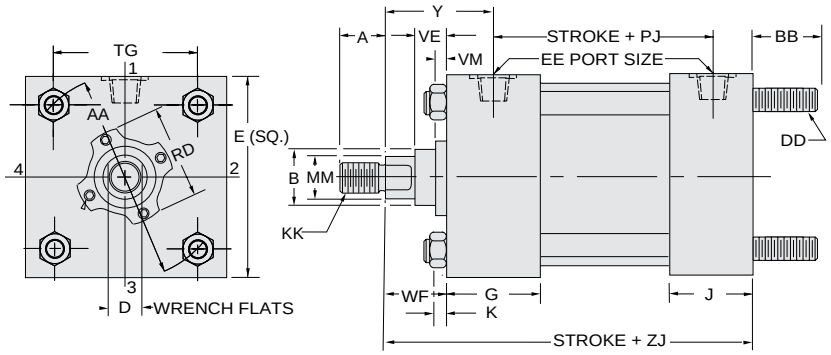
* Port location not ISO standard.
** Not available in all rod diameters. Consult Miller Fluid Power Application Engineering department.

Model 52-B (ISO MX2)
Bolted Bushing
Tie Rods Extended Cap End

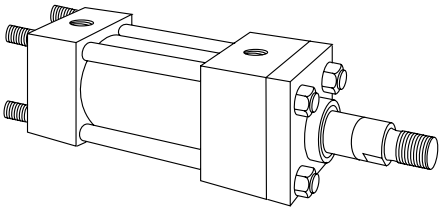


Also Available
Model 51-B (ISO MX1) Tie Rods Extended both ends.
Model 53-B (ISO MX3) Tie Rods Extended head end.
All of the above models can be dimensioned from Model 52-B shown.

Mounting Dimensions
(see tables on opposite page)

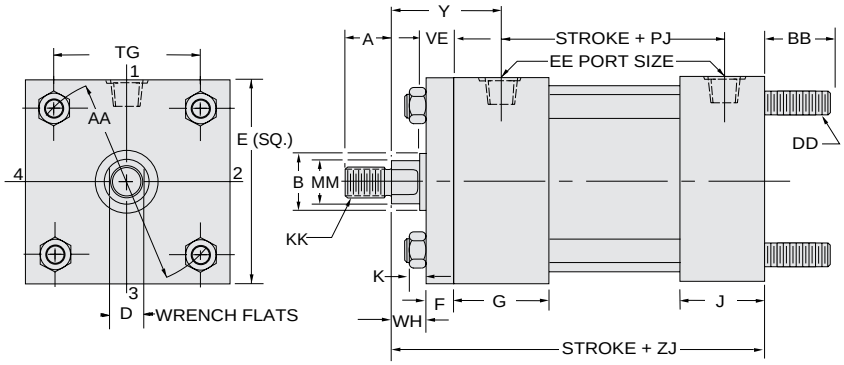


Model 52-R (ISO MX2)
Square Retainer Held Bushing
Tie Rods Extended Cap End



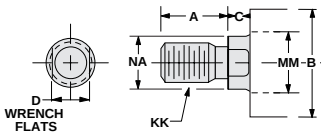
Also Available
Model 51-R (ISO MX1) Tie Rods Extended both ends.
Model 53-R (ISO MX3) Tie Rods Extended head end.
All of the above models can be dimensioned from Model 52-R shown.

Mounting Dimensions
(see tables on opposite page)

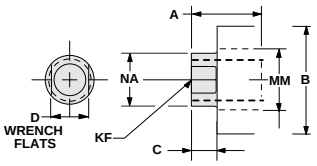


Rod End Styles & Dimensions

Style No. M or S
Threaded on Turndown Section

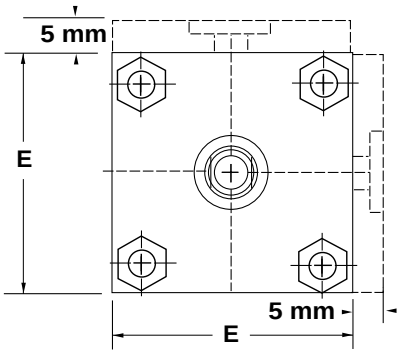


Style No. T
Short Rod End-Internal Threads



25 and 32 mm Bore Cylinders

To accommodate port, head height increased by 5 mm. Applies to port face only.



Miller MH Series Hydraulic Cylinders

Tie Rods Extended
25mm - 200mm Bore Cylinders

Cylinder Body Dimensions (mm)

Bore DIA.	E	F	G	J	K	TG	Y	AA	BB	DD	EE ISO 6149-1
25	40	10	40	25	4	28.3	50	40	19	M5 X 0.8	M14
32	45	10	40	25	5	33.2	60	47	24	M6 X 1	M14
40	63	10	44	38	6.5	41.7	62	59	35	M8 X 1	M18
50	75	16	44	38	10	52.3	67	74	46	M12 X1.25	M22
63	90	16	44	38	10	64.3	71	91	46	M12 X 1.25	M22
80	115	20	50	45	13	82.7	77	117	59	M16 X 1.5	M27
100	130	22	50	45	13	96.9	82	137	59	M16 X 1.5	M27
125	165	22	58	58	18	125.9	86	178	81	M22 X 1.5	M33
160	205	25	58	58	22	154.9	86	219	92	M27 X 2	M33
200	245	25	76	76	24	190.2	98	269	115	M30 X 2	M42

Add Stroke

ZJ	PJ
114	53
128	56
153	73
159	74
168	80
190	93
203	101
232	117
245	130
299	165

Rod End Dimensions (mm)

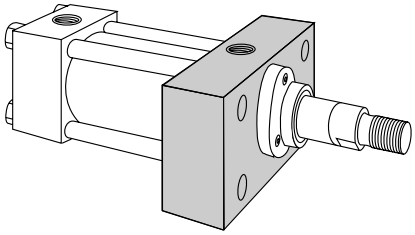
Bore DIA.	MM Rod DIA.	STYLE M		STYLE S		STYLE T		B f9	C	D	NA	VE	WF	WH	VM	RD
		KK	A	KK	A	KF	A									
25	12	M10 X 1.25	14	-	-	M8 X 1	14	24	9	10	11	16	25	15	–	–
	**18	M14 X 1.5	18	M10 X 1.25	14	M12 X 1.25	18	30	9	15	17	16				
32	14	M12 X 1.25	16	-	-	M10 X 1.25	16	26	19	12	13	16	35	25	–	–
	**22	M16 X 1.5	22	M12 X 1.25	16	M16 X 1.5	22	34	13	18	21	22				
40	18	M14 X 1.5	18	-	-	M12 X 1.25	18	30	19	15	17	16	35	25	10	55.4
	28	M20 X 1.5	28	M14 X 1.5	18	M20 X 1.5	28	42	13	22	26	22			16	68.4
50	22	M16 X 1.5	22	-	-	M16 X 1.5	22	34	19	18	21	22	41	25	16	60.4
	36	M27 X 2	36	M16 X 1.5	22	M27 X 2	36	50	16	30	34	25				78.3
	28	M20 X 1.5	28	M16 X 1.5	22	M20 X 1.5	28	42	19	22	26	22				68.4
63	28	M20 X 1.5	28	-	-	M20 X 1.5	28	42	26	22	26	22	48	32	16	68.4
	45	M33 X 2	45	M20 X 1.5	28	M33 X 2	45	60	19	39	43	29				88.5
	36	M27 X 2	36	M20 X 1.5	28	M27 X 2	36	50	23	30	34	25				78.3
80	36	M27 X 2	36	-	-	M27 X 2	36	50	26	30	34	25	51	31	16	78.3
	56	M42 X 2	56	M27 X 2	36	M42 X 2	56	72	22	48	54	29				100.5
	45	M33 X 2	45	M27 X 2	36	M33 X 2	45	60	22	39	43	29				88.5
100	45	M33 X 2	45	-	-	M33 X 2	45	60	28	39	43	29	57	35	16	88.5
	70	M48 X 2	63	M33 X 2	45	M48 X 2	63	88	25	62	68	32			22	116.5
	56	M42 X 2	56	M33 X 2	45	M42 X 2	56	72	28	48	54	29			16	100.5
125	56	M42 X 2	56	-	-	M42 X 2	56	72	28	48	54	29	57	35	16	100.5
	90	M64 X 3	85	M42 X 2	56	M64 X 3	85	108	25	80	88	32			22	136.5
	70	M48 X 2	63	M42 X 2	56	M48 X 2	63	88	25	62	68	32				116.5
160	70	M48 X 2	63	-	-	M48 X 2	63	88	25	62	68	32	57	32	22	116.5
	110	M80 X 3	95	M48 X 2	63	M80 X 3	95	133	25	100	108	32			25	171.5
	90	M64 X 3	85	M48 X 2	63	M64 X 3	85	108	25	80	88	32			22	136.5
200	90	M64 X 3	85	-	-	M64 X 3	85	108	25	80	88	32	57	32	22	136.5
	140	M100 X 3	112	M64 X 3	85	M100 X 3	112	163	25	128	138	32			25	201.5
	110	M80 X 3	95	M64 X 2	85	M80 X 3	95	133	25	100	108	32				171.5

** These sizes do not have a removable rod bushing.

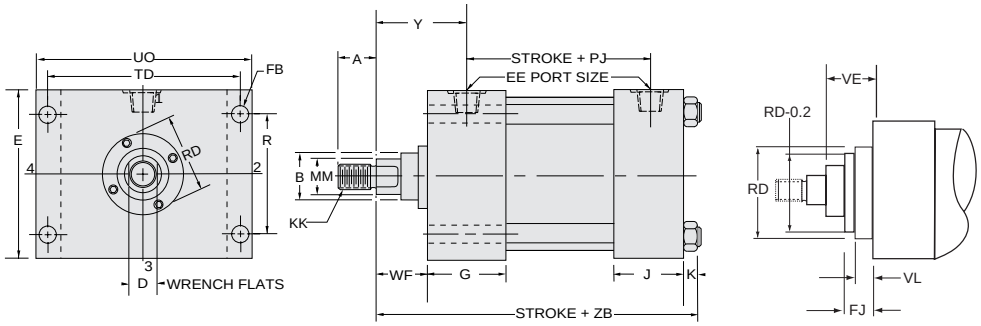
Miller MH Series Hydraulic Cylinders

Rectangular Head/Cap
25mm - 200mm Bore Cylinders

Model 67-B (ISO ME5)
Bolted Bushing
Rectangular Head

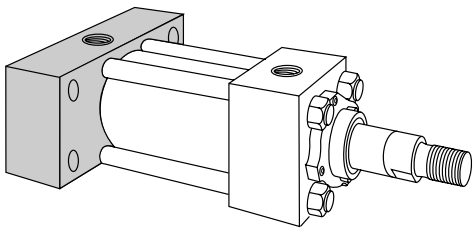


Mounting Dimensions
(See tables on opposite page)

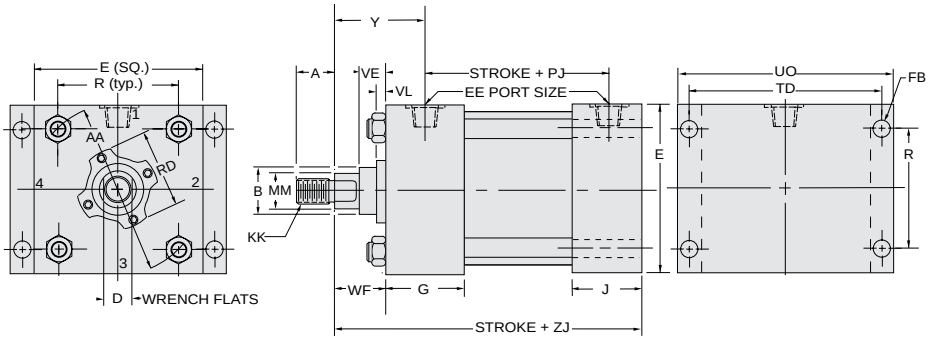


Note: High tensile mounting bolts should be used. Hardened flat washers should be used on 63 mm through 200 mm bore cylinders. Not available in Retainer Held Bushing construction.

Model 68-B (ISO ME6)
Bolted Bushing
Rectangular Cap

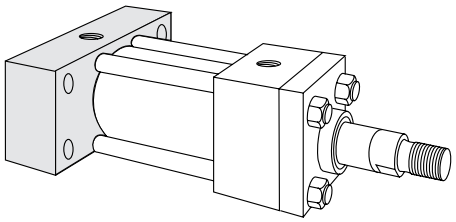


Mounting Dimensions
(See tables on opposite page)

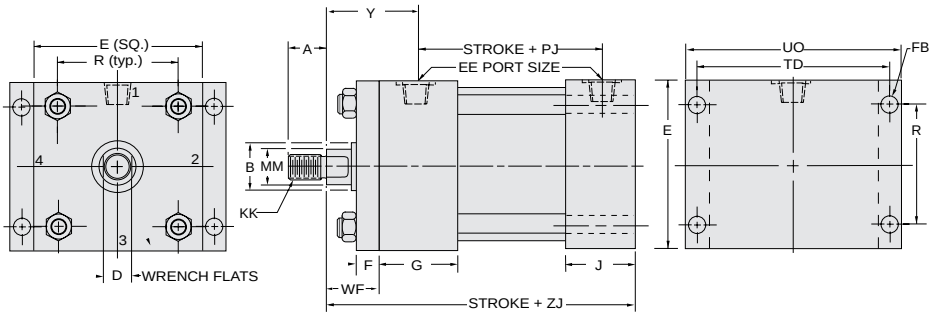


Note: High tensile mounting bolts should be used. Hardened flat washers should be used on 63 mm through 200 mm bore cylinders.

Model 68-R (ISO ME6)
Square Retainer Held Bushing
Rectangular Cap



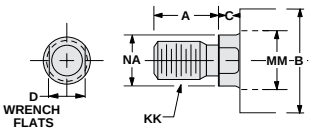
Mounting Dimensions
(See tables on opposite page)



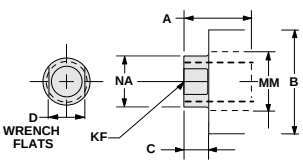
Note: High tensile mounting bolts should be used. Hardened flat washers should be used on 63 mm through 200 mm bore cylinders.

Rod End Styles & Dimensions

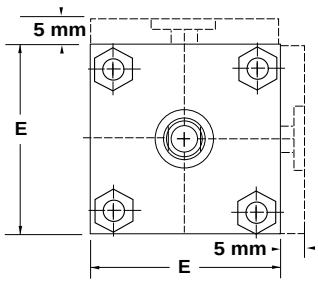
Style No. M or S
Threaded on Turndown Section



Style No. T
Short Rod End-Internal Threads



25 and 32 mm Bore Cylinders



To accommodate port, head height increased by 5 mm. Applies to port face only.

Cylinder Body Dimensions (mm)

Bore DIA.	E	F	G	J	K	R	Y	EE ISO 6149-1	FB h13	TD	UO Max.
25	40	10	40	25	4	27	50	M14	5.5	51	65
32	45	10	40	25	5	33	60	M14	6.6	58	70
40	63	10	44	38	6.5	41	62	M18	11	87	110
50	75	16	44	38	10	52	67	M22	14	105	130
63	90	16	44	38	10	65	71	M22	14	117	145
80	115	20	50	45	13	83	77	M22	18	149	180
100	130	-	50	45	13	97	82	M27	18	162	200
125	165	-	58	58	18	126	86	M33	22	208	250
160	205	-	58	58	22	155	86	M33	26	253	300
200	245	-	76	76	24	190	98	M42	33	300	360

Add Stroke

ZB Max.	ZJ	PJ
121	114	53
137	128	56
166	153	73
176	159	74
185	168	80
212	190	93
225	203	101
260	232	117
279	245	130
336	299	165

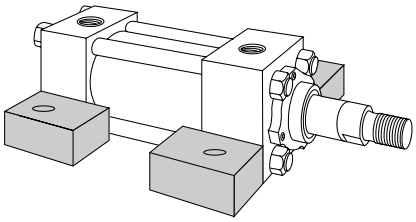
Rod End Dimensions (mm)

Bore DIA.	MM Rod DIA.	STYLE M		STYLE S		STYLE T		B f9	C	D	NA	VE Max.	WF
		KK	A	KK	A	KF	A						
25	12	M10 X 1.25	14	-	-	M8 X 1	14	24	9	10	11	16	25
	**18	M14 X 1.5	18	M10 X 1.25	14	M12 X 1.25	18	30	9	15	17	16	
32	14	M12 X 1.25	16	-	-	M10 X 1.25	16	26	19	12	13	16	35
	**22	M16 X 1.5	22	M12 X 1.25	16	M16 X 1.5	22	34	13	18	21	22	
40	18	M14 X 1.5	18	-	-	M12 X 1.25	18	30	19	15	17	16	35
	28	M20 X 1.5	28	M14 X 1.5	18	M20 X 1.5	28	42	13	22	26	22	
50	22	M16 X 1.5	22	-	-	M16 X 1.5	22	34	19	18	21	22	41
	36	M27 X 2	36	M16 X 1.5	22	M27 X 2	36	50	16	30	34	25	
	28	M20 X 1.5	28	M16 X 1.5	22	M20 X 1.5	28	42	19	22	26	22	
63	28	M20 X 1.5	28	-	-	M20 X 1.5	28	42	26	22	26	22	48
	45	M33 X 2	45	M20 X 1.5	28	M33 X 2	45	60	19	39	43	29	
	36	M27 X 2	36	M20 X 1.5	28	M27 X 2	36	50	23	30	34	25	
80	36	M27 X 2	36	-	-	M27 X 2	36	50	26	30	34	25	51
	56	M42 X 2	56	M27 X 2	36	M42 X 2	56	72	22	48	54	29	
	45	M33 X 2	45	M27 X 2	36	M33 X 2	45	60	22	39	43	29	
100	45	M33 X 2	45	-	-	M33 X 2	45	60	28	39	43	29	57
	70	M48 X 2	63	M33 X 2	45	M48 X 2	63	88	25	62	68	32	
	56	M42 X 2	56	M33 X 2	45	M42 X 2	56	72	28	48	54	29	
125	56	M42 X 2	56	-	-	M42 X 2	56	72	28	48	54	29	57
	90	M64 X 3	85	M42 X 2	56	M64 X 3	85	108	25	80	88	32	
	70	M48 X 2	63	M42 X 2	56	M48 X 2	63	88	25	62	68	32	
160	70	M48 X 2	63	-	-	M48 X 2	63	88	25	62	68	32	57
	110	M80 X 3	95	M48 X 2	63	M80 X 3	95	133	25	100	108	32	
	90	M64 X 3	85	M48 X 2	63	M64 X 3	85	108	25	80	88	32	
200	90	M64 X 3	85	-	-	M64 X 3	85	108	25	80	88	32	57
	140	M100 X 3	112	M64 X 3	85	M100 X 3	112	163	25	128	138	32	
	110	M80 X 3	95	M64 X 3	85	M80 X 3	95	133	25	100	108	32	

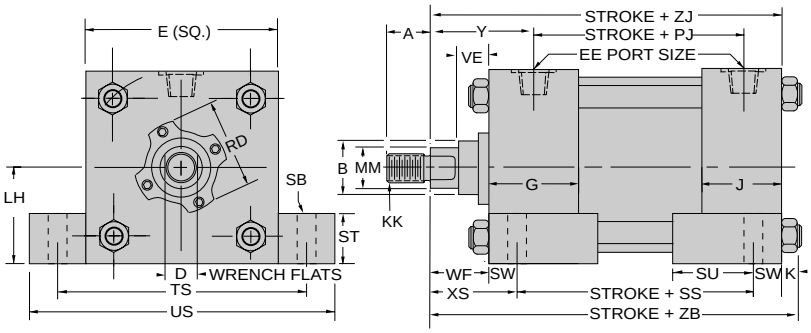
67 Mount Only		
VL Min.	RD f8	FJ
3	38	10
3	42	10
3	62	10
4	74	16
4	75	16
	88	
4	82	20
	105	
5	92	22
	125	
5	105	20
	150	22
5	125	22
	170	25
5	150	22
	210	25

** These sizes do not have a removable rod bushing.

Model 72-B (ISO MS2)
Bolted Bushing
Side Lug

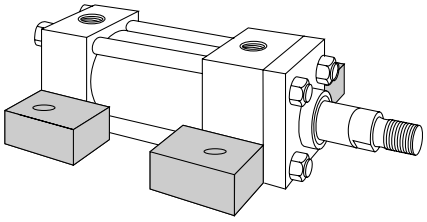


Mounting Dimensions
(See tables on opposite page)

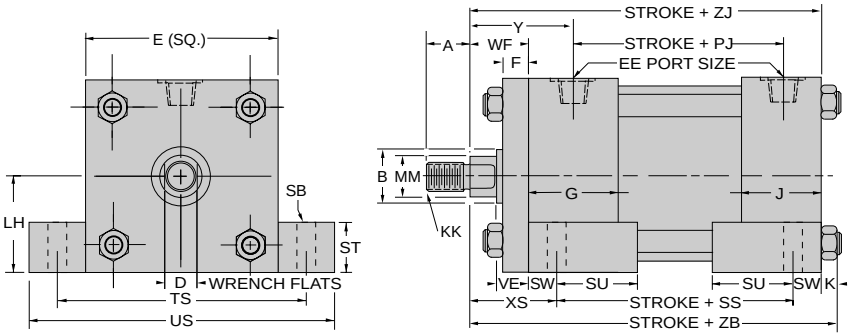


Note: Lugs should be blocked, or a "K" retainer should be mounted on the appropriate end to absorb hydraulic or mechanical shock. Bolts should not carry shear load.

Model 72-R (ISO MS2)
Square Retainer Held Bushing
Side Lug



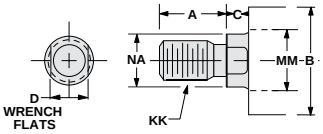
Mounting Dimensions
(See tables on opposite page)



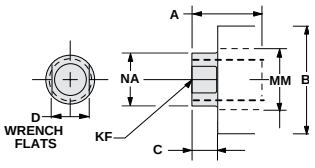
Note: Lugs should be blocked, or a "K" retainer should be mounted on the appropriate end to absorb hydraulic or mechanical shock. Bolts should not carry shear load.

Rod End Styles & Dimensions

Style No. M or S
Threaded on Turndown Section

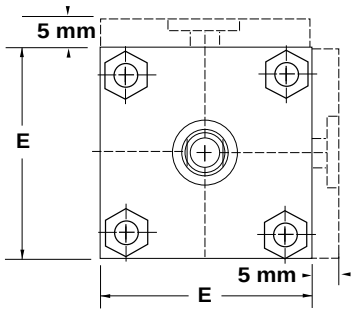


Style No.T
Short Rod End-Internal Threads



25 and 32 mm Bore Cylinders

To accommodate port, head height increased by 5 mm. Applies to port face only.



Cylinder Body Dimensions (mm)

Bore DIA.	E	F	G	J	K	Y	EE ISO 6149-1	LH	SB	ST	SW	TS	US	XS	SS	SU
25	40	10	40	25	4	50	M14	19	6.6	8.5	8	54	72	33	73	32
32	45	10	40	25	5	60	M14	22	9	12.5	10	63	84	45	73	30
40	63	10	44	38	6.5	62	M18	31	11	12.5	10	83	103	45	98	34
50	75	16	44	38	10	67	M22	37	14	19	13	102	127	54	92	31
63	90	16	44	38	10	71	M22	44	18	26	17	124	161	65	86	27
80	115	20	50	45	13	77	M27	57	18	26	17	149	186	68	105	33
100	130	-	50	45	13	82	M27	63	26	32	22	172	216	79	102	28
125	165	-	58	58	18	86	M33	82	26	32	22	210	254	79	131	36
160	205	-	58	58	22	86	M33	101	33	38	29	260	318	86	130	29
200	245	-	76	76	24	98	M42	122	39	44	35	311	381	92	172	41

Add Stroke

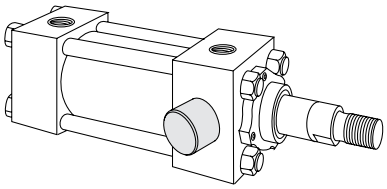
ZB Max.	ZJ	PJ
121	114	53
137	128	56
166	153	73
176	159	74
185	168	80
212	190	93
225	203	101
260	232	117
279	245	130
336	299	165

Rod End Dimensions (mm)

Bore DIA.	MM ROD DIA.	STYLE M		STYLE S		STYLE T		B f9	C	D	NA	VE	WF	RD
		KK	A	KK	A	KF	A							
25	12	M10 X 1.25	14	-	-	M8 X 1	14	24	9	10	11	16	25	-
	**18	M14 X 1.5	18	M10 X 1.25	14	M12 X 1.25	18	30	9	15	17	16		
32	14	M12 X 1.25	16	-	-	M10 X 1.25	16	26	19	12	13	16	35	-
	**22	M16 X 1.5	22	M12 X 1.25	16	M16 X 1.5	22	34	13	18	21	22		
40	18	M14 X 1.5	18	-	-	M12 X 1.25	18	30	19	15	17	16	35	55.4
	28	M20 X 1.5	28	M14 X 1.5	18	M20 X 1.5	28	42	13	22	26	22		68.4
50	22	M16 X 1.5	22	-	-	M16 X 1.5	22	34	19	18	21	22	41	60.4
	36	M27 X 2	36	M16 X 1.5	22	M27 X 2	36	50	16	30	34	25		78.3
	28	M20 X 1.5	28	M16 X 1.5	22	M20 X 1.5	28	42	19	22	26	22		68.4
63	28	M20 X 1.5	28	-	-	M20 X 1.5	28	42	26	22	26	22	48	68.4
	45	M33 X 2	45	M20 X 1.5	28	M33 X 2	45	60	19	39	43	29		88.5
	36	M27 X 2	36	M20 X 1.5	28	M27 X 2	36	50	23	30	34	25		78.3
80	36	M27 X 2	36	-	-	M27 X 2	36	50	26	30	34	25	51	78.3
	56	M42 X 2	56	M27 X 2	36	M42 X 2	56	72	22	48	54	29		100.5
	45	M33 X 2	45	M27 X 2	36	M33 X 2	45	60	22	39	43	29		88.5
100	45	M33 X 2	45	-	-	M33 X 2	45	60	28	39	43	29	57	88.5
	70	M48 X 2	63	M33 X 2	45	M48 X 2	63	88	25	62	68	32		116.5
	56	M42 X 2	56	M33 X 2	45	M42 X 2	56	72	28	48	54	29		100.5
125	56	M42 X 2	56	-	-	M42 X 2	56	72	28	48	54	29	57	100.5
	90	M64 X 3	85	M42 X 2	56	M64 X 3	85	108	25	80	88	32		136.5
	70	M48 X 2	63	M42 X 2	56	M48 X 2	63	88	25	62	68	32		116.5
160	70	M48 X 2	63	-	-	M48 X 2	63	88	25	62	68	32	57	116.5
	110	M80 X 3	95	M48 X 2	63	M80 X 3	95	133	25	100	108	32		171.5
	90	M64 X 3	85	M48 X 2	63	M64 X 3	85	108	25	80	88	32		136.5
200	90	M64 X 3	85	-	-	M64 X 3	85	108	25	80	88	32	57	136.5
	140	M100 X 3	112	M64 X 3	85	M100 X 3	112	163	25	128	138	32		201.5
	110	M80 X 3	95	M64 X 3	85	M80 X 3	95	133	25	100	108	32		171.5

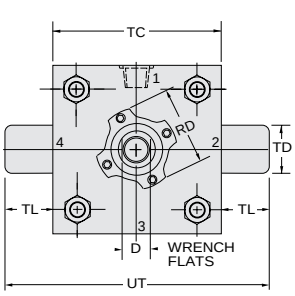
** These sizes do not have a removable rod bushing.

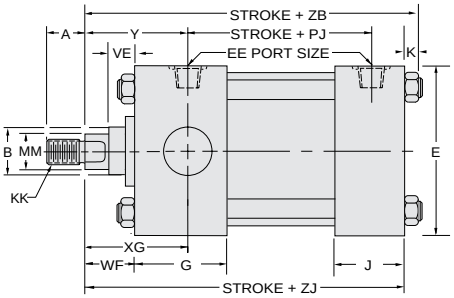
Model 81-B (ISO MT1) Bolted Bushing Trunnion Head End



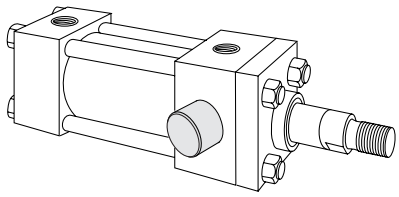
Note: Pins designed for shear, (not bending) loads.

Mounting Dimensions
(See tables on opposite page)



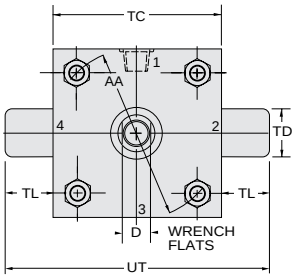


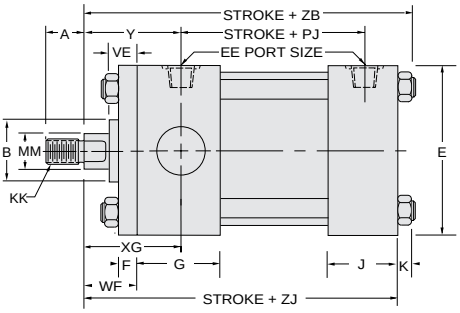
Model 81-R (ISO MT1) Square Retainer Trunnion Head End



Note: Pins designed for shear, (not bending) loads.

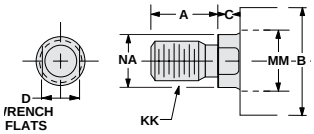
Mounting Dimensions
(See tables on opposite page)



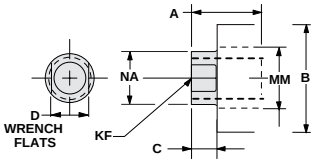


Rod End Styles & Dimensions

Style No. M or S
Threaded on Turndown Section

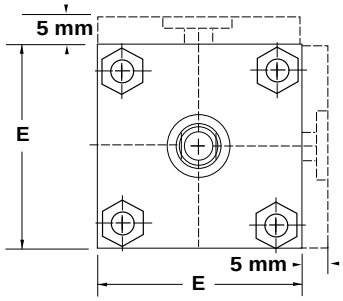


Style No. T
Short Rod End-Internal Threads



25 and 32mm Bore Cylinders

To accommodate port, head height increased by 5mm. Applies to port face only



Cylinder Body Dimensions (mm)

Bore DIA.	E	F	G	J	K	Y	EE ISO 6149-1	TC	TD f8	TL	XG	UT
25	40	10	40	25	4	50	M14	38	12	10	44	58
32	45	10	40	25	5	60	M14	44	16	12	54	68
40	63	10	44	38	6.5	62	M18	63	20	16	57	95
50	75	16	44	38	10	67	M22	76	25	20	64	116
63	90	16	44	38	10	71	M22	89	32	25	70	139
80	115	20	50	45	13	77	M27	114	40	32	76	178
100	130	-	72	45	13*	82	M27	127	50	40	71	207
125	165	-	80	58	18*	86	M33	165	63	50	75	265
160	205	-	86	58	22*	86	M33	203	80	63	75	329
200	245	-	106	76	24*	98	M42	241	100	80	85	401

* Threaded tie rod holes at head end or square retainer.

Add Stroke

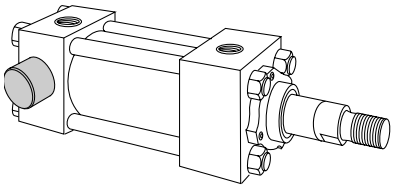
ZB Max.	ZJ	PJ
121	114	53
137	128	56
166	153	73
176	159	74
185	168	80
212	190	93
225	203	101
260	232	117
279	248	130
336	304	165

Rod End Dimensions (mm)

Bore DIA.	MM ROD DIA.	STYLE M		STYLE S		STYLE T		B f9	C	D	NA	VE	WF	RD
		KK	A	KK	A	KF	A							
25	12	M10 X 1.25	14	-	-	M8 X 1	14	24	9	10	11	16	25	-
	**18	M14 X 1.5	18	M10 X 1.25	14	M12 X 1.25	18	30	9	15	17	16		
32	14	M12 X 1.25	16	-	-	M10 X 1.25	16	26	19	12	13	16	35	-
	**22	M16 X 1.5	22	M12 X 1.25	16	M16 X 1.5	22	34	13	18	21	22		
40	18	M14 X 1.5	18	-	-	M12 X 1.25	18	30	19	15	17	16	35	55.4
	28	M20 X 1.5	28	M14 X 1.5	18	M20 X 1.5	28	42	13	22	26	22		68.4
50	22	M16 X 1.5	22	-	-	M16 X 1.5	22	34	19	18	21	22	41	60.4
	36	M27 X 2	36	M16 X 1.5	22	M27 X 2	36	50	16	30	34	25		78.3
	28	M20 X 1.5	28	M16 X 1.5	22	M20 X 1.5	28	42	19	22	26	22		68.4
63	28	M20 X 1.5	28	-	-	M20 X 1.5	28	42	26	22	26	22	48	68.4
	45	M33 X 2	45	M20 X 1.5	28	M33 X 2	45	60	19	39	43	29		88.5
	36	M27 X 2	36	M20 X 1.5	28	M27 X 2	36	50	23	30	34	25		78.3
80	36	M27 X 2	36	-	-	M27 X 2	36	50	26	30	34	25	51	78.3
	56	M42 X 2	56	M27 X 2	36	M42 X 2	56	72	22	48	54	29		100.5
	45	M33 X 2	45	M27 X 2	36	M33 X 2	45	60	22	39	43	29		88.5
100	45	M33 X 2	45	-	-	M33 X 2	45	60	28	39	43	7	35	88.5
	70	M48 X 2	63	M33 X 2	45	M48 X 2	63	88	25	62	68	10		116.5
	56	M42 X 2	56	M33 X 2	45	M42 X 2	56	72	28	48	54	7		100.5
125	56	M42 X 2	56	-	-	M42 X 2	56	72	28	48	54	7	35	100.5
	90	M64 X 3	85	M42 X 2	56	M64 X 3	85	108	25	80	88	10		136.5
	70	M48 X 2	63	M42 X 2	56	M48 X 2	63	88	25	62	68	10		116.5
160	70	M48 X 2	63	-	-	M48 X 2	63	88	25	62	68	7	32	116.5
	110	M80 X 3	95	M48 X 2	63	M80 X 3	95	133	25	100	108	7		171.5
	90	M64 X 3	85	M48 X 2	63	M64 X 3	85	108	25	80	88	7		136.5
200	90	M64 X 3	85	-	-	M64 X 3	85	108	25	80	88	7	32	136.5
	140	M100 X 3	112	M64 X 3	85	M100 X 3	112	163	25	128	138	7		201.5
	110	M80 X 3	95	M64 X 3	85	M80 X 3	95	133	25	100	108	7		171.5

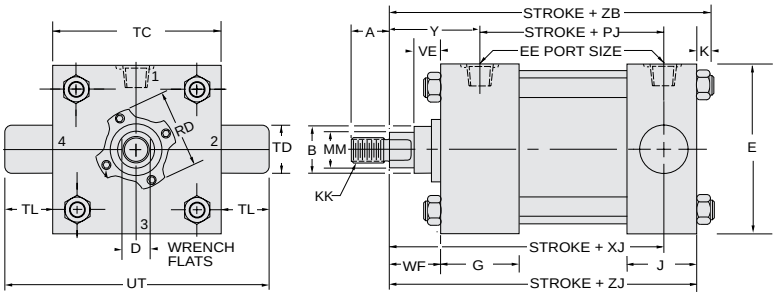
** These sizes do not have a removable rod bushing.

Model 82-B (ISO MT2) Bolted Bushing Trunnion Cap End

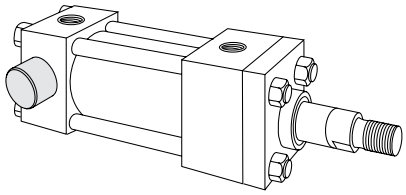


Note: Pins designed for shear (not bending) loads.

Mounting Dimensions
(See tables on opposite page)

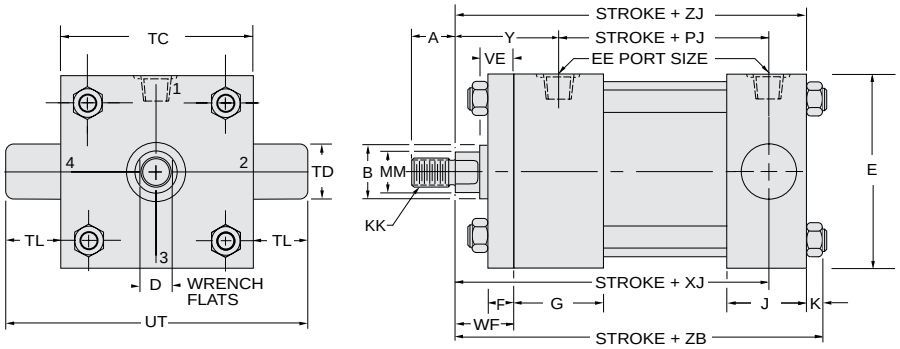


Model 82-R (ISO MT2) Square Retainer Held Bushing Trunnion Cap End



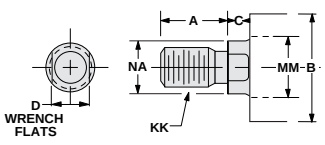
Note: Pins designed for shear (not bending) loads.

Mounting Dimensions
(See tables on opposite page)

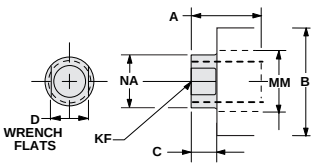


Rod End Styles & Dimensions

Style No. M or S
Threaded on Turndown Section

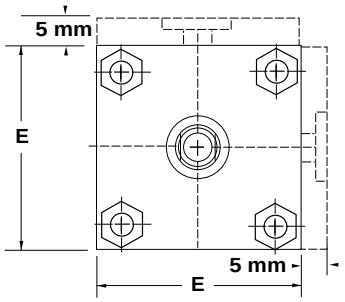


Style No. T
Short Rod End-Internal Threads



25 and 32 mm Bore Cylinders

To accommodate port, head height increased by 5mm. Applies to port face only



Cylinder Body Dimensions (mm)

Bore DIA.	E	F	G	J	K	Y	EE ISO 6149.1	TC	TD f8	TL	UT
25	40	10	40	25	4	50	M14	38	12	10	58
32	45	10	40	25	5	60	M14	44	16	12	68
40	63	10	44	38	6.5	62	M18	63	20	16	95
50	75	16	44	38	10	67	M22	76	25	20	116
63	90	16	44	38	10	71	M22	89	32	25	139
80	115	20	50	46	13	77	M27	114	40	32	178
100	130	-	50	58	13*	82	M27	127	50	40	207
125	165	-	58	70	18*	86	M33	165	63	50	265
160	205	-	58	86	22*	86	M33	203	80	63	329
200	245	-	76	106	24*	98	M42	241	100	80	401

*Threaded tie rod holes on cap.

Add Stroke

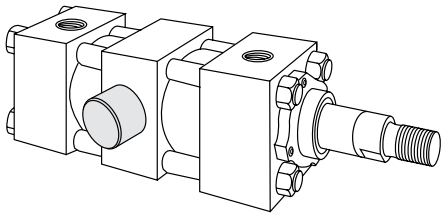
XJ	ZB Max.	ZJ	PJ
101	121	114	53
115	137	128	56
134	166	153	73
140	176	159	74
149	185	168	80
168	212	191	93
187	225	216	101
209	260	244	117
230	279	273	130
276	336	329	165

Rod End Dimensions (mm)

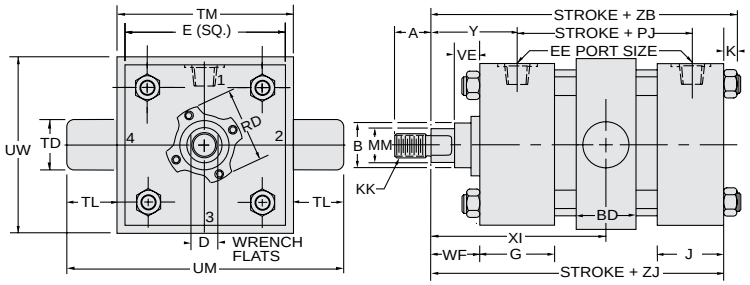
Bore DIA.	MM ROD DIA.	STYLE M		STYLE S		STYLE T		B f9	C	D	NA	VE	WF	RD
		KK	A	KK	A	KF	A							
25	12	M10 X 1.25	14	-	-	M8 X 1	14	24	9	10	11	16	25	-
	**18	M14 X 1.5	18	M10 X 1.25	14	M12 X 1.25	18	30	9	15	17	16		
32	14	M12 X 1.25	16	-	-	M10 X 1.25	16	26	19	12	13	16	35	-
	**22	M16 X 1.5	22	M12 X 1.25	16	M16 X 1.5	22	34	13	18	21	22		
40	18	M14 X 1.5	18	-	-	M12 X 1.25	18	30	19	15	17	16	35	55.4
	28	M20 X 1.5	28	M14 X 1.5	18	M20 X 1.5	28	42	13	22	26	22		68.4
50	22	M16 X 1.5	22	-	-	M16 X 1.5	22	34	19	18	21	22	41	60.4
	36	M27 X 2	36	M16 X 1.5	22	M27 X 2	36	50	16	30	34	25		78.3
	28	M20 X 1.5	28	M16 X 1.5	22	M20 X 1.5	28	42	19	22	26	22		68.4
63	28	M20 X 1.5	28	-	-	M20 X 1.5	28	42	26	22	26	22	48	68.4
	45	M33 X 2	45	M20 X 1.5	28	M33 X 2	45	60	19	39	43	29		88.5
	36	M27 X 2	36	M20 X 1.5	28	M27 X 2	36	50	23	30	34	25		78.3
80	36	M27 X 2	36	-	-	M27 X 2	36	50	26	30	34	25	51	78.3
	56	M42 X 2	56	M27 X 2	36	M42 X 2	56	72	22	48	54	29		100.5
	45	M33 X 2	45	M27 X 2	36	M33 X 2	45	60	22	39	43	29		88.5
100	45	M33 X 2	45	-	-	M33 X 2	45	60	28	39	43	29	57	88.5
	70	M48 X 2	63	M33 X 2	45	M48 X 2	63	88	25	62	68	32		116.5
	56	M42 X 2	56	M33 X 2	45	M42 X 2	56	72	28	48	54	29		100.5
125	56	M42 X 2	56	-	-	M42 X 2	56	72	28	48	54	29	57	100.5
	90	M64 X 3	85	M42 X 2	56	M64 X 3	85	108	25	80	88	32		136.5
	70	M48 X 2	63	M42 X 2	56	M48 X 2	63	88	25	62	68	32		116.5
160	70	M48 X 2	63	-	-	M48 X 2	63	88	25	62	68	32	57	116.5
	110	M80 X 3	95	M48 X 2	63	M80 X 3	95	133	25	100	108	32		171.5
	90	M64 X 3	85	M48 X 2	63	M64 X 3	85	108	25	80	88	32		136.5
200	90	M64 X 3	85	-	-	M64 X 3	85	108	25	80	88	32	57	136.5
	140	M100 X 3	112	M64 X 3	85	M100 X 3	112	163	25	128	138	32		201.5
	110	M80 X 3	95	M64 X 3	85	M80 X 3	95	133	25	100	108	32		171.5

** These sizes do not have a removable rod bushing.

Model 89-B (ISO MT4)
Bolted Bushing
Intermediate Trunnion

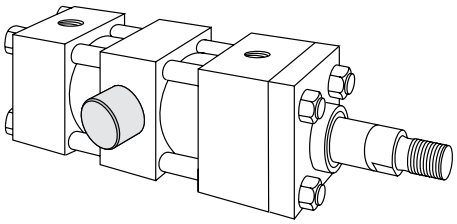


Mounting Dimensions
(See tables on opposite page)

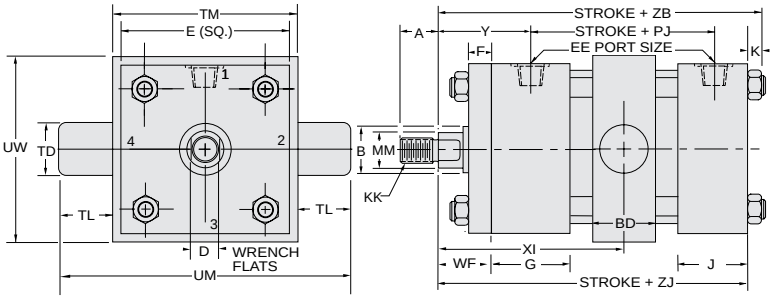


Note: Pins designed for shear (not bending) loads.
Specify dimension "XI" when ordering.

Model 89-R (ISO MT4)
Square Retainer Held Bushing
Intermediate Trunnion



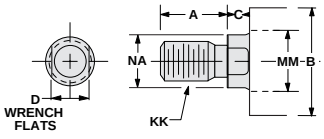
Mounting Dimensions
(See tables on opposite page)



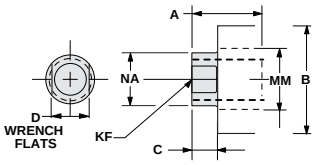
Note: Pins designed for shear (not bending) loads.
Specify dimension "XI" when ordering.

Rod End Styles & Dimensions

Style No. M or S
Threaded on Turndown Section

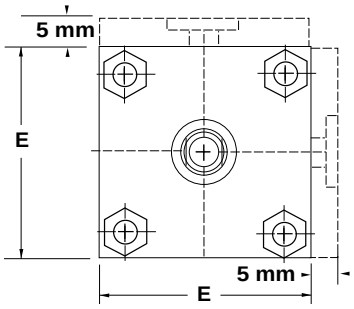


Style No. T
Short Rod End-Internal Threads



25 and 32 mm Bore Cylinders

To accommodate port, head height increased by 5mm. Applies to port face only



Cylinder Body Dimensions (mm)

Bore DIA.	E	F	G	J	K	BD	Y	EE ISO 6149-1	TM	TD f8	TL	UM	UW
25	40	10	40	25	4	20	50	M14	48	12	10	68	45
32	45	10	40	25	5	25	60	M14	55	16	12	79	54
40	63	10	44	38	6.5	30	62	M18	76	20	16	108	76
50	75	16	44	38	10	40	67	M22	89	25	20	129	89
63	90	16	44	38	10	40	71	M22	100	32	25	150	100
80	115	20	50	45	13	50	77	M27	127	40	32	191	127
100	130	-	50	45	13	60	82	M27	140	50	40	220	150
125	165	-	58	58	18	73	86	M33	178	63	50	278	200
160	205	-	58	58	22	90	86	M33	215	80	63	341	240
200	245	-	76	76	24	110	98	M42	279	100	80	439	300

Add Stroke

STROKE Min.	XI Min.	ZB Max.	ZJ	PJ
-	78	121	114	53
-	90	137	128	56
-	97	166	153	73
4	107	176	159	74
2	114	185	168	80
9	127	212	190	93
9	138	225	203	101
14	153	260	232	117
18	161	279	245	130
20	190	336	299	165

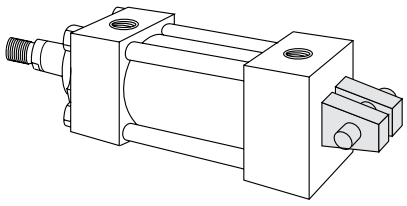
Rod End Dimensions (mm)

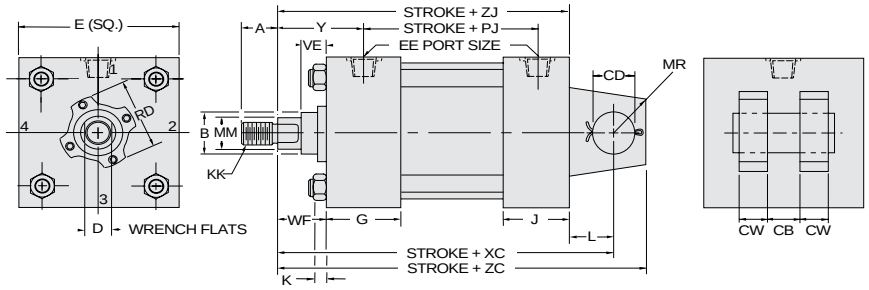
Bore DIA.	MM ROD DIA.	STYLE M		STYLE S		STYLE T		B f9	C	D	NA	VE	WF	RD
		KK	A	KK	A	KF	A							
25	12	M10 X 1.25	14	-	-	M8 X 1	14	24	9	10	11	16	25	-
	**18	M14 X 1.5	18	M10 X 1.25	14	M12 X 1.25	18	30	9	15	17	16		
32	14	M12 X 1.25	16	-	-	M10 X 1.25	16	26	19	12	13	16	35	-
	**22	M16 X 1.5	22	M12 X 1.25	16	M16 X 1.5	22	34	13	18	21	22		
40	18	M14 X 1.5	18	-	-	M12 X 1.25	18	30	19	15	17	16	35	55.4
	28	M20 X 1.5	28	M14 X 1.5	18	M20 X 1.5	28	42	13	22	26	22		68.4
50	22	M16 X 1.5	22	-	-	M16 X 1.5	22	34	19	18	21	22	41	60.4
	36	M27 X 2	36	M16 X 1.5	22	M27 X 2	36	50	16	30	34	25		78.3
	28	M20 X 1.5	28	M16 X 1.5	22	M20 X 1.5	28	42	19	22	26	22		68.4
63	28	M20 X 1.5	28	-	-	M20 X 1.5	28	42	26	22	26	22	48	68.4
	45	M33 X 2	45	M20 X 1.5	28	M33 X 2	45	60	19	39	43	29		88.5
	36	M27 X 2	36	M20 X 1.5	28	M27 X 2	36	50	23	30	34	25		78.3
80	36	M27 X 2	36	-	-	M27 X 2	36	50	26	30	34	25	51	78.3
	56	M42 X 2	56	M27 X 2	36	M42 X 2	56	72	22	48	54	29		100.5
	45	M33 X 2	45	M27 X 2	36	M33 X 2	45	60	22	39	43	29		88.5
100	45	M33 X 2	45	-	-	M33 X 2	45	60	28	39	43	29	57	88.5
	70	M48 X 2	63	M33 X 2	45	M48 X 2	63	88	25	62	68	32		116.5
	56	M42 X 2	56	M33 X 2	45	M42 X 2	56	72	28	48	54	29		100.5
125	56	M42 X 2	56	-	-	M42 X 2	56	72	28	48	54	29	57	100.5
	90	M64 X 3	85	M42 X 2	56	M64 X 3	85	108	25	80	88	32		136.5
	70	M48 X 2	63	M42 X 2	56	M48 X 2	63	88	25	62	68	32		116.5
160	70	M48 X 2	63	-	-	M48 X 2	63	88	25	62	68	32	57	116.5
	110	M80 X 3	95	M48 X 2	63	M80 X 3	95	133	25	100	108	32		171.5
	90	M64 X 3	85	M48 X 2	63	M64 X 3	85	108	25	80	88	32		136.5
200	90	M64 X 3	85	-	-	M64 X 3	85	108	25	80	88	32	57	136.5
	140	M100 X 3	112	M64 X 3	85	M100 X 3	112	163	25	128	138	32		201.5
	110	M80 X 3	95	M64 X 3	85	M80 X 3	95	133	25	100	108	32		171.5

** These sizes do not have a removable rod bushing.

Model 84-B (ISO MP1)
Bolted Bushing
Fixed Clevis
(Pivot Pin Included)

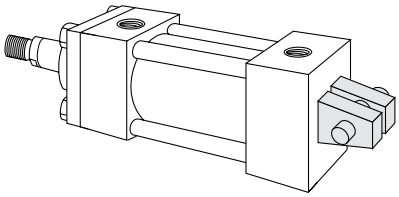
Mounting Dimensions
(See tables on opposite page)

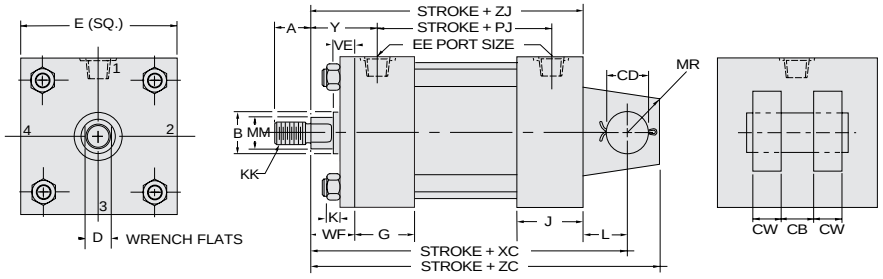




Model 84-R (ISO MP1)
Square Retainer Held Bushing
Fixed Clevis
(Pivot Pin Included)

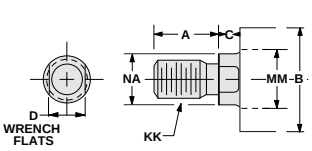
Mounting Dimensions
(See tables on opposite page)



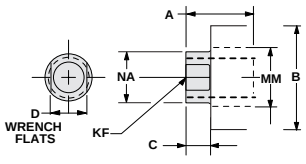


Rod End Styles & Dimensions

Style No. M or S
Threaded on Turndown Section

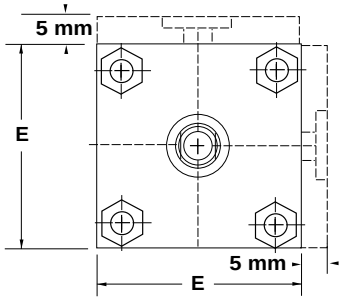


Style No. T
Short Rod End-Internal Threads



25 and 32 mm Bore Cylinders

To accommodate port, head height increased by 5mm. Applies to port face only



Cylinder Body Dimensions (mm)

Bore DIA.	E	F	G	J	K	L	Y	EE ISO 6149-1	CB	CD f8	MR Max.	CW Max.
25	40	10	40	25	4	13	50	M14	12	10	12	6
32	45	10	40	25	5	19	60	M14	16	12	17	8
40	63	10	44	38	6.5	19	62	M18	20	14	17	10
50	75	16	44	38	10	32	67	M22	30	20	29	15
63	90	16	44	38	10	32	71	M22	30	20	29	15
80	115	20	50	45	13	39	77	M27	40	28	34	20
100	130	-	50	45	13	54	82	M27	50	36	50	25
125	165	-	58	58	18	57	86	M33	60	45	53	30
160	205	-	58	58	22	63	86	M33	70	56	59	35
200	245	-	76	76	24	82	98	M42	80	70	78	40

Add Stroke

XC	ZC	ZJ	PJ
127	137	114	53
147	159	128	56
172	186	153	73
191	211	159	74
200	220	168	80
229	257	190	93
257	293	203	101
289	334	232	117
308	359	245	130
381	446	299	165

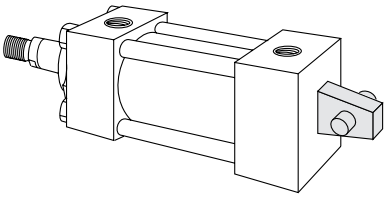
Rod End Dimensions (mm)

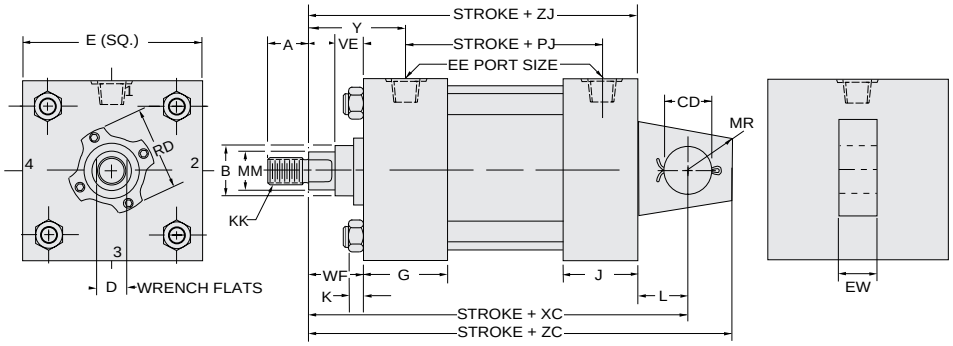
Bore DIA.	MM ROD DIA.	STYLE M		STYLE S		STYLE T		B f9	D	C	NA	VE	WF	RD
		KK	A	KK	A	KF	A							
25	12	M10 X 1.25	14	-	-	M8 X 1	14	24	10	9	11	16	25	-
	**18	M14 X 1.5	18	M10 X 1.25	14	M12 X 1.25	18	30	15	9	17	16		
32	14	M12 X 1.25	16	-	-	M10 X 1.25	16	26	12	19	13	16	35	-
	**22	M16 X 1.5	22	M12 X 1.25	16	M16 X 1.5	22	34	18	13	21	22		
40	18	M14 X 1.5	18	-	-	M12 X 1.25	18	30	15	19	17	16	35	55.4
	28	M20 X 1.5	28	M14 X 1.5	18	M20 X 1.5	28	42	22	13	26	22		68.4
50	22	M16 X 1.5	22	-	-	M16 X 1.5	22	34	18	19	21	22	41	60.4
	36	M27 X 2	36	M16 X 1.5	22	M27 X 2	36	50	30	16	34	25		78.3
	28	M20 X 1.5	28	M16 X 1.5	22	M20 X 1.5	28	42	22	19	26	22		68.4
63	28	M20 X 1.5	28	-	-	M20 X 1.5	28	42	22	26	26	22	48	68.4
	45	M33 X 2	45	M20 X 1.5	28	M33 X 2	45	60	39	19	43	29		88.5
	36	M27 X 2	36	M20 X 1.5	28	M27 X 2	36	50	30	23	34	25		78.3
80	36	M27 X 2	36	-	-	M27 X 2	36	50	30	26	34	25	51	78.3
	56	M42 X 2	56	M27 X 2	36	M42 X 2	56	72	48	22	54	29		100.5
	45	M33 X 2	45	M27 X 2	36	M33 X 2	45	60	39	22	43	29		88.5
100	45	M33 X 2	45	-	-	M33 X 2	45	60	39	28	43	29	57	88.5
	70	M48 X 2	63	M33 X 2	45	M48 X 2	63	88	62	25	68	32		116.5
	56	M42 X 2	56	M33 X 2	45	M42 X 2	56	72	48	28	54	29		100.5
125	56	M42 X 2	56	-	-	M42 X 2	56	72	48	28	54	29	57	100.5
	90	M64 X 3	85	M42 X 2	56	M64 X 3	85	108	80	25	88	32		136.5
	70	M48 X 2	63	M42 X 2	56	M48 X 2	63	88	62	25	68	32		116.5
160	70	M48 X 2	63	-	-	M48 X 2	63	88	62	25	68	32	57	116.5
	110	M80 X 3	95	M48 X 2	63	M80 X 3	95	133	100	25	108	32		171.5
	90	M64 X 3	85	M48 X 2	63	M64 X 3	85	108	80	25	88	32		136.5
200	90	M64 X 3	85	-	-	M64 X 3	85	108	80	25	88	32	57	136.5
	140	M100 X 3	112	M64 X 3	85	M100 X 3	112	163	128	25	138	32		201.5
	110	M80 X 3	95	M64 X 3	85	M80 X 3	95	133	100	25	108	32		171.5

** These sizes do not have a removable rod bushing.

Model 90-B (ISO MP3)
Bolted Bushing
Rear Eye

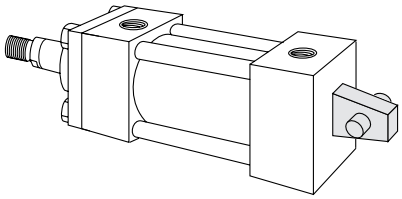
Mounting Dimensions
(See tables on opposite page)

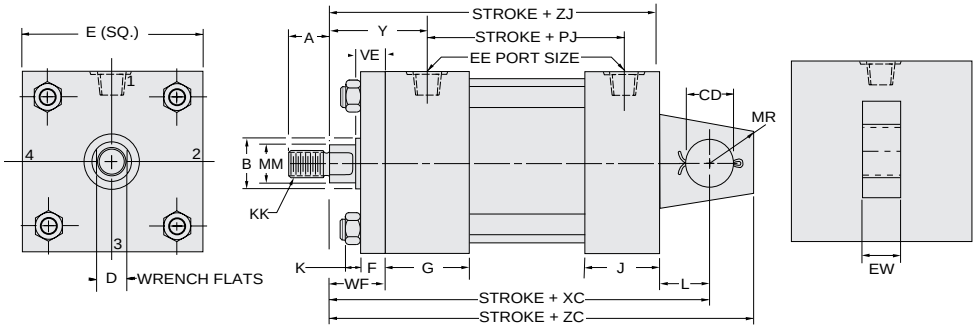




Model 90-R (ISO MP3)
Square Retainer Held Bushing
Rear Eye

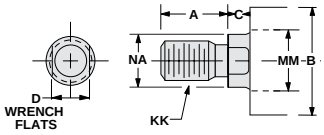
Mounting Dimensions
(See tables on opposite page)



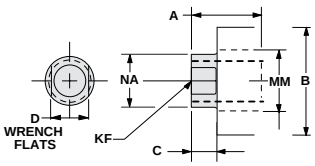


Rod End Styles & Dimensions

Style No. M or S
Threaded on Turndown Section

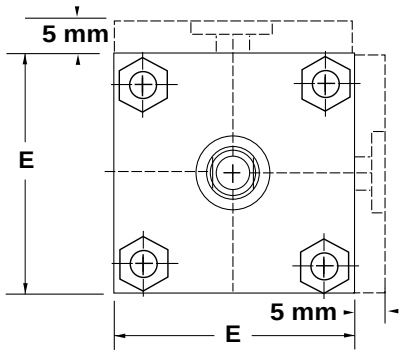


Style No. T
Short Rod End-Internal Threads



25 and 32 mm Bore Cylinders

To accommodate port, head height increased by 5 mm. Applies to port face only.



Cylinder Body Dimensions (mm)

Bore DIA.	E	F	G	J	K	L	Y	EE ISO 6149.1	EW h14	CD f8	MR Max.
25	40	10	40	25	4	13	50	M14	12	10	12
32	45	10	40	25	5	19	60	M14	16	12	17
40	63	10	44	38	6.5	19	62	M18	20	14	17
50	75	16	44	38	10	32	67	M22	30	20	29
63	90	16	44	38	10	32	71	M22	30	20	29
80	115	20	50	45	13	39	77	M27	40	28	34
100	130	-	50	45	13	54	82	M27	50	36	50
125	165	-	58	58	18	57	86	M33	60	45	53
160	205	-	58	58	22	63	86	M33	70	56	59
200	245	-	76	76	24	82	98	M42	80	70	78

Add Stroke

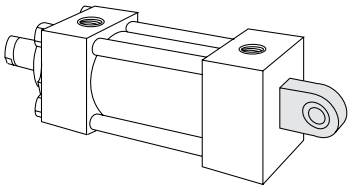
XC	ZC	ZJ	PJ
127	137	114	53
147	159	128	56
172	186	153	73
191	211	159	74
200	220	168	80
229	257	190	93
257	293	203	101
289	334	232	117
308	359	245	130
381	446	299	165

Rod End Dimensions (mm)

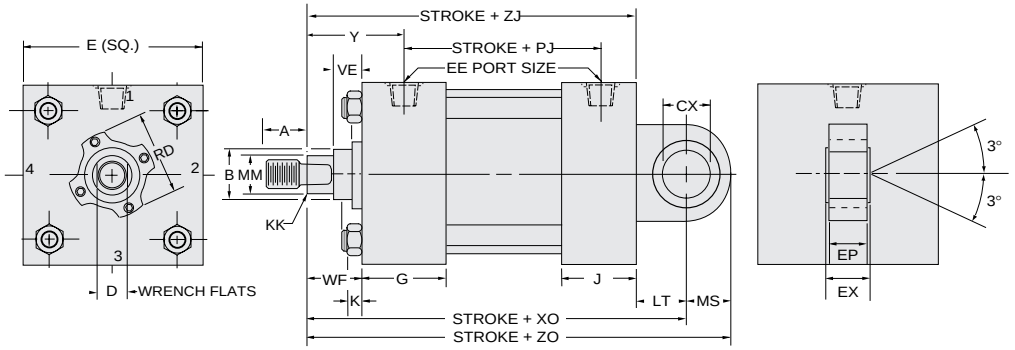
Bore DIA.	MM ROD DIA.	STYLE M		STYLE S		STYLE T		B f9	C	D	NA	VE	WF	RD
		KK	A	KK	A	KF	A							
25	12	M10 X 1.25	14	-	-	M8 X 1	14	24	9	10	11	16	25	-
	**18	M14 X 1.5	18	M10 X 1.25	14	M12 X 1.25	18	30	9	15	17	16		
32	14	M12 X 1.25	16	-	-	M10 X 1.25	16	26	19	12	13	16	35	-
	**22	M16 X 1.5	22	M12 X 1.25	16	M16 X 1.5	22	34	13	18	21	22		
40	18	M14 X 1.5	18	-	-	M12 X 1.25	18	30	19	15	17	16	35	55.4
	28	M20 X 1.5	28	M14 X 1.5	18	M20 X 1.5	28	42	13	22	26	22		68.4
50	22	M16 X 1.5	22	-	-	M16 X 1.5	22	34	19	18	21	22	41	60.4
	36	M27 X 2	36	M16 X 1.5	22	M27 X 2	36	50	16	30	34	25		78.3
	28	M20 X 1.5	28	M16 X 1.5	22	M20 X 1.5	28	42	19	22	26	22		68.4
63	28	M20 X 1.5	28	-	-	M20 X 1.5	28	42	26	22	26	22	48	68.4
	45	M33 X 2	45	M20 X 1.5	28	M33 X 2	45	60	19	39	43	29		88.5
	36	M27 X 2	36	M20 X 1.5	28	M27 X 2	36	50	23	30	34	25		78.3
80	36	M27 X 2	36	-	-	M27 X 2	36	50	26	30	34	25	51	78.3
	56	M42 X 2	56	M27 X 2	36	M42 X 2	56	72	22	48	54	29		100.5
	45	M33 X 2	45	M27 X 2	36	M33 X 2	45	60	22	39	43	29		88.5
100	45	M33 X 2	45	-	-	M33 X 2	45	60	28	39	43	29	57	88.5
	70	M48 X 2	63	M33 X 2	45	M48 X 2	63	88	25	62	68	32		116.5
	56	M42 X 2	56	M33 X 2	45	M42 X 2	56	72	28	48	54	29		100.5
125	56	M42 X 2	56	-	-	M42 X 2	56	72	28	48	54	29	57	100.5
	90	M64 X 3	85	M42 X 2	56	M64 X 3	85	108	25	80	88	32		136.5
	70	M48 X 2	63	M42 X 2	56	M48 X 2	63	88	25	62	68	32		116.5
160	70	M48 X 2	63	-	-	M48 X 2	63	88	25	62	68	32	57	116.5
	110	M80 X 3	95	M48 X 2	63	M80 X 3	95	133	25	100	108	32		171.5
	90	M64 X 3	85	M48 X 2	63	M64 X 3	85	108	25	80	88	32		136.5
200	90	M64 X 3	85	-	-	M64 X 3	85	108	25	80	88	32	57	136.5
	140	M100 X 3	112	M64 X 3	85	M100 X 3	112	163	25	128	138	32		201.5
	110	M80 X 3	95	M64 X 3	85	M80 X 3	95	133	25	100	108	32		171.5

** These sizes do not have a removable rod bushing.

Model 94-B (ISO MP5)
Bolted Bushing
Rear Eye Spherical Bearing

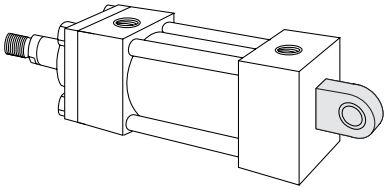


Mounting Dimensions
(See tables on opposite page)

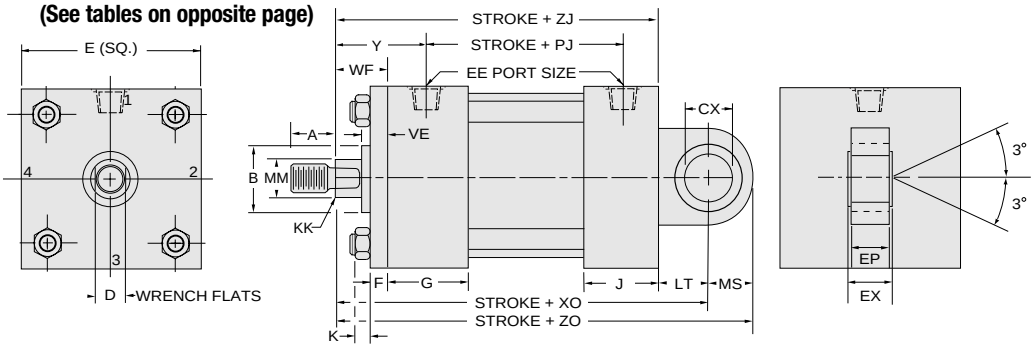


Model 94 should use Spherical Rod Eye on Rod End. See Page 29.

Model 94-R (ISO MP5)
Square Retainer Held Bushing
Rear Eye Spherical Bearing



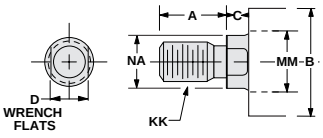
Mounting Dimensions
(See tables on opposite page)



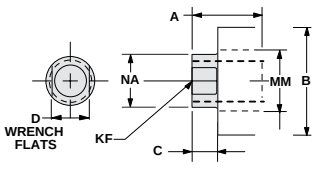
Model 94 should use Spherical Rod Eye on Rod End. See Page 29.

Rod End Styles & Dimensions

Style No. M or S
Threaded on Turndown Section

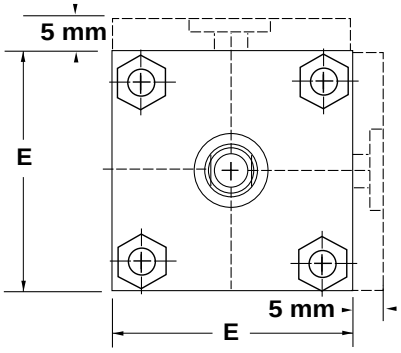


Style No. T
Short Rod End-Internal Threads



25 and 32mm Bore Cylinders

To accommodate port, head height increased by 5mm. Applies to port face only



Cylinder Body Dimensions (mm)

Bore DIA.	E	F	G	J	K	Y	EE ISO 6149-1	EP	EX	CX	MS Max.	LT Min.
25	40	10	40	25	4	50	M14	8	10 $^{+.000}_{-.012}$	12 $^{+.000}_{-.008}$	20	16
32	45	10	40	25	5	60	M14	11	14 $^{+.000}_{-.012}$	16 $^{+.000}_{-.008}$	22.5	20
40	63	10	44	38	6.5	62	M18	13	16 $^{+.000}_{-.012}$	20 $^{+.000}_{-.012}$	29	25
50	75	16	44	38	10	67	M22	17	20 $^{+.000}_{-.012}$	25 $^{+.000}_{-.012}$	33	31
63	90	16	44	38	10	71	M22	19	22 $^{+.000}_{-.012}$	30 $^{+.000}_{-.012}$	40	38
80	115	20	50	45	13	77	M27	23	28 $^{+.000}_{-.012}$	40 $^{+.000}_{-.012}$	50	48
100	130	-	50	45	13	82	M27	30	35 $^{+.000}_{-.012}$	50 $^{+.000}_{-.012}$	62	58
125	165	-	58	58	18	86	M33	38	44 $^{+.000}_{-.015}$	60 $^{+.000}_{-.015}$	80	72
160	205	-	58	58	22	86	M33	47	55 $^{+.000}_{-.015}$	80 $^{+.000}_{-.015}$	100	92
200	245	-	76	76	24	98	M42	57	70 $^{+.000}_{-.020}$	100 $^{+.000}_{-.020}$	120	116

Add Stroke

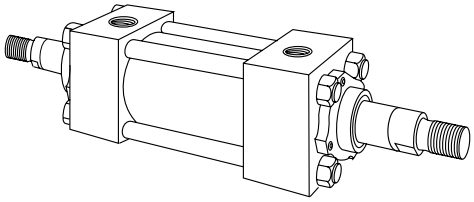
XO	ZO	ZJ	PJ
130	150	114	53
148	170.5	128	56
178	207	153	73
190	223	159	74
206	246	168	80
238	288	190	93
261	323	203	101
304	384	232	117
337	437	245	130
415	535	299	165

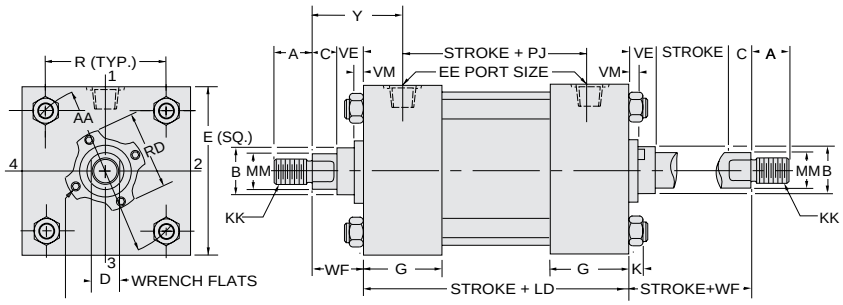
Rod End Dimensions (mm)

Bore DIA.	MM ROD DIA.	STYLE M		STYLE S		STYLE T		B f9	C	D	NA	VE	WF	RD
		KK	A	KK	A	KF	A							
25	12	M10 X 1.25	14	-	-	M8 X 1	14	24	9	10	11	16	25	-
	**18	M14 X 1.5	18	M10 X 1.25	14	M12 X 1.25	18	30	9	15	17	16		
32	14	M12 X 1.25	16	-	-	M10 X 1.25	16	26	19	12	13	16	35	-
	**22	M16 X 1.5	22	M12 X 1.25	16	M16 X 1.5	22	34	13	18	21	22		
40	18	M14 X 1.5	18	-	-	M12 X 1.25	18	30	19	15	17	16	35	55.4
	28	M20 X 1.5	28	M14 X 1.5	18	M20 X 1.5	28	42	13	22	26	22		68.4
50	22	M16 X 1.5	22	-	-	M16 X 1.5	22	34	19	18	21	22	41	60.4
	36	M27 X 2	36	M16 X 1.5	22	M27 X 2	36	50	16	30	34	25		78.3
	28	M20 X 1.5	28	M16 X 1.5	22	M20 X 1.5	28	42	19	22	26	22		68.4
63	28	M20 X 1.5	28	-	-	M20 X 1.5	28	42	26	22	26	22	48	68.4
	45	M33 X 2	45	M20 X 1.5	28	M33 X 2	45	60	19	39	43	29		88.5
	36	M27 X 2	36	M20 X 1.5	28	M27 X 2	36	50	23	30	34	25		78.3
80	36	M27 X 2	36	-	-	M27 X 2	36	50	26	30	34	25	51	78.3
	56	M42 X 2	56	M27 X 2	36	M42 X 2	56	72	22	48	54	29		100.5
	45	M33 X 2	45	M27 X 2	36	M33 X 2	45	60	22	39	43	29		88.5
100	45	M33 X 2	45	-	-	M33 X 2	45	60	28	39	43	29	57	88.5
	70	M48 X 2	63	M33 X 2	45	M48 X 2	63	88	25	62	68	32		116.5
	56	M42 X 2	56	M33 X 2	45	M42 X 2	56	72	28	48	54	29		100.5
125	56	M42 X 2	56	-	-	M42 X 2	56	72	28	48	54	29	57	100.5
	90	M64 X 3	85	M42 X 2	56	M64 X 3	85	108	25	80	88	32		136.5
	70	M48 X 2	63	M42 X 2	56	M48 X 2	63	88	25	62	68	32		116.5
160	70	M48 X 2	63	-	-	M48 X 2	63	88	25	62	68	32	57	116.5
	110	M80 X 3	95	M48 X 2	63	M80 X 3	95	133	25	100	108	32		171.5
	90	M64 X 3	85	M48 X 2	63	M64 X 3	85	108	25	80	88	32		136.5
200	90	M64 X 3	85	-	-	M64 X 3	85	108	25	80	88	32	57	136.5
	140	M100 X 3	112	M64 X 3	85	M100 X 3	112	163	25	128	138	32		201.5
	110	M80 X 3	95	M64 X 3	85	M80 X 3	95	133	25	100	108	32		171.5

** These sizes do not have a removable rod bushing.

Bolted Bushing Double Rod End



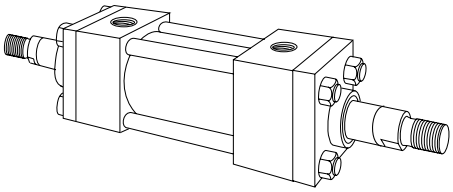


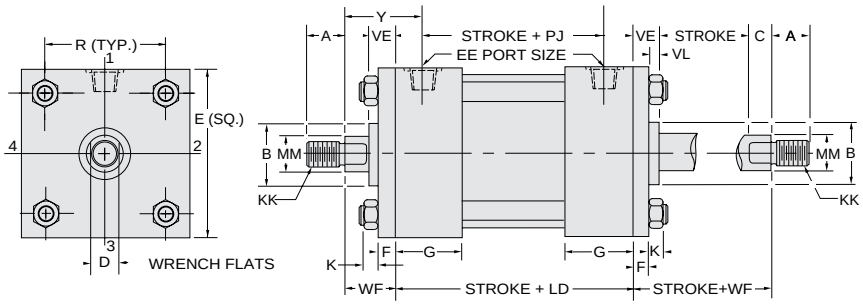
Note: To Determine the dimensions for your Double Rod End Cylinder:

- Refer to the Single Rod mounting style you are selecting on the preceding pages.
- Select the necessary dimensions which pertain to your mounting style.
- Return to this page and use these dimensions to finish sizing your cylinder.

Note: Double Rod End Cylinders have head (G dimensions) at both ends and LD dimensions. On Double Rod End cylinders where the rod end styles differ, be sure to clearly state which rod end is on which cylinder end. (Port position 1 is standard).

Square Retainer Held Bushing Double Rod End

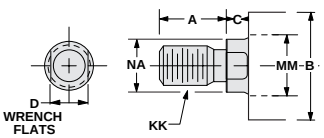




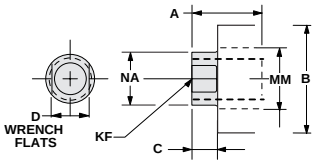
Note: Double Rod End Cylinders have head (G dimensions) at both ends and LD dimensions. On Double Rod End cylinders where the rod end styles differ, be sure to clearly state which rod end is on which cylinder end. (Port position 1 is standard).

Rod End Styles & Dimensions

Style No. M or S
Threaded on Turndown Section

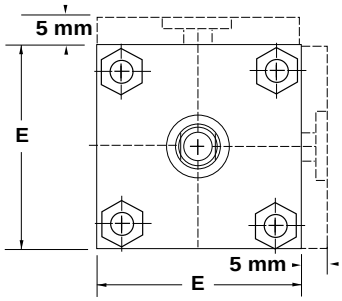


Style No. T
Short Rod End-Internal Threads



25 and 32 mm Bore Cylinders

To accommodate port, head height increased by 5 mm. Applies to port face only.



Cylinder Body Dimensions (mm)

Bore DIA.	E	F	G	K	Y	EE ISO 6149-1
25	40	10	40	4	50	M14
32	45	10	40	5	60	M14
40	63	10	44	6.5	62	M18
50	75	16	44	10	67	M22
63	90	16	44	0	71	M22
80	115	20	50	13	77	M27
100	130	-	50	13	82	M27
125	165	-	58	18	86	M33
160	205	-	58	22	86	M33
200	245	-	76	24	98	M42

Add Stroke

LD	PJ
104	54
108	58
125	71
125	73
127	81
144	92
151	101
175	117
188	130
242	160

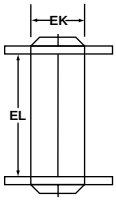
Rod End Dimensions (mm)

Bore DIA.	MM ROD DIA.	STYLE M		STYLE S		STYLE T		B f9	C	D	NA	VE	WF	RD	VM
		KK	A	KK	A	KF	A								
25	12	M10 X 1.25	14	-	-	M8 X 1	14	24	9	10	11	16	25	-	-
	**18	M14 X 1.5	18	M10 X 1.25	14	M12 X 1.25	18	30	9	15	17	16			
32	14	M12 X 1.25	16	-	-	M10 X 1.25	16	26	19	12	13	16	35	-	-
	**22	M16 X 1.5	22	M12 X 1.25	16	M16 X 1.5	22	34	13	18	21	22			
40	18	M14 X 1.5	18	-	-	M12 X 1.25	18	30	19	15	17	16	35	55.4	10
	28	M20 X 1.5	28	M14 X 1.5	18	M20 X 1.5	28	42	13	22	26	22		68.4	16
50	22	M16 X 1.5	22	-	-	M16 X 1.5	22	34	19	18	21	22	41	60.4	16
	36	M27 X 2	36	M16 X 1.5	22	M27 X 2	36	50	16	30	34	25		78.3	
	28	M20 X 1.5	28	M16 X 1.5	22	M20 X 1.5	28	42	19	22	26	22		68.4	
63	28	M20 X 1.5	28	-	-	M20 X 1.5	28	42	26	22	26	22	48	68.4	16
	45	M33 X 2	45	M20 X 1.5	28	M33 X 2	45	60	19	39	43	29		88.5	
	36	M27 X 2	36	M20 X 1.5	28	M27 X 2	36	50	23	30	34	25		78.3	
80	36	M27 X 2	36	-	-	M27 X 2	36	50	26	30	34	25	51	78.3	16
	56	M42 X 2	56	M27 X 2	36	M42 X 2	56	72	22	48	54	29		100.5	
	45	M33 X 2	45	M27 X 2	36	M33 X 2	45	60	22	39	43	29		88.5	
100	45	M33 X 2	45	-	-	M33 X 2	45	60	28	39	43	29	57	88.5	16
	70	M48 X 2	63	M33 X 2	45	M48 X 2	63	88	25	62	68	32		116.5	22
	56	M42 X 2	56	M33 X 2	45	M42 X 2	56	72	28	48	54	29		100.5	16
125	56	M42 X 2	56	-	-	M42 X 2	56	72	28	48	54	29	57	100.5	16
	90	M64 X 3	85	M42 X 2	56	M64 X 3	85	108	25	80	88	32		136.5	22
	70	M48 X 2	63	M42 X 2	56	M48 X 2	63	88	25	62	68	32		116.5	22
160	70	M48 X 2	63	-	-	M48 X 2	63	88	25	62	68	32	57	116.5	22
	110	M80 X 3	95	M48 X 2	63	M80 X 3	95	133	25	100	108	32		171.5	25
	90	M64 X 3	85	M48 X 2	63	M64 X 3	85	108	25	80	88	32		136.5	22
200	90	M64 X 3	85	-	-	M64 X 3	85	108	25	80	88	32	57	136.5	22
	140	M100 X 3	112	M64 X 3	85	M100 X 3	112	163	25	128	138	32		201.5	25
	110	M80 X 3	95	M64 X 3	85	M80 X 3	95	133	25	100	108	32		171.5	

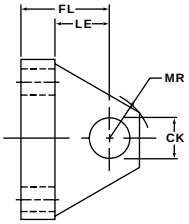
** These sizes do not have a removable rod bushing.

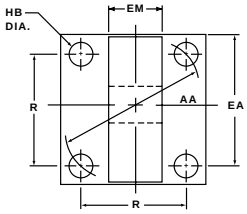
Selecting Rod End Accessories

Pivot Pin

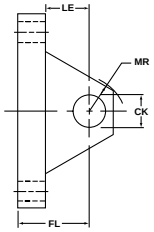


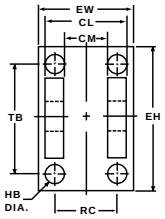
Eye Bracket





Clevis Bracket

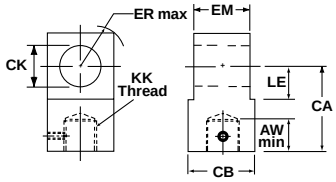




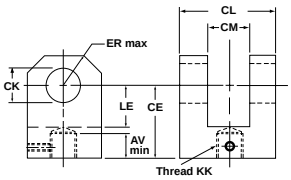
Pivot Pin Set Part No. Nominal Force kN	Eye Bracket Part No. Nominal Force kN	Clevis Bracket Part No. Nominal Force kN	AA	CK h9	CL MAX	CM	EH	EK f8	EL	EM h13	EW	FL JS14	HB H13	LE Min.	MR Max.	R JS14	RC JS14	TB JS14
057-PP009-00010 8	057-EB201-0025-00010 8	057-CB001-00010 8	40	10	26	12	60	10	29	12	35	23	5.5	13	12	28.3	18	47
057-PP009-00012 12.5	057-EB201-00032-00012 12.5	057-CB001-00012 12.5	47	12	34	16	70	12	37	16	45	29	6.6	19	17	33.2	24	57
057-PP009-00014 20	057-EB201-00040-00014 20	057-CB001-00014 20	59	14	42	20	85	14	45	20	55	29	9	19	17	41.7	30	68
057-PP009-00020 32*	057-EB201-00050-00020 32	057-CB001-00020 32*	74	20	62	30	125	20	66	30	80	48	13.5	32	29	52.3	45	102
057-PP009-00020 50	057-EB201-00063-00020 50	057-CB001-00020 50	91	20	62	30	125	20	66	30	80	48	13.5	32	29	64.3	45	102
057-PP009-00028 80	057-EB201-00080-00028 80	057-CB001-00028 80	117	28	83	40	170	28	87	40	100	59	17.5	39	34	82.7	60	135
057-PP009-00036 125	057-EB201-00100-00036 125	057-CB001-00036 125	137	36	103	50	200	36	107	50	130	79	17.5	54	50	96.9	75	167
057-PP009-00045 200	057-EB201-00125-00045 200	057-CB001-00045 200	178	45	123	60	230	45	129	60	150	87	24	57	53	125.9	90	203
057-PP009-00056 320	057-EB201-00160-00056 320	057-CB001-00056 320	219	56	143	70	300	56	149	70	180	103	30	63	59	154.9	105	242
057-PP009-00070 500	057-EB201-00200-00070 500	057-CB001-00070 500	269	70	163	80	360	70	169	80	200	132	33	82	78	190.2	120	300

***The rating reduction listed for this part is based on using it in an assembly that includes either rod eye number 057-RE003-M16-00150, rod clevis number 057-RC006-M16-00150, or eye bracket number 057-EB201-00050-00020.**

Rod Eye

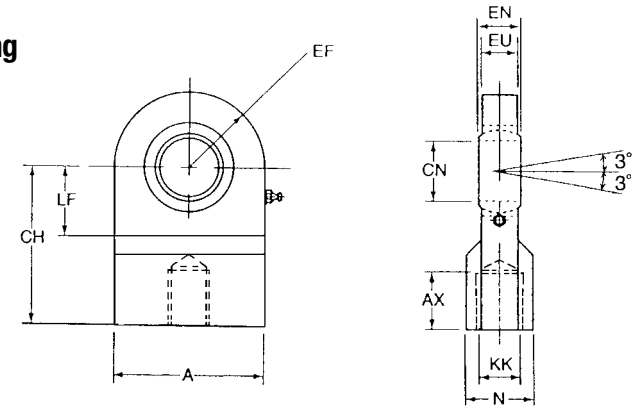


Rod Clevis



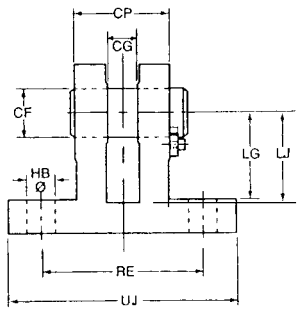
Rod Eye Part No. + Nominal Force kN	Rod Clevis Part No. + Nominal Force kN	Thd Size KK	AV Min.	AW Min.	CA JS13	CE JS13	CB	CK H9	CM	EM h13	ER Max.	LE Min.	CL Max.
057-RE003-M10-00125 8	057-RC006-M10-00125 8	M10 x 1.25	14	14	32	32	18	10	12.3	12	12	13	26
057-RE003-M12-00125 12.5	057-RC006-M12-00125 12.5	M12 x 1.25	16	16	36	36	22	12	16.3	16	17	19	34
057-RE003-M14-00150 20	057-RC006-M14-00150 20	M14 x 1.5	18	18	38	38	-	14	20.3	20	17	19	42
057-RE003-M16-00150 32	057-RC006-M16-00150 32	M16 x 1.5	22	22	54	54	-	20	30.3	30	29	32	62
057-RE003-M20-00150 50	057-RC006-M20-00150 50	M20 x 1.5	28	28	60	60	-	20	30.3	30	29	32	62
057-RE003-M27-00200 80	057-RC006-M27-00200 80	M27 x 2	36	36	75	75	-	28	40.3	40	34	39	83
057-RE003-M33-00200 125	057-RC006-M33-00200 125	M33 x 2	45	45	99	99	-	36	50.3	50	50	54	103
057-RE003-M42-00200 200	057-RC006-M42-00200 200	M42 x 2	56	56	113	113	-	45	60.3	60	53	57	123
057-RE003-M48-00200 320	057-RC006-M48-00200 320	M48 x 2	63	63	126	126	-	56	70.3	70	59	63	143
057-RE003-M64-00300 500	057-RC006-M64-00300 500	M64 x 3	85	85	168	168	-	70	80.3	80	78	83	163

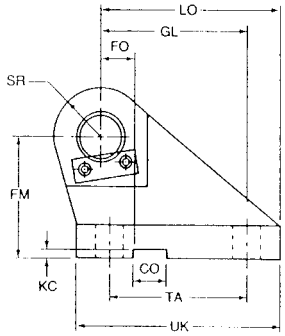
Rod Eye with Spherical Bearing



Rod Eye w/spherical bearing Part Number & Nominal force KN		A Max.	AX Min.	EF Max.	CH JS13	CN	EN	EU h13	KK	LF Min.	N Max.
057-SRE03-M10-00125	8	39	15	19	42	12 -0.008	10 -.012	8	M10 X 1.25	16	16
057-SRE03-M12-00125	12.5	44	17	21.5	48	16 -0.008	14 -.012	11	M12 X 1.25	20	20
057-SRE03-M14-00150	20	54	19	26.5	58	20 -0.012	16 -.012	13	M14 X 1.5	25	24
057-SRE03-M16-00150	32	64	23	31.5	68	25 -0.012	20 -.012	17	M16 X 1.5	30	29
057-SRE03-M20-00150	50	79	29	39	85	30 -0.012	22 -.012	19	M20 X 1.5	35	35
057-SRE03-M27-00200	80	99	37	49	105	40 -0.012	28 -.012	23	M27 X 2	45	44
057-SRE03-M33-00200	125	124	46	61.5	130	50 -0.012	35 -.012	30	M33 X 2	58	54
057-SRE03-M42-00200	200	159	57	79	150	60 -0.015	44 -.015	38	M42 X 2	68	67
057-SRE03-M48-00200	320	204	64	101.5	185	80 -0.015	55 -.015	47	M48 X 2	92	89
057-SRE03-M64-00300	500	239	86	119	240	100 -0.020	70 -.020	57	M64 X 3	116	109

Mounting Bracket and Pivot Pin





Bore mm	Mounting Bracket and Pin Part Number & Nominal force KN	CF k7/h6	CG +0.1,+0.3	CO n9	CP h14	FM js11	FO js14	GL js13	HB	KC 0, +0.30	LG	LJ	LO	RE js13	SR Max.	TA js13	UJ	UK
25	057-SCB01-00012 8	12	10	10	30	40	16	46	9	3.3	28	29	56	55	12	40	75	60
32	057-SCB01-00016 12.5	16	14	16	40	50	18	61	11	4.3	37	38	74	70	16	55	95	80
40	057-SCB01-00020 20	20	16	16	50	55	20	64	14	4.3	39	40	80	85	20	58	120	90
50	057-SCB01-00025 32	25	20	25	60	65	22	78	16	5.4	48	49	98	100	25	70	140	110
63	057-SCB01-00030 50	30	22	25	70	85	24	97	18	5.4	62	63	120	115	30	90	160	135
80	057-SCB01-00040 80	40	28	36	80	100	24	123	22	8.4	72	73	148	135	40	120	190	170
100	057-SCB01-00050 125	50	35	36	100	125	35	155	30	8.4	90	92	190	170	50	145	240	215
125	057-SCB01-00060 200	60	44	50	120	150	35	187	39	11.4	108	110	225	200	60	185	270	260
160	057-SCB01-00080 320	80	55	50	160	190	35	255	45	11.4	140	142	295	240	80	260	320	340
200	057-SCB01-00100 500	100	70	63	200	210	35	285	48	12.4	150	152	335	300	100	300	400	400

Determining the Proper Bore Size

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

1. In the table below, 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 next higher value) 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.

Bore Size Estimation Table

Cylinder Bores in mm	Piston Area Square mm	THEORETICAL PUSH STROKE FORCES IN KILONEWTONS PRESSURES OF OPERATING MEDIUM (BAR)							Oil Consumption Per Centimeter of Stroke in One Direction
		10	40	63	100	125	160	210	Liters Displaced
25	490.9	0.49	1.96	3.09	4.91	6.13	7.85	10.31	.0049
32	804.2	0.80	3.22	5.06	8.04	10.05	12.87	16.89	.0080
40	1256.6	1.26	5.03	7.91	12.57	15.70	20.11	26.39	.0126
50	1963.5	1.96	7.85	12.37	19.63	24.54	31.42	41.23	.0196
63	3117.2	3.12	12.47	19.63	31.17	38.96	49.88	65.46	.0312
80	5026.5	5.03	20.11	31.66	50.27	62.83	80.42	105.56	.0503
100	7854.0	7.85	31.42	49.48	78.54	98.17	125.66	164.39	.0785
125	12271.8	12.27	49.09	77.31	122.72	153.39	96.35	257.71	.1227
160	20106.2	20.11	80.42	126.66	201.06	251.32	321.70	422.23	.2011
200	31416.0	31.42	125.66	197.92	314.16	392.70	502.65	659.73	.3142

Theoretical thrusts for operating pressures not shown in the table may be calculated by multiplying the operating pressures by the piston areas and divide by 10,000.

$$F = \frac{PxA}{10,000}$$

F= Force in KN
P= Pressure of operating medium in bar
A= Effective area of cylinder piston in mm^2.

Pull Stroke Cylinder Bores and Forces

To find the force on the pull stroke, you need to adjust for: “the area on the rod end of the cylinder being less than the cylinder bore by the area of the rod.”

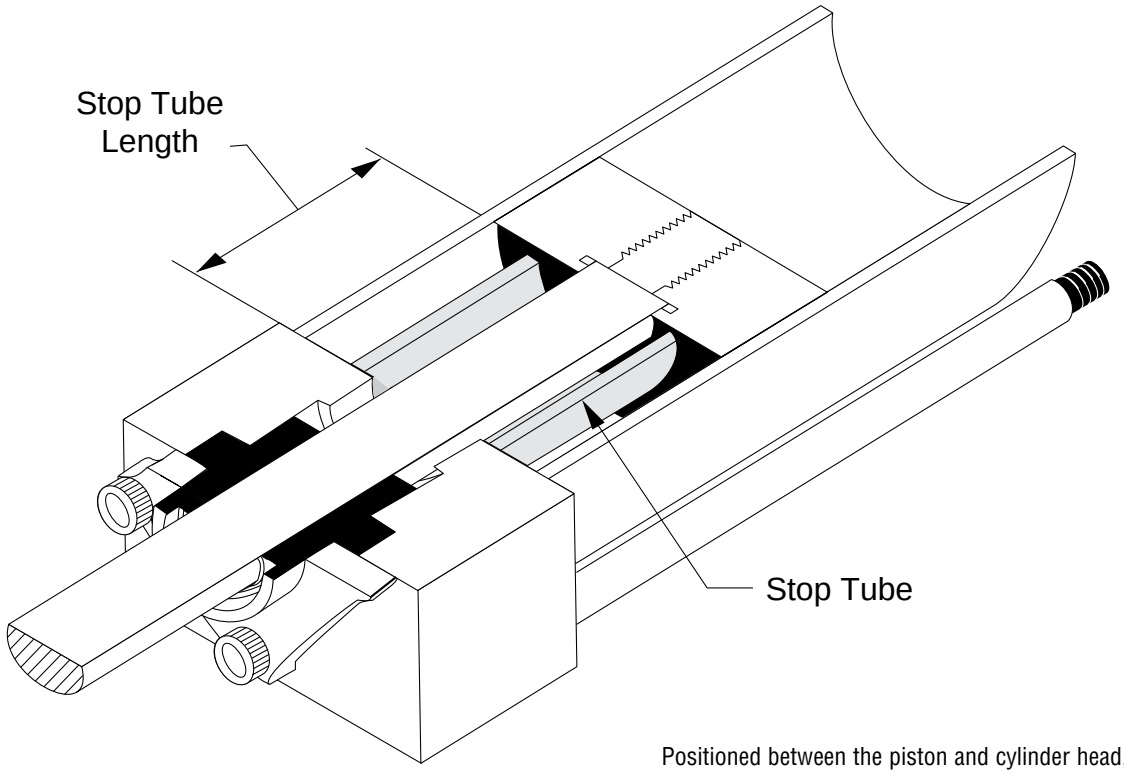
To find the force on the pull stroke, you need to know the area of the rod. Example: For a 80mm bore cylinder, the standard rod diameter is 36mm. Find 36mm in the left most column in the chart below, move along to the right until you find the column headed by the pressure you will be working at. The number shown, is the value you deduct from the push stroke thrust, in the chart above. The resultant is the force available for the pull stroke.

Should your pressure be different from those shown in the table, then use the following formula to calculate the pull force.
Pull force = (Bore Area -Rod Area) x Working Pressure.

Piston Rod Diameters in mm	Piston Rod Area Square mm	THEORETICAL PUSH STROKE FORCES IN KILONEWTONS Deduct the following thrusts or consumptions corresponding to rod size from push stroke pressures or consumptions to determine pull stroke pressure or consumptions PRESSURES OF OPERATING MEDIUM (BAR)							Oil Consumption Per Centimeter of Stroke in One Direction
		10	40	63	100	125	160	210	Liters Displaced
12	113.1	0.11	0.45	0.71	1.13	1.41	1.81	2.38	.0011
14	153.9	0.15	0.62	0.96	1.54	1.92	2.46	3.23	.0015
18	254.5	0.25	1.02	1.60	2.54	3.18	4.07	5.34	.0025
22	380.1	0.38	1.52	2.39	3.80	4.75	6.08	7.98	.0038
28	615.8	0.62	2.46	3.87	6.16	7.69	9.85	12.93	.0062
36	1017.9	1.02	4.07	6.41	10.18	12.72	16.29	21.38	.0102
45	1590.4	1.59	6.36	10.01	15.90	19.88	25.45	33.40	.0159
56	2463.0	2.46	9.85	15.51	24.63	30.78	39.41	51.72	.0246
70	3848.5	3.85	15.39	24.24	38.48	48.10	61.58	80.82	.0385
90	6361.7	6.36	25.45	40.07	63.62	79.52	101.79	133.60	.0636
110	9503.3	9.50	38.01	59.87	95.03	118.79	152.05	199.57	.0950
140	15393.8	15.39	61.58	96.98	153.94	192.42	246.30	323.27	.1539

Stop Tubes for Long Push Stroke Cylinders

The use of a stop tube 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.



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.

Determining the Length and Need For Stop Tube

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 32 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.

NOTE:
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 do not exceed 13.7 bar. Weight of fluid must be included on large dia. or long stroke cylinders. For assistance on this, contact Miller Fluid Power Application Engineering Dept. Next, continue on to Step 3, on the folowing page, to determine the length of stop tube needed.

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 that value of "L". The number shown to the right in the second column is the length of stop tube your cylinder requires.

4. Add the stop tube length to your "L" dimension to obtain an "Adjusted L 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 stop tube except models 53, 67, 81, & 89.

Stop Tube Table

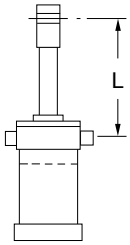
"L" (mm)	Stop Tube Length (mm)	"L" (mm)	Stop Tube Length (mm)
0-1016	0	4319-4572	355.6
1017-1270	25.4	4573-4826	381.0
1271-1524	50.8	4827-5080	406.4
1525-1799	76.2	5081-5334	431.8
1800-2032	101.6	5335-5588	457.2
2033-2286	127.0	5589-5842	482.6
2287-2540	152.4	5843-6096	508.0
2541-2794	177.8	6097-6350	533.4
2795-3048	203.2	6351-6604	558.8
3049-3302	228.6	6605-6858	584.2
3303-3556	254.0	6859-7112	609.6
3557-3810	279.4	7113-7366	635.0
3811-4064	304.8	7367-7620	660.4
4065-4318	330.2	7621-7874	685.8

Note: 'L' or 'D' are calculated from mounting point with rod extended.

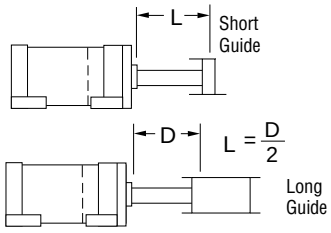
Group A

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

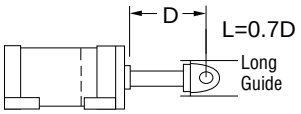
81



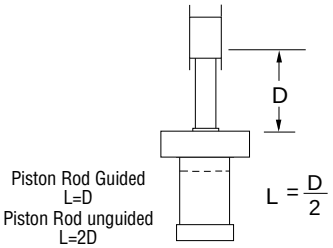
Vertical pivot mounting
Head end only



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



Load Pivot Mtg.
Supported & Guided



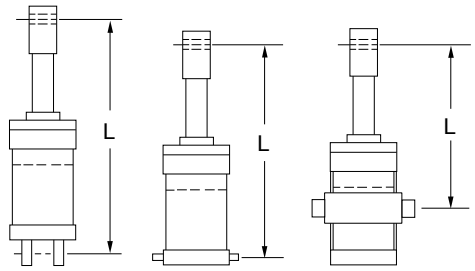
Piston Rod Guided
L=D
Piston Rod unguided
L=2D

53 & 67

Group B

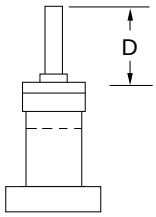
To avoid rod buckling or cylinder jackknifing, check for stop tube and rod diameter requirements with piston rod extended. Use cylinder dimensional charts. No stop tube required if cylinder operates on pull stroke only.

Horizontal or vertical pivot mounting



84, 90, 94 **82** **89**

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

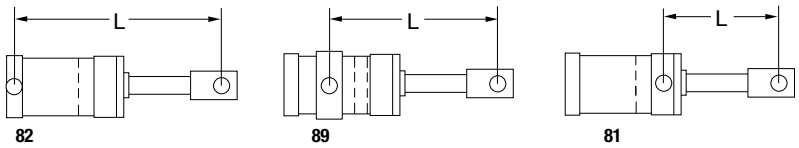


Cap flange vertical mount

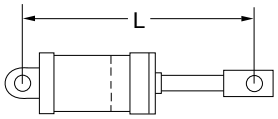
52, 68

Group C

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

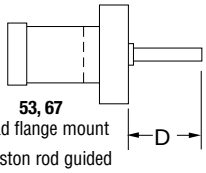


82 **89** **81**



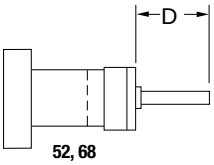
84, 90, 94

On long strokes support cap



53, 67
Head flange mount
Piston rod guided
L = 2D
Piston rod unguided
L = 4D

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



52, 68
Cap flange mount

On long strokes support head

Oversize Piston Rods for Column Strength on Long Push Stroke Cylinders

Long cylinder push strokes may need oversize piston rods due to column strength considerations.

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 end 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

Oversize Piston Rod Table

Thrust in kN	PISTON ROD DIAMETER (mm)											
	12	14	18	22	28	36	45	56	70	90	110	140
	"L" or "Adjusted L" in mm											
1	710	930	1450	2000	2805	3950						
2	560	720	1120	1590	2405	3475	4710					
4	450	590	860	1225	1870	2895	4145	5610	7600			
6	370	500	780	1045	1600	2490	3670	5195	7060	9930		
8	310	470	705	985	1440	2250	3330	4810	6685	9420	12340	
10	255	380	640	920	1320	2055	3030	4455	6400	9065	11920	
20	100	135	430	680	1080	1640	2345	3450	4740	7800	10480	14545
30	70	110	220	520	900	1440	2065	2960	4385	6830	9520	13530
40		85	160	375	770	1290	1920	2650	3920	6070	8655	12800
50			140	215	650	1160	1760	2530	3600	5620	7955	12025
60			120	195	535	1040	1640	2410	3345	5220	7405	11300
70			105	180	385	950	1530	2280	3240	4930	7035	10745
80				160	275	860	1430	2165	3145	4690	6665	10180
90				150	260	770	1330	2065	3050	4460	6370	9715
100				135	245	680	1260	1975	2950	4285	6130	9340
150					185	330	1010	1595	2515	3910	5230	8020
200						280	445	1300	2180	3525	4925	7195
250						235	405	1015	1920	3220	4620	6620
300						190	360	600	1680	2960	4300	6380
350							320	530	1455	2700	4050	6150
400							290	495	1225	2515	3820	5905
450							250	460	875	2330	3610	5630
500								425	685	2150	3400	5415
550								395	660	1970	3220	5210
600								370	630	1800	3070	5030
650								340	605	1615	2920	4850
700								315	575	1375	2770	4685
750								285	550	1095	2620	4520
800									520	895	2470	4355
850									500	870	2330	4190
900									480	850	2190	4075
950									455	830	2040	3960
1000									435	810	1870	3840

Foot mount cylinders should be keyed or pinned on the appropriate end to eliminate shearing loads on mounting bolts.

Cylinders with integral key mounts may be used where keyways can be cut in a machine member. This type of mounting accommodates shear loads, provides accurate alignment of the cylinder, and simplifies installation and servicing.

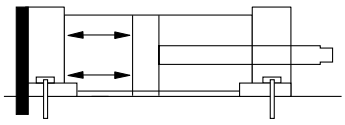
Only one end of a cylinder should be keyed to the machine. If both ends are keyed, there will be no cylinder elasticity to assist in absorbing shocks.

Locating pins may be used instead of shear keys to help take shear loads and to assure proper cylinder alignment. As with keys, cylinders should be pinned at either end (but not both ends). Contrary to common die design practices, cylinders should never be pinned across corners. To do so can result in severe warping under operating pressures and temperatures.

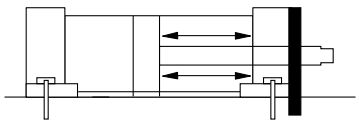
Pivoted mounts should have the same type of pivots at both the cylinder body and rod end. If a simple pivot pin mount is used, the pivot pin axes at each end should be parallel. Trunnion mounts are generally designed to resist only shear loads. Therefore, self-aligning mounts should not be used to support the trunnions, otherwise bending forces can also be set up.

Keying a Cylinder

RIGHT

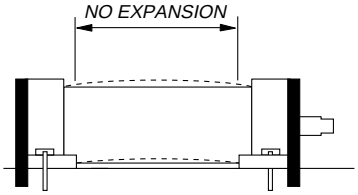


Maximum Load On Push Stroke
Key Cap End



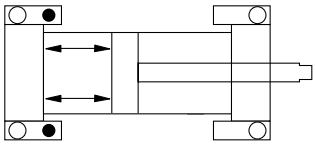
Maximum Load On Pull Stroke
Key Head End

WRONG

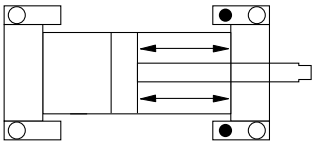


Pinning a Cylinder

RIGHT

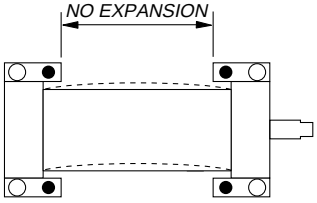


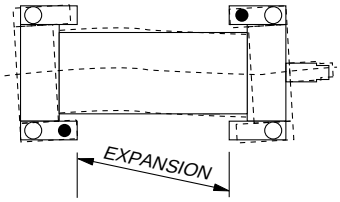
Maximum Load On Push Stroke
Pin Cap End



Maximum Load On Pull Stroke
Pin Head End

WRONG

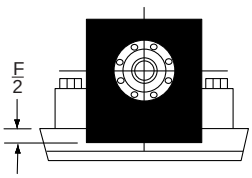


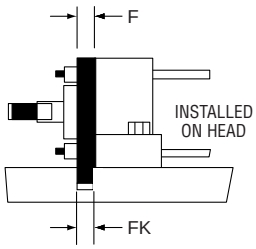


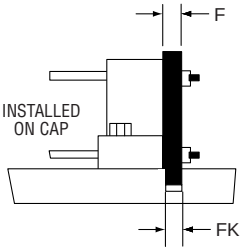
"K" Retainer-Key Extension

Provides Model 72 with Max. Mounting Rigidity Without Pins or Welded Keys

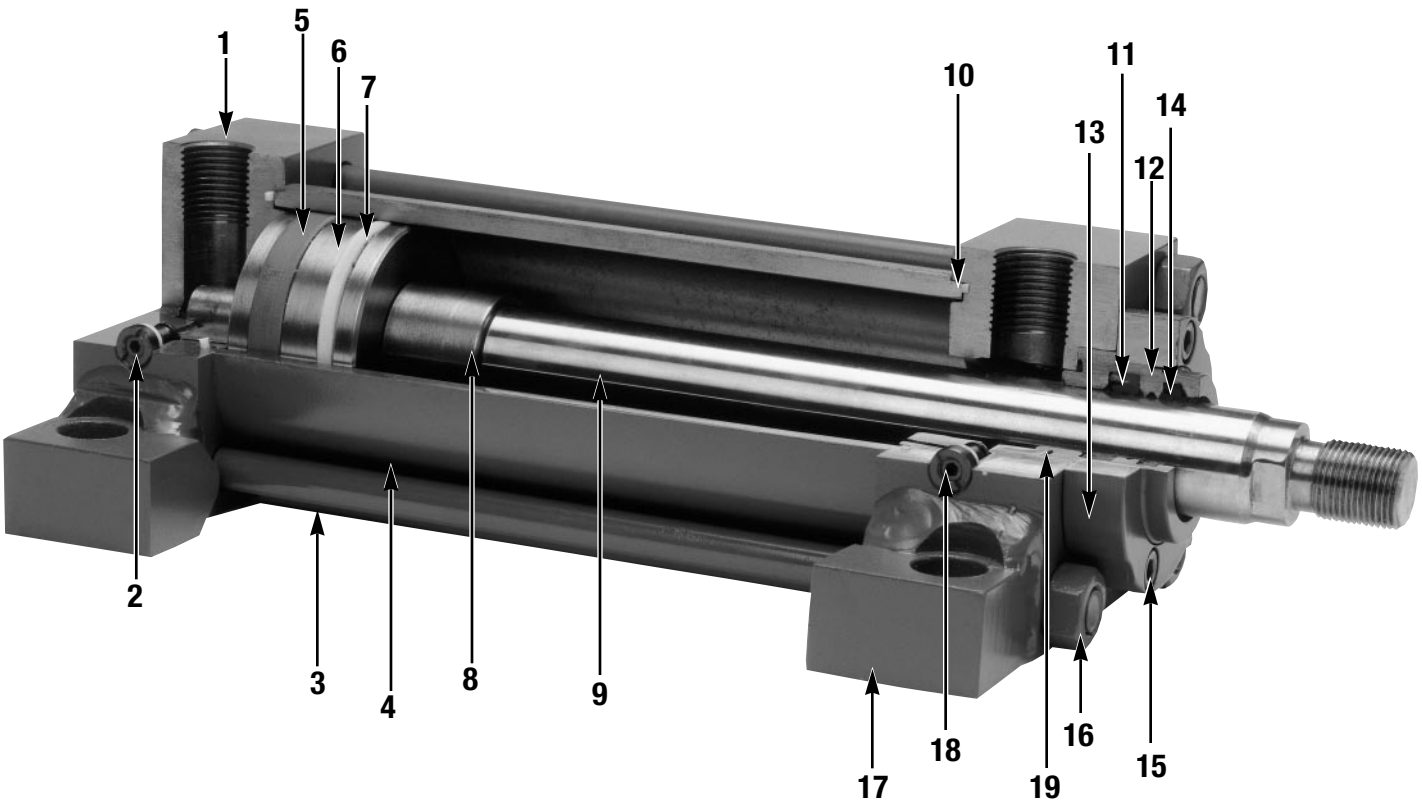
For a rugged mounting that cannot shift under maximum loads, the "K" retainer-key extension extends the rod retainer plate so that it slips into a slot milled in machine's mounting surface. "K" retainer thickness is dimension "FK". Extension $=\frac{F}{2}$
Available as option at additional cost.







Bore	F Nominal	FK -0.07
25	10	8
32	10	8
40	10	8
50	16	14
63	16	14
80	20	18
100	22	22
125	22	22
160	25	25
200	25	25



Rod Diameter	Bolted Bushing Rod Seal Kit Part No's. 11, 12, 13, 14, 19	Retainer Bushing Rod Seal Kit Part No's. 11, 12, 14, 19
12	051-KR086-00012	051-KR085-00012
14	051-KR086-00014	051-KR085-00014
18	051-KR086-00018	051-KR085-00018
22	051-KR086-00022	051-KR085-00022
28	051-KR086-00028	051-KR085-00028
36	051-KR086-00036	051-KR085-00036
45	051-KR086-00045	051-KR085-00045
56	051-KR086-00056	051-KR085-00056
70	051-KR086-00070	051-KR085-00070
90	051-KR086-00090	051-KR085-00090
110	051-KR086-00110	051-KR085-00110
140	051-KR086-00140	051-KR085-00140

Bore	Bore Kit Part No's. 5, 7, 10
25	191-KB001-00025
32	191-KB001-00032
40	191-KB001-00040
50	191-KB001-00050
63	191-KB001-00063
80	191-KB001-00080
100	191-KB001-00100
125	191-KB001-00125
160	191-KB001-00160
200	191-KB001-00200

IMPORTANT: When ordering parts, specify serial number and part name as shown. Serial number can be found on the cylinder name tag or stamped on the head and cap near the ports.

1. Cap
2. Cushion Adjustment Assembly
3. Tie Rod (4)
4. Tube
5. Wear Ring
6. Piston
7. Piston Seal
8. Rod End Cushion Plunger
9. Piston Rod
10. Tube End Seal (2)
11. Rod Seal
12. Bushing
13. Bushing Retainer
14. Rod Wiper
15. Socket Head Cap Screws
16. Tie Rod Nuts
17. Head
18. Cushion Adjustment Assembly
19. Bushing O-Ring

How To Order **Example: MH-72B2M-N 200-0600-090 B 110**

MH 72 B 2M N 200 - 0600 - 090 B - 1 1 - 0

Series	Mounting Style	Bushing	Rod End Style	Cushions **	Bore Dia. mm	Stroke mm	Rod Dia. mm	Port Type	Port Location	Modified
MH Standard **DMH** (D= Dbl. Rod End)		**B=** Bolted Bushing **R=** Retainer Held Bushing	**#M (Std)** **#S** **#T** **‡#Z**	**R=** Rod End Cushioned **C=** Cap End Cushioned **B=** Both Ends Cushioned **N=** Non-Cushioned				**M=ISO 6149 STANDARD** **S=**SAE STR. THD **B=**BSP ISO 228 **J=**BSPT **F=**SAE FLANGE **N=**NTP **G=**METRIC STR. THD	**Head End** / **Cap End** **1 (Std.)** **1** **2** **2** **3** **3** **4** **4** **1** **4**  **2** **3**	**0=** Standard **9=** Modified (See * Below)

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.

** The standard cushion adjustment screw location is position #2. Ball check is position #4.

* 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.

‡ Style Z Rod is anything other than M, S, or T. Drawing of Rod End must be furnished.

Examples of Other Modifications and Options Include:

- Tie Rod Extensions
- Air Bleeds
- Rod End Modifications
- Keyways
- Key Retainers
- Stainless Steel Piston Rods
- Chrome Plated Tube I.D.
- Stop Tube
- Position Sensing Cylinder
- External Drainback Bushing
- Port in Rear Face of Cap
- Viton Seals
- Adjustable Retract Stroke
- Metallic Rod Scrapers
- Drilling and Tapping Modifications
- Flush Tie Rod Nuts
- Epoxy or Special Paint
- Mixed Mounting Styles
- Proximity Switches
- Modifications for Special Environments
- Water Operation

For other Non-Standard Modifications, contact Miller Fluid Power Application Engineering Dept.

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 three 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, express 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.

Cylinder Component Torque Values

Chart 1

PISTON ROD TORQUE (Nm)		
BORE	THREAD SIZE	*TORQUE (Nm)
25	M10 x 1.25	14
32	M12 x 1.25	27
40	M14 x 1.5	41
50	M16 x 1.5	81
63	M20 x 1.5	169
80	M27 x 1.5	338
100	M33 x 2	615
125	M42 x 2	878
160	M48 x 2	1351
200	M64 X 3	6757

Chart 2

TIE ROD TORQUE (Nm)	
BORE	*TORQUE (Nm)
25	2.5
32	5
40	9.5
50	23
63	38
80	77
100	122
125	250
160	481
200	812

Chart 3

BOLTED BUSHING MOUNTING SCREW TORQUE		
ROD SIZE	CAP SCREW SIZE	TORQUE (Nm) (Dry)
12 THRU 90	M6 x 1	11
110 & 140 MODEL 67	M6 x 1	11
110 & 140 All Models Except 67	M8 X 1	17

*** Recommended Torques (Nm) with MoS2 lubricant or equivalent.**

Miller Fluid Power
Main Plant
800 North York Road
Bensenville, IL 60106
(630) 766-3400—Local
(800) 323-2520—Elsewhere
(630) 350-0294—FAX

Miller Fluid Power
33067 Industrial Road
Livonia, MI 48150
(800) 323-2520

Miller Fluid Power
2050 Del Rio
Ontario, CA 91761
(800) 323-2520

Miller Fluid Power Canada Ltd.
1214 Kamato
Mississauga, Ontario, Canada L4W 1Y1
(800) 268-0205—Ontario & Quebec
(905) 625-2780—Elsewhere
(905) 625-8724—FAX

Miller Potencia Fluida, S.A. de C.V.
Israel No. 301 Esq. Damasco
Col. Ricardo B. Anaya 2A. SECC
Apartado Postal F-1241
78090 San Luis Potosi, S.L.P. Mexico
(48) 21-19-21, 22, 37
(48) 21-21-60—FAX

Miller Potencia Fluida, S.A. de C.V.
Nogal No. 45—Despacho 202
Col. Sant Maria La Ribera
Delegacion: Cuauhtemoc
Mexico, D.F. 06400
(5) 547-2474
(5) 541-1123—FAX

Miller Fluid Power (UK) Ltd.
Unit 3, Bailey Drive
Norwood Industrial Estate
Killamarsh, Sheffield
South Yorkshire, England S31 8HB
(441)-462-438303
(441)-462-420901—FAX

File 9787 089909

Miller FLUID POWER