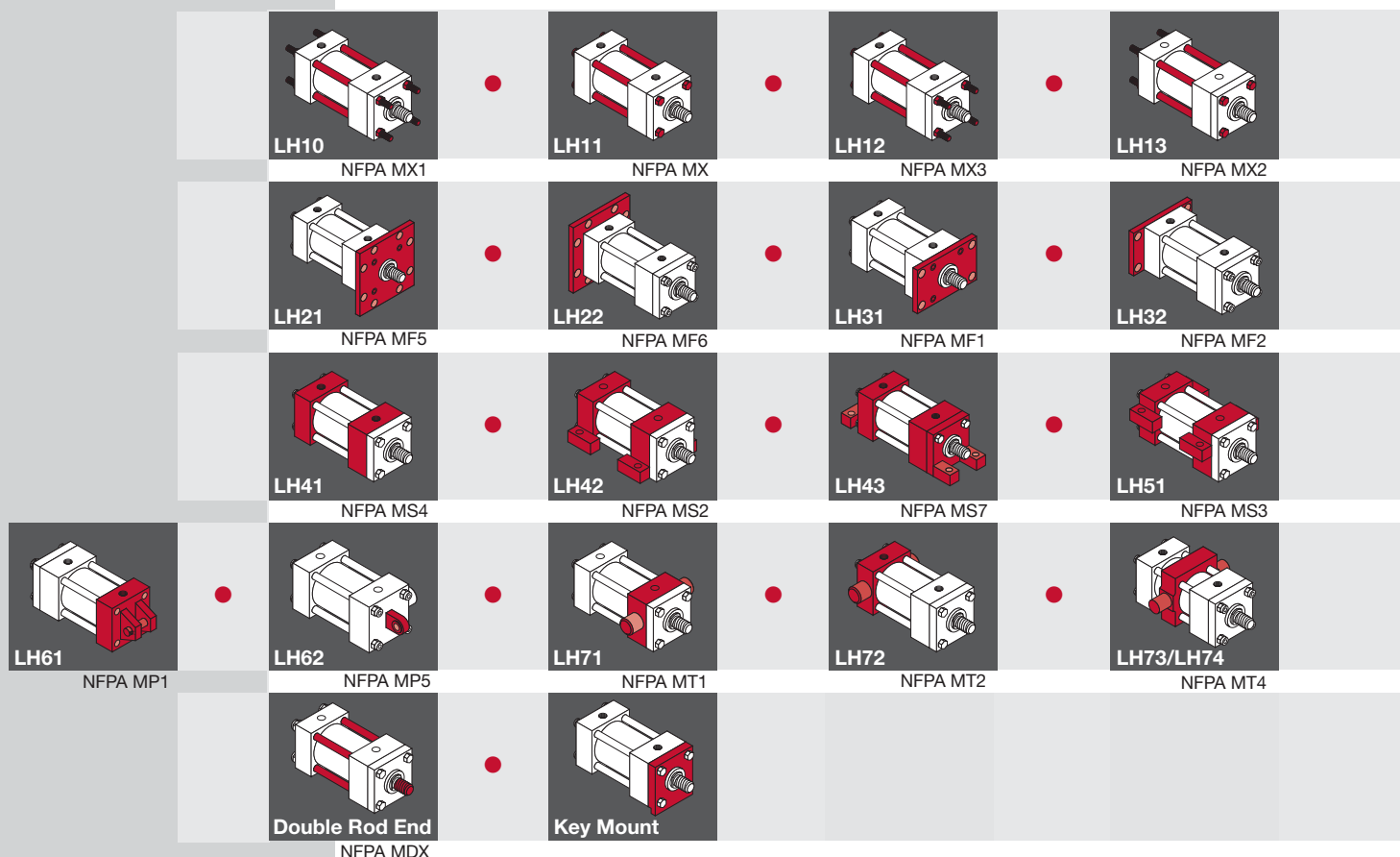


Series LH



Milwaukee Cylinder Series LH Low Pressure Hydraulic Cylinders are built to perform on the toughest applications. The nominal pressure for Series LH ranges from 750 psi to 1500 psi, depending on bore size. Advanced engineering, combined with quality materials and expert workmanship, contribute to the making of a rugged, top quality low-pressure hydraulic cylinder that will provide a long, maintenance-free service life.

General

TABLE 3 - Piston Rod End Styles

Standard Specifications and Features

52

Performance Tested Design Features

53**Mounting
Specifications**

Tie Rod Mount

54-55

Flange Mount

56-57

Side Mount and Lug Mount

58-59

Pin Mount and Trunnion Mount

60-61Double Rod End Cylinders
Key Mount**62****63****Additional
Information**

Design Options

64-65

Stop Tubes / Cylinder Sizing

66-67

Ordering Information / Replacement Parts

68-69

Installation / Trouble Shooting / Maintenance

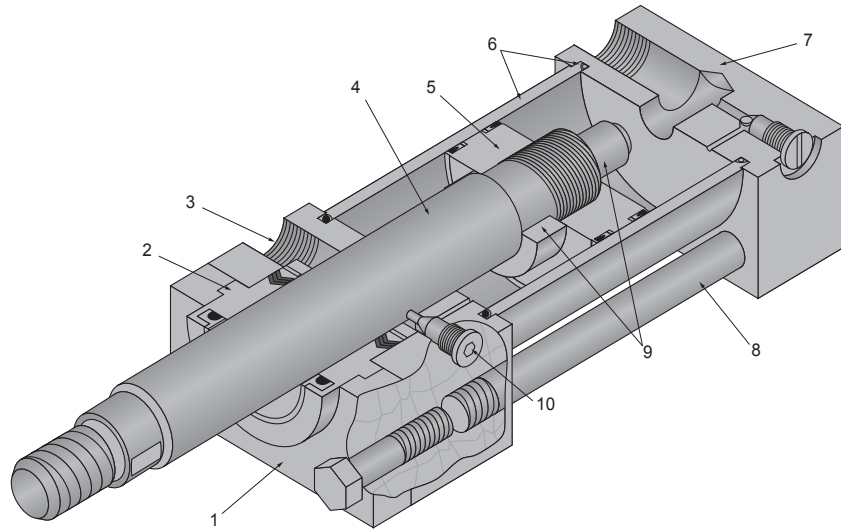
70-71**Accessories**

Clevis / Brackets / Pins / Rod Eyes Dimensional Data

Inside Back
Cover

STANDARD SPECIFICATIONS

- Standard construction – square head – tie rod design
- Nominal pressure – 750 psi to 1500 psi (range varies by bore size)
- Standard fluid-hydraulic oil
- Standard temperature – -20° F to +200° F
- Standard bore sizes – 1½" to 6"
- Standard piston rod diameters ⅝" thru 4"
- Standard mounting styles – 17 standard styles plus custom designs to suit your needs
- Strokes – available in any practical stroke length
- Cushions – available at either or both ends of stroke
- Standard 7 rod end styles, plus specials designed to order
- Rod end style KK₂ - is studded as standard for ⅝" and 1" diameter rods. Studded rod end style is available for all rod sizes.



STANDARD FEATURES

1. Removable Retainer Plate

The retainer plate and rod bushing are externally removable without disassembling the cylinder on most standard models. Four capscrews securely hold and lock the retainer plate in place.

2. Rod Bushing and Seals

A combination of spring loaded multiple lip vee rings with a supporting bronze bushing is standard in *Milwaukee Cylinder Series LH* Cylinders.

3. Ports

Large NPTF cylinder ports are standard and can be located to customer requirements. SAE ports available upon request.

4. Piston Rod

The piston rod is of high strength steel, hardened and plated to resist scoring and corrosion to assure maximum seal life.

5. Piston

The Series LH piston is precision machined from fine grained iron alloy. It is pilot fitted and threaded to the piston rod.

6. Cylinder Barrel and Seals

The barrel is of chrome plated steel tubing, honed to a fine finish to assure superior sealing, minimum friction and maximum seal life. It is step cut on the I.D. of both ends for O-ring seals.

7. End Caps

End caps and mountings are of high quality steel, precision machined for accurate mounting.

8. Tie-Rods

The tie rods are constructed from a high quality medium carbon steel. The threads are accurately rolled for rigid engagement of the nuts.

9. Cushions

Cushions are machined to close tolerance to provide positive, smooth deceleration at the end of stroke. On all bore sizes we provide the longest cushion possible, based on the rod size and blind end caps. Longer cushions are available; for further information, consult factory.

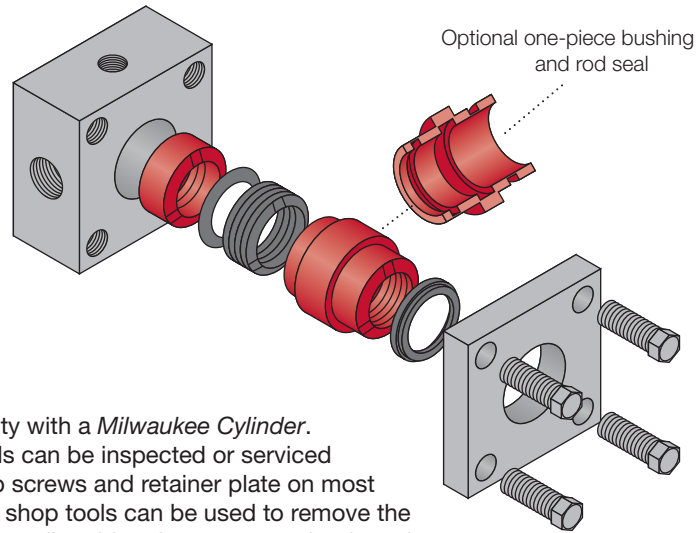
10. Cushion Needle Adjustment and Ball Check

The cushion needle adjustment valve and cushion-check ball retainer screw are specifically designed to provide full cushion adjustment.



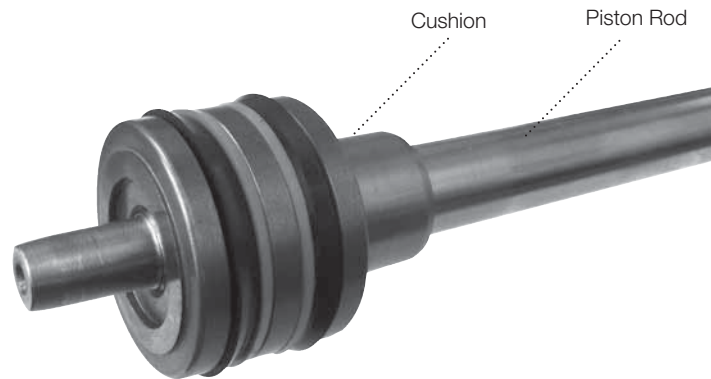
MilCad Cylinder Configurator

Visit milwaukeeecylinder.com to configure and download CAD files of your cylinders.



Simple Maintenance...

Simple maintenance is reality with a *Milwaukee Cylinder*. The rod bushing or rod seals can be inspected or serviced by merely removing the cap screws and retainer plate on most models. Standard available shop tools can be used to remove the rod bushing and seals without disturbing the torque on the tie-rods, assuring performance quality with maintenance ease.



Cushions...

The cushion is of a high grade alloy, precision machined and specially tapered to provide smooth deceleration of the piston at the end of stroke. The rod end cushion bushing is floated with an O-ring to compensate for minor misalignments during normal operation.

Piston Rod...

The piston rod is hardened, plated high strength steel, machined and processed to resist scoring and corrosion, assuring maximum life. *Milwaukee Cylinder* offers seven rod end styles as standard. **The style #2 rod end with two wrench flats is furnished as standard** unless otherwise specified. Special rod ends and extra wrench flats are also available. They must be specified at the time of order, giving the dimensional requirements and the location of additional wrench flats.

COMBINATION ROD SEAL DESIGN...

The *Milwaukee Cylinder* Series LH cylinder combines spring loaded multiple lip vee rings with a supporting bronze bushing and a double lip wiper as a secondary seal. This proven rod seal design combination is effective at both high and low pressures. It affords maximum sealing and an extra long bearing support.

As an optional design, a one-piece rod bushing with a double lip rod seal and a double lip wiper is available. Metallic rod scrapers may be supplied on request, in place of the double lip wiper with either rod bushing design.

The unique versatility of the *Milwaukee Cylinder* Series LH design makes available a selection of seals to meet all types of service conditions.

PISTON AND SEAL COMBINATION

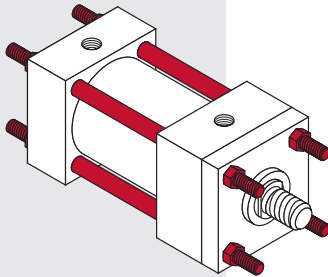
The *Milwaukee Cylinder* Series LH cylinder combines two u-cup seals and a fine grained iron alloy. This proven design combines low friction and smooth break away with the near zero leakage of the block vee seal.

For Package and Mounting
Dimension see
Tables 1LH and 2LH.

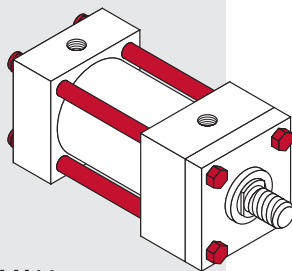
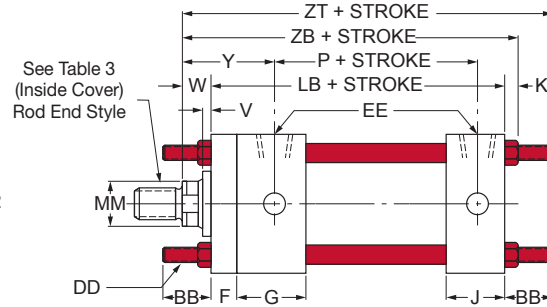
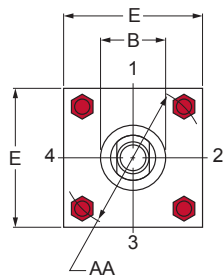
TIE ROD MOUNTED CYLINDERS

Tie-rod mounts are suited for many applications and are similar to flange mounts, but tie-rod mounts are not as rigid as the flange type of mounting. The best use of tie-rods extended on the blind end is in a thrust load application. When using tie-rods extended on the rod end, the best application is a tension load. When long strokes are required, the free end should be supported to prevent misalignment, sagging or possible binding of the cylinder.

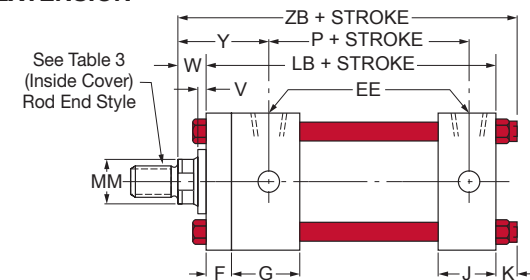
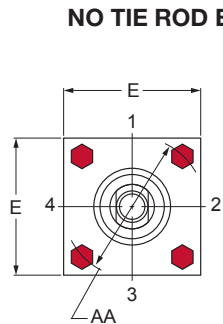
TIE RODS EXTENDED BOTH ENDS



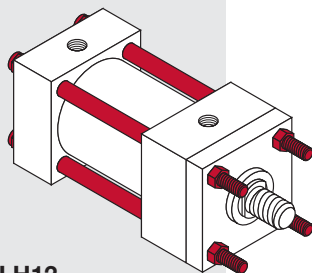
MODEL LH10
NFPA STYLE MX1



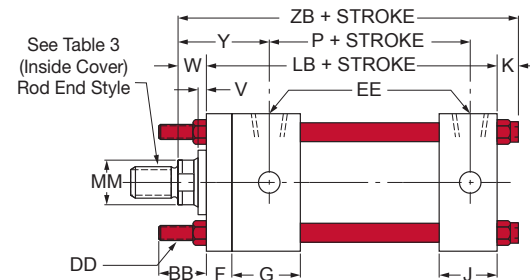
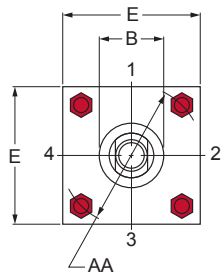
MODEL LH11
NFPA STYLE MX



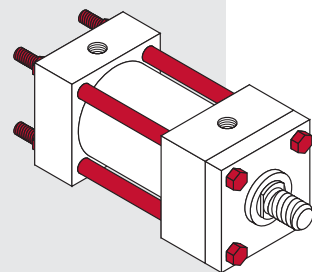
TIE RODS EXTENDED ROD END



MODEL LH12
NFPA STYLE MX3



TIE RODS EXTENDED BLIND END



MODEL LH13
NFPA STYLE MX2

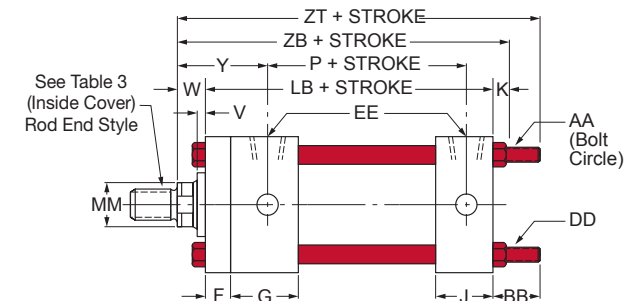
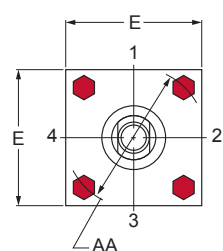


TABLE 1LH The dimensions given on this table are affected by the piston rod diameter and the stroke.

Bore Ø	Rod MM	Cylinder Code ♦	B	LB	P	V	W	Y	ZB	ZT
1½	⅝	LH0051	1⅛	4	2¼	¼	⅝	1⅝/16	5	5⅝
	•1	LH0052	1½			½	1	2⅝/16	5⅜	6
2	⅝	LH0510	1⅛	4	2¼	¼	⅝	1⅝/16	5⅝/16	5¾
	1	LH0511	1½			½	1	2⅝/16	5⅞/16	6⅞
	•1⅜	LH0512	2			⅝	1¼	2⅝/16	5⅞/16	6⅜
2½	⅝	LH0520	1⅛	4⅞	2⅜	¼	⅝	1⅝/16	5⅝/16	5⅞
	1	LH0521	1½			½	1	2⅝/16	5⅞/16	6¼
	1⅜	LH0522	2			⅝	1¼	2⅝/16	5⅞/16	6½
	•1¾	LH0523	2⅜			¾	1½	2⅝/16	6⅞/16	6¾
3¼	1	LH0530	1½	4⅞	2⅝	¼	¾	2⅞/16	6⅞	7
	1⅜	LH0531	2			⅜	1	2⅞/16	6⅞	7¼
	1¾	LH0532	2⅜			½	1¼	2⅞/16	6⅞	7½
	2	LH0533	2⅝			½	1⅜	3⅞/16	6¾	7⅝
4	1	LH0540	1½	4⅞	2⅝	¼	¾	2⅞/16	6⅞	7
	1⅜	LH0541	2			⅜	1	2⅞/16	6⅞	7¼
	1¾	LH0542	2⅜			½	1¼	2⅞/16	6⅞	7½
	2	LH0543	2⅝			½	1⅜	3⅞/16	6¾	7⅝
	2½	LH0544	3⅞			⅝	1⅝	3⅝/16	7	7⅞
5	1	LH0550	1½	5⅞	2⅞	¼	¾	2⅞/16	6⅞/16	7⅞/16
	1⅜	LH0551	2			⅜	1	2⅞/16	6⅞/16	7⅞/16
	1¾	LH0552	2⅜			½	1¼	2⅞/16	6⅞/16	8⅞/16
	2	LH0553	2⅝			½	1⅜	3⅞/16	7⅞/16	8⅞/16
	2½	LH0554	3⅞			⅝	1⅝	3⅝/16	7⅞/16	8⅞/16
	3	LH0555	3¾			⅝	1⅝	3⅝/16	7⅞/16	8⅞/16
	3½	LH0556	4¼			⅝	1⅝	3⅝/16	7⅞/16	8⅞/16
6	1⅜	LH0560	2	5¾	3⅞	¼	⅞	2⅞/16	7⅞/16	8⅞/16
	1¾	LH0561	2⅜			⅜	1⅞	3⅞/16	7⅞/16	8⅞/16
	2	LH0562	2⅝			⅜	1¼	3⅞/16	7⅞/16	8⅞/16
	2½	LH0563	3⅞			½	1½	3⅞/16	7⅞/16	9⅞/16
	3	LH0564	3¾			½	1½	3⅞/16	7⅞/16	9⅞/16
	3½	LH0565	4¼			½	1½	3⅞/16	7⅞/16	9⅞/16
	4	LH0566	4¾			½	1½	3⅞/16	7⅞/16	9⅞/16

TABLE 2LH The dimensions are constant regardless of rod diameter or stroke.

Bore Ø	AA	BB	DD	E	EE NPT	EE SAE	F	G	J	K
1½	2.02	1	¼-28	2	⅜	#6	⅜	1½	1	⅜
2	2.60	1⅞	⅝-24	2½	⅜	#6	⅜	1½	1	⅞/16
2½	3.10	1⅞	⅝-24	3	⅜	#6	⅜	1½	1	⅞/16
3¼	3.90	1⅞	⅝-24	3¾	½	#10	⅝	1¾	1¼	½
4	4.70	1⅞	⅝-24	4½	½	#10	⅝	1¾	1¼	½
5	5.80	1⅞/16	½-20	5½	½	#10	⅝	1¾	1¼	⅞/16
6	6.90	1⅞/16	½-20	6½	¾	#12	¾	2	1½	⅞/16

HOW TO ORDER

For ordering information refer to Page 68.

NOTES:

- ♦ For double rod end cylinders, add prefix letter D to cylinder code. Example: DLH0051 (Refer to page 62.)
- Available with fixed-non-adjustable cushions on rod end and standard adjustable cushions on the blind end only.

**Rod End Styles and Dimensions**

For rod end styles and dimensions see the Table 3 in the inside cover of the catalog.

Page ii

**MilCad Cylinder Configurator**

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Recommended Pressure Rating

Bore Ø	Pressure Rating (psi)
1½	1500
2	1500
2½	1500*
3¼	1500
4	1000
5	1000*
6	750

***NOTE:**

2½" Bore, ⅝" Rod, Rating 1000 psi
5" Bore, 1" Rod, Rating 750 psi

For Package and Mounting

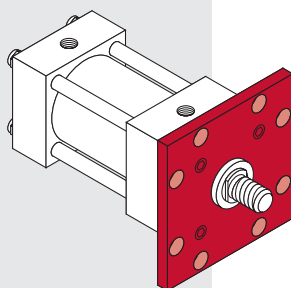
Dimension see
Tables 1LH and 2LH.

FLANGE MOUNTED CYLINDERS

The flange mount is one of the strongest, most rigid methods of mounting. With this type of mount there is little allowance for misalignment, though when long strokes are required, the free end opposite the mounting should be supported to prevent sagging and possible binding of the cylinder.

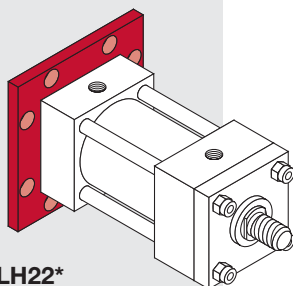
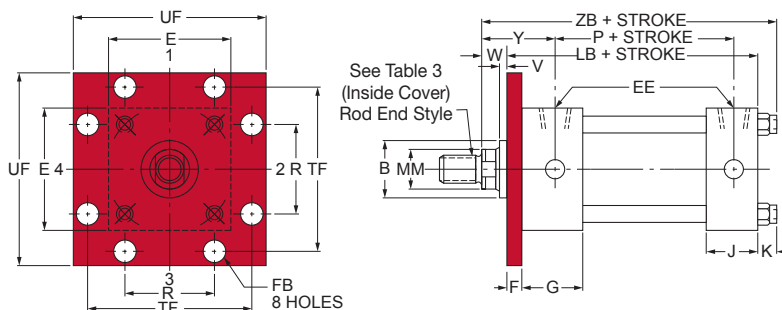
The best use of a blind end flange is in a thrust load application (rod in compression).

Rod end flange mounts are best used in tension applications. When a less rigid mount can be used and the cylinder can be attached to a panel or bulkhead, an extended tie-rod mounting could be considered.



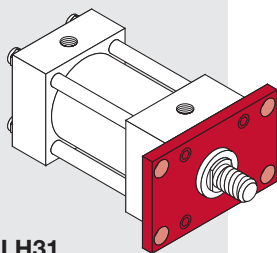
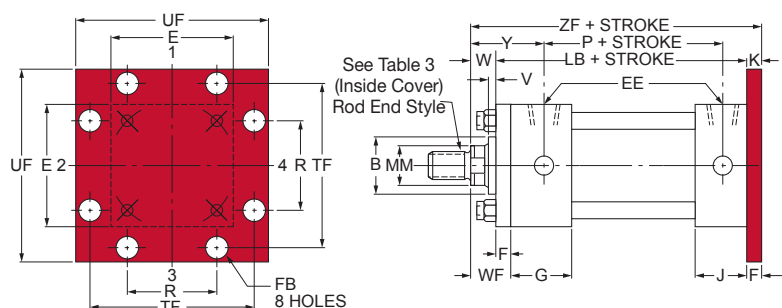
MODEL LH21
NFPA STYLE MF5

ROD SQUARE FLANGE MOUNTING



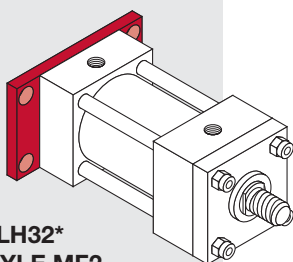
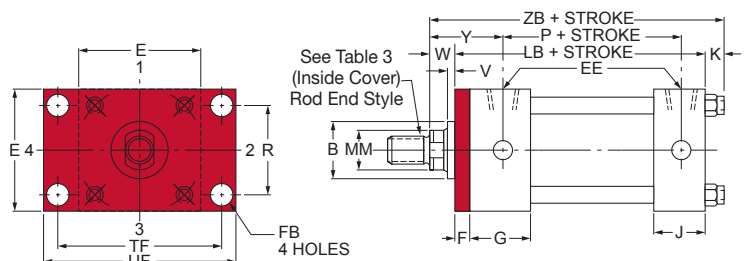
MODEL LH22*
NFPA STYLE MF6

BLIND SQUARE FLANGE MOUNTING



MODEL LH31
NFPA STYLE MF1

ROD RECTANGULAR FLANGE MOUNTING



MODEL LH32*
NFPA STYLE MF2

BLIND RECTANGULAR FLANGE MOUNTING

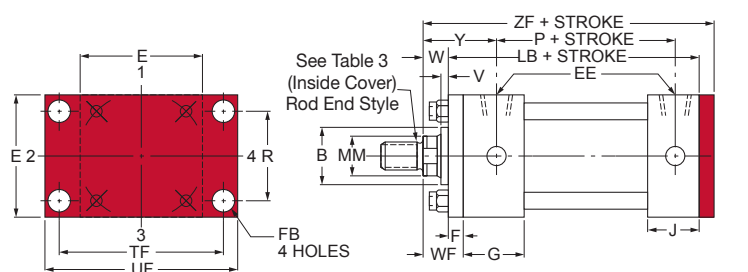


TABLE 1LH The dimensions given on this table are affected by the piston rod diameter and the stroke.

Bore Ø	Rod MM	Cylinder Code ♦	B	LB	P	V	W	Y	ZB	ZF
1½	⅝	LH0051	1⅛	4	2¼	¼	⅝	1⅝/16	5	5
	•1*	LH0052	1½			½	1	2⅝/16	5⅜	5⅜
2	⅝	LH0510	1⅛	4	2¼	¼	⅝	1⅝/16	5⅝/16	5
	1	LH0511	1½			½	1	2⅝/16	5⅞/16	5⅜
	•1⅜*	LH0512	2			⅝	1¼	2⅝/16	5⅞/16	5⅜
2½	⅝	LH0520	1⅛	4⅞	2⅜	¼	⅝	1⅝/16	5⅜/16	5⅝
	1	LH0521	1½			½	1	2⅝/16	5⅝/16	5½
	1⅜	LH0522	2			⅝	1¼	2⅝/16	5⅞/16	5¾
	•1¾*	LH0523	2⅜			¾	1½	2⅝/16	6⅞/16	6
3¼	1	LH0530	1½	4⅞	2⅝	¼	¾	2⅞/16	6⅞/16	6¼
	1⅜	LH0531	2			⅜	1	2⅞/16	6⅝/16	6½
	1¾	LH0532	2⅜			½	1¼	2⅝/16	6⅝/16	6¾
	2*	LH0533	2⅝			½	1⅜	3⅞/16	6¾/16	6⅞
4	1	LH0540	1½	4⅞	2⅝	¼	¾	2⅞/16	6⅞/16	6¼
	1⅜	LH0541	2			⅜	1	2⅞/16	6⅝/16	6½
	1¾	LH0542	2⅜			½	1¼	2⅝/16	6⅝/16	6¾
	2	LH0543	2⅝			½	1⅜	3⅞/16	6¾/16	6⅞
	2½*	LH0544	3⅞			⅝	1⅝	3⅝/16	7	7⅞
5	1	LH0550	1½	5⅞	2⅞	¼	¾	2⅞/16	6⅞/16	6½
	1⅜	LH0551	2			⅜	1	2⅞/16	6⅞/16	6¾
	1¾	LH0552	2⅜			½	1¼	2⅝/16	6⅝/16	7
	2	LH0553	2⅝			½	1⅜	3⅞/16	7⅞/16	7⅞
	2½	LH0554	3⅞			⅝	1⅝	3⅝/16	7⅝/16	7⅜
	3	LH0555	3¾			⅝	1⅝	3⅝/16	7⅝/16	7⅜
6	3½*	LH0556	4¼	5¾	3⅞	⅝	1⅝	3⅝/16	7⅝/16	7⅜
	1⅜	LH0560	2			¼	⅞	2⅞/16	7⅞/16	7⅜
	1¾	LH0561	2⅜			⅜	1⅞	3⅞/16	7⅞/16	7⅝
	2	LH0562	2⅝			⅜	1¼	3⅞/16	7⅞/16	7¾
	2½	LH0563	3⅞			½	1½	3⅞/16	7⅞/16	8
	3	LH0564	3¾			½	1½	3⅞/16	7⅞/16	8
	3½	LH0565	4¼			½	1½	3⅞/16	7⅞/16	8
6	4	LH0566	4¾			½	1½	3⅞/16	7⅞/16	8

TABLE 2LH The dimensions are constant regardless of rod diameter or stroke.

Bore Ø	E	EE NPT	EE SAE	F	FB	G	J	K	R	TF	UF
1½	2	⅜	#6	⅜	⅝/16	1½	1	⅜	1.43	2¾	3⅜
2	2½	⅜	#6	⅜	⅜	1½	1	⅞/16	1.84	3⅜	4⅞
2½	3	⅜	#6	⅜	⅜	1½	1	⅞/16	2.19	3⅞	4⅝
3¼	3¾	½	#10	⅝	⅞/16	1¾	1¼	½	2.76	4⅞/16	5½
4	4½	½	#10	⅝	⅞/16	1¾	1¼	½	3.32	5⅞/16	6¼
5	5½	½	#10	⅝	⅞/16	1¾	1¼	⅞/16	4.10	6⅝	7⅝
6	6½	¾	#12	¾	⅞/16	2	1½	⅞/16	4.88	7⅝	8⅝

HOW TO ORDER

For ordering information refer to Page 68.

NOTES:

- ♦ For double rod end cylinders, add prefix letter D to cylinder code. Example: DLH0051 (Refer to page 62.)
- Available with fixed-non-adjustable cushions on rod end and standard adjustable cushions on the blind end only.
- * Removable retainer not available for these bore and rod combinations in the LH22 and LH32 mounting styles.

Rod End Styles and Dimensions

For rod end styles and dimensions see the Table 3 in the inside cover of the catalog.

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Recommended Pressure Rating

Bore Ø	Pressure Rating (psi)
1½	1500
2	1500
2½	1500*
3¼	1500
4	1000
5	1000*
6	750

***NOTE:**

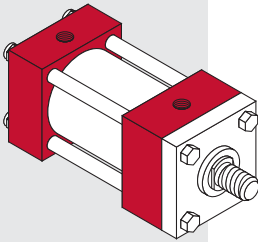
2½" Bore, ⅝" Rod, Rating 1000 psi
5" Bore, 1" Rod, Rating 750 psi

For Package and Mounting
Dimension see
Tables 1LH and 2LH.

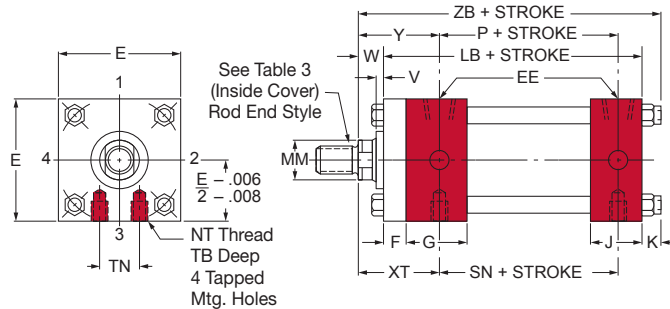
SIDE OR LUG MOUNTED CYLINDERS

The side or lug mounted cylinder provides a fairly rigid mount. These types of cylinders can tolerate a slight amount of misalignment when the cylinder is at full stroke, but as the piston moves toward the blind end, the tolerance for misalignment decreases. It is important to note that if the cylinder is used properly (without misalignment), the mounting bolts are either in simple shear or tension without any compound stresses.

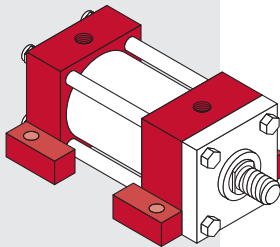
TAPPED HOLES IN CAPS FLUSH MOUNTING



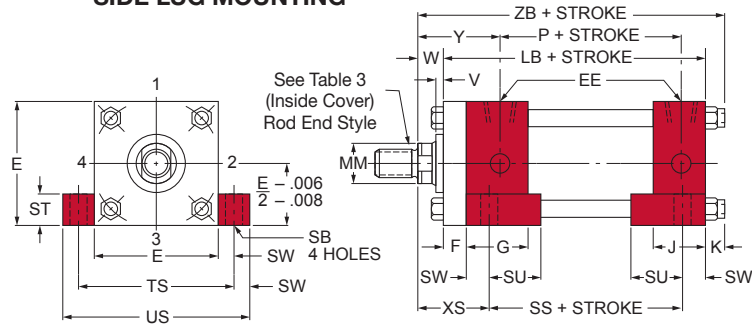
MODEL LH41
NFPA STYLE MS4



SIDE LUG MOUNTING

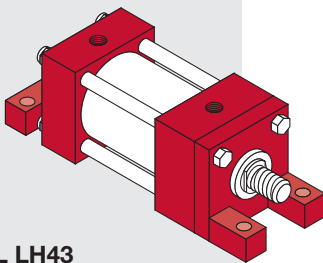


MODEL LH42
NFPA STYLE MS2

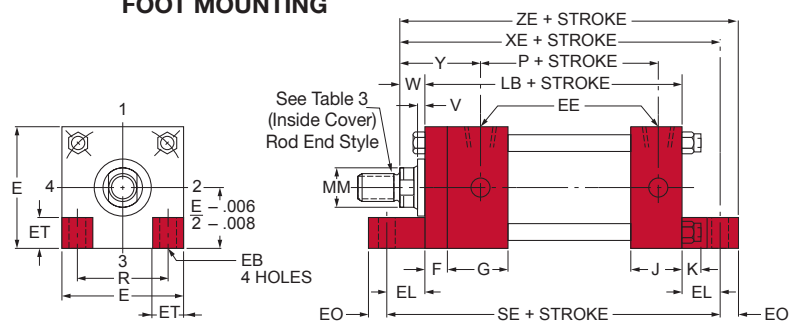


Not Available With
Removable Retainers.

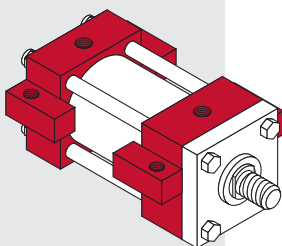
FOOT MOUNTING



MODEL LH43
NFPA STYLE MS7



CENTERLINE LUG MOUNTING



MODEL LH51
NFPA STYLE MS3

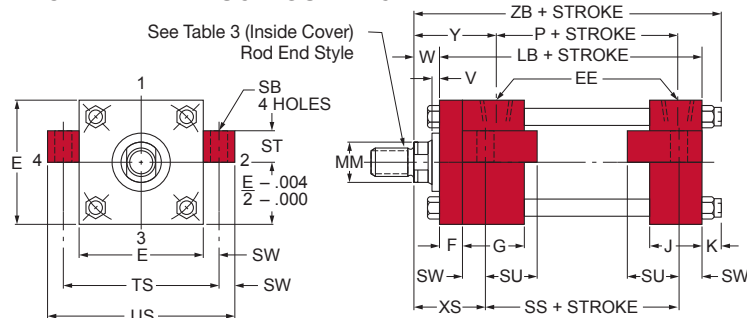


TABLE 1LH The dimensions given on this table are affected by the piston rod diameter and the stroke.

Bore Ø	Rod MM	Cylinder Code ♦	LB	P	SE ▲	SN	SS ■	V	W	XE	XS	XT	Y	ZB	ZE
1½	5/8 •1*	LH0051 LH0052	4	2¼	5½	2¼	27/8	¼ ½	5/8 1	53/8 5¾	13/8 1¾	115/16 25/16	115/16 25/16	5 53/8	6
2	5/8 †1* •13/8*	LH0510 LH0511 LH0512	4	2¼	57/8	2¼	27/8	¼ ½ 5/8	5/8 1 1¼	59/16 515/16 63/16	13/8 1¾ 2	115/16 25/16 29/16	115/16 25/16 29/16	51/16 57/16 511/16	57/8 6¼ 6½
2½	5/8 1 †13/8* •1¾*	LH0520 LH0521 LH0522 LH0523	4½	23/8	6¼	23/8	3	¼ ½ 5/8 ¾	5/8 1 1¼ 1½	513/16 63/16 67/16 611/16	13/8 1¾ 2 2¼	115/16 25/16 29/16 213/16	115/16 25/16 29/16 213/16	53/16 59/16 513/16 61/16	61/8 6½ 6¾ 7
3¼	1 13/8 1¾* 2*	LH0530 LH0531 LH0532 LH0533	47/8	25/8	65/8	25/8	3¼	¼ 3/8 ½ ½	¾ 1 1¼ 13/8	6½ 6¾ 7 71/8	17/8 21/8 23/8 2½	27/16 211/16 215/16 31/16	27/16 211/16 215/16 31/16	61/8 63/8 65/8 6¾	67/8 71/8 73/8 7½
4	1 13/8 1¾ 2 2½*	LH0540 LH0541 LH0542 LH0543 LH0544	47/8	25/8	67/8	25/8	3¼	¼ 3/8 ½ ½ 5/8	¾ 1 1¼ 13/8 15/8	65/8 67/8 71/8 7¼ 7½	17/8 21/8 23/8 2½ 2¾	27/16 211/16 215/16 31/16 35/16	27/16 211/16 215/16 31/16 35/16	61/8 63/8 65/8 6¾ 7	7 7¼ 7½ 75/8 77/8
5	1 13/8 1¾ 2 2½ 3 3½*	LH0550 LH0551 LH0552 LH0553 LH0554 LH0555 LH0556	51/8	27/8	7¼	27/8	3½	¼ 3/8 ½ ½ 5/8 5/8 5/8	¾ 1 1¼ 13/8 15/8 15/8 15/8	615/16 73/16 77/16 79/16 713/16 713/16 713/16	21/16 25/16 29/16 215/16 215/16 215/16 215/16	27/16 211/16 215/16 31/16 35/16 35/16 35/16	27/16 211/16 215/16 31/16 35/16 35/16 35/16	67/16 611/16 615/16 71/16 75/16 75/16 75/16	77/16 711/16 715/16 81/16 85/16 85/16 85/16
6	13/8 1¾ 2 2½ 3 3½ 4*	LH0560 LH0561 LH0562 LH0563 LH0564 LH0565 LH0566	5¾	31/8	7¾	31/8	35/8	¼ 3/8 3/8 ½ ½ ½ ½	7/8 11/8 1¼ 1½ 1½ 1½ 1½	75/8 77/8 8 8¼ 8¼ 8¼ 8¼	25/16 29/16 211/16 215/16 215/16 215/16 215/16	213/16 31/16 33/16 37/16 37/16 37/16 37/16	213/16 31/16 33/16 37/16 37/16 37/16 37/16	73/16 77/16 79/16 713/16 713/16 713/16 713/16	81/8 83/8 8½ 8¾ 8¾ 8¾ 8¾

HOW TO ORDER

For ordering information refer to Page 68.

NOTES:

- ♦ For double rod end cylinders, add prefix letter D to cylinder code. (Example: DLH0051 (Refer to page 62.)
- * Model LH41 is not available in these sizes.
- † The standard rod eye or rod clevis will interfere with foot lugs on Model LH43. When these rod end accessories are required, use additional rod extension.
- ▲ For double rod end cylinders from 1½" thru 6" bore, add ½ + F to this dimension.
- For double rod end cylinders from 1½" thru 6" bore, add ½ to this dimension.
- Available with fixed non-adjustable cushions on rod end and standard adjustable cushions on the blind end only

i Rod End Styles and Dimensions

For rod end styles and dimensions see Table 3 in the inside cover of the catalog.

Page ii

Recommended Pressure Rating

Bore Ø	Pressure Rating (psi)
1½	1500
2	1500
2½	1500*
3¼	1500
4	1000
5	1000*
6	750

***NOTE:**

2½" Bore, 5/8" Rod, Rating 1000 psi
5" Bore, 1" Rod, Rating 750 psi

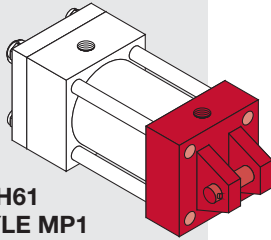
TABLE 2LH The dimensions are constant regardless of rod diameter or stroke.

Bore Ø	E	EB	EE NPT	EE SAE	EL	EO	ET	F	G	J	K	NT	R	SB	ST	SU	SW	TB	TN	TS	US
1½	2	5/16	3/8	#6	¾	¼	½	3/8	1½	1	3/8	¼-20	1.43	7/16	½	15/16	3/8	3/8	5/8	2¾	3½
2	2½	3/8	3/8	#6	15/16	5/16	19/32	3/8	1½	1	7/16	5/16-18	1.84	7/16	½	15/16	3/8	9/16	7/8	3¼	4
2½	3	3/8	3/8	#6	11/16	5/16	¾	3/8	1½	1	7/16	3/8-16	2.19	7/16	½	15/16	3/8	5/8	1¼	3¾	4½
3¼	3¾	7/16	½	#10	7/8	3/8	29/32	5/8	1¾	1¼	½	½-13	2.76	9/16	¾	1¼	½	¾	1½	4¾	5¾
4	4½	7/16	½	#10	1	3/8	11/8	5/8	1¾	1¼	½	½-13	3.32	9/16	¾	1¼	½	1	21/16	5½	6½
5	5½	9/16	½	#10	11/16	½	111/32	5/8	1¾	1¼	9/16	5/8-11	4.10	13/16	1	19/16	11/16	1	211/16	67/8	8¼
6	6½	9/16	¾	#12	1	½	19/16	¾	2	1½	9/16	¾-10	4.88	13/16	1	19/16	11/16	11/8	3¼	77/8	9¼

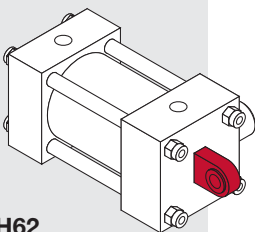
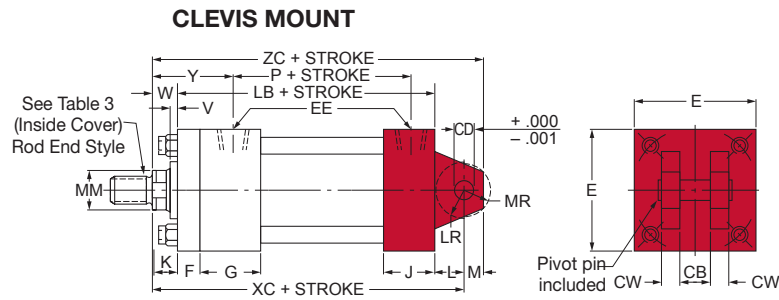
For Package and Mounting
Dimension see
Tables 1LH and 2LH.

PIN AND TRUNNION MOUNTED CYLINDERS

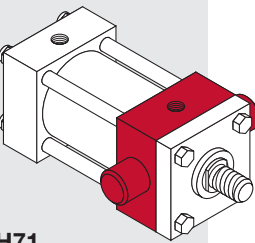
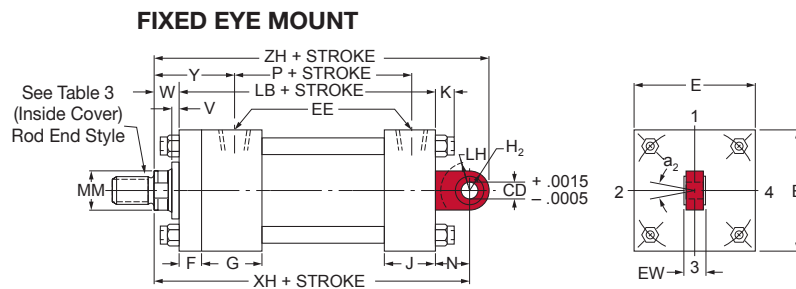
All pin and trunnion cylinders need a provision on both ends for pivoting. These types of cylinders are designed to carry shear loads and the trunnion and pivot pins should be carried by bearings that are rigidly held and closely fit for the entire length of the pin.



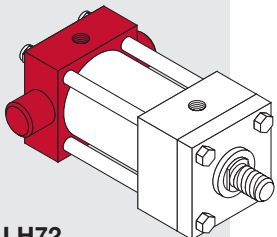
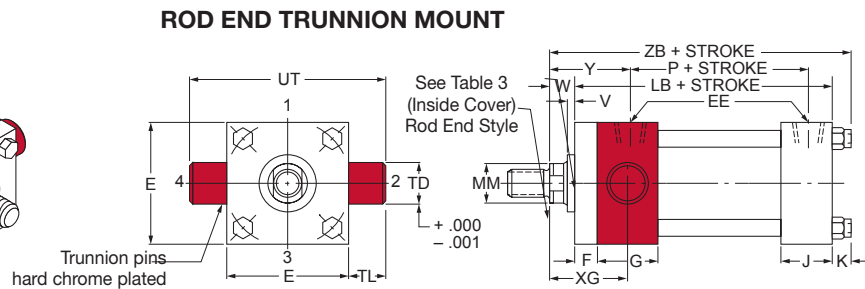
**MODEL LH61
NFPA STYLE MP1**



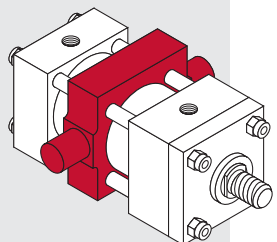
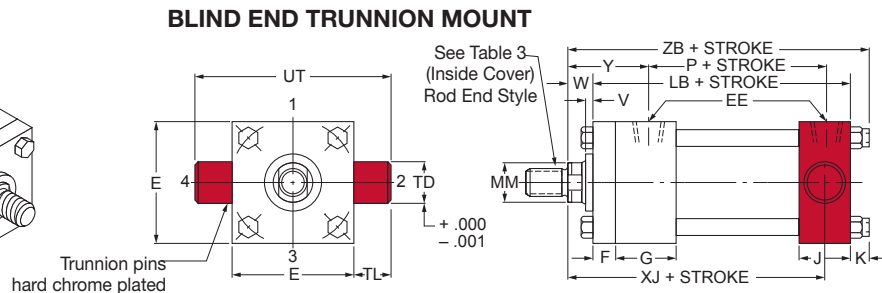
**MODEL LH62
NFPA STYLE MP5**



**MODEL LH71
NFPA STYLE MT1**



**MODEL LH72
NFPA STYLE MT2**



**MODEL LH73/LH74
NFPA STYLE MT4**

LH73 is an exclusive Milwaukee Cylinder design.
LH74 is the Industry "Standard" design.

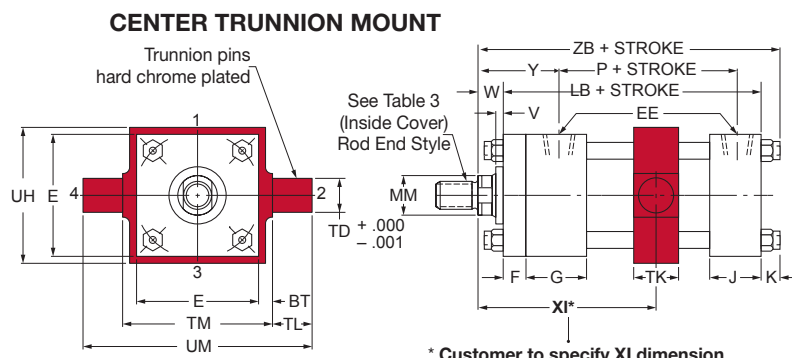


TABLE 1LH The dimensions given on this table are affected by the piston rod diameter and the stroke.

Bore Ø	Rod MM	Cylinder Code ♦	LB	P	V	W	XC	XG	XH	XJ	Y	ZB	ZC	ZH
1½	⅝	LH0051	4	2¼	¼	⅝	5⅜	1¾	5½	4⅞	11⅝	5	5⅞	6¼
	•1*	LH0052			½	1	5¾	2½	5⅞	4½	2⅝	5⅜	6¼	6⅝
2	⅝	LH0510	4	2¼	¼	⅝	5⅜	1¾	5½	4⅞	11⅝	5⅞	5⅞	6¼
	1*	LH0511			½	1	5¾	2½	5⅞	4½	2⅝	5⅞	6¼	6⅝
	•1⅜*	LH0512			⅝	1¼	6	2⅜	6⅞	4¾	2⅞	5⅞	6½	6⅞
2½	⅝	LH0520	4⅞	2⅜	¼	⅝	5½	1¾	5⅝	4¼	11⅝	5⅞	6	6⅜
	1	LH0521			½	1	5⅞	2½	6	4⅝	2⅝	5⅞	6⅜	6¾
	1⅜	LH0522			⅝	1¼	6⅞	2⅜	6¼	4⅞	2⅞	5⅞	6⅞	7
	•1¾*	LH0523			¾	1½	6⅞	2⅝	6⅞	5½	2⅞	6⅞	6⅞	7⅞
3¼	1	LH0530	4⅞	2⅝	¼	¾	6⅞	2¼	6⅞	5	2⅞	6⅞	7⅞	8⅞
	1⅜	LH0531			⅝	1	7⅞	2½	7⅞	5¼	2⅞	6⅞	7⅞	8⅞
	1¾	LH0532			½	1¼	7⅞	2¾	7⅞	5½	2⅞	6⅞	8⅞	8⅞
	2*	LH0533			½	1⅜	7½	2⅞	7½	5⅝	3⅞	6¾	8¼	8¾
4	1	LH0540	4⅞	2⅝	¼	¾	6⅞	2¼	6⅞	5	2⅞	6⅞	7⅞	8⅞
	1⅜	LH0541			⅝	1	7⅞	2½	7⅞	5¼	2⅞	6⅞	7⅞	8⅞
	1¾	LH0542			½	1¼	7⅞	2¾	7⅞	5½	2⅞	6⅞	8⅞	8⅞
	2	LH0543			½	1⅜	7½	2⅞	7½	5⅝	3⅞	6¾	8¼	8¾
	2½*	LH0544			⅝	1⅝	7¾	3⅞	7¾	5⅞	3⅝	7	8½	9
5	1	LH0550	5⅞	2⅞	¼	¾	7⅞	2¼	7⅞	5¼	2⅞	6⅞	7⅞	8⅞
	1⅜	LH0551			⅝	1	7⅞	2½	7⅞	5½	2⅞	6⅞	8⅞	8⅞
	1¾	LH0552			½	1¼	7⅞	2¾	7⅞	5¾	2⅞	6⅞	8⅞	8⅞
	2	LH0553			½	1⅜	7¾	2⅞	7¾	5⅞	3⅞	7⅞	8½	9
	2½	LH0554			⅝	1⅝	8	3⅞	8	6⅞	3⅝	7⅞	8¾	9¼
	3	LH0555			⅝	1⅝	8	3⅞	8	6⅞	3⅝	7⅞	8¾	9¼
6	3½*	LH0556	5¾	3⅞	⅝	1⅝	8	3⅞	8	6⅞	3⅝	7⅞	8¾	9¼
	1⅜	LH0560			¼	⅞	8⅞	2⅝	8¼	5⅞	2⅞	7⅞	9⅞	10
	1¾	LH0561			⅝	1⅞	8⅞	2⅞	8½	6⅞	3⅞	7⅞	9⅞	10¼
	2	LH0562			⅝	1¼	8½	3	8⅝	6¼	3⅞	7⅞	9½	10⅝
	2½	LH0563			½	1½	8¾	3¼	8⅞	6½	3⅞	7⅞	9¾	10⅞
	3	LH0564			½	1½	8¾	3¼	8⅞	6½	3⅞	7⅞	9¾	10⅞
	3½	LH0565			½	1½	8¾	3¼	8⅞	6½	3⅞	7⅞	9¾	10⅞
	4	LH0566			½	1½	8¾	3¼	8⅞	6½	3⅞	7⅞	9¾	10⅞

HOW TO ORDER

For ordering information refer to Page 68.

NOTES:

- ♦ For double rod end cylinders, add prefix letter D to cylinder code. Example: DLH0051 (Refer to page 62.) Double rod ends are not available on LH61 or LH62 mount styles of Series LH cylinders.
- Available with fixed non-adjustable cushions on rod end and standard adjustable cushions on the blind end only.
- * Removable retainer not available for these bore and rod combinations: LH61 and LH73/LH74 mounting styles.



Rod End Styles and Dimensions
Rod End Styles and Dimensions

For rod end styles and dimensions see the Table 3 in the inside cover of the catalog.

Page ii



MilCad Cylinder Configurator

Visit milwaukeekeecylinder.com to configure and download CAD files of your cylinders.

Recommended Pressure Rating

Bore Ø	Pressure Rating (psi)
1½	1500
2	1500
2½	1500*
3¼	1500
4	1000
5	1000*
6	750

***NOTE:**

2½" Bore, ⅝" Rod, Rating 1000 psi
5" Bore, 1" Rod, Rating 750 psi

TABLE 2LH The dimensions are constant regardless of rod diameter or stroke.

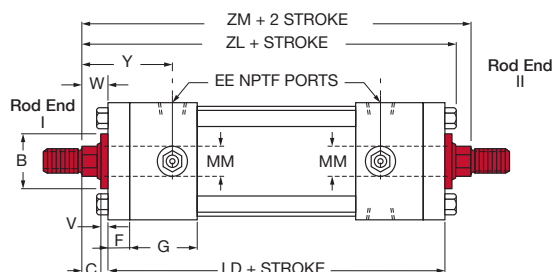
Bore Ø	a ₂	BT	CB	CD	CW	E	EE NPT	EE SAE	EW	F	G	H ₂	J	K	L	LH	LR	M	MR	N	TD	TL	TK	TM	UH	UM	TK	TM	UH	UM	UT
1½	13°	¾	¾	½	½	2	¾	#6	⅝	¾	1½	1⅜	1	¾	¾	⅝	⅝	½	2⅜	⅞	1	1	1⅞	3½	2⅞	5½	1¼	2½	2½	4½	4
2	13°	¾	¾	½	½	2½	¾	#6	⅝	¾	1½	1⅜	1	7/16	¾	⅝	⅝	½	1⅞	⅞	1	1	1⅞	4	2⅞	6	1½	3	3	5	4½
2½	13°	¾	¾	½	½	3	¾	#6	⅝	¾	1½	1⅜	1	7/16	¾	⅝	⅝	½	1⅞	⅞	1	1	1⅞	4½	3⅞	6½	1½	3½	3½	5½	5
3¼	13°	¾	1¼	¾	⅝	3¾	½	#10	⅞	⅝	1¾	1¼	1¼	½	1¼	1	1⅞	¾	1⅞	1¼	1	1	1¼	5¼	4⅞	7¼	2	4½	4½	6½	5¾
4	13°	¾	1¼	¾	⅝	4½	½	#10	⅞	⅝	1¾	1¼	1¼	½	1¼	1	1⅞	¾	1⅞	1¼	1	1	1¼	6	5	8	2	5¼	5	7¼	6½
5	13°	¾	1¼	¾	⅝	5½	½	#10	⅞	⅝	1¾	1¼	1¼	9/16	1¼	1	1⅞	¾	1⅞	1¼	1	1	1¼	7	6	9	2	6¼	6	8¼	7½
6	12½°	1	1½	1	¾	6½	¾	#12	1⅜	¾	2	1¾	1½	9/16	1½	1¼	1¼	1	1⅞	1⅝	1⅞	1⅞	1½	8½	7	11¼	2½	7⅞	7	10⅞	9¼

DOUBLE ROD END CYLINDERS

Milwaukee Cylinder's Double Rod End Cylinders are available with all the standard types of mountings, except LH61 and LH62 mount styles of Series LH cylinders.

To obtain dimensional information on a double rod end cylinder, first select the desired mounting style and refer to the corresponding single rod end cylinder model shown on the preceding pages. After you have determined all necessary dimensions from the previous page covering the desired mounting, turn back to this page. Supplement those dimensions with additional ones from the drawings below and the table at the right. These added dimensions differ from, or are in addition to, those shown on the preceding pages and provide the additional information needed to completely dimension a double rod end cylinder model.

On a double rod end cylinder where two different rod ends are required, or two different rod sizes are required, or cushions on one end are required, be sure to state clearly which rod is to go at which end of the cylinder. When two types of mounting styles are required, be sure to specify their relationship to the piston rods, if they are not the same.



▼ DOUBLE ROD END CYLINDERS

Bore Ø	Rod MM	Cylinder Code	LD*	SE*	SS*	ZL	ZM
1½	5/8	DLH051	4 7/8	6 3/8	3 3/8	5 7/8	6 1/8
	1	DLH052				6 1/4	6 7/8
2	5/8	DLH510	4 7/8	6 3/4	3 3/8	5 15/16	6 1/8
	1	DLH511				6 9/16	6 7/8
	1 3/8	DLH512				6 9/16	7 3/8
2½	5/8	DLH520	5	7 1/8	3 1/2	6 1/16	6 1/4
	1	DLH521				6 7/16	7
	1 3/8	DLH522				6 11/16	7 1/2
	1 3/4	DLH523				6 15/16	8
3¼	1	DLH530	6	7 3/4	3 3/4	7 1/4	7 1/2
	1 3/8	DLH531				7 1/2	8
	1 3/4	DLH532				7 3/4	8 1/2
	2	DLH533				7 7/8	8 3/4
4	1	DLH540	6	8	3 3/4	7 1/4	7 1/2
	1 3/8	DLH541				7 1/2	8
	1 3/4	DLH542				7 3/4	8 1/2
	2	DLH543				7 7/8	8 3/4
	2 1/2	DLH544				8 1/8	9 1/4
5	1	DLH550	6 1/4	8 3/8	3 5/8	7 9/16	7 3/4
	1 3/8	DLH551				7 13/16	8 1/4
	1 3/4	DLH552				8 1/16	8 3/4
	2	DLH553				8 3/16	9
	2 1/2	DLH554				8 7/16	9 1/2
	3	DLH555					
6	3 1/2	DLH556	7	8 7/8	4 1/8	8 7/16	8 3/4
	1 3/8	DLH560					
	1 3/4	DLH561					
	2	DLH562					
	2 1/2	DLH563				9 1/16	9 1/4
	3	DLH564					
	3 1/2	DLH565					
	4	DLH566				9 1/16	10

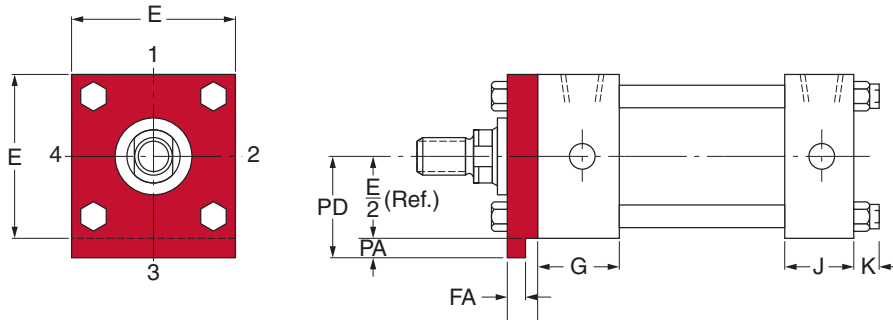
* NOTE: These dimensions are to be substituted for the related mounting dimensions given on the preceding pages. All dimensions given on this table are plus stroke.

KEY MOUNT CYLINDERS

The *Milwaukee Cylinder* Key Mount retainer plate is a mounting option designed to add rugged stability to foot and side mount cylinders. The retainer plate is extended below the mounting surface of the cylinder. This extension may be fitted into a milled keyway in your mounting pad, eliminating the need for welded keys or locator pins.

HOW TO ORDER

For ordering information refer to Page 68.



▼ KEY MOUNT CYLINDERS

Bore Ø	E	F	FA	G	PA	PD
1½	2	¾	.312/.310	1½	¾	1¾
2	2½	¾	.312/.310	1½	¾	17/16
2½	3	¾	.312/.310	1½	¾	111/16
3¼	3¾	¾	.562/.560	1¾	5/16	2¾
4	4½	¾	.562/.560	1¾	5/16	29/16
5	5½	¾	.562/.560	1¾	5/16	31/16
6	6½	¾	.687/.684	2	¾	3¾



**MilCad Cylinder
Configurator**

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CAD files of your cylinders.

Series LH

Series A

Series MN

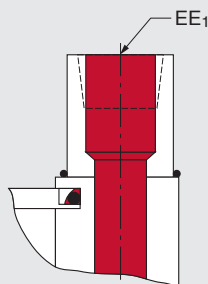
Hyd-Pne Devices

Cyl Accessories

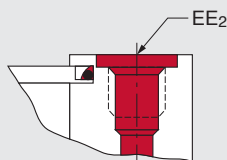
Manipulators

Power Units/Valves

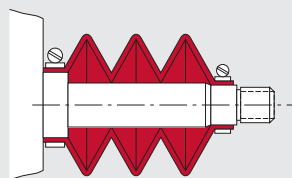
Design Guide



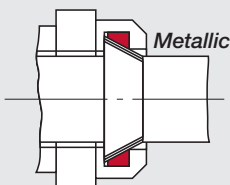
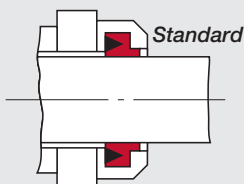
**Oversize Port
Welded Boss**



**SAE Straight Thread
O-ring Port**



Rod Boots



Metallic Rod Wipers



**MilCad Cylinder
Configurator**

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CAD files of your cylinders.

STANDARD DESIGN OPTIONS

Standard Ports

The *Milwaukee Cylinder* Series LH Cylinders are manufactured as standard, with the largest NPTF tapered thread ports that will fit in both the rod and blind ends of a given bore size. Upon request, extra ports can be provided on the sides of the end caps not occupied by mountings or cushion adjusters.

Oversize Ports

On most bore sizes, welded bosses may be provided for oversize NPTF ports. These bosses protrude from the sides of the end caps. For information as to the boss height in relation to your bore and port requirements, contact your local *Milwaukee Cylinder* Representative. Also, special heavier end caps can be provided so that oversize ports can be accommodated without the use of a welded boss.

Straight Thread Ports

On request, *Milwaukee Cylinder* will furnish an SAE straight thread O-Ring port on the Series LH Cylinders. In addition to the standard oversize NPTF ports, welded bosses may also be used for oversize SAE straight thread O-Ring ports. For further information on oversize SAE ports, contact the factory.

Note:

Flange and manifold style ports are available from *Milwaukee Cylinder*.

Rod Boots

When cylinders are used in areas of high contamination or where contaminants have an air hardening property, the exposed piston rod should be covered with a rod boot to protect the rod bearing and seals. A rod boot is simply a collapsible cover. It is of sewn construction made from a neoprene coated fabric. The rod boots are impervious to oil, grease and water. They will operate effectively from 0° F to +200° F without cracking. For additional details on Rod Boots, please see page 186.

Metallic Rod Wipers

If requested, metallic rod wipers will be supplied in place of the standard synthetic rubber wiper. This type of seal is recommended for applications where contaminants would tend to cling to the rod and damage a standard synthetic rubber rod wiper.

▼ PORT SIZES

Bore Ø	Standard NPTF Port EE	Oversized NPTF Port EE ₁	SAE Straight O-Ring Port	
			EE ₂	SAE Standard Thread Series
1½	⅜	½	#6	⅜-18
2	⅜	½	#6	⅜-18
2½	⅜	½	#6	⅜-18
3¼	½	¾	#10	7/8-14
4	½	¾	#10	7/8-14
5	½	¾	#10	7/8-14
6	¾	1	#12	1½-12

DESIGN OPTIONS FOR SPECIAL CYLINDERS

Special Rod Ends

Modifications of standard or entirely special rod ends are available from *Milwaukee Cylinder*. When your requirements call for a special rod end style, your order should include a sketch if it is to be an entirely special rod end or note reference as to which letter dimensions you wish to have modified (see inside front cover).

Special Assemblies from Standard Parts

Each style of the various standard cylinder mountings is illustrated, using the commonly recognized cylinder dimensional symbols of the National Fluid Power Association. Each side of the end views are numbered to aid in communication when referring to the relationship between the ports and the mountings. When requesting information or placing an order that requires a dimension other than standard, always make reference to the given dimensional symbol in the catalog and then give your requirements.

Cushion Adjustment Locations

A ball check and a cushion adjustment needle are supplied as standard in position #2 on most models. The cushion needle and ball check are interchangeable as far as location and may be put in any side not occupied by a port or mounting.

Port Locations

Ports are located in position #1 as standard unless otherwise specified. By using the position numbers given with the end views in the dimensional data section of this catalog, ports can be arranged in any one of four 90° positions in relation to the cylinder mounting. When ports are relocated on a cushioned cylinder, the cushion needle and ball check are automatically relocated to hold their relationship to the port as on a standard cylinder, unless otherwise specified at the time of the order.

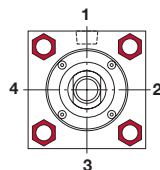
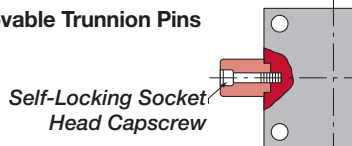


Figure 1

Removable Trunnion Pins



Removable trunnion pins are available on models LH71 and LH72. They can be

used on all bore and rod combinations, except on the largest oversize rods offered with each bore size on all model LH71 cylinders.

Single-Acting Cylinders

The *Milwaukee Cylinder's* Series LH cylinders are designed for either single or double action. When used as a single acting cylinder, hydraulic power drives the piston in one direction, only relying on either the load or an external force to return the piston after the pressure is exhausted.

Single-Acting Spring Cylinders

Single-acting spring return cylinders normally have a spring inside of the cylinder to return the piston to its original position. The application load and friction conditions must be specified when placing an order to properly size the spring. Also specify whether the spring is to return or advance the piston. A spring return cylinder is designed with a stop tube to act as spring guide, which prevents binding of the cylinder due to misalignment of the spring. To accurately determine the cylinder length and mounting dimensions for your application, contact your local *Milwaukee Cylinder* representative or the factory.

Water Service Cylinders

Milwaukee Cylinder's Series LH Cylinders can be used with water as an operating fluid with some standard modifications to the types of material and the manufacturing processes used. These modifications will include, at some additional cost, bronze piston, nickel plated end caps, a hard chrome plated cylinder barrel and a chrome plated piston or stainless steel piston rod at extra cost. Due to the increased factors of corrosion, electrolysis and mineral deposits acting within a water fitted cylinder, *Milwaukee Cylinder* cannot warrant or make any guarantees other than a water service cylinder will be free of defects in workmanship or materials.

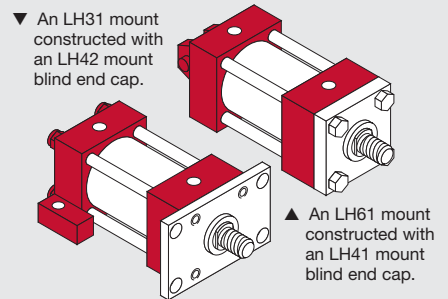
Proximity Switches

End of Stroke Limit Switches:

We provide inductive proximity switches for end of stroke sensing. These non-contact switches detect the presence of the spud/cushion bushing. See page 185 for more information.

Combined Mountings

Standard mountings may be combined when specified by the customer. Some examples of this are:



These and other combinations can be readily made from standard parts. If you are unsure of a possible combination or if it will suit your particular needs, consult with your local *Milwaukee Cylinder* representative or contact the factory.

Adjustable Stroke Cylinders

When a cylinder application requires stroke adjustment, *Milwaukee Cylinder* offers a number of designs, the most common of which is illustrated below. This particular design is externally adjustable, incorporating a threaded rod (of piston rod quality) with the standard hydraulic rod end multiple lip vee seal and bushing design. This provides a proven-effective high and low pressure seal, affording maximum sealing on the stroke adjustment rod.

Further information concerning design limitations, cushioning or alternate designs can be obtained by contacting the factory.



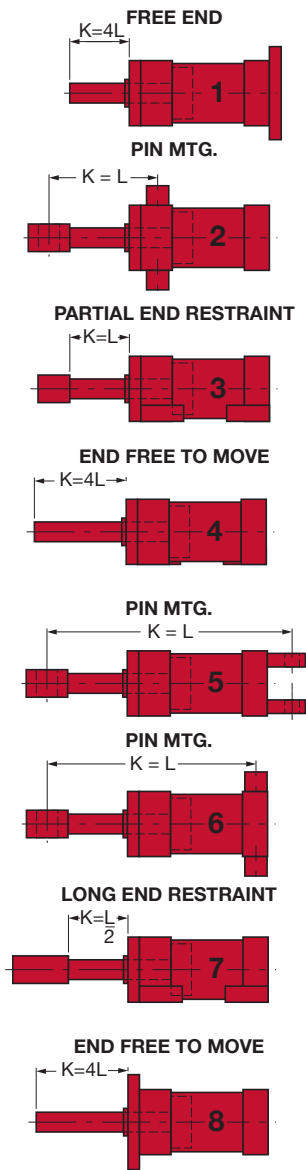
CAUTION!

Cylinders with removable trunnion pins will have a reduced pressure rating.

Consult the factory.



▼ FIGURE 1



Stop Tubes

For more information on Stop Tubes, see page 181 in the Design Engineer's Guide.

STOP TUBES

Stop tubes are used to maintain bearing pressure within acceptable limits and are recommended on cylinders with long strokes or poorly guided rods.

The stop tube is a spacer between the rod end cap and the piston, which provides separation between the piston and the rod bearing. This separation reduces the moment forces developed between the rod bearing and piston when the rod is extended.

To determine if stop tube is necessary for your cylinder requirements, you have to solve for "K" (refer to Figure 1). If your required cylinder has a "K" dimension in excess of 40 inches, stop tube is required. For each 10 inch increment or fraction thereof in excess of 40 inches, one inch of stop tube is recommended. When stop tube is required, the overall length of the cylinder will be increased by the length of the stop tube to be used.

To determine "K" (see to Figure 1)

*Note: W = the rod stick out
(refer to pages 54-63)

Cylinder #1, #4, #8 – see Figure 1

$$K = 4L = 4 (\text{stroke} + W^*)$$

Cylinder #2 - see Figure 1

$$K = L = (CA \text{ or } CE) + XG + \text{Stroke}$$

Note:

CA = rod eye dimension (back inside cover)

CE = rod clevis dimension (back inside cover)

XG = mounting dimension page 60

Cylinder #3 – see Figure 1

$$K = L = W^* + \text{Stroke}$$

Cylinder #5 – see Figure 1

$$K = L = (CA \text{ or } CE) + XC + (2 \times \text{Stroke})$$

Note:

CA = rod eye dimension (back inside cover)

CE = rod clevis dimension (back inside cover)

XC = mounting dimension page 60

Cylinder #6 – see Figure 1

$$K = L = (CA \text{ or } CE) + XJ + (2 \times \text{Stroke})$$

Note:

CA = rod eye dimension (back inside cover)

CE = rod clevis dimension (back inside cover)

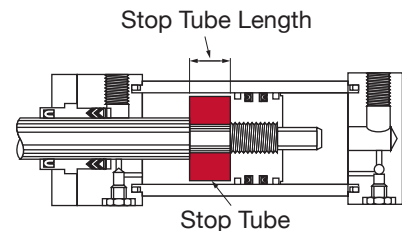
XJ = mounting dimension page 60

Cylinder #7 – see Figure 1

$$K = L/2 = (W^* + \text{Stroke})/2$$

When mounting long stroke cylinders, care should be taken to assure cylinder alignment over the entire length of stroke. The use of external guides or swivel bushings is recommended to reduce side load conditions and prolong the cylinder's service life.

Note: Stop tube length must be added to "K" factor before making final selection of rod size. This is primarily true in No. 5 long stroke applications.



The stop tube is located between the piston and the rod end cap. It limits the extended stroke of the cylinder, providing additional strength for less cost and reduced weight than the use of an oversize rod.

▼ TABLE 1 - VALUE OF "K" IN INCHES

Thrust Force (in-lbs)	Piston Rod Diameter (in)												
	¾	1	1⅜	1½	2	2½	3	3½	4	4½	5	5½	7
400	35	84	134	—	—	—	—	—	—	—	—	—	—
700	30	68	119	—	—	—	—	—	—	—	—	—	—
1,000	26	60	105	156	190	—	—	—	—	—	—	—	—
1,400	24	54	93	144	175	244	308	—	—	—	—	—	—
1,800	23	48	84	127	160	230	294	366	—	—	—	—	—
2,400	18	45	75	114	145	214	281	347	—	—	—	—	—
3,200	16	40	68	103	131	196	262	329	398	—	—	—	—
4,000	12	38	63	93	119	174	240	310	373	446	—	—	—
5,000	9	36	60	87	112	163	225	289	359	426	—	—	—
6,000	—	30	56	82	102	152	209	274	342	411	476	—	—
8,000	—	25	51	76	93	136	186	244	310	375	448	—	—
10,000	—	21	45	70	89	125	172	221	279	349	412	—	—
12,000	—	17	41	64	85	117	155	210	270	326	388	455	—
16,000	—	—	35	57	75	110	141	188	233	291	350	421	—
20,000	—	—	28	52	66	103	136	173	218	270	325	385	—
30,000	—	—	—	39	56	87	120	156	190	232	285	330	—
40,000	—	—	—	24	43	75	108	142	177	210	248	293	—
50,000	—	—	—	—	30	66	97	131	165	201	234	268	408
60,000	—	—	—	—	—	57	88	119	154	190	226	256	384
80,000	—	—	—	—	—	36	71	104	136	170	204	240	336
100,000	—	—	—	—	—	—	56	91	120	154	199	224	324
120,000	—	—	—	—	—	—	45	76	108	146	174	207	313
140,000	—	—	—	—	—	—	—	64	98	129	162	194	301
160,000	—	—	—	—	—	—	—	47	87	118	149	182	279
200,000	—	—	—	—	—	—	—	—	65	98	131	160	260
250,000	—	—	—	—	—	—	—	—	—	72	109	143	236
300,000	—	—	—	—	—	—	—	—	—	—	85	120	212
350,000	—	—	—	—	—	—	—	—	—	—	53	100	195
400,000	—	—	—	—	—	—	—	—	—	—	—	72	182
500,000	—	—	—	—	—	—	—	—	—	—	—	—	152
600,000	—	—	—	—	—	—	—	—	—	—	—	—	114
700,000	—	—	—	—	—	—	—	—	—	—	—	—	70

▼ TABLE 2 - DEDUCTIONS FOR PULL STROKE FORCE & DISPLACEMENT

Piston Rod Ø	Piston Rod Area	Cylinder Force in Pounds for Various Pressures								Displacement /in of Stroke	
		100 psi	200 psi	250 psi	500 psi	750 psi	1000 psi	1250 psi	1500 psi	Gallons Oil Displaced	
¾	.307	31	61	77	154	230	307	384	461	.00133	
1	.785	79	157	196	393	589	785	981	1178	.00340	
1⅝	1.485	149	297	371	743	1114	1485	1856	2228	.00643	
1½	2.405	241	481	601	1203	1804	2405	3006	3608	.01041	
2	3.142	314	628	786	1571	2357	3142	3928	4713	.01360	
2½	4.909	491	982	1227	2455	3682	4909	6137	7364	.02125	
3	7.069	707	1414	1767	3535	5302	7069	8836	10600	.03060	
3½	9.621	962	1924	2405	4811	7216	9621	12026	14430	.04165	
4	12.57	1257	2514	3143	6285	9428	12570	15708	18860	.05442	

▼ TABLE 3 - THRUST FORCE AND DISPLACEMENT

Cylinder Bore Ø	Piston Area	Cylinder Force in Pounds for Various Pressures								Displacement /in of Stroke	
		100 psi	200 psi	250 psi	500 psi	750 psi	1000 psi	1250 psi	1500 psi	Gallons Oil Displaced	
1½	1.767	177	353	442	884	1325	1767	2209	2651	.00765	
2	3.142	314	628	786	1571	2357	3142	3928	4713	.01360	
2½	4.909	491	982	1227	2455	3682	4909	6137	7364	.02125	
3¼	8.296	830	1659	2074	4148	6222	8296	10370	12440	.03591	
4	12.57	1257	2514	3143	6285	9428	12570	15708	18860	.05442	
5	19.64	1964	3928	4910	9820	14730	19640	24544	29460	.08502	
6	28.27	2827	5654	7068	14140	21200	28270	35342	42400	.12230	

CYLINDER SIZING

The selection of the correct rod size is one of the most important factors in sizing a cylinder. The standard rod for each bore size that *Milwaukee Cylinder* manufactures is sufficient to handle the maximum tension force that the cylinder is capable of producing. It is primarily in compression and long stroke, high thrust applications that the column strength needs to be considered.

The following steps should be used to determine the proper rod size for an application:

1. Select the cylinder bore size required from Table 3 based on the required cylinder thrust force and the operating line pressure at the cylinder.
2. Determine the length between mounting points or "L" as shown on Figure 1, page 66.
3. Based on the distance between mounting points ("L"), determine the value of "K" as shown on Figure 1, page 66.
4. Using the thrust force and the developed "K" dimension, refer to Table 1 to select the proper rod size.
5. If an oversized rod is required, re-check the overall length dimension ("K") in Step 1 and confirm your previous rod size selection.

To determine the cylinder pull (tension), stroke force, or displacement, deduct the force or displacement corresponding to the rod size in Table 2 from the force or displacement corresponding to the bore size shown in Table 3.

Feature	Description	Page Number	Code Number	Example
Double Rod End		62	D	LH0542 - 31 - 1 4 - 7 × 14 ³ / ₄
Cylinder Code	Refer to Table 1LH	55, 57, 59, and 61	—	
Mounting Style	Model Number Only	54, 56, 58, and 60	—	
Rod End Style	Code Number	inside front cover (ii)	—	
Cushions	None Rod End Blind End Both Ends	— — — —	1 2 3 4	
Cylinder Modifications	Special		S	If Standard Leave Blank
Seals	BUNA-N (-20° to 200° F) Viton (-15° to 350° F) Special		7 8 S	*If Special Describe Requirements
Stroke	Specify in Inches Including Fractional Requirements		—	



DUPLICATE CYLINDERS

Duplicate cylinders can be ordered by giving the serial number from the nameplate of the original cylinder. Factory records supply a quick, positive identification.



MilCad Cylinder Configurator

Visit milwaukeeecylinder.com to configure and download CAD files of your cylinders.

***NOTE:** Use "S" if any special design features or seals are required, describe in detail on your order.

EXAMPLE: The code for a hydraulic cylinder 4" bore, rod end rectangular flange mounting, 1³/₄" rod, style No. 1 rod end, cushion both ends, standard seals with a 14³/₄" stroke is **LH0542-31-14-7x14³/₄**.

HOW TO ORDER

Series LH Cylinders

Standard Series LH Cylinders can be completely and accurately described by a model number. If your requirements are completely standard, select the alphanumeric codes from above that represent your cylinder and place them in the sequence indicated by the example. Use of the cylinder model number will eliminate untimely delays in handling your order.

General Order Data

1. Bore & Rod Size or the Cylinder Code: (refer to pages 54-63)
2. Mounting Style: (refer to page 54-63)
3. Rod End Style: (refer to Inside Cover, page ii)
4. Cushion Requirements
5. Length of Stroke

Application Data

1. **Port Requirements:** refer to page 64.
2. **Operating Fluid or Medium:** Series LH Cylinders are equipped with seals for use with hydraulic oil. If other than a quality grade hydraulic oil will be used, specify the type of fluid in your order. See page 184 for more details.
3. **Temperature Range:** Series LH Hydraulic Cylinders contain seals of Nitrile (Buna-N) suitable to -20° F to +200° F. Specify your operating temperature if your application does not fall within this temperature range.
4. **Operating Pressure:** Series LH Cylinders are rated for 750-1500 PSI. If your requirements are in excess of the rated pressure, describe your application in your order.
5. **Accessories:** Specify any accessories you require, using the part numbers given on the inside back cover.
6. **Special Requirements:** If you require special seals, rod material, stop tube, center support, adjustable stroke or any other special requirements not covered, specify in detail on your order.

REPLACEMENT SEALS OR CYLINDER PARTS

For replacement seals or cylinder parts, the serial number of your cylinder, the cylinder model number and the item number of the part you require (below) should appear on your order. To order entire seal kits for your cylinder, simply specify the serial number and the cylinder model number from page 68 on your request for service parts.

HOW TO ORDER COMPLETE SEAL KITS

When ordering complete seal kits, specify the following information on your order:

1. The serial number of the cylinder the seals will be used on.
2. The bore and rod size.
3. If the cylinder is cushioned.

To eliminate untimely delays in the handling of your order, please use the seal kit code as shown in the example below:

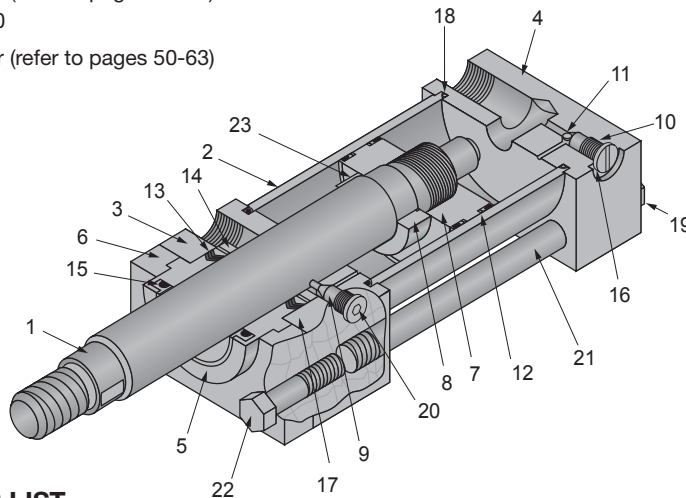
Example:

Buna-N Kit No. XXXXX-7-50

- cylinder code number (refer to pages 50-63)

Viton Kit No. XXXXX-8-50

- cylinder code number (refer to pages 50-63)



STANDARD PARTS LIST

Item No.	Description
1	Piston Rod
2	Cylinder Barrel
3	Head End Cap
4	Cap End Cap
5	Rod Bushing
6	Retainer Plate
7	Piston
8	Cushion Plunger
9	Cushion Adj. Plunger
10	Ball Check Retainer
11	Ball Check
12	U-Cup Seal & Backup Washer for Piston
13	Rod Vee Ring Set
14	Rear Bearing Ring
15	Rod Wiper
16	O-Ring Seal for Ball Check Retainer
17	Wave Spring
18	Cylinder Barrel O-Ring
19	Tie Rod Flex Lock Nut
20	O-Ring Seal for Cushion Adj. Needle
21	Tie Rod
22	Self-Locking Cap Screw
23	O-Ring for Floating Cushion

Retainer Plate Cap Screw Torques

▼ For Square Retainers

Bore Ø	Torque (Ft-lbs)
1½	10
2	20
2½	20
3¼	30
4	30
5	50
6	50

Tie-rod Nut Torques

▼ Nut Torque Specifications

Bore Ø	Torque (Ft-lbs)
1½	8
2	18
2½	18
3¼	35
4	35
5	60
6	60

When it is necessary to remove the tie-rod nuts on a cylinder, they must be reassembled to the torque specifications given above. To prevent the tie-rods from twisting when tightened, use a vice grip or locking clamp. Note that the torque specification is based on lubricated threads.

INSTALLATION FOR SERIES LH

General Information

Cleanliness

The most important consideration when installing the cylinder. When cylinders are shipped from *Milwaukee Cylinder*, the ports are securely plugged with plastic plugs which should not be removed until the piping is to be installed. All piping should be thoroughly clean, to include the removal of all threading and flaring burrs or chips, before making the connection to the cylinder ports. One chip can cause premature failure of the cylinder or other hydraulic system components.

Alignment

Improper alignment will result in excessive cylinder wear. Check to assure rod alignment between the cylinder and its mating component on your machine in both the extended and retracted positions.

Environment

Cylinders operating in areas where there is weld splatter, fast drying chemicals, paint, excessive heat or other hazardous conditions, should have covers or shields to prevent damage to the rod and rod seals.

Bleeding

Air within the cylinder or system will cause erratic operation of the cylinder. Our cylinders generally do not require bleed ports if the cylinder ports are mounted in an upright position. Several full strokes of the cylinder will purge air from the cylinder into the circuit piping, where it can be bled off. Bleeder ports are available for applications where the cylinder is the high point of the circuit or where the cylinder does not complete a full stroke during its normal cycle.

MOUNTING RECOMMENDATIONS

Foot Mounted Cylinders

The use of high strength alloy steel mounting bolts 1/16" smaller than the hole size is recommended. After final alignment, foot mounted cylinders should be dowel pinned in place.

Trunnion Mounted Cylinders

Lubricated pillow blocks designed for close tolerance applications should be used. It is important to rigidly mount and align the pillow blocks so that the trunnion pins will not be subjected to any extreme bending moments. The rod end should be pivoted with the pivot pin in line and parallel to the axis of the trunnion pins.

Flush Mount Cylinders

The use of high strength alloy steel mounting bolts is recommended. Shear keys should be used to reduce the stress on the mounting bolts created by the normal push and pull forces created by the cylinder cycle.

Flange Mount Cylinders

The controlled diameter rod bushing extension can be used as a pilot to locate the flange mount. Dowel pins should be used after the cylinder is mounted and aligned to prevent shifting.

Clevis Mount Cylinders

This type of cylinder must be pivoted at both ends and the pins must be in line and parallel to each other. After the cylinder is mounted, the customer should check to assure that the cylinder is free to swing through its working arc without interference from other machined parts.

STORAGE

Often times, cylinders are delivered before a customer is prepared to install them and must be stored for a period of time. When storage is required:

1. Select an area indoors for storage, which has dry and non-corrosive atmosphere. Take caution to protect the cylinder from both internal and external corrosion.
2. Cylinders to be stored should be kept in a vertical position (piston rod up) whenever possible.
3. Port protector plugs should be kept in the cylinder ports until the time of installation.

CYLINDER TROUBLE SHOOTING

1. External leakage

If leaking occurs between the end cap and barrel, check tie-rod torque. Do not over torque. If the torque is correct, then replace the barrel seal. When leakage occurs in the rod bushing area, replace the rod seals. If leakage continues or reoccurs in short period of operation, check items 2 thru 5, page 69.

2. Cylinder misalignment

Side load is a common problem which occurs when the cylinder application does not allow the piston rod to work in line during the extend and retract motions of the cylinder. Evidence of this is excessive seal failure, bushing wear or galling of the piston rod. Often, bending of the piston rod or complete failure (breakage) of the rod occurs.

3. Contamination on the piston rod

Dirt and other material is often picked up when the piston rod is extended. When the rod is retracted in an excessive dirty application, it often carries the dirt back into the rod seal cavity of the cylinder, causing damage to the seals. With a slight modification of the cylinder rod end, a rod boot can be added to protect the rod bushing and seals for most applications.

4. Bad mountings

Due to wear of pivot pins or mounting bolts working loose, a cylinder may have side load, even though the rod was in line when the cylinder was first installed. All cylinder mountings should be checked periodically.

5. Damaged piston rod

An extended piston rod can be damaged by the impact of a hard object which could burr the rod. If this occurs, the rod should be checked immediately to prevent seal damage.

6. Internal leakage

Inside the cylinder, leakage past the piston seals can cause sluggish movement or settling of the cylinder under load conditions. This occurs due to leakage of worn piston seals or rings.

7. Creeping cylinder

When a cylinder is stopped in midstroke and it creeps, check for internal leakage. Creeping can also be caused by a worn control valve and this should be checked, even if the cylinder is found to have internal leakage.

8. Erratic operation

When a cylinder is erratic or sluggish in operation, this may be caused by a number of problems. The most common cause of sluggish operation is air in the system. Internal leakage could also be a

cause. If the system starts out sluggishly and, as it warms, speeds up, the oil may be of too high viscosity. The whole system should be checked for worn components if after these checks, the cylinder is still operating in a sluggish manner.

CYLINDER MAINTENANCE

Rod Seal Replacement

When changing rod seals, extend the piston rod 3" or more if possible, being sure to support the rod at all times. Remove the retainer plate screws (if tie-rod nuts have to be removed, refer to the nut torque specification on this page when reassembling the cylinder), retainer plate and outer bushing. Using an eye hook or thin screwdriver, pry the vees from the end cap cavity (if low pressure air is applied to the rod end port, this will help to force the vees from the cavity). The new set of vees should be assembled into the cavity separately and lubed with the soft vee in the center. Replace the rod wiper in the bushing and reassemble the cylinder.

Piston Seal Replacement

When changing piston seals, extend the piston rod 3" or more if possible, being sure to support the piston rod and the piston at all times.

*Remove the tie-rod nuts, blind end cap, the barrel and then the piston seals. A light grease, compatible with the system fluid, should be used on the rings and block vee seals for smooth assembly. Install the block vee piston seals, scarf cutting on only the back-up washers. Then install the cast iron rings with the joints in opposite directions. To reassemble, start the piston into the tube, compressing the cast iron rings using twine or a ring compressor. When the piston block vee seal is to the edge of the barrel, use a thin rounded blade to start the lip of the block vee, making sure the entire lip is started before moving the piston further into the tube.

***Note:** When a cylinder has been disassembled this far, the barrel seals should at least be inspected, if not replaced.

Barrel Seal Replacement

When replacing barrel seals, use the same method of disassembling the cylinder as used when replacing piston seals. The barrel seal consists of a backup washer and O-Ring, which is assembled on the first step of both ends of the tube, with the backup washer going on first. The outer diameter of the tube groove on the end caps must be checked for nicks or burrs and then greased. Position the end caps squarely on the tube (check to make sure port location is correct) and firmly force or tap the end cap over the tube until it bottoms. Check to make sure the O-Ring did not shear and then finish assembling the cylinder.

▼ Nut Torque Specifications

Bore Ø	Torque (Ft-lbs)
1½	8
2	18
2½	18
3¼	35
4	35
5	60
6	60

When it is necessary to remove the tie-rod nuts on a cylinder, they must be reassembled to the torque specifications given above. To prevent the tie-rods from twisting when tightened, use a vice grip or locking clamp. Note that the torque specification is based on lubricated threads.

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