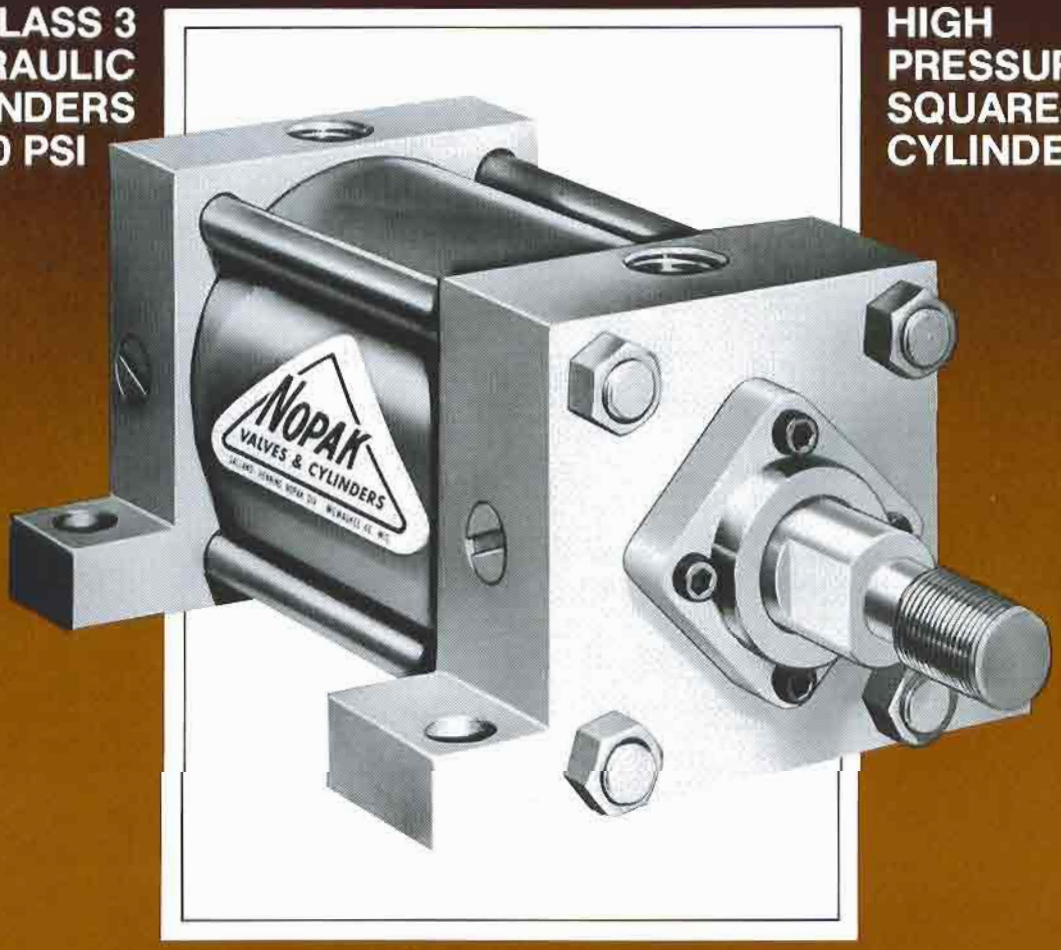
NOPAK®

CATALOG 103

CLASS 3
HYDRAULIC
CYLINDERS
TO 3000 PSI

HIGH
PRESSURE
SQUARE-HEAD
CYLINDERS



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NOPAK HIGH PRESSURE SQUARE-HEAD CYLINDERS

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CLASS 3M NON-TIE-ROD MILL TYPE CYLINDER 40

CYL. DIA.	4/1*	RECOMMENDED MAXIMUM CONTINUOUS PRESSURE
1½	2265	3000
2	3209	3000
2½	3209	3000
3¼	2465	3000
4	2288	3000
5	2752	3000
6	2326	3000
7	2632	3000
8	2326	3000
10	3072	3000
12	2710	3000
14	2631	3000
16	2014	3000
18	2099	3000
20	2064	3000

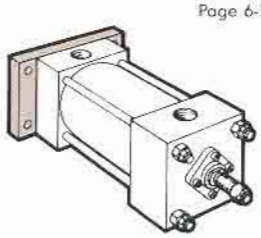
*The 4/1 pressure rating is the lowest calculated value of the various pressure containing elements of a cylinder and is based on ¼th of the minimum tensile strength of the material. While this is a conservative rating method, it does not include factors for type of mounting, length of stroke, method or speed of load application, fluid, temperature, environment, or fatigue. For specific recommendations consult your nearest Nopak field representative or factory application engineer.

APPROXIMATE UNCRATED CLASS 3 HYDRAULIC CYLINDER WEIGHTS (LBS)

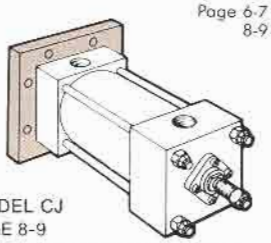
CYLINDER BORE	1½	2	2½	3¼	4	5	6	7	8	10	12	14	16	18	20
BASIC MODELS ZERO STROKE	7.8	12	17.5	33	45	81	137	193	298	532	890	1480	1930	2810	3700
MODELS ME, MF, MP & MT — ADD	2.2	3	3.5	7	8	13	20	27	36	84	130	270	420	540	800
STANDARD ROD PER INCH OF STROKE	.45	.75	1.1	1.6	2.5	4.0	5.2	6.3	8.2	15.5	23	32	38	48	57
LARGE ROD PER INCH OF STROKE	.59	.95	1.6	2.1	3.2	5.8	7.4	9.9	12.2	21.9	30	43	46	52	—

MOUNTING STYLES INDEX

MODEL C
(NFPA MF2)
1½" THROUGH 8" DIA. BORE
Page 6-7

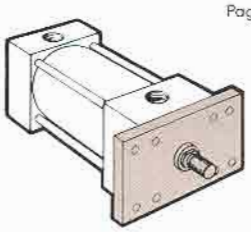


MODEL CC
(NFPA MF6)
1½" THROUGH 12" DIA. BORE
Page 6-7
8-9

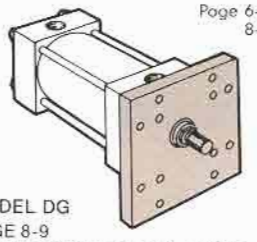


MODEL CJ
PAGE 8-9
14" THROUGH 20" DIA. BORE

MODEL D
(NFPA STD. MF1)
1½" THROUGH 8" DIA. BORE
Page 6-7

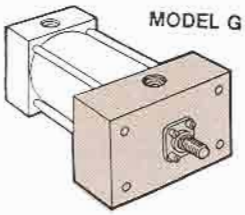


MODEL DD
(NFPA MF5)
1½" THROUGH 12" DIA. BORE
Page 6-7
8-9

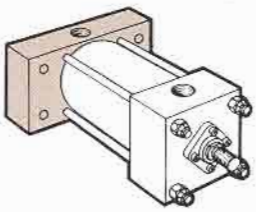


MODEL DG
PAGE 8-9
14" THROUGH 20" DIA. BORE

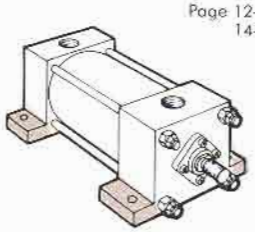
MODEL G
(NFPA STD. ME5)
1½" THROUGH 12" DIA. BORE
Page 10-11



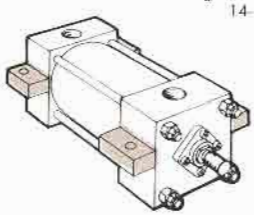
MODEL J
(NFPA STD. ME6)
1½" THROUGH 12" DIA. BORE
Page 10-11



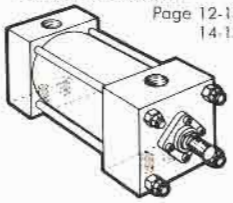
MODEL A
(NFPA STD. MS2)
1½" THROUGH 14" DIA. BORE
Page 12-13
14-15



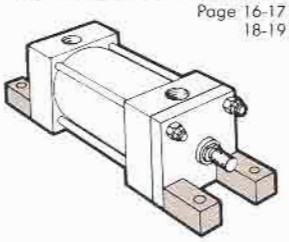
MODEL B
(NFPA STD. MS3)
1½" THROUGH 20" DIA. BORE
Page 12-13
14-15



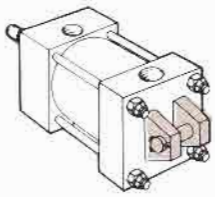
MODEL S
(NFPA STD. MS4)
1½" THROUGH 8" DIA. BORE
SMALL ROD ONLY
Page 12-13
14-15



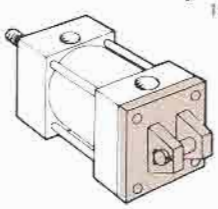
MODEL AL
(NFPA STD. MS7)
1½" THROUGH 8" DIA. BORE
Page 16-17
18-19



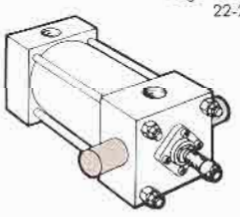
MODEL E
(NFPA STD. MP1)
1½" THROUGH 20" DIA. BORE
Page 16-17
18-19



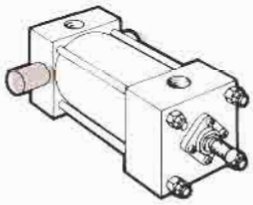
MODEL HE
(NFPA STD. MP2)
1½" THROUGH 8" DIA. BORE
Page 16-17
18-19



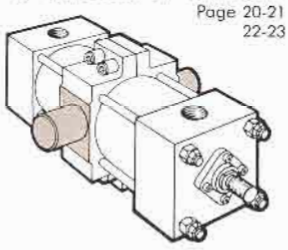
MODEL FR
(NFPA STD. MT1)
1½" THROUGH 14" DIA. BORE
Page 20-21
22-23



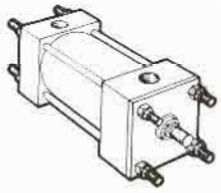
MODEL FB
(NFPA STD. MT2)
1½" THROUGH 14" DIA. BORE
Page 20-21
22-23



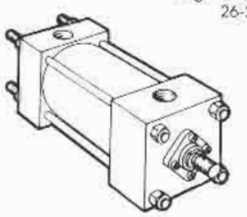
MODEL F
(NFPA STD. MT4)
1½" THROUGH 14" DIA. BORE
Page 20-21
22-23



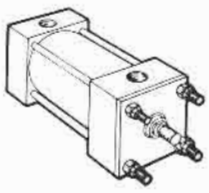
MODEL T
(NFPA STD. MX1)
1½" THROUGH 14" DIA. BORE
Page 24-25
26-27



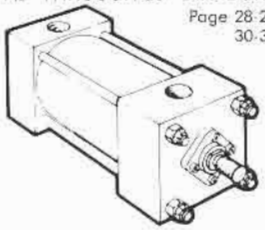
MODEL TB
(NFPA STD. MX2)
1½" THROUGH 14" DIA. BORE
Page 24-25
26-27



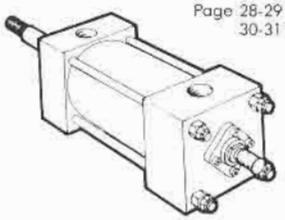
MODEL TR
(NFPA STD. MX3)
1½" THROUGH 14" DIA. BORE
Page 24-25
26-27



MODEL H
(BASIC MODEL)
1½" THROUGH 20" DIA. BORE
Page 28-29
30-31

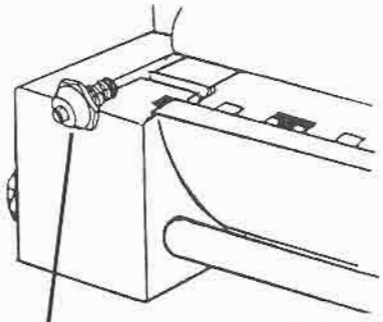


MODEL XH
(DOUBLE ROD)
1½" THROUGH 20" DIA. BORE
AVAILABLE IN MOST MODELS
Page 28-29
30-31



NOPAK HIGH PRESSURE SQUARE-HEAD CLASS 3 HYDRAULIC CYLINDERS

IMPROVED CUSHION ADJUSTMENT – Newly designed needle valve is interchangeable with current design and offers improved sealing characteristics.



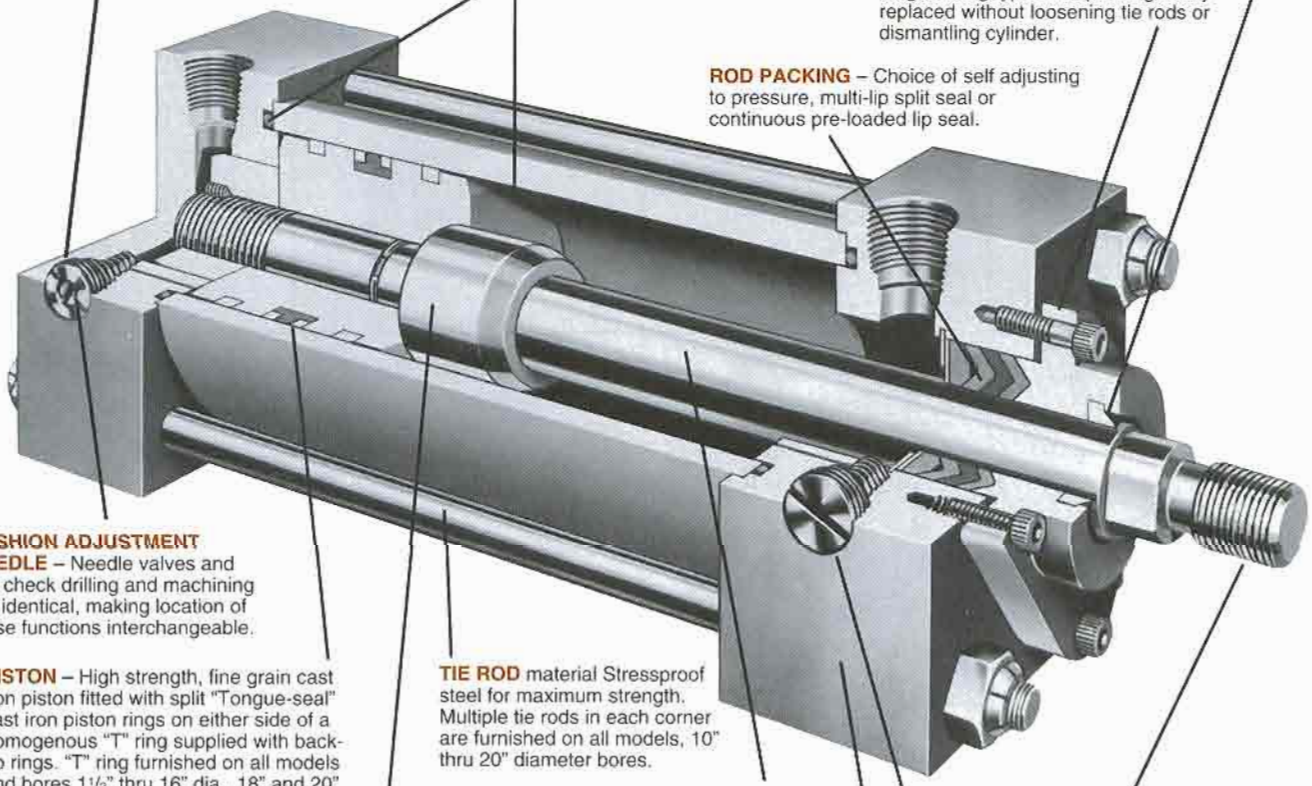
HEAVY WALL steel tubing, precision honed with extra long stones to provide over-lap and eliminate a spiral condition detrimental to long stroke cylinders. The resulting ultra-smooth finish provides maximum seal life.

TUBE SEAL – Two-Step Pilot Recess Grooves afford Positive Controlled Squeeze on Pressure Sealed O-Ring, while Tubing locates concentrically against End Cap.

ROD WIPER – Wipes rod clean and dry. Keeps foreign matter from entering cylinder, extending packing life.

PACKING GLAND – Readily removable long bearing type. Rod packing easily replaced without loosening tie rods or dismantling cylinder.

ROD PACKING – Choice of self adjusting to pressure, multi-lip split seal or continuous pre-loaded lip seal.



CUSHION ADJUSTMENT NEEDLE – Needle valves and ball check drilling and machining are identical, making location of these functions interchangeable.

PISTON – High strength, fine grain cast iron piston fitted with split "Tongue-seal" cast iron piston rings on either side of a homogenous "T" ring supplied with back-up rings. "T" ring furnished on all models and bores 1½" thru 16" dia., 18" and 20" fitted with piston rings. Other designs on application. The outboard piston rings effectively seal off initial shock loads and allow the "T" ring to seal any by-pass fluid to provide a leak-proof piston seal with maximum life.

TIE ROD material Stressproof steel for maximum strength. Multiple tie rods in each corner are furnished on all models, 10" thru 20" diameter bores.

PISTON ROD is high tensile 100,000 psi minimum yield stressproof steel, ground, polished, and flash chrome plated .0003/.0005 to provide a hard, long-wearing surface with low friction, but not corrosion resistant. Consult factory for special applications.

ROD END THREADING – Choice of standard catalog male and female thread types plus standard wrench flats.

CUSHION BALL CHECK assures quick starting under full power; pressure acts on full piston area instantaneously.

CUSHION SLEEVES precision fitted with predetermined taper to provide a gradual deceleration and reduce shock.

END CAPS (Cylinder Heads) – Precision Broached Steel Blocks

NOPAK • OPTIONS • MODIFICATIONS • ORDERING INFORMATION

OPTIONS

Bore Size Selection

Unlike air applications, the output force of a cylinder for hydraulic service need be only slightly greater than the required force. Hydraulic cylinder speed is dependent directly on the relationship of supply flow rate to cylinder volume.

Force tables to aid in cylinder sizing are on page 35.

Mountings

Select the cylinder mounting which will keep the line of force as close as possible to the centerline of the piston rod and free of misalignment. This will maximize seal and bearing life.

CUSTOM MODIFICATIONS

Stop Tubes

In long cylinders used on push applications, internal stop tubes are installed to prevent excessive bearing wear. They are located between the piston and rod end head. See page 37 for instructions.

Oversize Rods

For long, push stroke cylinders, oversize rods may be required. See page 37 for instructions.

HOW TO ORDER NOPAK CLASS 3 CYLINDERS

You can help assure prompt processing of your order by including all of the following requested information:

1. Quantity Required
2. Specify Class 3
3. Bore or cylinder diameter size.
4. Stroke length in inches.
5. Type of mounting (Nopak model or NFPA style.)
6. Type of cushioning:
   non-cushioned-NN — cushioned blind end-NA
   cushioned rod end-AN — cushioned both ends-AA
7. Piston rod diameter, and type of rod end threading as 1, 3, 4, 5, or special (see page 32.)

Double Rod End

Nopak Class 3 cylinders when ordered as double rod end are designated by prefixing the model with the letter "X". Mounting dimensions may vary from standard because two rod end heads are used.

See page 28-30.

Cushions

Nopak Class 3 cylinders are available with adjustable cushions on either or both ends, or non-cushion.

The purpose of a cushion is to slow up piston speed at the end of the stroke, eliminate shock. The mass to be cushioned should be limited to one half the cylinder power unless other provisions are made for deceleration or special cushioning.

Piston Rod Extension and Rod Threading

Longer than standard piston rod extensions may be required to accommodate load fastening.

Depending upon the details of rod engagement to load, special threading or rod end configuration may be required.

Cylinder Ports

Ports are offered as NPTF, SAE O Ring or SAE Flange Type. NPTF ports standard for 1½" thru 8" diameter cylinder bores.

To increase cylinder speed, increased fluid volume is necessary. This can be done by using enlarged or additional ports.

Also Specify:

1. Position of cylinder ports and cushion adjustment screw if other than standard. Normal positions are Cylinder Ports — position 1, Ball Check — position 2, Cushion Adjustment — position 4.
2. Extreme high or low operating or ambient temperatures.
3. Extreme operating pressures.
4. Type of operating fluid if other than standard petroleum base oil.
5. Unusual operating conditions.

ORDERING CODE

EXAMPLE:

Phone: 414-645-6000
Fax No.: 414-645-6048

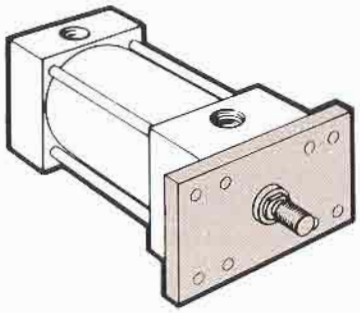
CL3 - 4 x 18 - A - △ △ - 1.75 - 4 - OPT.

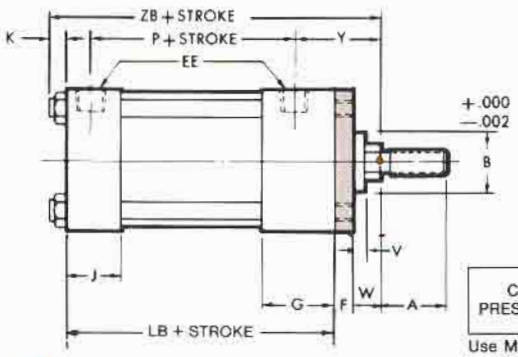
- OPT: Special modification if required.
- Rod End Thread: See chart on page 32.
- Rod Diameter: See chart at respective bore size for rod sizes available in that bore.
- Cushions: See chart below.
- Mounting style: Use either Nopak or NFPA's designation.
  NOTE: If double rod is required, add X before mounting style. (Example: XA, XD, XG, etc.)
- Stroke
- Bore (1.50" through 20")
- Class 3 Hydraulic

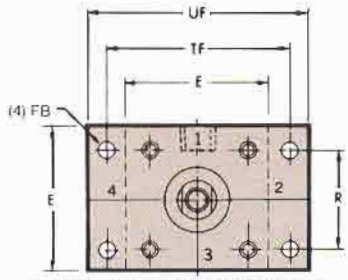
△ △ Two letters required:
NN = No cushions
NA = No cushion rod end, cushion blind end
AN = Cushion rod end, no cushion blind end
AA = Cushion both ends
OPT = Optional features required such as VITON seals, port position, etc.

NOPAK FLANGE MOUNT CYLINDERS

MODEL D (NFPA STD. MF1)





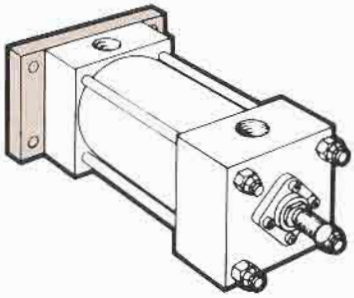


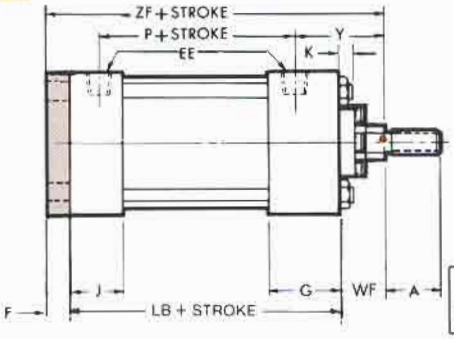
PRESSURE LIMITATIONS (PUSH)

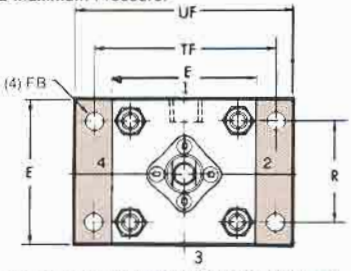
CYL. DIA	5	6	7	8
PRESSURE (PSI)	1800	1500	1000	800

Use Model DD (Below) or Model G (Page 10) for Recommended Maximum Pressure.

MODEL C (NFPA STD. MF2) ▲





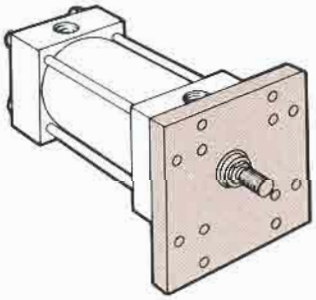


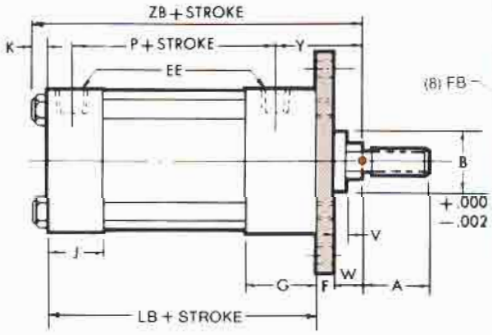
PRESSURE LIMITATIONS (PULL)

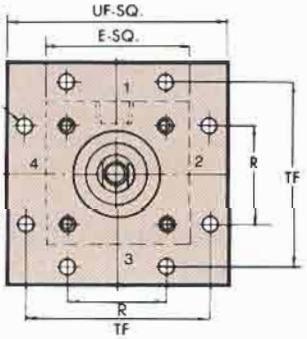
CYL. DIA	5	6	7	8
PRESSURE (PSI)	2000	1600	1200	1000

Use Model CC (Below) or Model J (Page 10) for Recommended Maximum Pressure.

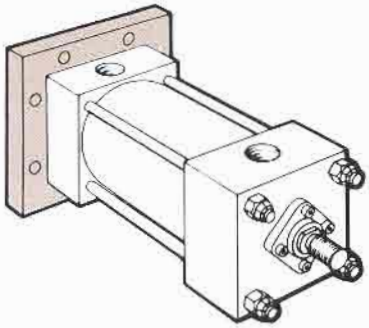
MODEL DD (NFPA STD. MF5)

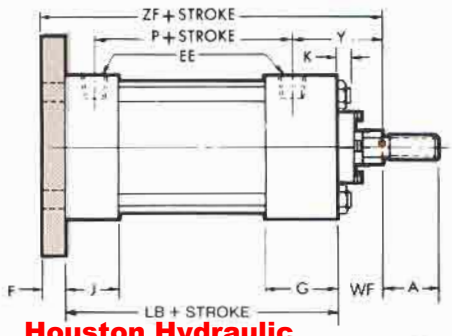


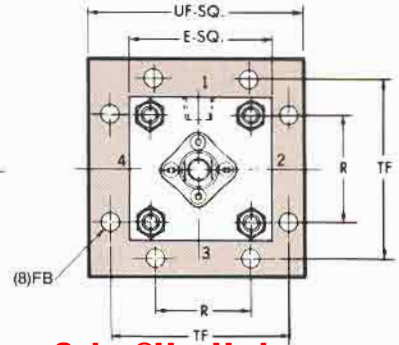




MODEL CC (NFPA STD. MF6)







▲See Table A on page 29 for bore and rod combinations using head plates with threaded bronze gland.

TABLE 1

These dimensions are constant regardless of rod diameter or stroke.

Double rod end models are designated by letter "X" preceding the model identification. See page 28.
†Dimensions refer to bolt diameter.

BORE DIA.	E	F	G	J	K	R	EE	FB†	TF	UF
1½	2½	⅜	1¾	1½	½	1.63	½	⅜	3 7/16	4¼
2	3	⅝	1¾	1½	½	2.05	½	½	4⅛	5⅛
2½	3½	⅝	1¾	1½	⅝	2.55	½	½	4⅝	5⅝
3¼	4½	¾	2¼	1¾	¾	3.25	¾	⅝	5⅞	7⅛
4	5	⅞	2¼	1¾	¾	3.82	¾	⅝	6⅜	7⅝
5	6½	⅞	2¼	1¾	1	4.95	¾	⅞	8 3/16	9¾
6	7½	1	2½	2¼	1⅛	5.73	1	1	9 7/16	11¼
7	8½	1	2¾	2¾	1⅛	6.58	1¼	1⅛	10⅝	12⅝
8	9½	1	3	3	1⅜	7.50	1½	1¼	11 13/16	14

TABLE 2

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

- Heads bored for these rod sizes are normally in stock– thus faster delivery.

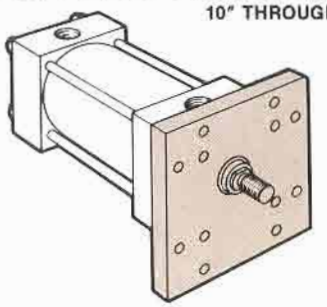
* For piston rod dimensions see page 32.

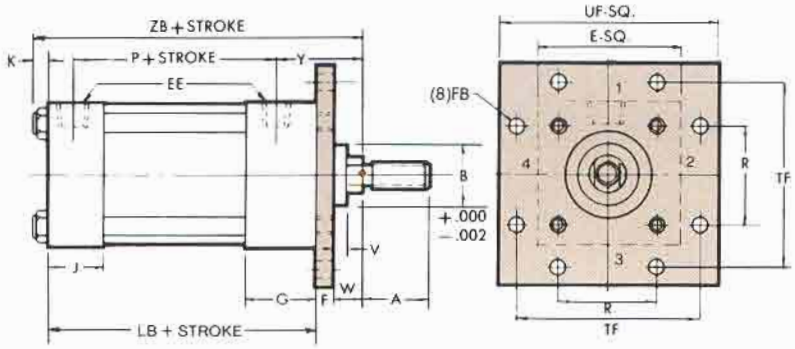
BORE DIA.	*ROD MM	A	B	P	V	W	Y	LB	WF	ZB	ZF
1½	⅝ •	¾	1⅛	2¾	¼	⅝	2 1/16	4⅝	1	6⅛	6
	1 •	1⅛	1½		½	1	2 7/16		1⅜	6½	6⅜
2	1 •	1⅛	1½	2¾	¼	¾	2 7/16	4⅝	1⅜	6½	6⅝
	1⅜ •	1⅝	2		⅜	1	2 11/16		1⅝	6¾	6⅞
2½	1 •	1⅛	1½	2⅞	¼	¾	2 7/16	4¾	1⅜	6¾	6¾
	1⅜ •	1⅝	2		⅜	1	2 11/16		1⅝	7	7
	1¾ •	2	2⅜		½	1¼	2 15/16		1⅞	7¼	7¼
3¼	1⅜ •	1⅝	2	3¼	¼	⅞	3	5½	1⅝	7⅞	7⅞
	1¾ •	2	2⅜		⅜	1⅛	3¼		1⅞	8⅛	8⅛
	2 •	2¼	2⅝		⅜	1¼	3⅜		2	8¼	8¼
4	1¾ •	2	2⅜	3½	¼	1	3¼	5¾	1⅞	8⅜	8½
	2 •	2¼	2⅝		¼	1⅛	3⅜		2	8½	8⅝
	2½ •	3	3⅛		⅜	1⅜	3⅝		2¼	8¾	8⅞
5	2 •	2¼	2⅝	4	¼	1⅛	3⅜	6¼	2	9¼	9⅛
	2½	3	3⅛		⅜	1⅜	3⅝		2¼	9½	9⅜
	3 •	3½	3¾		⅜	1⅜	3⅝		2¼	9½	9⅜
	3½ •	3½	4¼		⅜	1⅜	3⅝		2¼	9½	9⅜
6	2½ •	3	3⅛	4⅝	¼	1¼	3¾	7⅜	2¼	10¾	10⅝
	3	3½	3¾								
	3½	3½	4¼								
	4 •	4	4¾								
7	3 •	3½	3¾	5⅜	¼	1¼	3 13/16	8½	2¼	11⅞	11¾
	3½	3½	4¼								
	4	4	4¾								
	4½	4½	5¼								
	5	5	5¾								
8	3½ •	3½	4¼	6	¼	1¼	4	9½	2¼	13⅛	12¾
	4	4	4¾								
	4½	4½	5¼								
	5	5	5¾								
	5½ •	5½	6¼								

NOPAK FLANGE-MOUNT SQUARE-HEAD MOUNT CYLINDERS

MODEL DD
(ROD END FLANGE MOUNT)

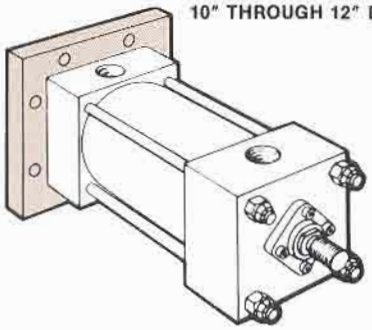
10" THROUGH 12" DIA. BORE

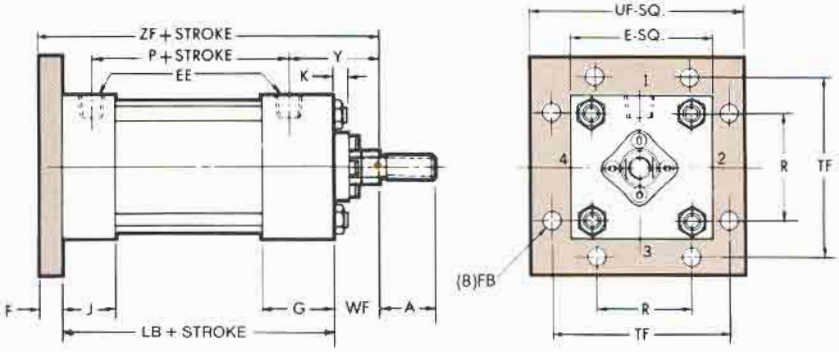




MODEL CC
(BLIND END FLANGE MOUNT)

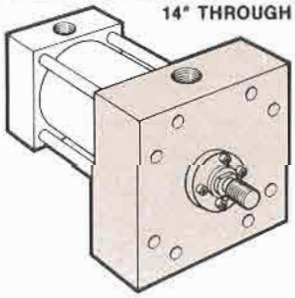
10" THROUGH 12" DIA. BORE

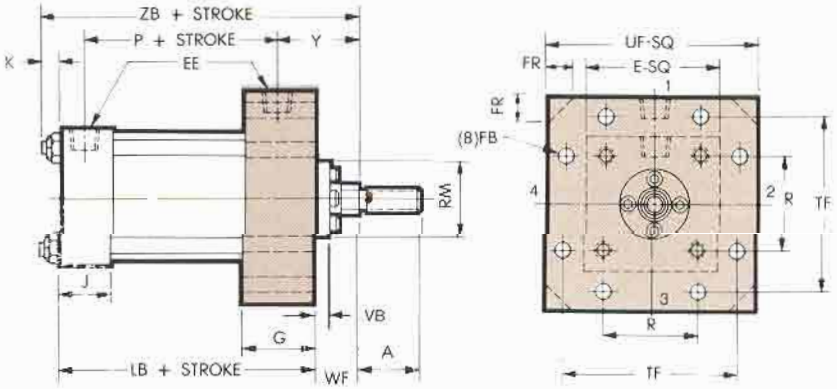




MODEL DG
(ROD HEAD SQUARE MOUNT)

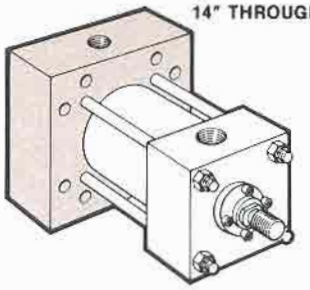
14" THROUGH 20" DIA. BORE





MODEL CJ
(BLIND HEAD SQUARE MOUNT)

14" THROUGH 20" DIA. BORE



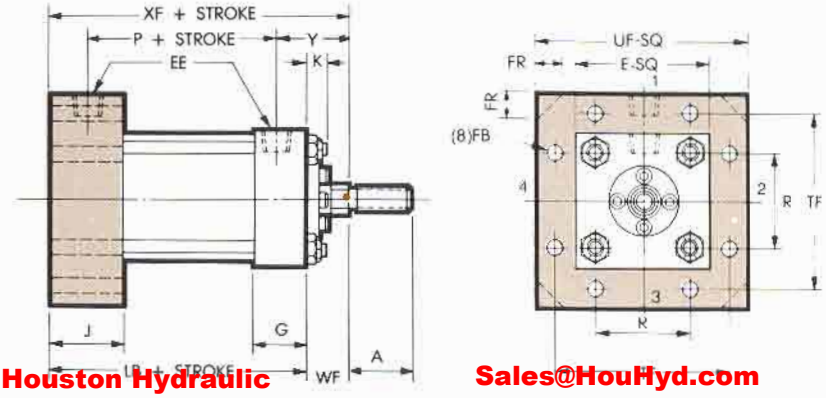


TABLE 1

These dimensions are constant regardless of rod diameter or stroke.

Double rod end models are designated by letter "X" preceding the model identification. See page 30.
†Dimensions refer to bolt diameter.

BORE DIA.	E	F	G	J	K	R	EE	FB†	FR	TF	UF
10	12 5/8	1 11/16	3 11/16	3 11/16	1 1/8	9.62	2	1 3/4	—	15 7/8	19
12	14 7/8	1 15/16	4 7/16	4 7/16	1 1/8	11.45	2 1/2	2	—	18 1/2	22
14	17 1/4	—	4 7/8	4 7/8	1 7/16	13.34	2 1/2	2 1/4	—	21	25
16	19 1/4	—	5 7/8	5 7/8	1 7/16	15.10	3	2 1/2	—	23 7/8	28 3/8
18	22	—	6 7/8	6 7/8	1 7/16	16.88	3	2 3/4	4	26 1/4	31
20	23 5/8	—	7 7/8	7 7/8	1 7/16	18.74	3	3	6	29	34 1/2

TABLE 2

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

- Heads bored for these rod sizes are normally in stock– thus faster delivery, Models DD and CC only.
- * For piston rod dimensions see page 32.

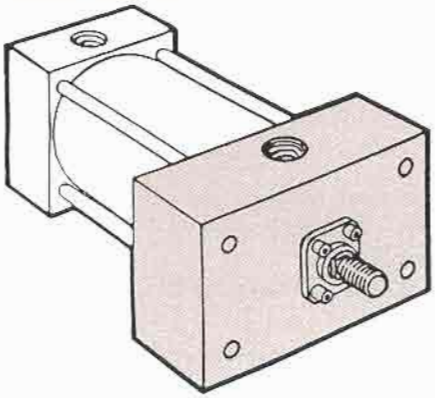
BORE DIA.	*ROD MM	A	B	P	V	W	Y	LB	RM	VB	WF	XF	ZB	ZF
10	4 1/2 •	4 1/2	5 1/4	8	1/4	1 1/4	5	12 1/8	7 1/2		2 15/16	15 1/16	16 3/16	16 3/4
	5	5	5 3/4			1 1/2	5 1/4		8 3/8		3 3/16	15 5/16	16 7/16	17
	5 1/2	5 1/2	6 1/4			1 1/2	5 1/4		9					
	7	7	10 1/4		11/16	1 1/2	5 1/4		10 1/4	2 3/8				
12	5 1/2	5 1/2	6 1/4	9 5/8	1/4	1 1/4	5 5/8	14 1/2	9		3 3/16	17 11/16	18 3/16	19 5/8
	7	7	10 1/4		7/16	1 1/2	5 7/8		10 1/4	2 3/8	3 7/16	17 15/16	19 1/16	19 7/8
	8	8	11 1/4			1 1/2	5 7/8		11 1/4					
14	7	7	—	9 7/8	—	—	6 3/8	15 5/8	10 1/4	2 3/8	3 1/2	19 1/8	20 1/4	21 3/8
	8	8	—				6 3/8		11 1/4					
	10	10	—				6 3/8		14	2 1/2				
16	8	8	—	11 3/8	—	—	7 3/8	18 1/8	11 1/4	2 3/8	4	22 1/4	23 9/16	24 7/8
	9	9	—				7 3/8		12 1/2	2 1/2				
	10	10	—				7 3/8		14					
18	9	9	—	12 3/8	—	—	8 5/8	21 1/8	12 1/2	2 1/2	4 1/4	25 3/8	26 13/16	28 3/8
	10	10	—				8 5/8		14					
20	10	10	—	13 3/8	—	—	9 5/8	23 5/8	14	2 1/2	4 1/2	28 1/8	29 9/16	31 3/8

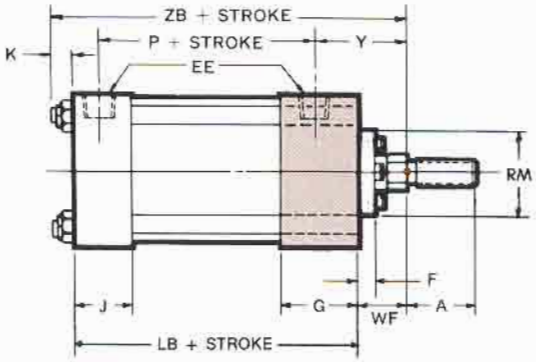
NOPAK

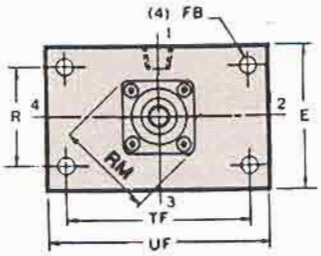
- ROD HEAD RECTANGULAR MOUNT
- BLIND HEAD RECTANGULAR MOUNT

1½" THROUGH 12" BORE

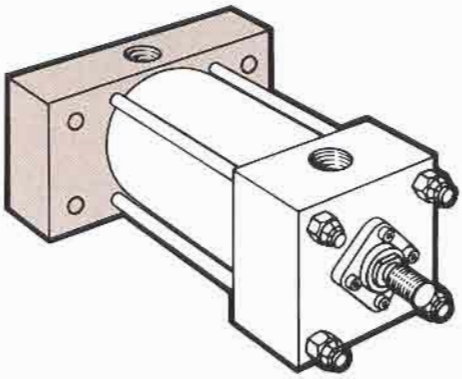
MODEL G (NFPA STD. ME5)

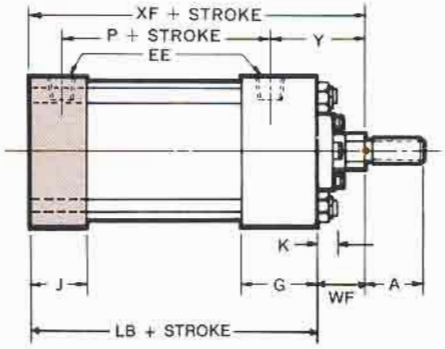






MODEL J (NFPA STD. ME6) ▲





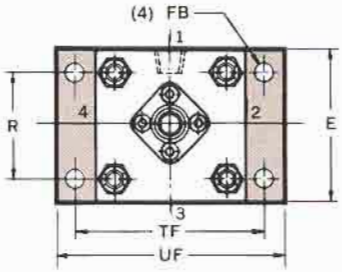


TABLE 1

These dimensions are constant regardless of rod diameter or stroke.

Double rod end models are designated by letter "X" preceding the model identification. See page 30.
†Dimensions refer to bolt diameter.

BORE DIA.	E	G	J	K	R	EE	†FB	TF	UF
1½	2½	1¾	1½	½	1.63	½	⅜	3 7/16	4¼
2	3	1¾	1½	½	2.05	½	½	4⅛	5⅛
2½	3½	1¾	1½	⅝	2.55	½	½	4⅝	5⅝
3¼	4½	2¼	1¾	¾	3.25	¾	⅝	5⅞	7⅛
4	5	2¼	1¾	¾	3.82	¾	⅝	6⅜	7⅝
5	6½	2¼	1¾	1	4.95	¾	⅞	8 3/16	9¾
6	7½	2½	2¼	1⅛	5.73	1	1	9 7/16	11¼
7	8½	2¾	2¾	1¼	6.58	1¼	1⅛	10⅝	12⅝
8	9½	3	3	1½	7.50	1½	1¼	11 13/16	14
10	12⅝	3 11/16	3 11/16	1⅛	9.62	2	1¾	15⅞	19
12	14⅞	4 7/16	4 7/16	1⅛	11.45	2½	2	18½	22

▲See Table A on page 28 for bolt and combinations using head plates with threaded bronze gland.

TABLE 2

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

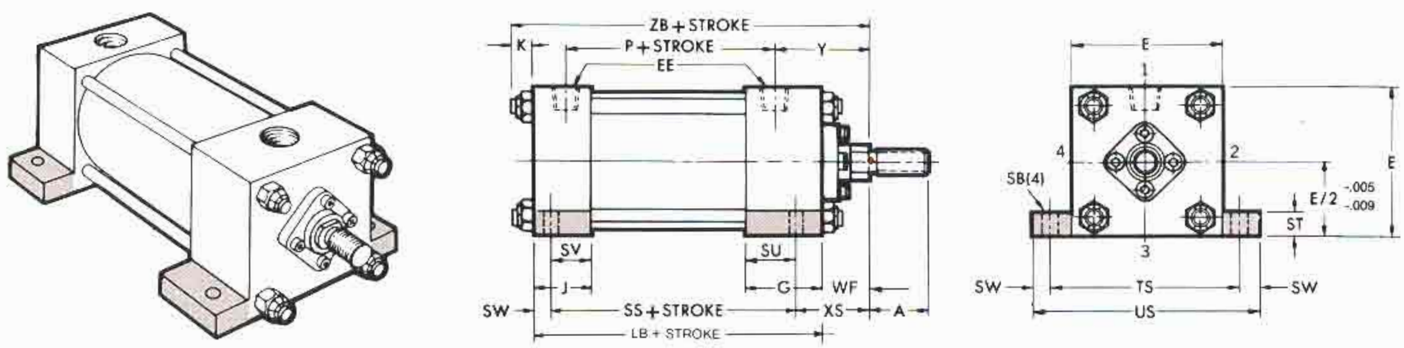
- Heads bored for these rod sizes are normally in stock– thus faster delivery. ■ Model J only.
- * For piston rod dimensions see page 32.

BORE DIA.	*ROD MM	A	F	P	Y	LB	RM	WF	XF	ZB
1½	5/8 •	3/4	3/8	2¾	2 1/16	4⅝	2⅛	1	5⅝	6⅛
	1 •■	1⅛	½		2 7/16		2⅜	1⅜	6	6½
2	1 •	1⅛	½	2¾	2 7/16	4⅝	2⅜	1⅜	6	6½
	1⅜ •■	1⅝	9/16		2 11/16		3	1⅝	6¼	6¾
2½	1 •	1⅛	½	2⅞	2 7/16	4¾	2⅜	1⅜	6⅛	6¾
	1⅜ •■	1⅝	9/16		2 11/16		3	1⅝	6⅜	7
	1¾ •■	2	9/16		2 15/16		3½	1⅞	6⅝	7¼
3¼	1⅜ •	1⅝	9/16	3¼	3	5½	3	1⅝	7⅛	7⅞
	1¾ •■	2	9/16		3¼		3½	1⅞	7⅜	8⅛
	2 •■	2¼	9/16		3⅜		4⅛	2	7½	8¼
4	1¾ •	2	9/16	3½	3¼	5¾	3½	1⅞	7⅝	8⅜
	2 •■	2¼	9/16		3⅜		4⅛	2	7¾	8½
	2½ •■	3	¾		3⅝		4⅝	2¼	8	8¾
5	2 •	2¼	9/16	4	3⅜	6¼	4⅛	2	8¼	9¼
	2½	3	¾		3⅝		4⅝	2¼	8½	9½
	3 •■	3½	¾		3⅝		5⅜	2¼	8½	9½
	3½ •■	3½	¾		3⅝		6⅛	2¼	8½	9½
6	2½ •	3	¾	4⅝	3¾	7⅜	4⅝	2¼	9⅝	10¾
	3	3½	¾				5⅜		9⅝	10¾
	3½	3½	¾				6⅛		9⅝	10¾
	4 •■	4	13/16				6⅞		9⅝	10¾
7	3 •	3½	¾	5⅜	3 13/16	8½	5⅜	2¼	10¾	11⅞
	3½	3½	¾				6⅛		10¾	11⅞
	4	4	13/16				6⅞		10¾	11⅞
	4½	4½	13/16				7½		10¾	11⅞
	5	5	15/16				8⅜		10¾	11⅞
8	3½ •	3½	¾	6	4	9½	6⅛	2¼	11¾	13⅛
	4	4	13/16				6⅞		11¾	13⅛
	4½	4½	13/16				7½		11¾	13⅛
	5	5	15/16				8⅜		11¾	13⅛
	5½ •■	5½	15/16				9		11¾	13⅛
10	4½	4½	13/16	8	5	12⅛	7½	2 15/16	15 1/16	16 3/16
	5	5	15/16		5¼		8⅜	3 3/16	15 5/16	16 7/16
	5½	5½	15/16		5¼		9		15 5/16	16 7/16
	7	7	2 3/16		5¼		10¼		15 5/16	16 7/16
12	5½	5½	15/16	9⅝	5⅝	14½	9	3 3/16	17 11/16	18 13/16
	7	7	2 3/16		5⅞		10¼	3 7/16	17 15/16	19 1/16
	8	8	2 7/16		5⅞		11¼		17 15/16	19 1/16

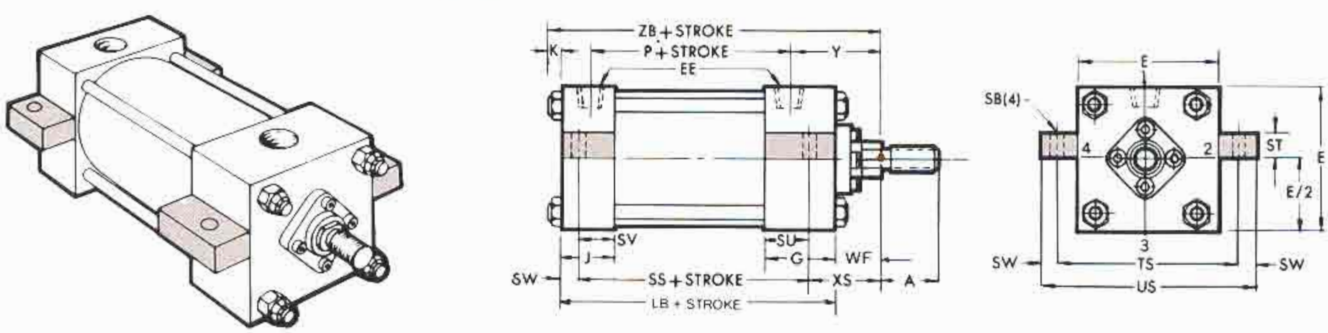
NOPAK SIDE AND LUG MOUNT CYLINDERS

1½" THROUGH 7" BORE

MODEL A (NFPA STD. MS2) ▲



MODEL B (NFPA STD. MS3) ▲



For double rod end cylinders Model A and B — subtract dimension SV from SU and add the difference to dimension SS + stroke.

Double rod end models are designated by letter "X" preceding the model identification. See page 28.
†Dimensions refer to bolt diameter.

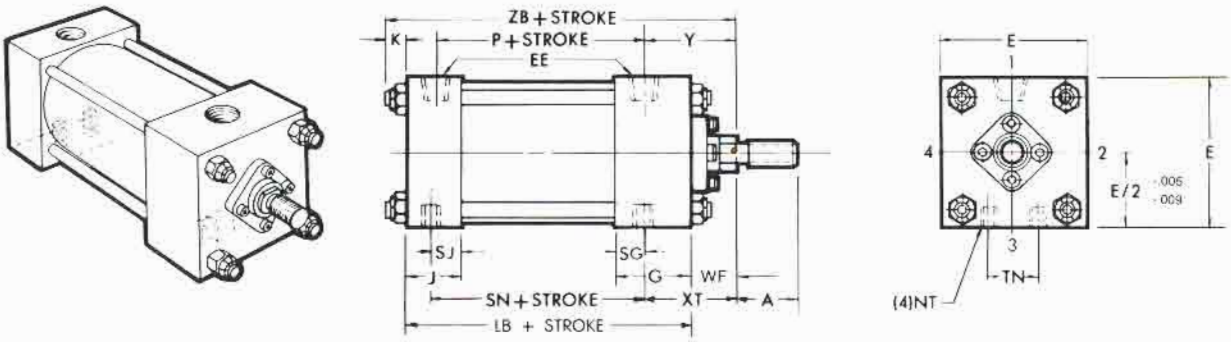
TABLE 1

These dimensions are constant regardless of rod diameter or stroke.

BORE DIA.	E	G	J	K	EE	NT	SB†	SG	SJ	ST	SU	SV	SW	TN	TS	US
1½	2½	1¾	1½	½	½	⅜-16	⅜	¾	¾	½	1⅜	1⅛	⅜	¾	3¼	4
2	3	1¾	1½	½	½	½-13	½	¾	¾	¾	1¼	1	½	15/16	4	5
2½	3½	1¾	1½	⅝	½	⅝-11	¾	¾	¾	1	1 1/16	13/16	11/16	1 5/16	4⅞	6¼
3¼	4½	2¼	1¾	¾	¾	¾-10	¾	1⅛	⅞	1	1 9/16	1 1/16	11/16	1½	5⅞	7¼
4	5	2¼	1¾	¾	¾	1-8	1	1⅛	⅞	1¼	1⅜	⅞	⅞	2 1/16	6¾	8½
5	6½	2¼	1¾	1	¾	1-8	1	1⅛	⅞	1¼	1⅜	⅞	⅞	2 15/16	8¼	10
6	7½	2½	2¼	1⅛	1	1¼-7	1¼	1¼	1¼	1½	1⅜	1⅛	1⅛	3 5/16	9¾	12
7	8½	2¾	2¾	1⅛	1¼	1½-6	1½	1 13/16	1 11/16	1¾	1⅜	1⅜	1⅜	3¾	11¼	14

▲See Tab[illegible]ons using[illegible]bronze gland.

MODEL S (USA STD. MS4)



For double rod end cylinders Model S — In place of dimension SN + stroke, multiply dimension XT times 2 and to this total add the cylinder stroke. From this figure, subtract the ZM + double stroke (See Page 29-31).

TABLE 2

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

- Heads bored for these rod sizes are normally in stock– thus faster delivery. NOTE: MODEL B EXCLUDED.

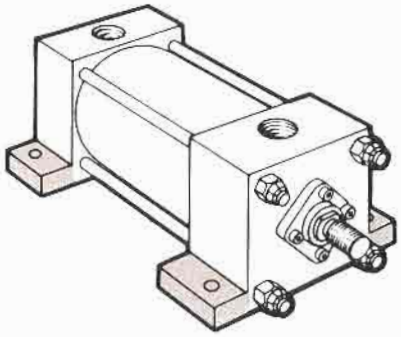
* For piston rod dimensions see page 32.

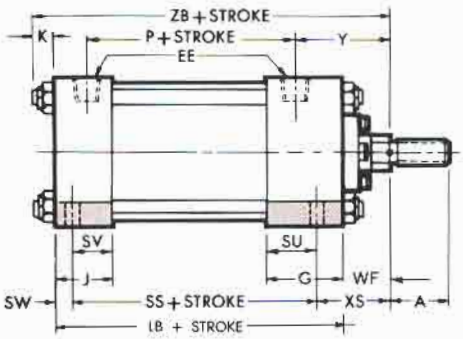
BORE DIA.	*ROD MM	A	P	Y	LB	SN	SS	WF	XS	XT	ZB
1½	5/8 •	3/4	2¾	2 1/16	4⅝	2⅞	3⅞	1	1⅜	2	6⅛
	1 •	1⅛		2 7/16				1⅜	1¾		6½
2	1 •	1⅛	2¾	2 7/16	4⅝	2⅞	3⅝	1⅜	1⅞	2⅜	6½
	1⅜ •	1⅝		2 11/16				1⅝	2⅛		6¾
2½	1 •	1⅛	2⅞	2 7/16	4¾	3	3⅜	1⅜	2 1/16	2⅜	6¾
	1⅜ •	1⅝		2 11/16				1⅝	2 5/16		7
	1¾ •	2		2 15/16				1⅞	2 9/16		7¼
3¼	1⅜ •	1⅝	3¼	3	5½	3½	4⅛	1⅝	2 5/16	2¾	7⅞
	1¾ •	2		3¼				1⅞	2 9/16		8⅛
	2 •	2¼		3⅜				2	2 11/16		8¼
4	1¾ •	2	3½	3¼	5¾	3¾	4	1⅞	2¾	3	8⅜
	2 •	2¼		3⅜				2	2⅞		8½
	2½ •	3		3⅝				2¼	3⅛		8¾
5	2 •	2¼	4	3⅜	6¼	4¼	4½	2	2⅞	3⅛	9¼
	2½	3		3⅝				2¼	3⅛		9½
	3 •	3½		3⅝				2¼	3⅛		9½
	3½ •	3½		3⅝				2¼	3⅛		9½
6	2½ •	3	4⅝	3¾	7⅜	5⅛	5⅛	2¼	3⅜	3½	10¾
	3	3½		3¾				2¼	3⅜		10¾
	3½	3½		3¾				2¼	3⅜		10¾
	4 •	4		3¾				2¼	3⅜		10¾
7	3 •	3½	5⅜	3 13/16	8½	5⅞	5¾	2¼	3⅝	3 13/16	11⅞
	3½	3½		3 13/16				2¼	3⅝		11⅞
	4	4		3 13/16				2¼	3⅝		11⅞
	4½	4½		3 13/16				2¼	3⅝		11⅞
	5	5		3 13/16				2¼	3⅝		11⅞

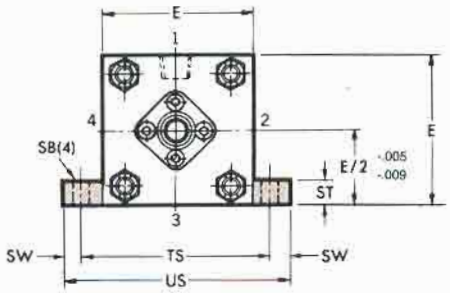
NOPAK SIDE AND LUG MOUNT CYLINDERS

MODEL A (NFPA STD. MS2)

8" THROUGH 14" DIA. BORE

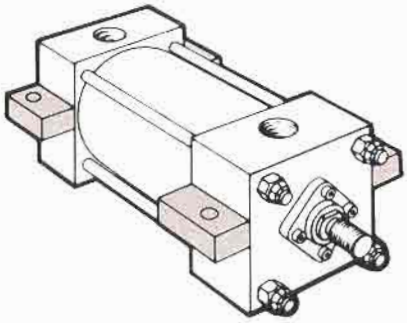


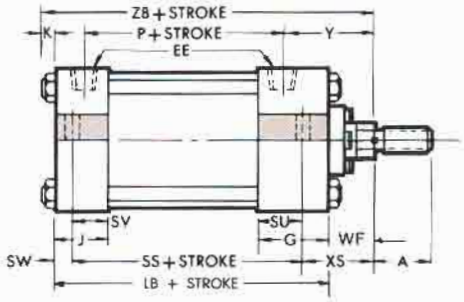


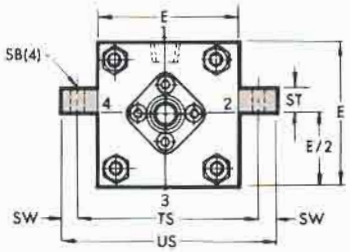


MODEL B (NFPA STD. MS3)

8" THROUGH 20" DIA. BORE







For double rod end cylinders Model A and B — subtract dimension SV from SU and add the difference to dimension SS + stroke.

Double rod end models are designated by letter "X" preceding the model identification. See page 30.

†Dimensions refer to bolt diameter.

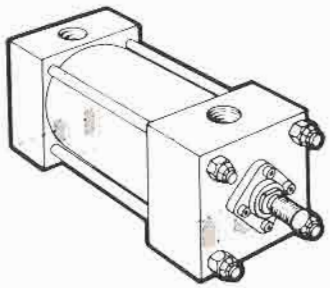
TABLE 1

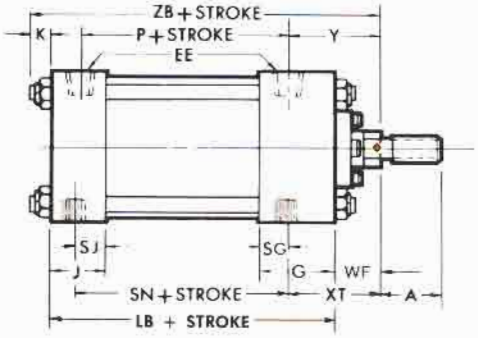
These dimensions are constant regardless of rod diameter or stroke.

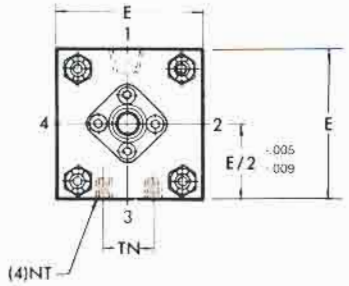
BORE DIA.	E	G	J	K	EE	NT	SB†	SG	SJ	ST	SU	SV	SW	TN	TS	US
8	9 1/2	3	3	1 3/8	1 1/2	1 1/2-6	1 1/2	1 5/16	1 13/16	1 3/4	1 5/8	1 5/8	1 3/8	4 1/4	12 1/4	15
10	12 5/8	3 11/16	3 11/16	1 1/8	2	—	1 1/2	—	—	2 1/4	2 1/16	2 1/16	1 5/8	—	15 7/8	19 1/8
12	14 7/8	4 7/16	4 7/16	1 1/8	2 1/2	—	1 1/2	—	—	3	2 7/16	2 7/16	2	—	18 7/8	22 7/8
14	17 1/4	4 7/8	4 7/8	1 7/16	2 1/2	—	2 1/4	—	—	4	2 5/8	2 5/8	2 1/4	—	21 3/4	26 1/4
16	19 1/4	5 7/8	5 7/8	1 7/16	3	—	2 1/2	—	—	4 1/2	3 1/8	3 1/8	2 1/2	—	24 1/4	29 1/4
18	22	6 7/8	6 7/8	1 7/16	3	—	2 3/4	—	—	5 1/4	3 5/8	3 5/8	2 3/4	—	27 1/2	33
20	23 5/8	7 7/8	7 7/8	1 7/16	3	—	3	—	—	6 1/2	4	4	3 1/4	—	30 1/8	36 5/8

MODEL S (NFPA STD. MS4)

8" DIA. BORE







THIS MODEL AVAILABLE IN SMALL ROD ONLY

For double rod end cylinders Model S — In place of dimension SN + stroke, multiply dimension XT times 2 and to this total add the cylinder stroke. From this figure, subtract the ZM + double stroke (See Page 29-31).

TABLE 2

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

- Heads bored for these rod sizes are normally in stock– thus faster delivery. Models A and S only.

* For piston rod dimensions see page 32.

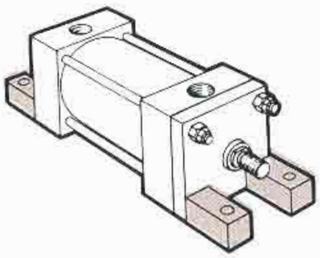
BORE DIA.	*ROD MM	A	P	Y	LB	SN	SS	WF	XS	XT	ZB
8	3½ •	3½	6	4	9½	6⅝	6¾	2¼	3⅝	3 15/16	13⅛
	4	4				—				—	
	4½	4½									
	5	5									
	5½	5½									
10	4½	4½	8	5	12⅛	—	8⅞	2 15/16	4 9/16	—	16 3/16
	5	5		5¼				3 3/16	4 13/16		16 7/16
	5½	5½									
	7	7									
12	5½	5½	9⅝	5⅝	14½	—	10½	3 3/16	5 3/16	—	18 13/16
	7	7		5⅞				3 7/16	5 7/16		19 1/16
	8	8									
14	7	7	9⅞	6⅜	15⅝	—	11⅛	3½	5¾	—	20¼
	8	8									
	10	10									
16	8	8	11⅜	7⅜	18⅛	—	12⅝	4	6¾	—	23 9/16
	9	9									
	10	10									
18	9	9	12⅜	8⅝	21⅛	—	14⅝	4¼	7½	—	26 13/16
	10	10									
20	10	10	13⅜	9⅝	23⅝	—	15⅞	4½	8⅜	—	29 9/16

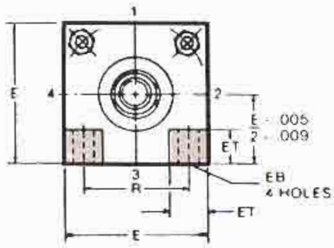
NOPAK

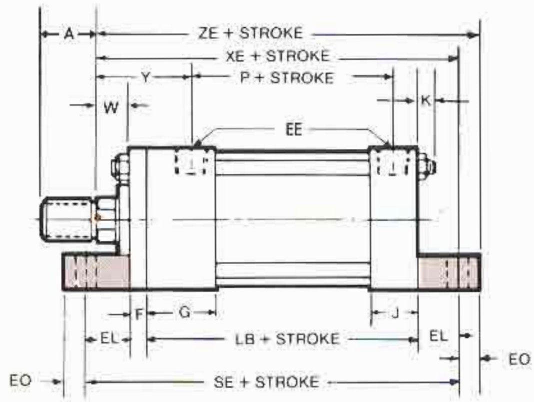
1½" THROUGH 7" DIA.

END LUG FIXED CLEVIS DETACHABLE CLEVIS MOUNT CYLINDERS

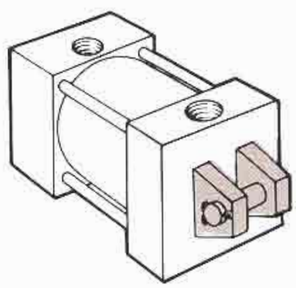
MODEL AL (NFPA STD. MS7)



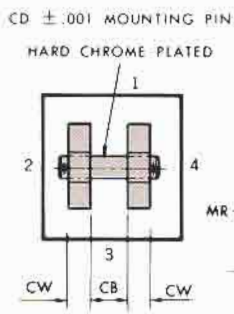


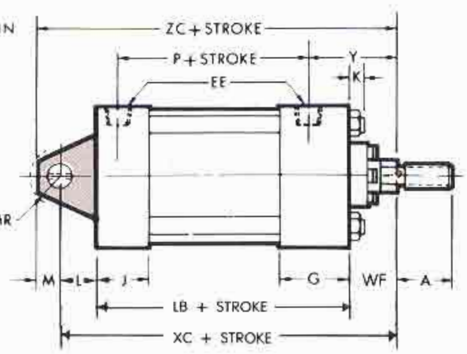


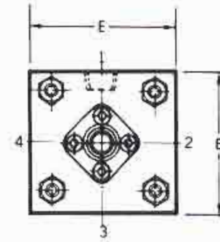
MODEL E (NFPA STD. MP1) ▲



Note: Pin Ø is CD.
Swing radius is MR.







For double rod end cylinders Model AL — subtract dimension J from G and add to dimension SE + stroke.

Double rod end models are designated by letter "X" preceding the model identification. See page 28.
†Dimensions refer to bolt diameter.

TABLE 1

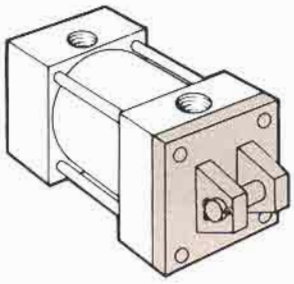
These dimensions are constant regardless of rod diameter or stroke.

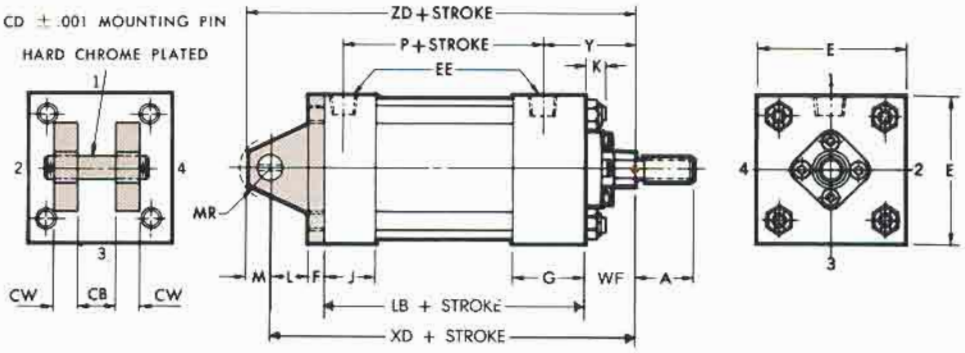
BORE DIA.	E	F AL	F HE	G	J	K	L	M	R	CB	CD	CW	EB†	EE	EL	EO	ET	MR
1½	2½	⅜	⅜	1¾	1½	½	¾	½	1.81	¾	½	½	⅜	½	⅞	⅜	11/16	⅝
2	3	⅝	⅝	1¾	1½	½	1¼	¾	2.19	1¼	¾	⅝	½	½	15/16	½	13/16	⅞
2½	3½	⅝	⅝	1¾	1½	⅝	1¼	¾	2.55	1¼	¾	⅝	½	½	15/16	½	15/16	⅞
3¼	4½	¾	⅞	2¼	1¾	¾	1½	1	3.25	1½	1	¾	⅝	¾	1⅛	⅝	1¼	1¼
4	5	⅞	⅞	2¼	1¾	¾	2⅛	1⅜	3.82	2	1⅜	1	⅝	¾	1⅛	⅝	1 3/16	1⅝
5	6½	⅞	1⅛	2¼	1¾	1	2¼	1¾	4.95	2½	1¾	1¼	⅞	¾	1½	¾	1 9/16	2
6	7½	1	1 7/16	2½	2¼	1⅛	2½	2	5.73	2½	2	1¼	1	1	1 11/16	⅞	1¾	2⅜
7	8½	1	1⅝	2¾	2¾	1⅛	3	2½	6.58	3	2½	1½	1⅛	1¼	1 13/16	1	1⅞	3

▲See Tabl[illegible]ns using [illegible]bronze gland.

MODEL HE (NFPA STD. MP2) ▲

(1½" THROUGH 7" DIA.)





Note: Pin Ø is CD.
Swing radius is MR.

TABLE 2

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

- Heads bored for these rod sizes are normally in stock– thus faster delivery. NOTE: MODEL AL EXCLUDED.

* For piston rod dimensions see page 32.

BORE DIA.	*ROD MM	A	P	W	Y	LB	SE	WF	XC	XD	XE	ZC	ZD	ZE
1½	5/8 •	3/4	2 3/4	5/8	2 1/16	4 5/8	6 3/4	1	6 3/8	6 3/4	6 1/2	6 7/8	7 1/4	6 7/8
	1 •	1 1/8		1	2 7/16			1 3/8	6 3/4	7 1/8	6 7/8	7 1/4	7 5/8	7 1/4
2	1 •	1 1/8	2 3/4	3/4	2 7/16	4 5/8	7 1/8	1 3/8	7 1/4	7 7/8	6 15/16	8	8 5/8	7 7/16
	1 3/8 •	1 5/8		1	2 11/16			1 5/8	7 1/2	8 1/8	7 3/16	8 1/4	8 7/8	7 11/16
2½	1 •	1 1/8	2 7/8	3/4	2 7/16	4 3/4	7 1/4	1 3/8	7 3/8	8	7 1/16	8 1/8	8 3/4	7 9/16
	1 3/8 •	1 5/8		1	2 11/16			1 5/8	7 5/8	8 1/4	7 5/16	8 3/8	9	7 13/16
	1 3/4 •	2		1 1/4	2 15/16			1 7/8	7 7/8	8 1/2	7 9/16	8 5/8	9 1/4	8 1/16
3 1/4	1 3/8 •	1 5/8	3 1/4	7/8	3	5 1/2	8 1/2	1 5/8	8 5/8	9 1/2	8 1/4	9 5/8	10 1/2	8 7/8
	1 3/4 •	2		1 1/8	3 1/4			1 7/8	8 7/8	9 3/4	8 1/2	9 7/8	10 3/4	9 1/8
	2 •	2 1/4		1 1/4	3 3/8			2	9	9 7/8	8 5/8	10	10 7/8	9 1/4
4	1 3/4 •	2	3 1/2	1	3 1/4	5 3/4	8 7/8	1 7/8	9 3/4	10 5/8	8 3/4	11 1/8	12	9 3/8
	2 •	2 1/4		1 1/8	3 3/8			2	9 7/8	10 3/4	8 7/8	11 1/4	12 1/8	9 1/2
	2 1/2 •	3		1 3/8	3 5/8			2 1/4	10 1/8	11	9 1/8	11 1/2	12 3/8	9 3/4
5	2 •	2 1/4	4	1 1/8	3 3/8	6 1/4	10 1/8	2	10 1/2	11 5/8	9 3/4	12 1/4	13 3/8	10 1/2
	2 1/2	3		1 3/8	3 5/8			2 1/4	10 3/4	11 7/8	10	12 1/2	13 5/8	10 3/4
	3 •	3 1/2		1 3/8				2 1/4						
	3 1/2 •	3 1/2		1 3/8				2 1/4						
6	2 1/2 •	3	4 5/8	1 1/4	3 3/4	7 3/8	11 3/4	2 1/4	12 1/8	13 9/16	11 5/16	14 1/8	15 9/16	12 1/2
	3	3 1/2												
	3 1/2	3 1/2												
	4 •	4												
7	3 •	3 1/2	5 3/8	1 1/4	3 13/16	8 1/2	13 1/8	2 1/4	13 3/4	15 3/8	12 9/16	16 1/4	17 7/8	13 9/16
	3 1/2	3 1/2												
	4	4												
	4 1/2	4 1/2												
	5	5												

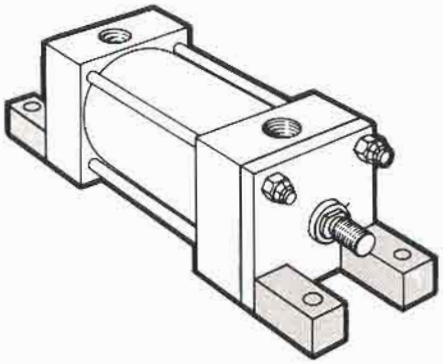
▲See Table A on page 29 for bore and rod combinations using head plates with threaded bronze gland.

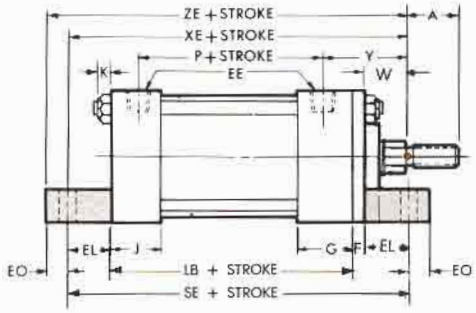
NOPAK

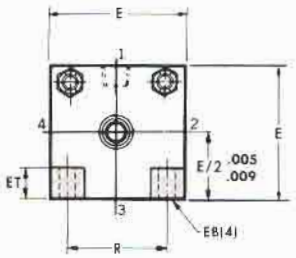
END LUG
FIXED CLEVIS
DETACHABLE CLEVIS
MOUNT CYLINDERS

MODEL AL (NFPA STD. MS7)

8" DIA. BORE

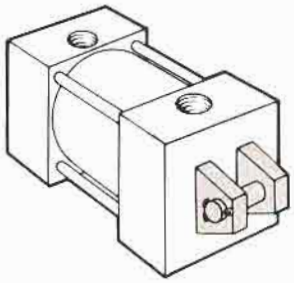


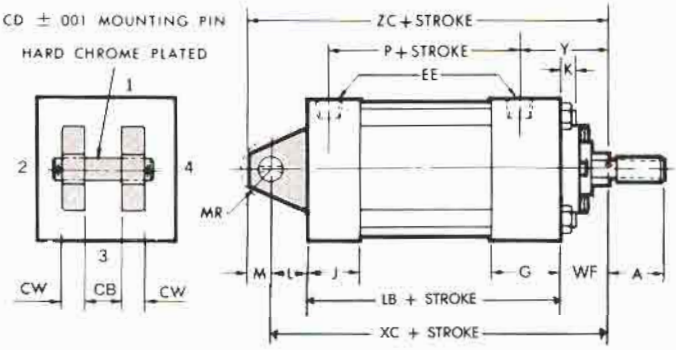


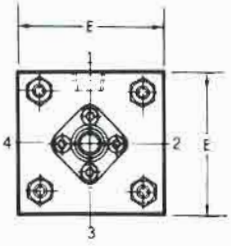


MODEL E (NFPA STD. MP1)

8" THROUGH 20" DIA. BORE







Note: Pin Ø is CD.
Swing radius is MR.

For double rod end cylinders Model AL — subtract dimension J from G and add to dimension SE + stroke.

Double rod end models are designated by letter "X" preceding the model identification. See page 30.

†Dimensions refer to bolt diameter.

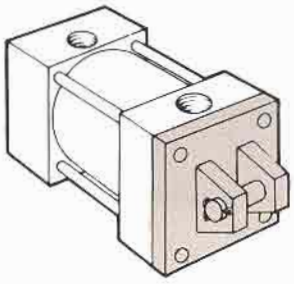
TABLE 1

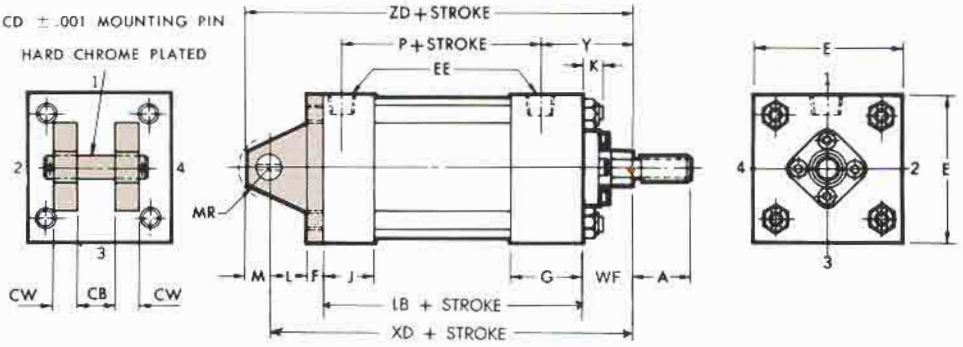
These dimensions are constant regardless of rod diameter or stroke.

BORE DIA.	E	F AL	F HE	G	J	K	L	M	R	CB	CD	CW	EB†	EE	EL	EO	ET	MR
8	9½	1	2	3	3	1⅜	3¼	2¾	7.50	3	3	1½	1¼	1½	2	1⅛	2	3¼
10	12⅝	—		3 11/16	3 11/16	1⅛	4	3½	—	4	3½	2	—	2	—	—	—	3½
12	14⅞	—		4 7/16	4 7/16	1⅛	4⅝	4	—	4½	4	2¼	—	2½	—	—	—	4
14	17¼	—		4⅞	4⅞	1 7/16	5⅝	5	—	6	5	3	—	2½	—	—	—	5
16	19¼	—		5⅞	5⅞	1 7/16	7	6	—	7	6	3½	—	3	—	—	—	6
18	22	—		6⅞	6⅞	1 7/16	7⅝	6½	—	8	6½	4	—	3	—	—	—	6½
20	23⅝	—		7⅞	7⅞	1 7/16	8¾	7½	—	9	7½	4½	—	3	—	—	—	7½

MODEL HE (NFPA STD. MP2)

8" DIA. BORE





Note: Pin Ø is CD.
Swing radius is MR.

TABLE 2

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

- Heads bored for these rod sizes are normally in stock– thus faster delivery. NOTE: MODEL AL EXCLUDED.

* For piston rod dimensions see page 32.

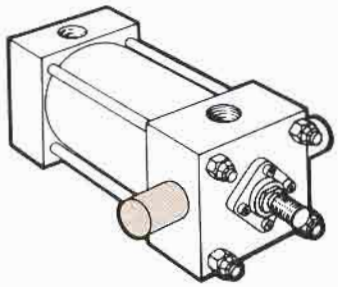
BORE DIA.	*ROD MM	A	P	W	Y	LB	SE	WF	XC	XD	XE	ZC	ZD	ZE
8	3½ •	3½	6	1¼	4	9½	14½	2¼	15	17	13¾	17¾	19¾	14⅞
	4	4												
	4½	4½												
	5	5												
	5½ •	5½												
10	4½ •	4½	8	—	5	12⅛	—	2 15/16	19 1/16	—	—	22 9/16	—	—
	5	5			5¼			3 3/16	19 5/16			22 13/16		
	5½	5½												
	7	7												
12	5½	5½	9⅝	—	5⅝	14½	—	3 3/16	22 5/16	—	—	26 5/16	—	—
	7	7			5⅞			3 7/16	22 9/16			26 9/16		
	8	8												
14	7	7	9⅞	—	6⅜	15⅝	—	3½	24¾	—	—	29¾	—	—
	8	8												
	10	10												
16	8	8	11⅜	—	7⅜	18⅛	—	4	29⅛	—	—	35⅛	—	—
	9	9												
	10	10												
18	9	9	12⅜	—	8⅝	21⅛	—	4¼	33	—	—	39½	—	—
	10	10												
20	10	10	13⅜	—	9⅝	23⅝	—	4½	36⅞	—	—	44⅜	—	—

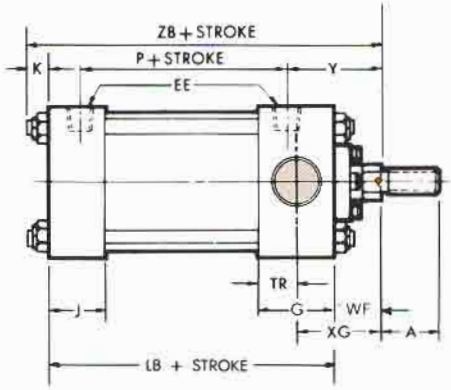
NOPAK TRUNNION MOUNT CYLINDERS

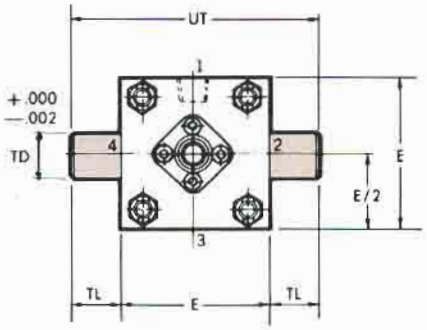
1½" THROUGH 7" DIA.

MODEL FR (NFPA STD. MT1) ▲

Integral trunnion pins are designed for shear, not bending, loads.

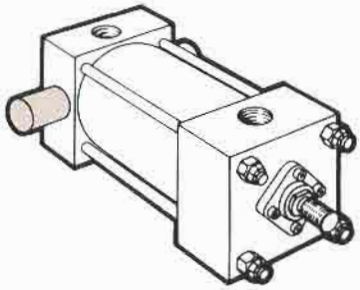


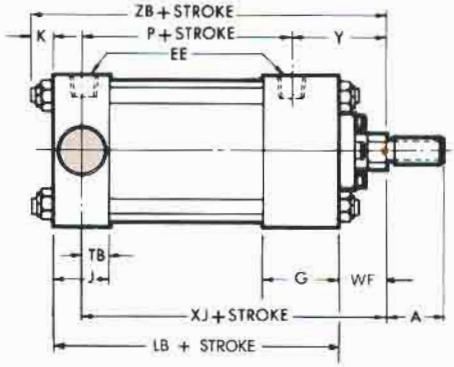




MODEL FB (NFPA STD. MT2) ▲

Integral trunnion pins are designed for shear, not bending, loads.





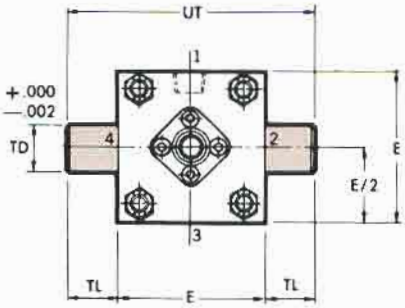


TABLE 1

These dimensions are constant regardless of rod diameter or stroke.

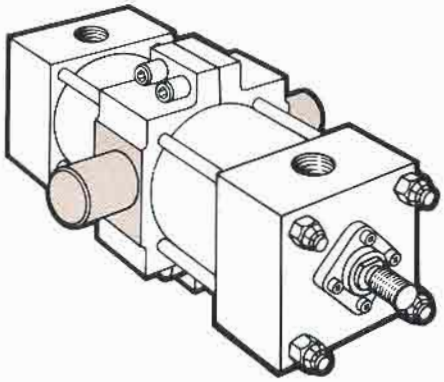
Double rod end models are designated by letter "X" preceding the model identification. See page 28.

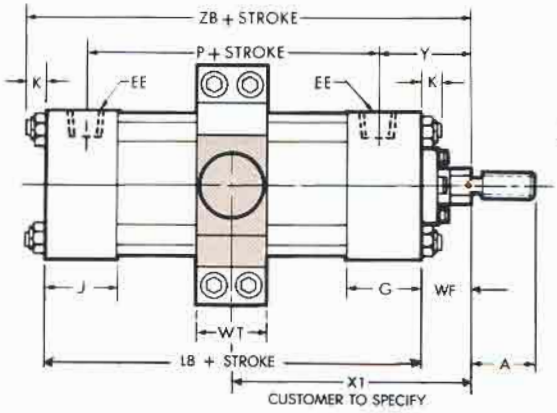
BORE DIA.	E	G	J	K	EE	TB	TD	TL	TM	TR	UM	UT	UV	WT
1½	2½	1¾	1½	½	½	¾	1	1	3	⅞	5	4½	4	1¼
2	3	1¾	1½	½	½	¾	1⅜	1⅜	3½	⅞	6¼	5¾	4¾	1½
2½	3½	1¾	1½	⅝	½	¾	1⅜	1⅜	4	⅞	6¾	6¼	5¼	1½
3¼	4½	2¼	1¾	¾	¾	⅞	1¾	1¾	5	1¼	8½	8	6¾	2
4	5	2¼	1¾	¾	¾	⅞	1¾	1¾	5½	1¼	9	8½	7¼	2
5	6½	2¼	1¾	1	¾	⅞	1¾	1¾	7	1¼	10½	10	9	2
6	7½	2½	2¼	1⅛	1	1	2	2	8	1⅜	12	11½	10¼	2½
7	8½	2¾	2¾	1⅛	1¼	1⅜	2½	2½	9	1⅜	14	13½	11¼	2¾

▲See Table A on page 29 for bore and rod combinations using head plates with threaded bronze gland.

MODEL F (NFPA STD. MT4) ▲

Integral trunnion pins are designed for shear, not bending loads. The intermediate trunnion pin mounting location, being non-adjustable, is determined by the "XI" dimension which should be specified by the customer. It can be located at any point between the heads of the cylinder.





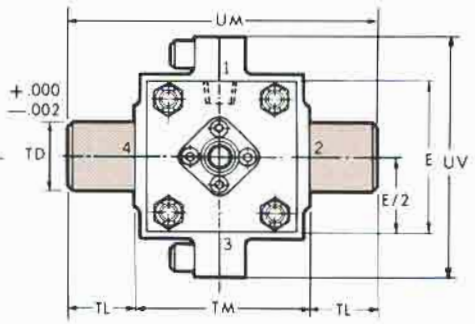


TABLE 2

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

- Heads bored for these rod sizes are normally in stock– thus faster delivery.
- ■ Models F and FB only.
- * For piston rod dimensions see page 32.

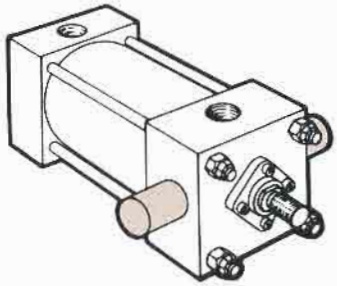
BORE DIA.	*ROD MM	A	P	Y	LB	WF	XG	(MIN.) XI	XJ	ZB
1½	5/8 •	3/4	2¾	2 1/16	4⅝	1	1⅞	3 7/16	4⅞	6⅛
	1 •■	1⅛		2 7/16		1⅜	2¼	3 13/16	5¼	6½
2	1 •	1⅛	2¾	2 7/16	4⅝	1⅜	2¼	3 15/16	5¼	6½
	1⅜ •■	1⅝		2 11/16		1⅝	2½	4 3/16	5½	6¾
2½	1 •	1⅛	2⅞	2 7/16	4¾	1⅜	2¼	3 15/16	5⅜	6¾
	1⅜ •	1⅝		2 11/16		1⅝	2½	4 3/16	5⅝	7
	1¾ •■	2		2 15/16		1⅞	2¾	4 7/16	5⅞	7¼
3¼	1⅜ •	1⅝	3¼	3	5½	1⅝	2⅝	4 15/16	6¼	7⅞
	1¾ •■	2		3¼		1⅞	2⅞	5 3/16	6½	8⅛
	2 •■	2¼		3⅜		2	3	5 5/16	6⅝	8¼
4	1¾ •	2	3½	3¼	5¾	1⅞	2⅞	5 3/16	6¾	8⅜
	2 •■	2¼		3⅜		2	3	5 5/16	6⅞	8½
	2½ •■	3		3⅝		2¼	3¼	5 9/16	7⅛	8¾
5	2 •	2¼	4	3⅜	6¼	2	3	5 5/16	7⅜	9¼
	2½	3		3⅝		2¼	3¼	5 9/16	7⅝	9½
	3 •■	3½								
	3½ •■	3½								
6	2½ •	3	4⅝	3¾	7⅜	2¼	3⅜	6 1/16	8⅜	10¾
	3	3½								
	3½	3½								
	4 •■	4								
7	3 •	3½	5⅜	3 13/16	8½	2¼	3⅝	6 7/16	9⅜	11⅞
	3½	3½								
	4	4								
	4½	4½								
	5	5								

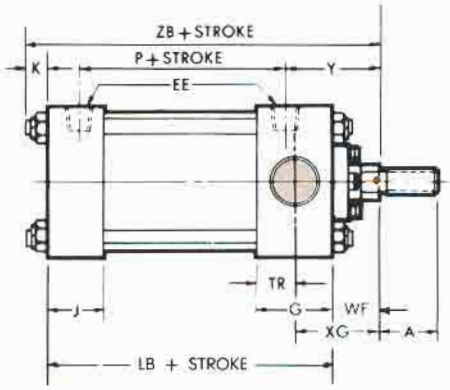
▲See Table A on page 29 for bore and rod combinations using head plates with threaded bronze gland.

NOPAK TRUNNION MOUNT CYLINDERS

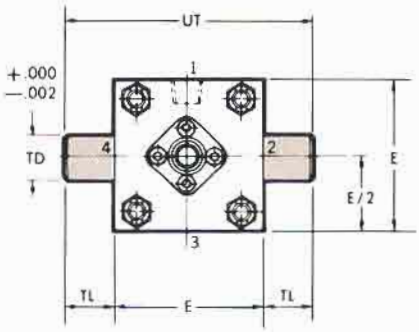
8" THROUGH 14" DIA.

MODEL FR (NFPA STD. MT1)

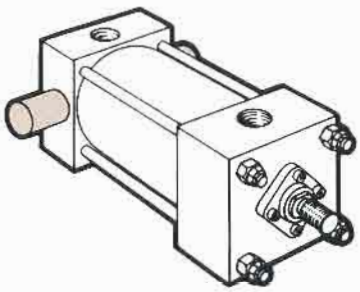


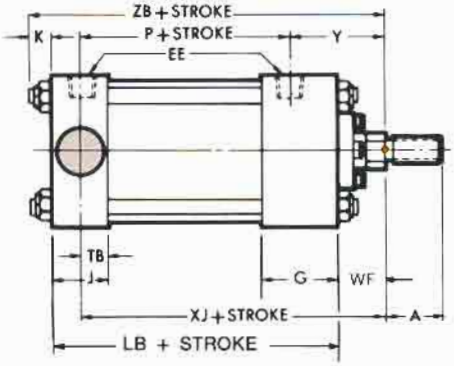


Integral trunnion pins are designed for shear, not bending, loads.



MODEL FB (NFPA STD. MT2)





Integral trunnion pins are designed for shear, not bending, loads.

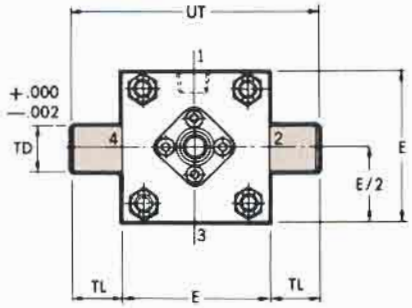


TABLE 1

These dimensions are constant regardless of rod diameter or stroke.

Double rod end models are designated by letter "X" preceding the model identification. See page 30.

BORE DIA.	E	G	J	K	EE	TB	TD	TL	TM	TR	UM	UT	UV	WT
8	9½	3	3	1⅜	1½	1½	3	3	10	1½	16	15½	12½	3¼
10	12⅝	3 11/16	3 11/16	1⅛	2	1⅞	3½	3½	14	1⅞	21	19⅝	16½	4½
12	14⅞	4 7/16	4 7/16	1⅛	2½	2¼	4	4	16½	2¼	24½	22⅞	19¼	5½
14	17¼	4⅞	4⅞	1 7/16	2½	2 7/16	4½	4½	19⅝	2½	28⅝	26⅛	22½	5½

MODEL F (NFPA STD. MT4)

Integral trunnion pins are designed for shear, not bending loads. The intermediate trunnion pin mounting location, being non-adjustable, is determined by the "XI" dimension which should be specified by the customer. It can be located at any point between the heads of the cylinder.

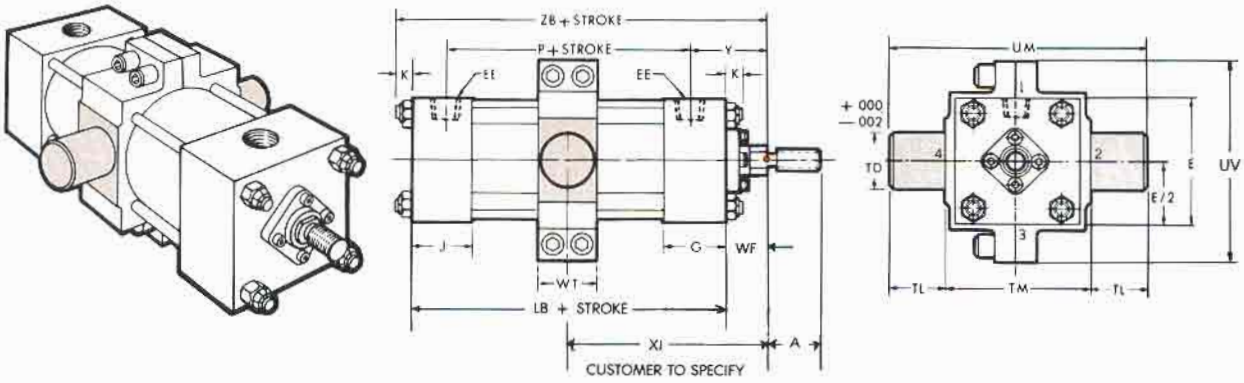


TABLE 2

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

- Heads bored for these rod sizes are normally in stock– thus faster delivery.
- ■ Models F and FB only.

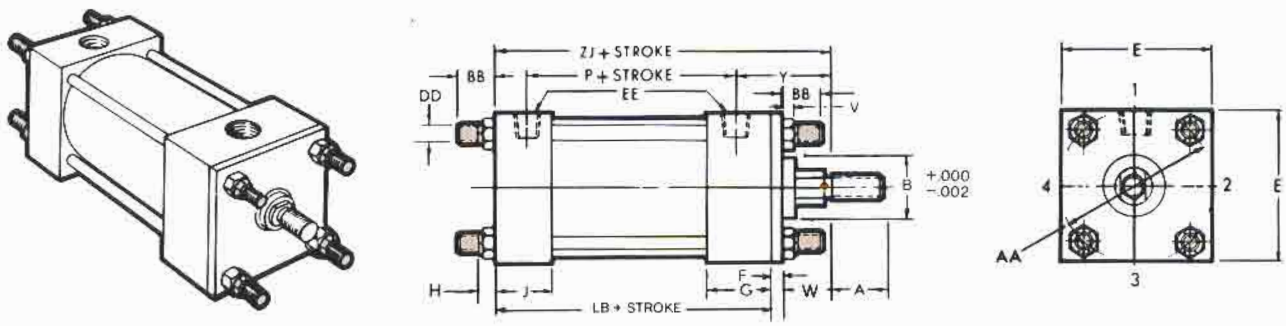
* For piston rod dimensions see page 32.

BORE DIA.	ROD MM	A	P	Y	LB	WF	XG	(MIN.) XI	XJ	ZB
8	3½ •	3½	6	4	9½	2¼	3¾	6 15/16	10¼	13⅛
	4	4								
	4½	4½								
	5	5								
	5½ • ■	5½								
10	4½ • ■	4½	8	5	12⅛	2 15/16	4¾	8⅞	13¼	16 3/16
	5	5		5¼		3 3/16	5	9⅛	13½	16 7/16
	5½	5½								
	7	7								
12	5½	5½	9⅝	5⅝	14½	3 3/16	5⅜	10⅜	15½	18 3/16
	7	7		5⅞		3 7/16	5⅝	10⅝	15¾	19 1/16
	8	8								
14	7	7	9⅞	6⅜	15⅝	3½	5⅞	11⅛	16¾	20¼
	8	8								
	10	10								

NOPAK TIE-ROD MOUNT CYLINDERS

1½″ THROUGH 8″ DIA.

MODEL T (NFPA STD. MX1)



MODEL TB (NFPA STD. MX2) ▲

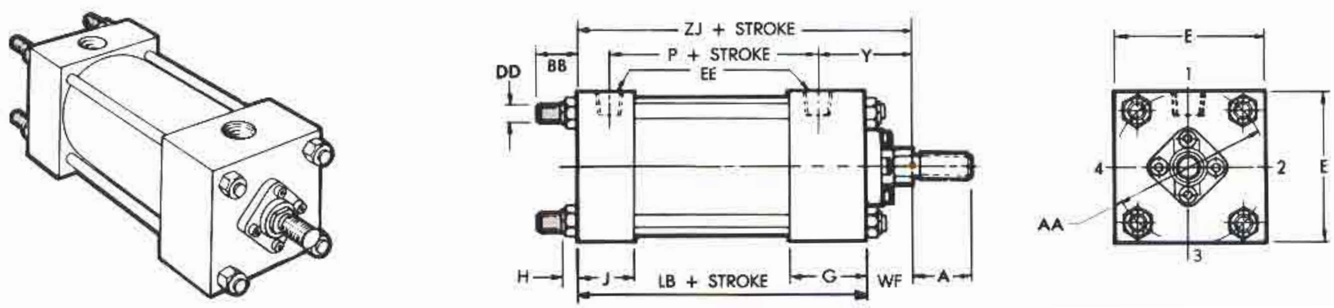


TABLE 1

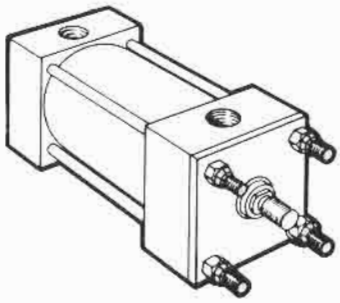
These dimensions are constant regardless of rod diameter or stroke.

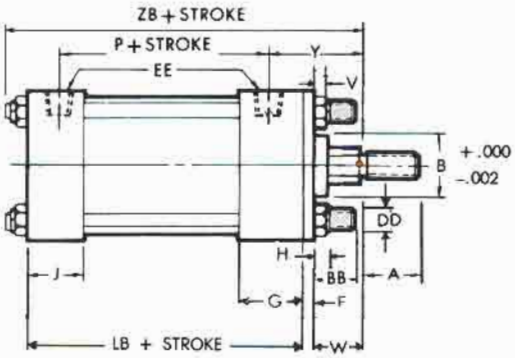
Double rod end models are designated by letter "X" preceding the model identification. See page 28.

BORE DIA.	E	F	G	H	J	AA	BB	DD	EE
1½	2½	3/8	1¾	11/32	1½	2.56	1⅜	3/8-24	½
2	3	5/8	1¾	3/8	1½	3.10	1⅝	7/16-20	½
2½	3½	5/8	1¾	15/32	1½	3.61	1⅞	1/2-20	½
3¼	4½	3/4	2¼	9/16	1¾	4.60	2⅜	5/8-18	¾
4	5	7/8	2¼	9/16	1¾	5.40	2⅜	5/8-18	¾
5	6½	7/8	2¼	25/32	1¾	7.00	3¼	7/8-14	¾
6	7½	1	2½	7/8	2¼	8.10	3⅝	1-14	1
7	8½	1	2¾	1	2¾	9.30	4⅛	1⅛-12	1¼
8	9½	1	3	1⅛	3	10.61	4½	1¼-12	1½

▲See Table [illegible] s using [illegible] onze gland.

MODEL TR (NFPA STD. MX3)





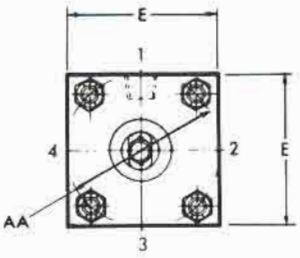


TABLE 2

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

- Heads bored for these rod sizes are normally in stock– thus faster delivery.

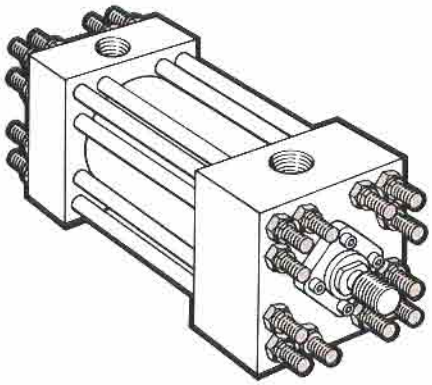
* For piston rod dimensions see page 32.

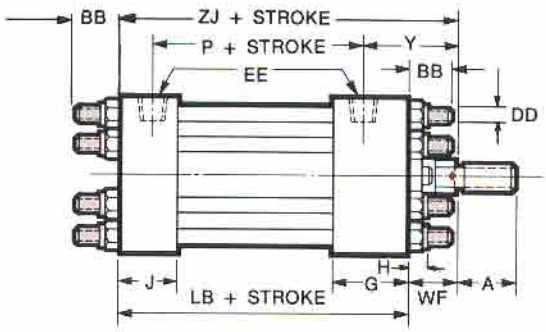
BORE DIA.	ROD MM	A	B	P	V	W	Y	LB	WF	ZB	ZJ
1½	5/8 •	3/4	1 1/8	2 3/4	1/4	5/8	2 1/16	4 5/8	1	6 1/8	5 5/8
	1 •	1 1/8	1 1/2		1/2	1	2 7/16		1 3/8	6 1/2	6
2	1 •	1 1/8	1 1/2	2 3/4	1/4	3/4	2 7/16	4 5/8	1 3/8	6 1/2	6
	1 3/8 •	1 5/8	2		3/8	1	2 11/16		1 5/8	6 3/4	6 1/4
2½	1 •	1 1/8	1 1/2	2 7/8	1/4	3/4	2 7/16	4 3/4	1 3/8	6 3/4	6 1/8
	1 3/8 •	1 5/8	2		3/8	1	2 11/16		1 5/8	7	6 3/8
	1 3/4 •	2	2 3/8		1/2	1 1/4	2 15/16		1 7/8	7 1/4	6 5/8
3 1/4	1 3/8 •	1 5/8	2	3 1/4	1/4	7/8	3	5 1/2	1 5/8	7 7/8	7 1/8
	1 3/4 •	2	2 3/8		3/8	1 1/8	3 1/4		1 7/8	8 1/8	7 3/8
	2 •	2 1/4	2 5/8		3/8	1 1/4	3 3/8		2	8 1/4	7 1/2
4	1 3/4 •	2	2 3/8	3 1/2	1/4	1	3 1/4	5 3/4	1 7/8	8 3/8	7 5/8
	2 •	2 1/4	2 5/8		1/4	1 1/8	3 3/8		2	8 1/2	7 3/4
	2 1/2 •	3	3 1/8		3/8	1 3/8	3 5/8		2 1/4	8 3/4	8
5	2 •	2 1/4	2 5/8	4	1/4	1 1/8	3 3/8	6 1/4	2	9 1/4	8 1/4
	2 1/2	3	3 1/8		3/8	1 3/8	3 5/8		2 1/4	9 1/2	8 1/2
	3 •	3 1/2	3 3/4		3/8	1 3/8	3 5/8		2 1/4	9 1/2	8 1/2
	3 1/2 •	3 1/2	4 1/4		3/8	1 3/8	3 5/8		2 1/4	9 1/2	8 1/2
6	2 1/2 •	3	3 1/8	4 5/8	1/4	1 1/4	3 3/4	7 3/8	2 1/4	10 3/4	9 5/8
	3	3 1/2	3 3/4								
	3 1/2	3 1/2	4 1/4								
	4 •	4	4 3/4								
7	3 •	3 1/2	3 3/4	5 3/8	1/4	1 1/4	3 13/16	8 1/2	2 1/4	11 7/8	10 3/4
	3 1/2	3 1/2	4 1/4								
	4	4	4 3/4								
	4 1/2	4 1/2	5 1/4								
	5	5	5 3/4								
8	3 1/2 •	3 1/2	4 1/4	6	1/4	1 1/4	4	9 1/2	2 1/4	13 1/8	11 3/4
	4	4	4 3/4								
	4 1/2	4 1/2	5 1/4								
	5	5	5 3/4								
	5 1/2 •	5 1/2	6 1/4								

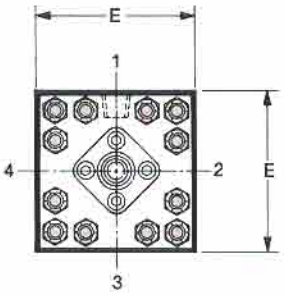
NOPAK TIE-ROD MOUNT CYLINDERS

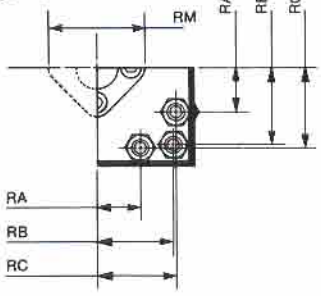
10" THROUGH 14" DIA.

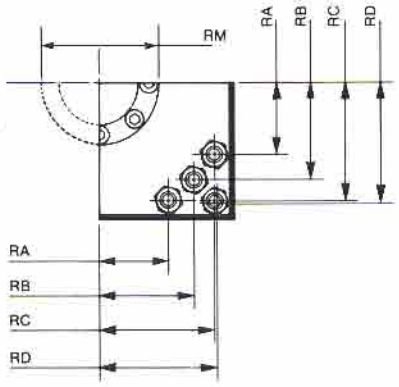
MODEL T (NFPA STD. MX1)

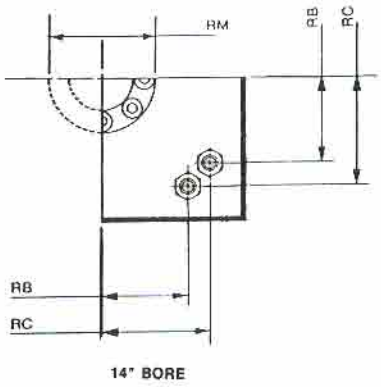




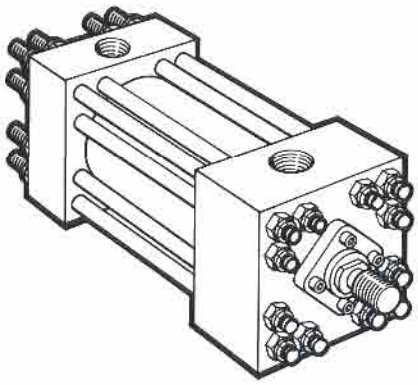


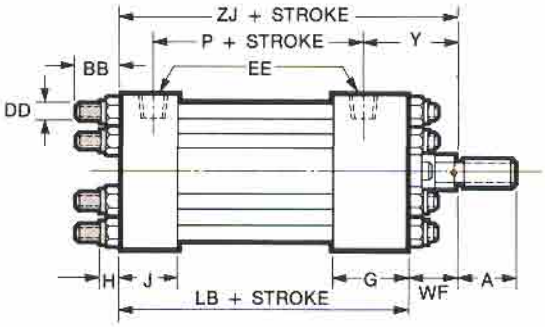






MODEL TB (NFPA STD. MX2)





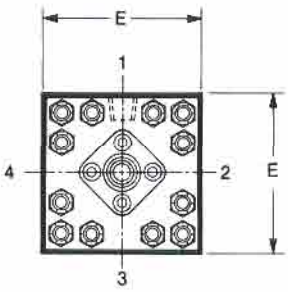


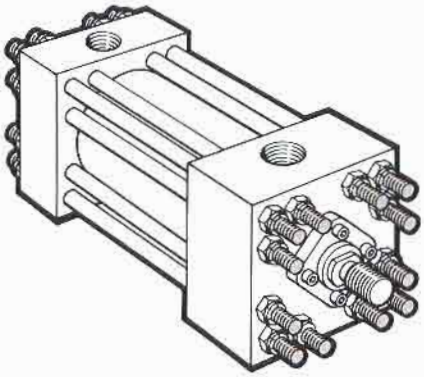
TABLE 1

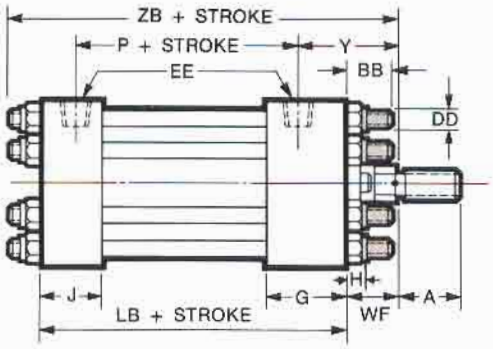
These dimensions are constant regardless of rod diameter or stroke.

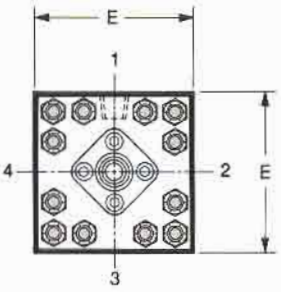
Double rod end models are designated by letter "X" preceding the model identification. See page 30.

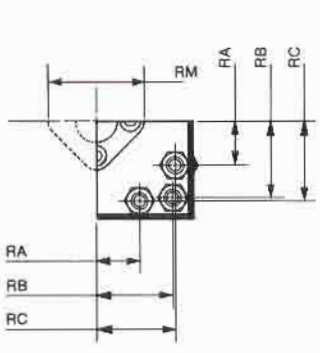
BORE DIA.	E	G	H	J	BB	DD	EE	RA	RB	RC	RD	RE
10	12 5/8	3 11/16	7/8	3 11/16	6	1-14	2	3.312	5.438	5.531	—	—
12	14 7/8	4 7/16	7/8	4 7/16	7	1-14	2 1/2	3.718	5.344	6.593	6.656	—
14	17 1/4	4 7/8	1 9/32	4 7/8	8	1 1/2-12	2 1/2	—	5.000	7.313	—	—

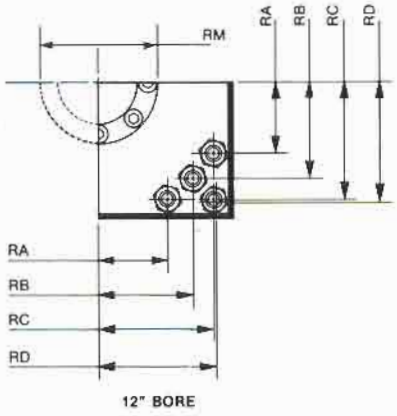
MODEL TR (NFPA STD. MX3)











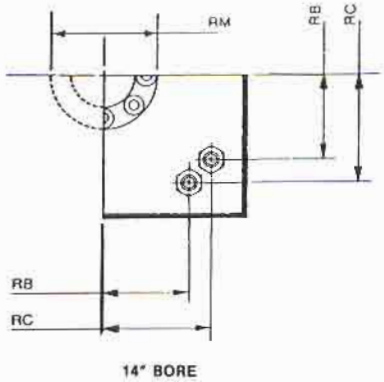


TABLE 2

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

- Heads bored for these rod sizes are normally in stock– thus faster delivery.

* For piston rod dimensions see page 32.

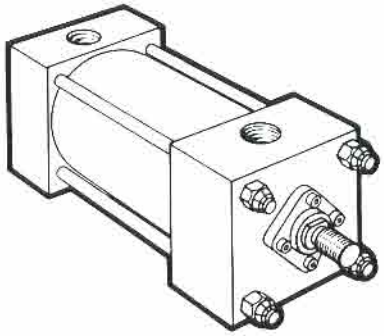
BORE DIA.	ROD MM	A	P	Y	LB	RM	WF	ZB	ZJ
10	4½ •	4½	8	5	12⅛	7½	2 15/16	16 3/16	15 1/16
	5	5		5¼		8⅜	3 3/16	16 7/16	15 5/16
	5½	5½				9			
	7	7				10¼			
12	5½	5½	9⅝	5⅝	14½	9	3 3/16	18 13/16	17 11/16
	7	7		5⅞		10¼	3 7/16	19 1/16	17 15/16
	8	8				11¼			
14	7	7	9⅞	6⅜	15⅝	10¼	3½	20¼	19⅛
	8	8				11¼			
	10	10				14			

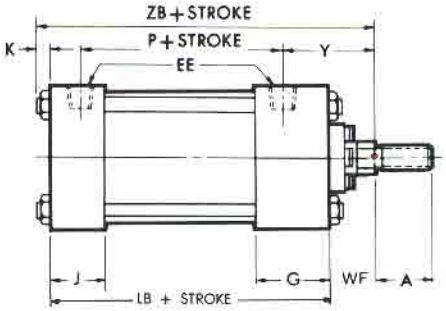
NOPAK

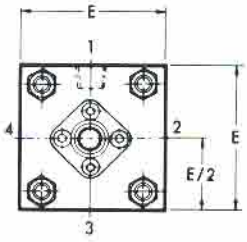
BASIC MODEL NO MOUNT CYLINDERS DOUBLE-ROD CYLINDER

1½" THROUGH 6" DIA.

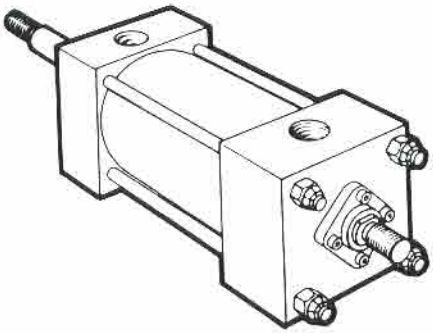
MODEL H-BASIC CYLINDER NO MOUNT ▲

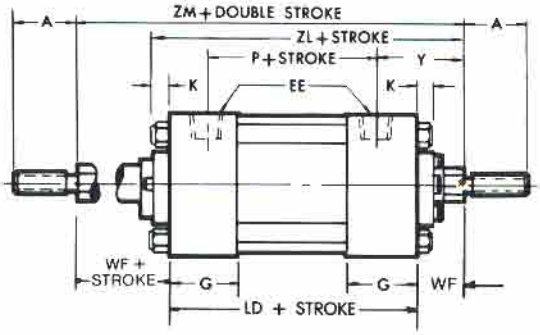






MODEL XH-BASIC CYLINDER DOUBLE ROD END ▲





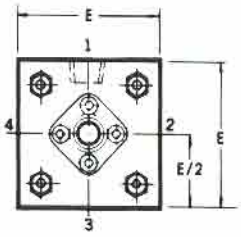


TABLE 1

These dimensions are constant regardless of rod diameter or stroke.

BORE DIA.	E	F	G	J	K
1 1/2	2 1/2	3/8	1 3/4	1 1/2	1/2
2	3	5/8	1 3/4	1 1/2	1/2
2 1/2	3 1/2	5/8	1 3/4	1 1/2	5/8
3 1/4	4 1/2	3/4	2 1/4	1 3/4	3/4
4	5	7/8	2 1/4	1 3/4	3/4
5	6 1/2	7/8	2 1/4	1 3/4	1
6	7 1/2	1	2 1/2	2 1/4	1 1/8

▲See Table A on page 29 for bore and rod combinations using head plates with threaded bronze gland.

NOPAK H & XH CYLINDER DIMENSIONAL DATA

TABLE 2

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

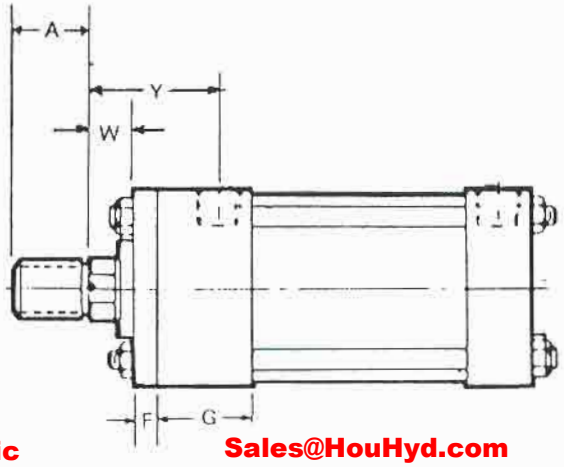
- Heads bored for these rod sizes are normally in stock– thus faster delivery.
- * For piston rod dimensions see page 32.

BORE DIA.	*ROD MM	A	P	Y	LB	LD	W	WF	ZB	ZL	ZM
1 1/2	5/8 •	3/4	2 3/4	2 1/16	4 5/8	4 7/8	5/8	1	6 1/8	6 3/8	6 7/8
	1 •	1 1/8		2 7/16			1	1 3/8	6 1/2	6 3/4	7 5/8
2	1 •	1 1/8	2 3/4	2 7/16	4 5/8	4 7/8	3/4	1 3/8	6 1/2	6 3/4	7 5/8
	1 3/8 •	1 5/8		2 11/16			1	1 5/8	6 3/4	7	8 1/8
2 1/2	1 •	1 1/8	2 7/8	2 7/16	4 3/4	5	3/4	1 3/8	6 3/4	7	7 3/4
	1 3/8 •	1 5/8		2 11/16			1	1 5/8	7	7 1/4	8 1/4
	1 3/4 •	2		2 15/16			1 1/4	1 7/8	7 1/4	7 1/2	8 3/4
3 1/4	1 3/8 •	1 5/8	3 1/4	3	5 1/2	6	7/8	1 5/8	7 7/8	8 3/8	9 1/4
	1 3/4 •	2		3 1/4			1 1/8	1 7/8	8 1/8	8 5/8	9 3/4
	2 •	2 1/4		3 3/8			1 1/4	2	8 1/4	8 3/4	10
4	1 3/4 •	2	3 1/2	3 1/4	5 3/4	6 1/4	1	1 7/8	8 3/8	8 7/8	10
	2 •	2 1/4		3 3/8			1 1/8	2	8 1/2	9	10 1/4
	2 1/2 •	3		3 5/8			1 3/8	2 1/4	8 3/4	9 1/4	10 3/4
5	2 •	2 1/4	4	3 3/8	6 1/4	6 3/4	1 1/8	2	9 1/4	9 3/4	10 3/4
	2 1/2	3		3 5/8			1 3/8	2 1/4	9 1/2	10	11 1/4
	3 •	3 1/2					1 3/8				
	3 1/2 •	3 1/2					1 3/8				
6	2 1/2 •	3	4 5/8	3 3/4	7 3/8	7 5/8	1 1/4	2 1/4	10 3/4	11	12 1/8
	3	3 1/2					1 1/4				
	3 1/2	3 1/2					1 1/4				
	4 •	4					1 1/4				

NOTE: CYLINDER MOUNTINGS, ROD SIZES AND THREAD TYPES ARE INTERCHANGEABLE ON EITHER END OF DOUBLE ROD END CYLINDER ASSEMBLY.

THE FOLLOWING BORE/ROD COMBINATIONS USE HEAD PLATE AND BRONZE GLANDS AS SHOWN AT RIGHT.	
BORE	ROD DIAMETER (MM)
1.50"	1.00"
2.00"	1.38"
2.50"	1.75"

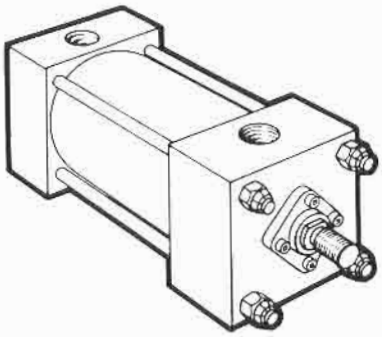
Note: Threaded Bronze Gland used on all Model D and DD Cylinders. Bolt-on Gland used on all Model G and DG Cylinders.

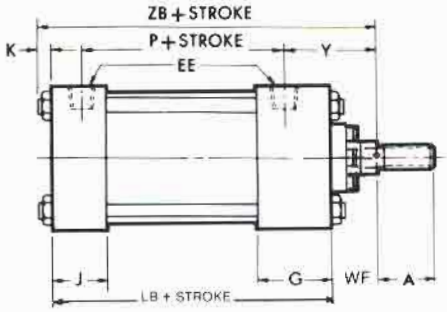


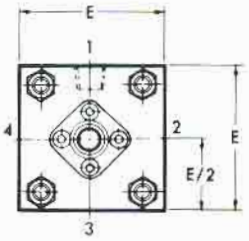
NOPAK BASIC MODEL NO MOUNT CYLINDERS DOUBLE-ROD CYLINDER

7" THROUGH 20" DIA.

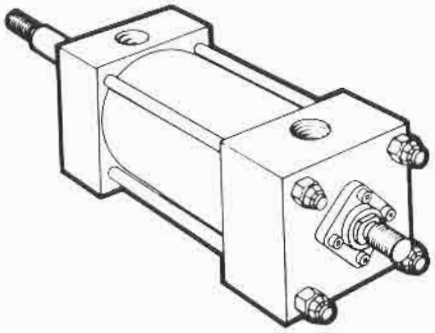
MODEL H BASIC CYLINDER NO MOUNT

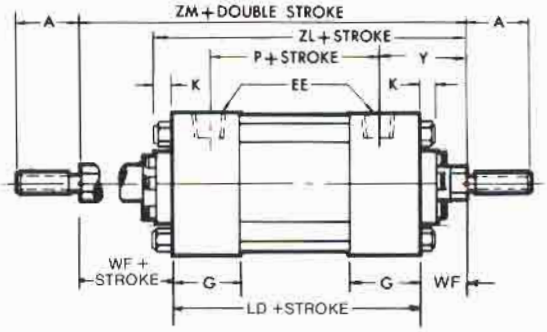






MODEL XH BASIC CYLINDER DOUBLE ROD END





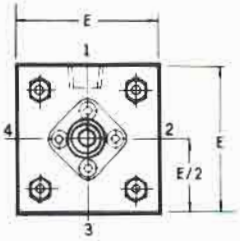


TABLE 1

These dimensions are constant regardless of rod diameter or stroke.

BORE DIA.	E	G	J	K	EE
7	8 1/2	2 3/4	2 3/4	1 1/8	1 1/4
8	9 1/2	3	3	1 3/8	1 1/2
10	12 5/8	3 11/16	3 11/16	1 1/8	2
12	14 7/8	4 7/16	4 7/16	1 1/8	2 1/2
14	17 1/4	4 7/8	4 7/8	1 1/4	2 1/2
16	19 1/4	5 7/8	5 7/8	1 7/16	3
18	22	6 7/8	6 7/8	1 7/16	3
20	23 5/8	7 7/8	7 7/8	1 7/16	3

NOPAK H & XH CYLINDER DIMENSIONAL DATA

TABLE 2

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

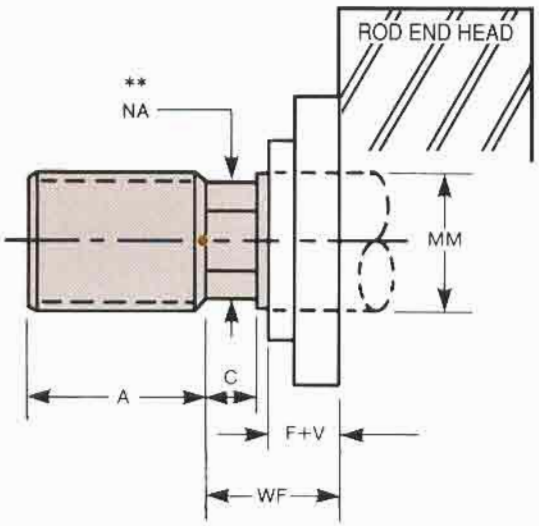
- • Heads bored for these rod sizes are normally in stock– thus faster delivery.
- * For piston rod dimensions see page 32.

BORE DIA.	*ROD MM	A	P	Y	LB	LD	WF	ZB	ZL	ZM
7	3 •	3½	5⅜	3 13/16	8½	8½	2¼	11⅞	11⅞	13
	3½	3½								
	4	4								
	4½	4½								
	5	5								
8	3½ •	3½	6	4	9½	9½	2¼	13⅛	13⅛	14
	4	4								
	4½	4½								
	5	5								
	5½ •	5½								
10	4½ •	4½	8	5	12⅛	12⅛	2 15/16	16 3/16	16 3/16	18
	5	5		5¼			3 3/16	16 7/16	16 7/16	18½
	5½	5½								
	7	7								
12	5½	5½	9⅝	5⅝	14½	14½	3 3/16	18 13/16	18 13/16	20⅞
	7	7		5⅞			3 7/16	19 1/16	19 1/16	21⅜
	8	8								
14	7	7	9⅞	6⅜	15⅝	15⅝	3½	20¼	20¼	22⅝
	8	8								
	10	10								
16	8	8	11⅜	7⅜	18⅛	18⅛	4	23 9/16	23 9/16	26⅛
	9	9								
	10	10								
18	9	9	12⅜	8⅝	21⅛	21⅛	4¼	26 13/16	26 13/16	29⅝
	10	10								
20	10	10	13⅜	9⅝	23⅝	23⅝	4½	29 9/16	29 9/16	32⅝

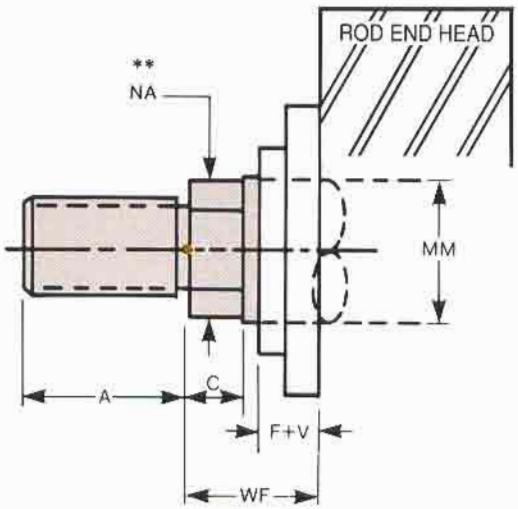
NOTE: CYLINDER MOUNTINGS, ROD SIZES AND THREAD TYPES ARE INTERCHANGEABLE ON EITHER END OF DOUBLE ROD END CYLINDER ASSEMBLY.

NOPAK CLASS 3 CYLINDER PISTON ROD ENDS DIMENSIONAL DATA

ROD TYPE NO. 1

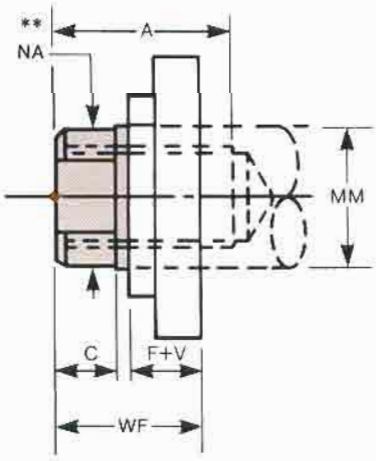


ROD END TYPE NO. 3 *NO. 4



*TYPE NO. 4 THREAD IS SIZED FOR ROD CLEVIS AND EYE

ROD END TYPE NO. 5



DIA. ROD MM	ROD END TYPE NO. 1	NO. 3	NO. 4*	NO. 5	A	C	D †	F + V	WF
5/8	5/8-18	1/2-20	7/16-20	7/16-20	3/4	3/8	1/2	5/8	See the respective charts covering model (mount), bore, and rod diameter.
1	1-14	7/8-14	3/4-16	3/4-16	1 1/8	1/2	7/8	3/4	
1 3/8	1 3/8-12	1 1/4-12	1-14	1-14	1 5/8	5/8	1 1/8	1	
1 3/4	1 3/4-12	1 1/2-12	1 1/4-12	1 1/4-12	2	3/4	1 1/2	3/4	
2	2-12	1 3/4-12	1 1/2-12	1 1/2-12	2 1/4	7/8	1 11/16	7/8	
2 1/2	2 1/2-12	2 1/4-12	1 7/8-12	1 7/8-12	3	1	2 1/16	1 1/16	
3	3-12	2 3/4-12	2 1/4-12	2 1/4-12	3 1/2	1	2 5/8	1 1/8	
3 1/2	3 1/2-12	3 1/4-12	2 1/2-12	2 1/2-12	3 1/2	1	3	1 1/8	
4	4-12	3 3/4-12	3-12	3-12	4	1	3 3/8	1 1/4	
4 1/2	4 1/2-12	4 1/4-12	3 1/4-12	3 1/4-12	4 1/2	1	3 7/8	1 1/4	
5	5-12	4 3/4-12	3 1/2-12	3 1/2-12	5	1	4 1/4	1 1/4	
5 1/2	5 1/2-12	5 1/4-12	4-12	4-12	5 1/2	1	4 5/8	1 1/4	
7	7-12	6 1/2-12	5 1/2-12	5 1/2-12	7	1	–	2 3/8	
8	8-12	7 1/2-12	5 3/4-12	5 3/4-12	8	1	–	2 3/8	
9	9-12	8 1/2-12	6 1/2-12	6 1/2-12	9	1	–	2 1/2	
10	10-12	9 1/2-12	7 1/4-12	7 1/4-12	10	1	–	2 1/2	

**Dimension NA is .060 under MM dia. dimension

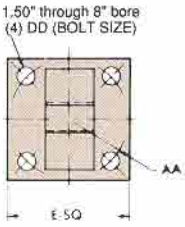
† Dimension D is size across wrench flats

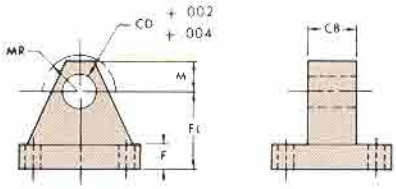
(4) 1/2 Dia. Spanner Holes Furnished in all rods 7" thru 10" Dia. all types.

NOTE: Rod Threads are Class UNF-2A or 2B unless specifically quoted otherwise.

CYLINDER ACCESSORIES

EYE BRACKET



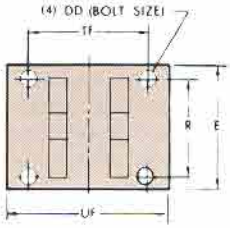


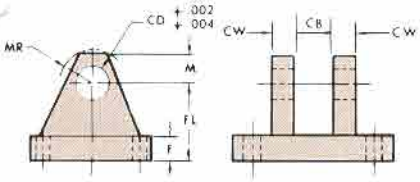
CYL. DIA.	E	F	M	AA	CB	CD	DD	FL	MR	(FORMER) PART NO.	(PRESENT) PART NO.
1½	2½	⅜	½	2.30	¾	½	⅜	1⅛	⅝	A-12008CY	2716 L47
2-2½	3½	⅜	¾	3.61	1¼	¾	½	1⅞	⅞	A-26139CY	2719 L32
3¼	4½	⅞	1	4.60	1½	1	⅝	2⅜	1¼	A-26140CY	2720 L33
4	5	⅞	1⅜	5.40	2	1⅜	⅝	3	1⅜	A-26141CY	2721 L34
5	6½	1⅛	1¾	7.00	2½	1¾	⅞	3⅜	2	A-26142CY	2722 L35
6	7½	1 7/16	2	8.10	2½	2	1	3 15/16	2⅜	A-26143CY	2723 L36
7	8½	1⅝	2½	9.30	3	2½	1⅛	4⅜	3	A-26144CY	2724 L37
8	9½	2	2¾	10.61	3	3	1¼	5¼	3¼	A-26145CY	2725 L38
10	12⅝	2⅜	3½	*	4	3½	1	6⅜	3½	A-26146CY	2726 L39
12	14⅞	2⅞	4	*	4½	4	1	7½	4	A-26147CY	2727 L40
14	17¼	3⅜	5	*	6	5	1	9	5	A-26148CY	2728 L41

FOR CLEVIS BRACKET REFERENCE SEE PAGE 17 & 19

*See page 26 for bolt hole location.

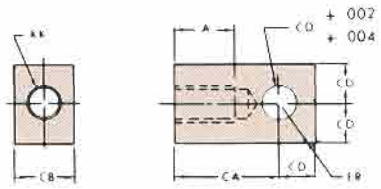
MOUNTING BRACKET





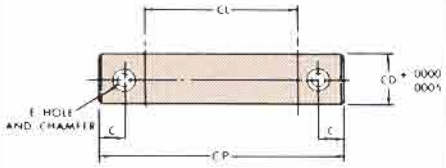
CYL. DIA.	E	F	M	R	CB	CD	CW	DD	FL	MR	TF	UF	(FORMER) PART NO.	(PRESENT) PART NO.
1½	2½	⅜	½	1.63	¾	½	½	⅜	1⅛	⅝	2¾	3½	A-8496CY	2683 L47
2-2½	3½	⅝	¾	2.55	1¼	¾	⅜	½	1⅞	⅞	3¾	4¾	A-8497CY	2684 L47
3¼	4½	⅞	1	3.25	1½	1	¾	⅝	2⅜	1¼	4½	5¾	A-26157CY	2685 L47
4	5	⅞	1⅜	3.82	2	1⅜	1	⅝	3	1⅝	5½	6¾	A-8499CY	2686 L47
5	6½	1⅛	1¾	4.95	2½	1¾	1¼	⅞	3⅜	2	7	8½	A-26158CY	2687 L47
6	7½	1 7/16	2	5.73	2½	2	1¼	1	3 15/16	2⅜	7½	9¼	A-26159CY	2688 L47
7	8½	1⅝	2½	6.58	3	2½	1½	1⅛	4⅜	3	8½	10½	A-26160CY	2689 L47
8	9½	2	2¾	7.50	3	3	1½	1¼	5¼	3¼	8¾	10¾	A-26161CY	2690 L47
10	12⅝	2⅜	3½	9.62	4⅛	3½	2	1¾	6⅜	3½	12	15	B-26162CY	2691 L47
12	14⅞	2⅞	4	11.45	4⅝	4	2¼	2	7½	4	14	18	B-26163CY	2692 L47
14	17¼	3⅜	5	13.36	6⅛	5	3	2¼	9	5	17¾	22½	B-26164CY	2693 L47

EYE (FEMALE)



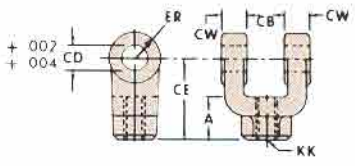
KK	A	CA	CB	CD	ER	PART NO.
7/16-20	¾	1½	¾	½	⅝	1810L59
¾-16	1⅛	2 1/16	1¼	¾	1 1/16	1812 L59
1-14	1⅝	2 13/16	1½	1	1 7/16	1813 L59
1¼-12	2	3 7/16	2	1⅜	2	1814 L59
1½-12	2¼	4	2½	1¾	2 1/16	1815 L59
1⅞-12	3	5	2½	2	2¼	1817 L59
2¼-12	3½	5 13/16	3	2½	2⅞	1820 L59
2½-12	3½	6⅛	3	3	3⅛	1821 L59
3¼-12	4½	7⅝	4	3½	3⅞	1824 L59
4-12	5½	9⅛	4½	4	4 7/16	1825 L59
5½-12	7	11⅞	6	5	5	1826 L59

PIVOT — PIN



CYL. DIA.	C	E	CD	CP	CL	PART NO.
1½	3/16	⅛	½	2⅜	1.8	3222 L47-1
2-2½	¼	3/16	¾	3¼	2.6	3222 L47-2
3¼	¼	3/16	1	3¾	3.1	3222 L47-3
4	¼	3/16	1⅜	4⅞	4.1	3222 L47-4
5	¼	3/16	1¾	5⅞	5.1	3222 L47-5
6	5/16	¼	2	6⅛	5.2	3222 L47-6
7	5/16	¼	2½	7⅛	6.3	3222 L47-8
8	5/16	¼	3	7⅛	6.3	3222 L47-7
10	⅜	¼	3½	9¼	8.0	3222 L47-9
12	⅜	¼	4	10¼	9.0	3222 L47-10
14	⅜	¼	5	13½	12.3	3222 L47-11

CLEVIS (FEMALE)



KK	A	CB	CD	CE	CW	ER	PART NO.
7/16-20	¾	¾	½	1½	½	½	2834 L59
¾-16	1⅛	1¼	¾	2⅜	⅝	¾	2835 L59
1-14	1⅝	1½	1	3⅛	¾	1	2836 L59
1¼-12	2	2	1⅜	4⅛	1	1⅜	2837 L59
1½-12	2¼	2½	1¾	4½	1¼	1¾	2838 L59
1⅞-12	3	2½	2	5½	1¼	2	2839 L59
2¼-12	3½	3	2½	6½	1½	2½	2840 L59
2½-12	3½	3	3	6¾	1½	3	2841 L59
3¼-12	4½	4	3½	8½	2	3½	2842 L59
4-12	5½	4½	4	10	2¼	4	2843 L59
5½-12	7	6	5	12¾	3	5	2844 L59

NOPAK CLASS 3 ENGINEERING INFORMATION

ENGINEERING INFORMATION

NOPAK Class 3 pressure-rated cylinders are designed for hydraulic service. For reference to basic pressure ratings, see table page 2. Cylinders 1½" through 8" diameter bore are assembled from standard inventory components. Special design and large diameter Class 3 cylinders are available. Send us your specifications.

OPERATING TEMPERATURES AND MEDIA

Class 3 hydraulic cylinders equipped with standard Type A packings may be operated at temperatures from -40°F to 225°F air, water* or oil. The following chart relates in a simplified general purpose manner the limitations and uses of available piston and rod packings.

PACKING TYPE	
A = Nitrile (Buna-N)	B = Viton
-40°F to +225°F Std. Hyd. Oil Air Water (not steam) Water Glycol fire resistant fluid	-20°F to +325°F Std. Hyd. Oil Air Phosphate Ester fire resistant fluid

For specific media and temperature or conditions exceeding the chart ratings, consult NOPAK Engineering Department.

Applications involving Fire Resistant Fluids must be so specified for compatible component materials. When considering temperature, remember that as the temperature increases (within the rated limits) the packing life decreases.

INTERCHANGEABILITY

Class 3 cylinders are dimensionally interchangeable with other square-head cylinders of the same pressure classification. Construction and performance are in conformance with applicable recommended NFPA Standards.

CUSHIONS

NOPAK Class 3 cylinders are available with adjustable cushions on either or both ends, or non-cushion.

The purpose of a cushion is to slow up piston speed at the end of the stroke, eliminating hammer and shock.

Cushion adjusting screws serve to by-pass the fluid from the trapped section between the piston and the cylinder head when the cushion sleeve has entered the bore. Turning the needle inward against the seat results in maximum cushion intensity. Backing up on the needle decreases the effect.

Where standard cushions are inadequate for unusual requirements, special cushions possibly requiring longer-than-standard heads can be furnished at additional charge. Very rapid cushioning of high speed movement may require deceleration valves.

The purpose of the ball check in the cushion mechanism is to allow fluid to pass to the piston face without obstruction (while the cushion sleeve is still within the bore in the head). This results in essential quick starting of the piston.

CYLINDER PORT TYPES & LOCATION

Standard ports are NPT. SAE O-ring boss ports are available at extra charge. SAE 4-bolt flange ports are offered at extra charge. Specify Code 61 or Code 62.

Inlet ports are located in Position 1 as standard (see rod end view on dimension drawings). They can however, be located at other numbered locations on application. Extra inlets furnished at additional charge. Oversize and special inlets require dimensions and quotation on application.

*WATER SERVICE

Special cylinders can be built for water service. Due to the uncertainty of action of water supply on some materials, responsibility for premature failure due to corrosion, mineral deposits or electrolysis cannot be accepted.

NOPAK CLASS 3 ENGINEERING DATA

PRE-STRESSING TIE-RODS

Some of the tie-rod torque values shown in Table 1 may be impractical to obtain with an ordinary torque wrench. If so, another method for prestressing the tie-rods may be used. Lightly tighten opposite tie-rods alternately to a 100 ft.-lb. torque value. Measure the stressed length of the tie-rod (the distance between the nut faces of thread engaged surfaces) and multiply this length by the proper "N" factor as specified in Table A. This will indicate the amount of turn or turns required. Scribe a reference mark on each nut and the adjacent bolted surface to assist in determining the amount of rotation. Slowly and evenly heat the exposed center length of the tie-rod using caution not to overheat the tie-rod or nearby cylinder or head surfaces. (If desired, use a fireproof heat shield for insulation of the cylinder barrel). When the tie-rod is sufficiently heated the nut can be turned to the proper location. This procedure may be followed for the other tie-rods in the alternate fashion until all the tie-rods have been tightened the desired amount. After they have cooled, the tie-rods will be stressed to the proper torque value.

TABLE A • TIE ROD TORQUE

Cyl. Dia.	1½	2	2½	3¼	4	5	6	7	8	10	12	14	16	18	20
No. of Tie Rod	4	4	4	4	4	4	4	4	4	12	16	8	8	12	12
Tie Rod Size	3/8	7/16	1/2	5/8	5/8	7/8	1	1⅛	1¼	1	1	1½	1½	1½	1½
Torque Ft. Lbs.	20	45	60	150	150	400	600	850	1000	600	600	2500	2500	2500	2500
N. Factor							.043	.036	.040	.044	.044	.044	.043	.044	.043

TABLE B — DEDUCTIONS FOR PULL STROKE FORCE AND DISPLACEMENT

Rod Size	Rod Area Sq. In.	ROD DIAMETER FORCE IN POUNDS FOR VARIOUS LINE PRESSURES							DISPLACEMENT Per Inch of Stroke	
		500	750	1000	1250	1500	2000	3000	Cu. Inch	Gallons
5/8	.307	154	230	307	384	461	614	921	.307	.0013
1	.785	393	589	785	981	1,178	1,570	2,355	.785	.0034
1⅜	1.485	743	1114	1,485	1856	2228	2970	4455	1.485	.0064
1¾	2.405	1203	1804	2405	3006	3608	4810	7215	2.405	.0104
2	3.142	1571	2357	3142	3928	4713	6284	9426	3.142	.0136
2½	4.909	2455	3682	4909	6137	7364	9818	14,727	4.909	.0213
3	7.069	3535	5302	7069	8836	10,604	14,138	21,207	7.069	.0306
3½	9.621	4811	7216	9621	12,026	14,432	19,242	28,863	9.621	.0416
4	12.566	6283	9425	12,566	15,708	18,849	25,132	37,698	12.566	.0544
4½	15.904	7952	11,928	15,904	19,880	23,856	31,808	47,712	15.904	.0688
5	19.635	9818	14,726	19,635	24,544	29,452	39,270	58,905	19.635	.0850
5½	23.758	11,879	17,819	23,758	29,698	35,637	47,516	71,274	23.758	.1028
7	38.484	19,242	28,863	38,484	48,105	57,726	76,968	115,452	38.484	.1666
8	50.265	25,133	37,699	50,265	62,831	75,398	100,530	150,795	50.265	.2176
9	63.617	31,809	47,713	63,617	79,521	95,426	127,234	190,851	63.617	.2754
10	78.539	39,270	58,904	78,539	98,174	117,809	157,079	235,617	78.539	.3400

NOTE:

To determine cylinder pull stroke force or displacement, deduct force or displacement corresponding to rod size in Table B from force or displacement corresponding to bore size shown in Table C.

1 gallon = 231 Cu. In.

Area of Circle = $.7854\ d^2$

$$\text{Piston Speed (In./Min)} = \frac{\text{Pressure Source Delivery (GPM)}}{\text{Cylinder Displacement (Gal./In.)}}$$

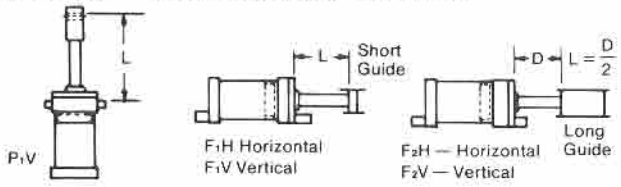
TABLE C — THRUST FORCE AND DISPLACEMENT

Bore Size	Piston Area Sq. In.	CYLINDER THRUST FORCE IN POUNDS FOR VARIOUS LINE PRESSURES							DISPLACEMENT Per Inch of Stroke	
		500	750	1000	1250	1500	2000	3000	Cu. Inch	Gallons
1½	1.767	884	1,325	1,767	2,209	2,650	3,534	5,301	1.767	.00765
2	3.142	1,571	2,357	3,142	3,928	4,713	6,284	9,426	3.142	.0136
2½	4.909	2,455	3,682	4,909	6,137	7,364	9,818	14,727	4.909	.0213
3¼	8.296	4,148	6,222	8,296	10,370	12,444	16,592	24,888	8.296	.0359
4	12.566	6,283	9,425	12,566	15,708	18,849	25,132	37,698	12.566	.0544
5	19.635	9,818	14,726	19,635	24,544	29,452	39,270	58,905	19.365	.0850
6	28.274	14,137	21,206	28,274	35,342	42,411	56,548	84,822	28.274	.1224
7	38.485	19,242	28,864	38,485	48,106	57,727	76,970	115,455	38.485	.1666
8	50.265	25,133	37,699	50,265	62,832	75,398	100,530	150,795	50.265	.2176
10	78.54	39,270	58,905	78,540	98,175	117,810	157,080	235,620	78.54	.3400
12	113.10	56,550	84,825	113,100	141,375	169,650	226,200	339,300	113.10	.4896
14	153.94	76,970	115,455	153,940	192,425	230,910	307,880	461,820	153.94	0.666
16	201.06	100,530	150,795	201,060	251,325	301,590	402,120	603,180	201.06	0.870
18	254.47	127,235	190,853	254,470	318,088	381,705	508,940	763,410	254.47	1.102
20	314.16	157,080	235,620	314,160	392,700	471,240	628,320	942,480	314.16	1.360

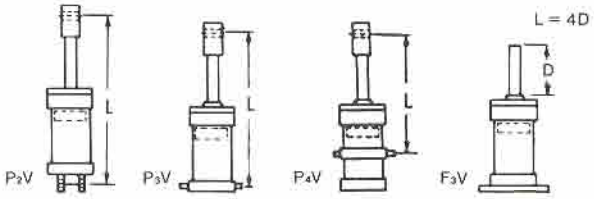
ENGINEERING DATA

INFORMATION TO PREVENT EXCESSIVE BEARING WEAR AND PISTON ROD COLUMN FAILURES

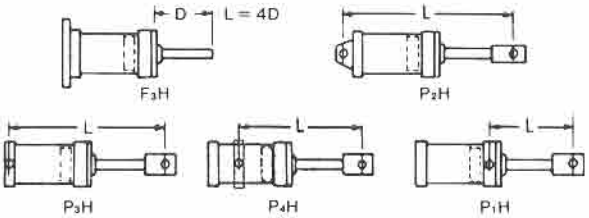
GROUP A — With piston rods extended.



GROUP B — To be checked for buckling or jack-knifing with piston rods extended and vertically mounted.



GROUP C — To be checked for load on bearing with piston rods extended and horizontally mounted.



STEP 1 – Find drawing in one of three groups above that fits your cylinder application, and follow instructions listed for that group.

Instructions: Stop tubes are used on log push stroke cylinders to prevent jack-knifing or buckling. They are placed between the piston and cylinder head to restrict the extended position of the piston rod so that the lengthened space between piston and bushing provides additional piston rod guide support.
The best choice for a cylinder with an exceptionally long stop tube requirement is the DOUBLE PISTON WITH SPACER. Note that the piston effective bearing area is doubled in addition to gaining the normal increased minimum distance between bearing points.

To determine whether a stop tube is required on a push stroke cylinder, proceed as follows:

a. Using above drawings, determine value of "L" from stroke length, rod and cylinder dimensions.
b. Refer to Table 1 for stop tube recommendation. A cylinder having an "L" value 45 requires a minimum of 1" stop tube and a maximum of 5" stop tube. Specifications for more than the maximum stop tube will usually adversely increase the cylinder weight.

Example: In a P_2V type application requiring 32" of stroke, "L" = 32" + 32" + approximately 10" for head and cap thickness = 74". A stop tube 4" long is required. (when a fraction of an inch of stop tube is calculated, use the next full inch.) Adjusted value of "L" is 74" + 4" or 78". Use of up to 8" of stop tube will further reduce bearing loads.

Instructions: Stop tubing is recommended for reducing piston and bushing/bearing loads on long stroke cylinders of the types shown. To determine length of stop tube required for this type of application, resolve the turning moments and loads between the piston and rod bushing. Include the weight of the fluid especially on large bore cylinders. It is ideal to keep projected bearing area loads lower than 200 PSI.

Caution: Do not use oversize rods to lessen bearing loads. Stop tubes are more economical and effective; oversize rods are heavier, cost more than stop tubing and if misalignment occurs, bearing loads are considerably increased due to stiffness of the oversize rod.

If your drawing is F_3H, P_2H, P_3H, or P_4H, in Group C, check for stop tube requirements from instructions in Group B.

Use whichever stop tube is longer. Determine value of "L" and proceed to Step 2.

STEP 2 – Find Rod Diameter for Column Strength.

Standard diameter piston rods are recommended on all installations except where column strength, piston rod sag, or return rate of hydraulic cylinders requires larger diameter rods.

Bushing/bearing loads caused by unavoidable misalignment are minimized when piston rods of correct diameter instead of unnecessarily large diameter piston rods are used. Correct (usually standard) piston rod diameters decrease and absorb shock loads to a greater extend than unnecessarily large oversize rods.

To determine the minimum piston rod diameter on push stroke cylinders:

a. Determine your push stroke thrust from table on page 35.
b. Find your push stroke thrust "T" in Table 2. If exact thrust isn't shown, use next larger shown.
c. In the horizontal column in line with your thrust, find value of "L" determined in Step 1.
d. Find minimum piston rod diameter required by following the same vertical line where your value of "L" is located, toward the top of the table.

TABLE 1

"L" INCHES	MINIMUM STOP TUBE LENGTH (INCHES)	*MAXIMUM STOP TUBE LENGTH (INCHES)	"L" INCHES	MINIMUM STOP TUBE LENGTH (INCHES)	*MAXIMUM STOP TUBE LENGTH (INCHES)
5-10		1	161-170	13	17
11-20		2	171-180	14	18
21-30		3	181-190	15	19
31-40		4	191-200	16	20
41-50	1	5	201-210	17	21
51-60	2	6	211-220	18	22
61-70	3	7	221-230	19	23
71-80	4	8	231-240	20	24
81-90	5	9	241-250	21	25
91-100	6	10	251-260	22	26
101-110	7	11	261-270	23	27
111-120	8	12	271-280	24	28
121-130	9	13	281-290	25	29
131-140	10	14	291-300	26	30
141-150	11	15	301-310	27	31
151-160	12	16			

***NOTE:** USING STOP TUBE LENGTHS GREATER THAN "MAXIMUM STOP TUBE" HAS DIMINISHING EFFECT ON REDUCING BEARING LOADS.

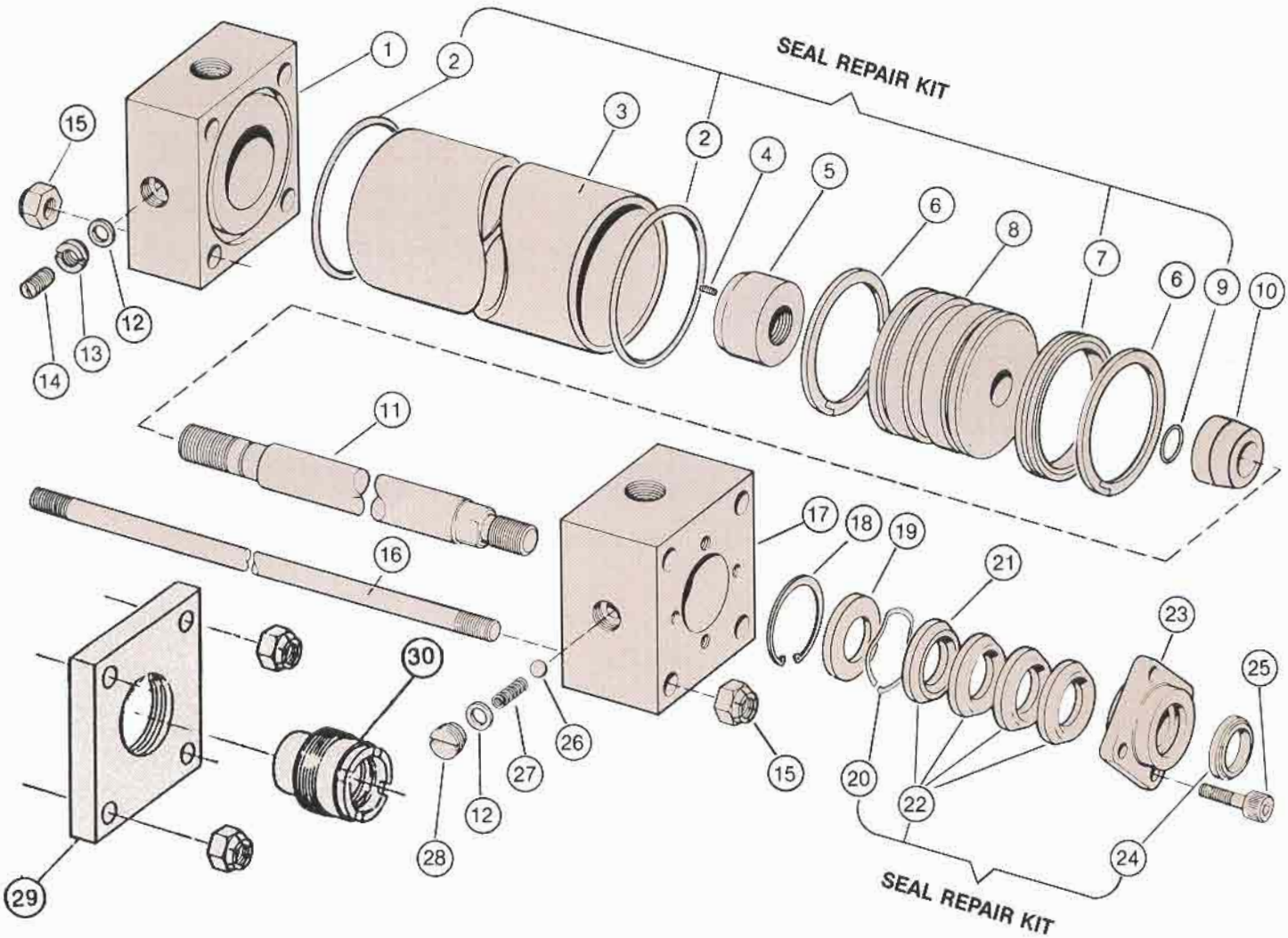
TABLE 2
VALUE OF "L" IN INCHES

Value of "T" in Lbs. in This Column	PISTON ROD DIAMETERS															
	0.63	1.00	1.38	1.75	2.00	2.50	3.00	3.50	4.00	4.50	5.00	5.50	7.00	8.00	9.00	10.00
1,000	27	60	105	155	190	257	330									
1,400	24	53	92	142	174	244	308	385								
1,800	23	48	82	127	160	230	296	366	440							
2,400	19	45	75	114	145	213	281	347	415	488						
3,200	16	41	67	103	130	194	261	329	400	461						
4,000	13	38	63	94	119	175	240	310	378	446						
5,000	9	34	60	87	110	163	225	289	360	426	494					
6,000		30	56	82	102	152	208	274	342	410	476					
8,000		26	50	76	93	137	188	245	310	375	447					
10,000		21	45	70	89	125	172	222	279	349	412	482				
12,000		17	41	65	84	118	155	210	269	326	388	454				
16,000			34	57	75	110	142	188	235	292	350	420				
20,000			28	52	68	103	136	172	218	270	326	385				
30,000				39	55	87	120	156	189	230	285	330				
40,000				22	43	74	108	142	177	210	248	294				
50,000					*30*	*66*	*96*	*130*	*165*	*200*	*234*	*269*	*408*			
60,000						57	88	119	154	190	225	256	384			
80,000						36	71	104	137	170	204	240	336			
100,000							57	90	120	154	189	222	324	400		
120,000							45	77	108	140	175	207	313	377		
140,000								64	98	128	160	194	301	365		
160,000								47	86	118	148	182	279	350	421	
200,000									67	98	131	161	260	330	402	
250,000										72	109	141	236	301	375	
300,000											86	120	212	281	351	420
350,000											52	100	195	261	328	396
400,000												77	182	241	309	374
500,000													152	212	274	341
600,000													114	183	247	310
700,000													70	162	221	280
800,000														118	197	260
900,000														82	168	237
1,000,000															115	212

Values of "L" less than those shown have a slenderness ratio (length ÷ radius of gyration which is length ÷ ¼ diameter of piston rod) of less than 50. Thus, the compressive strength formula (s = thrust ÷ rod area) is used rather than the column strength formula on which Table 2 is based. For very low slenderness ratios (below 20), compressive strength formulae with a 2 to 1 factor of safety are satisfactory. For slenderness ratios between 20 and 50, use compressive strength formulae with proportionate factors between 2 to 1 and 5 to 1.

IMPROVED CUSHION ADJUSTMENT —
Newly designed needle valve is interchangeable with current design and offers improved sealing characteristics.

REPLACEMENT PARTS



1. Blind End Head
2. Tube Seal★
3. Tube
4. Lock Screw
5. Lock Sleeve
6. Piston Ring
7. "T" Seal and Back-Ups★††
8. Piston
9. Piston O-Ring★
10. Cushion Sleeve – Rod End
11. Piston Rod
12. Seal
13. Cushion Adjusting Screw Gland
14. Cushion Adjusting Screw
15. Tie Rod Nut
16. Tie Rod
17. Rod End Head
18. Snap Ring††
19. Packing Spacer††
20. Wave Spring★††
21. Bottom Adapter Ring★☆††
22. Rod Packing★††
23. Packing Gland††
24. Rod Wiper★
25. Packing Gland Cap Screw
26. Check Ball
27. Ball Check Spring
28. Ball Check Plug

IF APPLICABLE:
29. Head Plate
30. Screw Gland

† "T" Seal used thru 16" dia. bore 18" and 20" fitted with piston rings.
†† For 7" dia. rods and larger.
Parts 18, 19, 20, and 21 are eliminated
Part 22 replaced by a U-cup style seal
Part 23 replaced by a rod bearing and a multi-bolt gland retainer.

★ Items are included in seal repair kits.
See page 5 for ordering information.
☆ Item 21 is metallic for high temp applications.

When ordering replacement parts be sure to specify:
– Part by name and item number
– Bore, stroke, mounting, and Serial number shown on Nopak label

NOTE: Isometric view of DOUBLE ROD cylinders available at N/C.
Consult factory or our authorized distributor.

REPAIR KITS
CLASS 3

ROD SEAL KITS

SINGLE ROD •	
ROD DIA.	PART NO.*
0.63"	RK3-63
1.00"	RK3-100
1.38"	RK3-138
1.75"	RK3-175
2.00"	RK3-200
2.50"	RK3-250
3.00"	RK3-300
3.50"	RK3-350
4.00"	RK3-400
4.50"	RK3-450
5.00"	RK3-500
5.50"	RK3-550
7.00"	RK3-700

Each Rod Seal Kit consists of:
- 1 - "V" ring rod packing
- 1 - Rod wiper
- 1 - Wave spring

• To service DOUBLE ROD END CYLINDER, order one Rod Kit for EACH rod end, and if applicable, one Piston Kit.

PISTON SEAL KITS

SINGLE OR DOUBLE ROD	
BORE SIZE	PART NO.*
1.50"	PK3-150
2.00"	PK3-200
2.50"	PK3-250
3.25"	PK3-325
4.00"	PK3-400
5.00"	PK3-500
6.00"	PK3-600
7.00"	PK3-700
8.00"	PK3-800
10.00"	PK3-1000
12.00"	PK3-1200
14.00"	PK3-1400

Each Piston Seal Kit consists of:
- 2 - Tube "O" rings
- 1 - G. T. ring (piston seal)
- 1 - Piston "O" ring

NOTE: Cast Iron Rings NOT included.

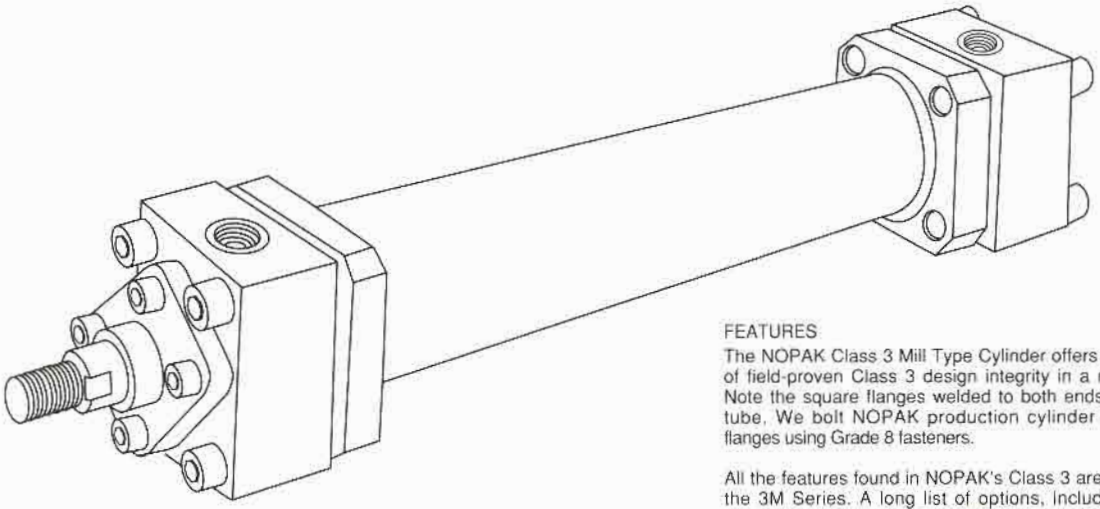
***When ordering, specify Type "A" or Type "B" seals**
Type "A" = Buna-N (NITRILE)
Type "B" = Viton

PACKING GLANDS

ROD DIA.	PACKING GLANDS	
	ALL MODELS EXCEPT D & DD •	MODELS D & DD ONLY
	PART NUMBER	PART NUMBER
0.63"	1069G70	1071G70
1.00" *	1068G73	2859G73
1.38" *	1066G75	2858G75
1.75" *	1067G77	2857G77
2.00"	1065G78	2856G78
2.50"	1064G79	2855G79
3.00"	1063G81	2854G81
3.50"	1062G82	2853G82
4.00"	1061G83	2852G83
4.50"	1060G84	C/F
5.00"	1070G85	C/F
5.50"	1059G86	C/F
7.00"	C/F	C/F

* Use pkg. gland 2859G73 for 1.50" cyl. with 1.00" Ø rod.
Use pkg. gland 2858G75 for 2.00" cyl. with 1.38" Ø rod.
Use pkg. gland 2857G77 for 2.50" cyl. with 1.75" Ø rod.
• For Models AL, T, and TR, consult factory.

NOPAK CLASS 3M NON-TIE-ROD MILL TYPE CYLINDER



FEATURES

The NOPAK Class 3 Mill Type Cylinder offers the advantages of field-proven Class 3 design integrity in a non-tie-rod unit. Note the square flanges welded to both ends of the cylinder tube. We bolt NOPAK production cylinder heads to these flanges using Grade 8 fasteners.

All the features found in NOPAK's Class 3 are incorporated in the 3M Series. A long list of options, including dual piston stop tube, integral LDT (Linear Displacement Transducer), servo or proportional valve footprint in cylinder head and multiple mounting styles are available.

WARRANTY

GALLAND HENNING NOPAK, INC. warrants every product of its manufacture to be of proper materials and first class workmanship. We agree to repair or replace, F.O.B. Factory, but not to remove or install in the field, any perishable "soft goods" such as seals, gaskets, etc., which fail within a six-month period after shipment, normal wear excepted. We warrant for one year from date of shipment, all other parts which fail because of defective materials or workmanship. GHN assumes no responsibility for work done or expenses incurred, in the field, pertaining to such repairs or replacements, except upon written authority from our home office. Components not produced by GHN are subject only to the warranty extended to GHN by their respective manufacturer. For a complete statement of terms and warranty, see your NOPAK distributor or the reverse side of any GHN invoice.

When orders have been correctly filled, there shall be no returns without GHN's approval. Such returns will be subject to a restocking charge.

NATIONAL FLUID POWER ASSOCIATION MEMBER

PREFERRED NOPAK DISTRIBUTOR

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