Class 3

High Pressure Square-Head Cylinders

GHN NOPAK

First in Manufacturing. Engineered to Last.

TABLE OF CONTENTS

PRESSURE RATINGS (PSI)

CYL. BORE	4/1•	RECOMMENDED MAXIMUM CONTINUOUS PRESSURE
1-1/2	2265	3000
2	3209	3000
2-1/2	3209	3000
3-1/4	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 1/4th 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	1-1/2	2	2-1/2	3-1/4	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 D
(NFPA STD. MF1)
1-1/2" – 8" DIA. BORE
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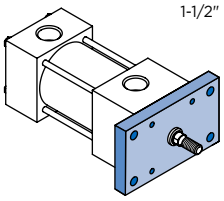

MODEL C
(NFPA STD. MF2)
1-1/2" – 8" DIA. BORE
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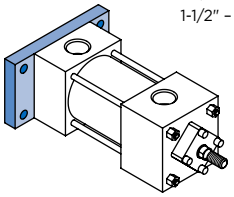

MODEL DD
(NFPA STD. MF5)
1-1/2" – 8" DIA. BORE
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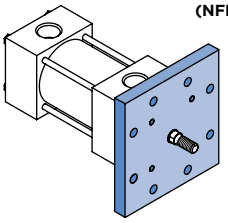
10" – 12" DIA. BORE
PAGE 32



MODEL CC
(NFPA STD. MF6)
1-1/2" – 8" DIA. BORE
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10" – 12" DIA. BORE
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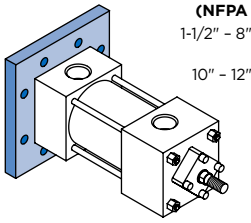

MODEL DG
(ROD HEAD SQUARE MOUNT)
14" – 20" DIA. BORE
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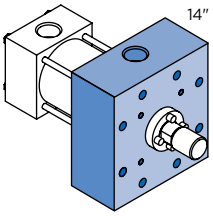

MODEL CJ
(BLIND HEAD SQUARE MOUNT)
14" – 20" DIA. BORE
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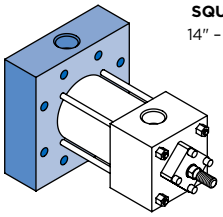

MODEL G
(NFPA STD. ME5)
1-1/2" – 12" DIA. BORE
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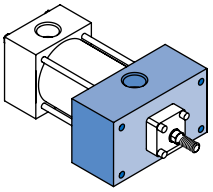

MODEL J
(NFPA STD. ME6)
1-1/2" – 12" DIA. BORE
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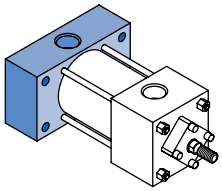

MODEL A
(NFPA STD. MS2)
1-1/2" – 7" DIA. BORE
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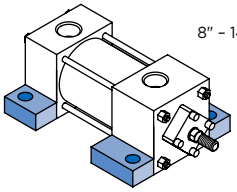

MODEL B
(NFPA STD. MS3)
1-1/2" – 7" DIA. BORE
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8" – 20" DIA. BORE
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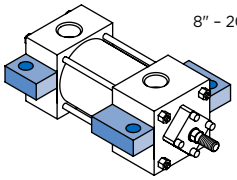

MODEL S
(NFPA STD. MS4)
1-1/2" – 7" DIA. BORE
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8" DIA. BORE
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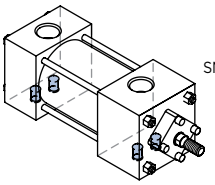
SMALL ROD ONLY



MODEL AL
(NFPA STD. MS7)
1-1/2" – 7" DIA. BORE
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8" DIA. BORE
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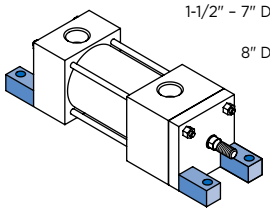

MODEL E
(NFPA STD. MP1)
1-1/2" – 7" DIA. BORE
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8" – 20" DIA. BORE
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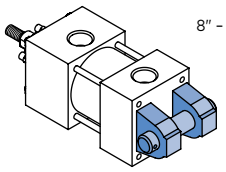

MODEL HE
(NFPA STD. MP2)
1-1/2" – 7" DIA. BORE
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8" DIA. BORE
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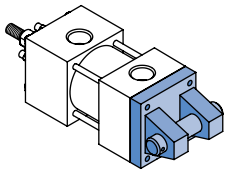

MODEL E3
(NFPA STD. MP3)
1-1/2" – 20" DIA. BORE
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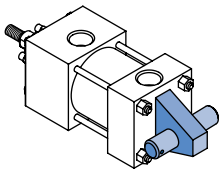

MODEL EU3
(NFPA STD. MPU3)
1-1/2" – 6" DIA. BORE
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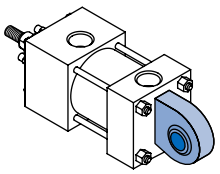

MODEL FR
(NFPA STD. MT1)
1-1/2" – 7" DIA. BORE
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8" – 14" DIA. BORE
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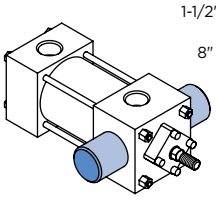

MODEL FB
(NFPA STD. MT2)
1-1/2" – 7" DIA. BORE
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8" – 14" DIA. BORE
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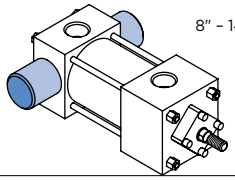

MODEL F
(NFPA STD. MT4)
1-1/2" – 7" DIA. BORE
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8" – 14" DIA. BORE
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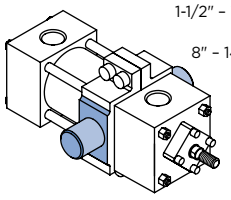

MODEL T
(NFPA STD. MX1)
1-1/2" – 8" DIA. BORE
PAGE 52
10" – 14" DIA. BORE
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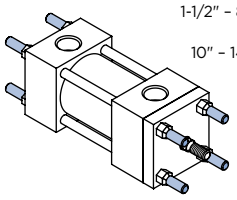

MODEL TB
(NFPA STD. MX2)
1-1/2" – 8" DIA. BORE
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10" – 14" DIA. BORE
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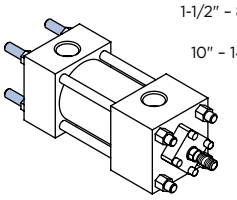

MODEL TR
(NFPA STD. MX3)
1-1/2" – 8" DIA. BORE
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10" – 14" DIA. BORE
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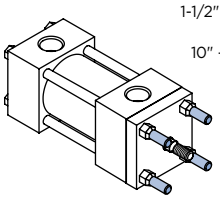

MODEL H
(BASIC CYLINDER NO MOUNT)
1-1/2" – 6" DIA. BORE
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7" – 20" DIA. BORE
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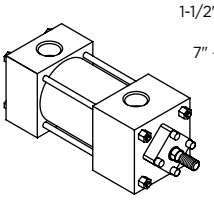

MODEL XH
(BASIC CYLINDER DOUBLE ROD END)
1-1/2" – 6" DIA. BORE
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7" – 20" DIA. BORE
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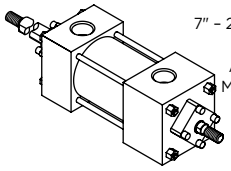
AVAILABLE IN MOST MODELS



HIGH PRESSURE SQUARE-HEAD CLASS 3 HYDRAULIC CYLINDERS CUTAWAY VIEW

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 furnished with backup rings. "T" ring funished on all models and bores 1-1/2" through 16" diameter; 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 bypass fluid to provide a leak-proof piston seal with maximum life.

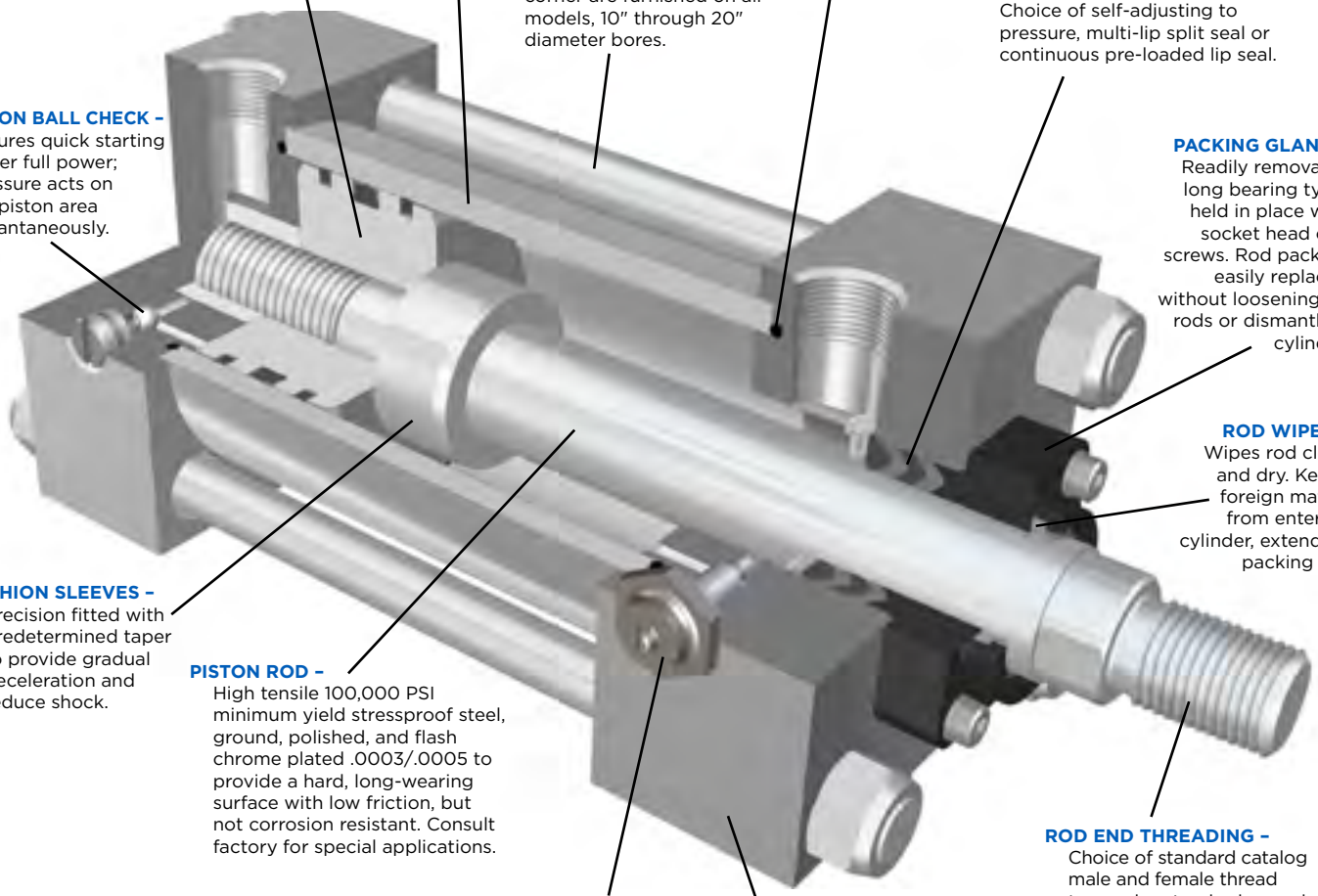
HEAVY WALL –
Steel tubing, precision honed with extra long stones to provide overlap and eliminate a spiral condition detrimental to long stroke cylinders. The resulting ultra-smooth finish provides maximum seal life.

TUBE SEAL –
Two-step pilot recess grooves afford positive controlled squeeze on pressure sealed O-ring, while tubing locates concentrically against end cap.

TIE ROD –
Material is stressproof steel for maximum strength. Multiple tie rods in each corner are furnished on all models, 10" through 20" diameter bores.

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

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



PACKING GLAND –
Readily removable long bearing type, held in place with socket head cap screws. Rod packing easily replaced without loosening tie rods or dismantling cylinder.

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

CUSHION SLEEVES –
Precision fitted with predetermined taper to provide gradual deceleration and reduce shock.

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

END CAPS –
(Cylinder Heads) Precision broached steel blocks.

ALTERNATE FLUSH CUSHION DESIGN

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 65.

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 66 for instructions.

OVERSIZE RODS
For long, push stroke cylinders, oversize rods may be required. See page 66 for instructions.

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 56 through page 59.

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 shock. The mass to be cushioned should be limited to one-half the cylinder force 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 1-1/2" thru 8" diameter cylinder bores. To increase cylinder speed, increased fluid volume is necessary. This can be done by using enlarged or additional ports.

HOW TO ORDER

You can help ensure 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:
   - NN = non-cushioned
   - NA = cushioned blind end
   - AN = cushioned rod end
   - AA = cushioned both ends
7. Piston rod diameter and type of rod threading – specify Type 1, 3, 4, 5, 6 or 7. See page 60.

Also Specify:

1. Position of cylinder ports and cushion adjustment screw, if other than standard. Standard 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. Any unusual operating conditions.

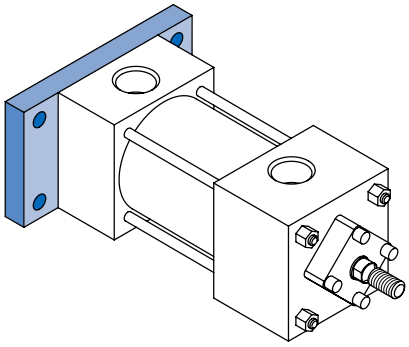
ORDERING CODE EXAMPLE

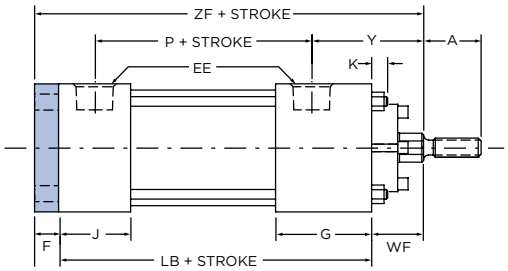
CL3 - 4 x 18 - A - Δ Δ - 1.75 - 4 - OPT

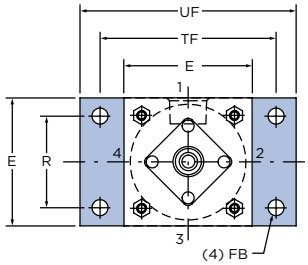
Any special requirements should be described IN WORDS below model number.

- OPT: Special modification if required.
- Rod End Thread: See chart on page 60.
- Rod Diameter: See chart at respective bore size for rod sizes available in that bore.
- Cushions: Two letters required in model number:
  - NN = No cushions
  - NA = No cushion rod end, cushion blind end
  - AN = Cushion rod end, no cushion blind end
  - AA = Cushioned both ends
- 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 (1-1/2" through 20")
- Class 3 Hydraulic

MODEL C (NFPA STD. MF2)▲





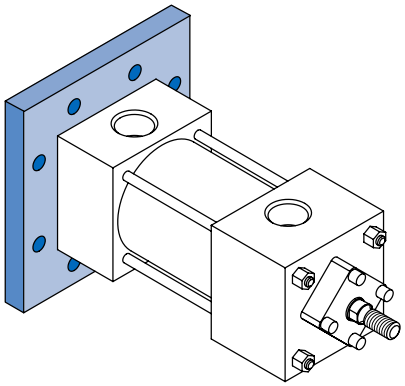


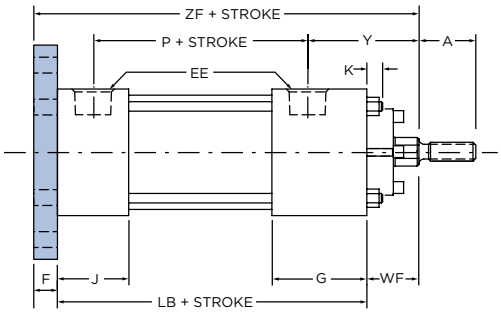
PRESSURE LIMITATIONS (PULL)

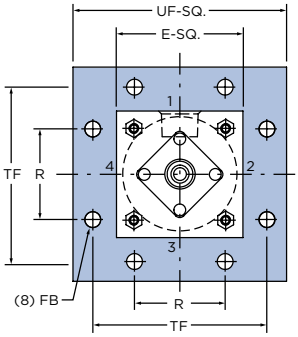
CYL. DIAMETER	5	6	7	8
PRESSURE (PSI)	2000	1600	1200	1000

Use Model CC (below) or Model J (page 34) for Recommended Maximum Pressure.

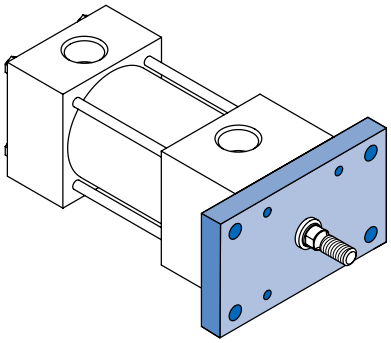
MODEL CC (NFPA STD. MF6)

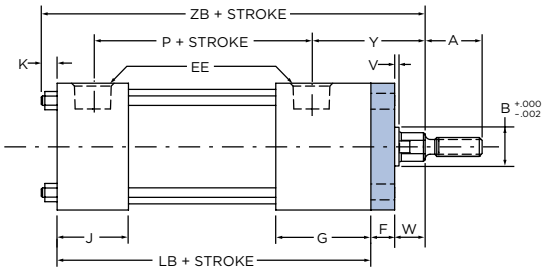


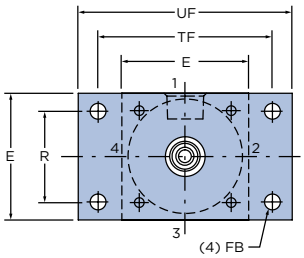




MODEL D (NFPA STD. MF1)





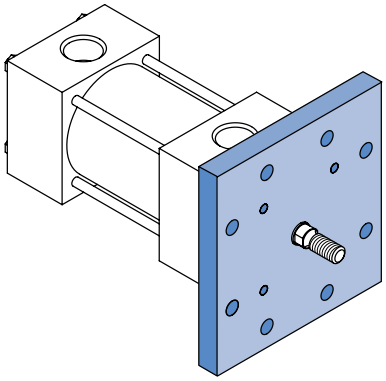


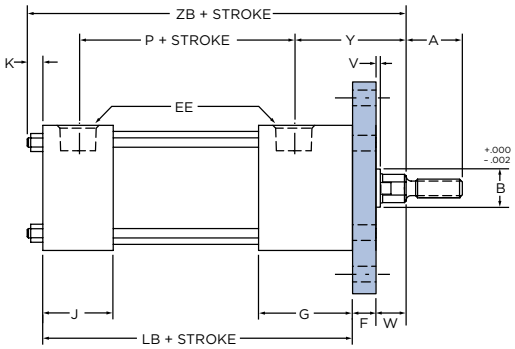
PRESSURE LIMITATIONS (PUSH)

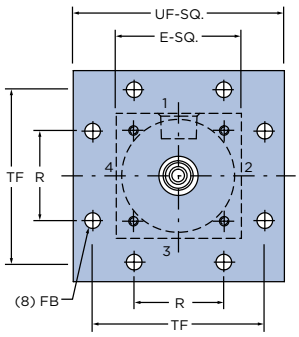
CYL. DIAMETER	5	6	7	8
PRESSURE (PSI)	1800	1500	1000	800

Use Model DD (below) or Model G (page 34) for Recommended Maximum Pressure.

MODEL DD (NFPA STD. MF5)







▲ = See Table A on page 57 for bore and rod combinations using head plates with threaded bronze glands.

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 56.
• = Dimensions refer to bolt diameter.

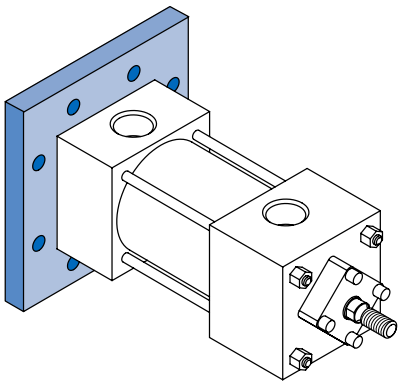
BORE DIA.	E	F	G	J	K	R	EE	FB•	TF	UF
1-1/2	2-1/2	3/8	1-3/4	1-1/2	1/2	1.63	1/2	3/8	3-7/16	4-1/4
2	3	5/8	1-3/4	1-1/2	1/2	2.05	1/2	1/2	4-1/8	5-1/8
2-1/2	3-1/2	5/8	1-3/4	1-1/2	5/8	2.55	1/2	1/2	4-5/8	5-5/8
3-1/4	4-1/2	3/4	2-1/4	1-3/4	3/4	3.25	3/4	5/8	5-7/8	7-1/8
4	5	7/8	2-1/4	1-3/4	3/4	3.82	3/4	5/8	6-3/8	7-5/8
5	6-1/2	7/8	2-1/4	1-3/4	1	4.95	3/4	7/8	8-3/16	9-3/4
6	7-1/2	1	2-1/2	2-1/4	1-1/8	5.73	1	1	9-7/16	11-1/4
7	8-1/2	1	2-3/4	2-3/4	1-1/8	6.58	1-1/4	1-1/8	10-5/8	12-5/8
8	9-1/2	1	3	3	1-3/8	7.50	1-1/2	1-1/4	11-13/16	14

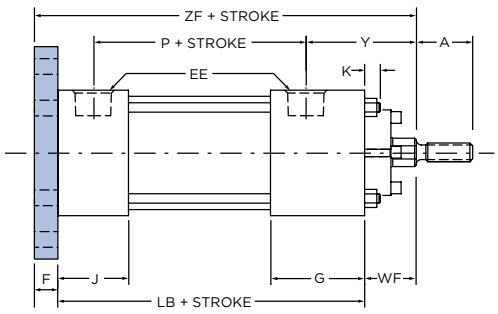
Table 2 The dimensions given on this table are affected by the piston rod diameter and the stroke.

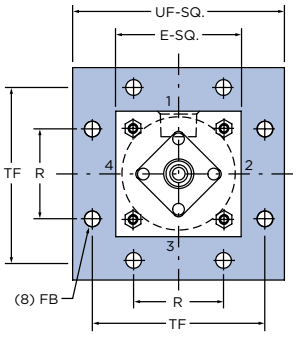
• = For piston rod dimensions see page 60.

BORE DIA.	ROD MM•	A	B	P	V	W	Y	LB	WF	ZB	ZF
1-1/2	5/8	3/4	1-1/8	2-3/4	1/4	5/8	2-1/16	4-5/8	1	6-1/8	6
	1	1-1/8	1-1/2	2-3/4	1/2	1	2-7/16	4-5/8	1-3/8	6-1/2	6-3/8
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	6-5/8
	1-3/8	1-5/8	2	2-3/4	3/8	1	2-11/16	4-5/8	1-5/8	6-3/4	6-7/8
2-1/2	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	6-3/4
	1-3/8	1-5/8	2	2-7/8	3/8	1	2-11/16	4-3/4	1-5/8	7	7
	1-3/4	2	2-3/8	2-7/8	1/2	1-1/4	2-15/16	4-3/4	1-7/8	7-1/4	7-1/4
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	7-7/8
	1-3/4	2	2-3/8	3-1/4	3/8	1-1/8	3-1/4	5-1/2	1-7/8	8-1/8	8-1/8
	2	2-1/4	2-5/8	3-1/4	3/8	1-1/4	3-3/8	5-1/2	2	8-1/4	8-1/4
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	8-1/2
	2	2-1/4	2-5/8	3-1/2	1/4	1-1/8	3-3/8	5-3/4	2	8-1/2	8-5/8
	2-1/2	3	3-1/8	3-1/2	3/8	1-3/8	3-5/8	5-3/4	2-1/4	8-3/4	8-7/8
5	2	2-1/4	2-5/8	4	1/4	1-1/8	3-3/8	6-1/4	2	9-1/4	9-1/8
	2-1/2	3	3-1/8	4	3/8	1-3/8	3-5/8	6-1/4	2-1/4	9-1/2	9-3/8
	3	3-1/2	3-3/4	4	3/8	1-3/8	3-5/8	6-1/4	2-1/4	9-1/2	9-3/8
	3-1/2	3-1/2	4-1/4	4	3/8	1-3/8	3-5/8	6-1/4	2-1/4	9-1/2	9-3/8
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	10-5/8
	3	3-1/2	3-3/4	4-5/8	1/4	1-1/4	3-3/4	7-3/8	2-1/4	10-3/4	10-5/8
	3-1/2	3-1/2	4-1/4	4-5/8	1/4	1-1/4	3-3/4	7-3/8	2-1/4	10-3/4	10-5/8
	4	4	4-3/4	4-5/8	1/4	1-1/4	3-3/4	7-3/8	2-1/4	10-3/4	10-5/8
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	11-3/4
	3-1/2	3-1/2	4-1/4	5-3/8	1/4	1-1/4	3-13/16	8-1/2	2-1/4	11-7/8	11-3/4
	4	4	4-3/4	5-3/8	1/4	1-1/4	3-13/16	8-1/2	2-1/4	11-7/8	11-3/4
	4-1/2	4-1/2	5-1/4	5-3/8	1/4	1-1/4	3-13/16	8-1/2	2-1/4	11-7/8	11-3/4
	5	5	5-3/4	5-3/8	1/4	1-1/4	3-13/16	8-1/2	2-1/4	11-7/8	11-3/4
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	12-3/4
	4	4	4-3/4	6	1/4	1-1/4	4	9-1/2	2-1/4	13-1/8	12-3/4
	4-1/2	4-1/2	5-1/4	6	1/4	1-1/4	4	9-1/2	2-1/4	13-1/8	12-3/4
	5	5	5-3/4	6	1/4	1-1/4	4	9-1/2	2-1/4	13-1/8	12-3/4
	5-1/2	5-1/2	6-1/4	6	1/4	1-1/4	4	9-1/2	2-1/4	13-1/8	12-3/4

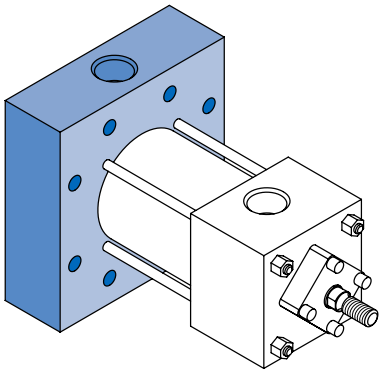
MODEL CC (BLIND END FLANGE MOUNT) *10" THROUGH 12" DIAMETER BORE*

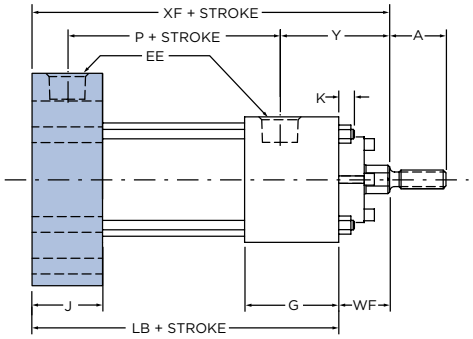


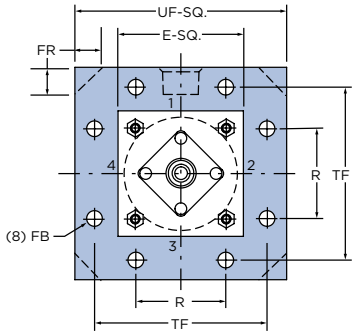




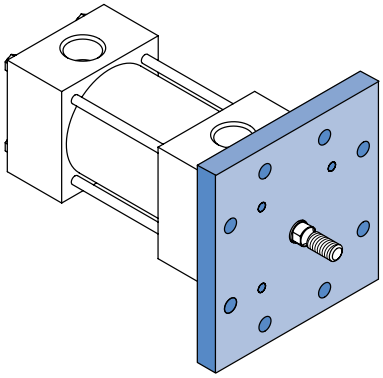
MODEL CJ (BLIND HEAD SQUARE MOUNT) *14" THROUGH 20" DIAMETER BORE*

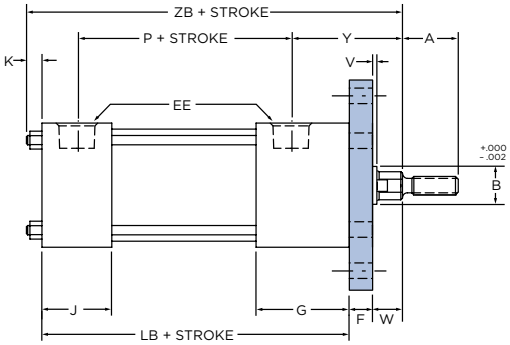


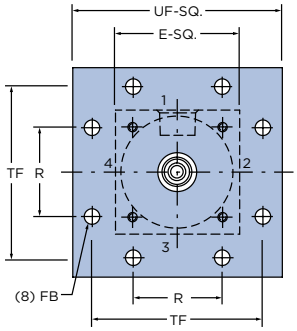




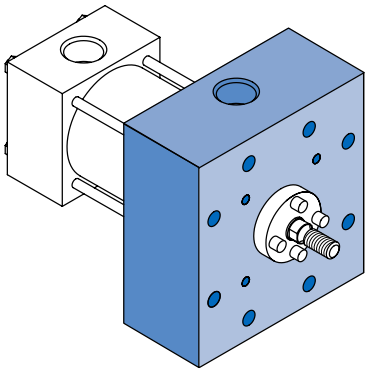
MODEL DD (ROD END FLANGE MOUNT) *10" THROUGH 12" DIAMETER BORE*

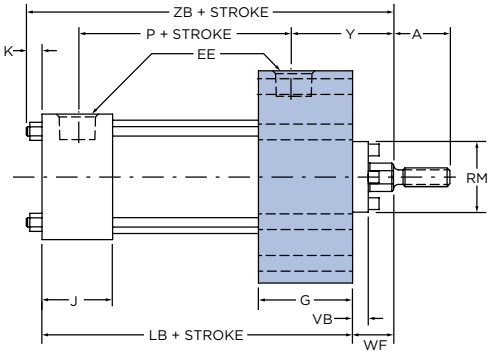






MODEL DG (ROD HEAD SQUARE MOUNT) *14" THROUGH 20" DIAMETER BORE*





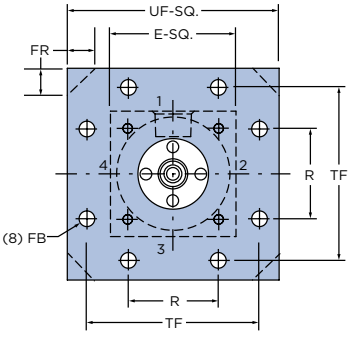


Table 1 These dimensions are constant regardless of rod diameter or stroke.

Double rod end models are designated by letter "X" preceding the model identification. See page 56.

• = Dimensions refer to bolt diameter.

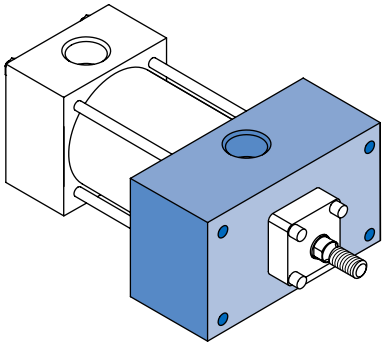
BORE DIA.	E	F	G	J	K	R	EE	FB•	FR	TF	UF
10	12-5/8	1-11/16	3-11/16	3-11/16	1-1/8	9.62	2	1-3/4	–	15-7/8	19
12	14-7/8	1-15/16	4-7/16	4-7/16	1-1/8	11.45	2-1/2	2	–	18-1/2	22
14	17-1/4	–	4-7/8	4-7/8	1-7/16	13.34	2-1/2	2-1/4	–	21	25
16	19-1/4	–	5-7/8	5-7/8	1-7/16	15.10	3	2-1/2	–	23-7/8	28-3/8
18	22	–	6-7/8	6-7/8	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

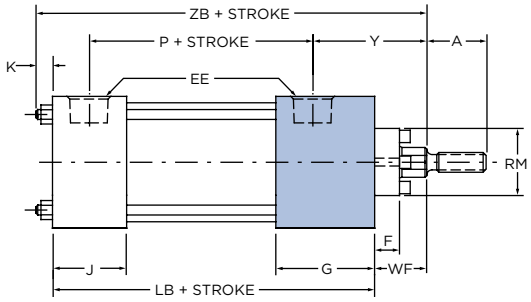
Table 2 The dimensions given on this table are affected by the piston rod diameter and the stroke.

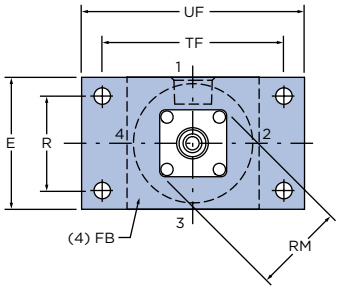
• = For piston rod dimensions see page 60.

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	7-3/4	–	2-15/16	15-1/16	16-3/16	16-3/4
	5	5	5-3/4	8	1/4	1-1/2	5-1/4	12-1/8	8-3/8	–	3-3/16	15-5/16	16-7/16	17
	5-1/2	5-1/2	6-1/4	8	1/4	1-1/2	5-1/4	12-1/8	9	–	3-3/16	15-5/16	16-7/16	17
	7	7	10-1/4	8	11/16	1-1/2	5-1/4	12-1/8	10-1/4	2-3/8	3-3/16	15-5/16	16-7/16	17
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	18-13/16	19-5/8
	7	7	10-1/4	9-5/8	7/16	1-1/2	5-7/8	14-1/2	10-1/4	2-3/8	3-7/16	17-15/16	19-1/16	19-7/8
	8	8	11-1/4	9-5/8	7/16	1-1/2	5-7/8	14-1/2	11-1/4	2-3/8	3-7/16	17-15/16	19-1/16	19-7/8
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	–	9-7/8	–	–	6-3/8	15-5/8	11-1/4	2-3/8	3-1/2	19-1/8	20-1/4	21-3/8
	10	10	–	9-7/8	–	–	6-3/8	15-5/8	14	2-1/2	3-1/2	19-1/8	20-1/4	21-3/8
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	–	11-3/8	–	–	7-3/8	18-1/8	12-1/2	2-1/2	4	22-1/4	23-9/16	24-7/8
	10	10	–	11-3/8	–	–	7-3/8	18-1/8	14	2-1/2	4	22-1/4	23-9/16	24-7/8
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	–	12-3/8	–	–	8-5/8	21-1/8	14	2-1/2	4-1/4	25-3/8	26-13/16	28-3/8
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

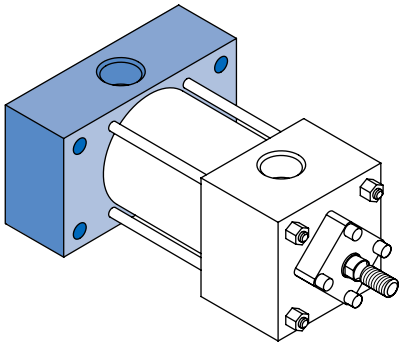
MODEL G (NFPA STD. ME5)

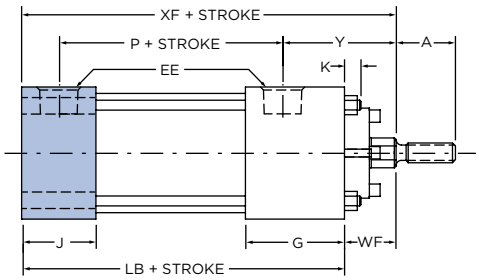


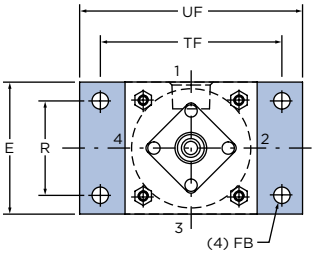




MODEL J (NFPA STD. ME6)▲







▲ = See Table A on page 57 for bore and rod combinations using head plates with threaded bronze glands.

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 56.
• = Dimensions refer to bolt diameter.

BORE DIA.	E	G	J	K	R	EE	FB•	TF	UF
1-1/2	2-1/2	1-3/4	1-1/2	1/2	1.63	1/2	3/8	3-7/16	4-1/4
2	3	1-3/4	1-1/2	1/2	2.05	1/2	1/2	4-1/8	5-1/8
2-1/2	3-1/2	1-3/4	1-1/2	5/8	2.55	1/2	1/2	4-5/8	5-5/8
3-1/4	4-1/2	2-1/4	1-3/4	3/4	3.25	3/4	5/8	5-7/8	7-1/8
4	5	2-1/4	1-3/4	3/4	3.82	3/4	5/8	6-3/8	7-5/8
5	6-1/2	2-1/4	1-3/4	1	4.95	3/4	7/8	8-3/16	9-3/4
6	7-1/2	2-1/2	2-1/4	1-1/8	5.73	1	1	9-7/16	11-1/4
7	8-1/2	2-3/4	2-3/4	1-1/4	6.58	1-1/4	1-1/8	10-5/8	12-5/8
8	9-1/2	3	3	1-1/2	7.50	1-1/2	1-1/4	11-13/16	14
10	12-5/8	3-11/16	3-11/16	1-1/8	9.62	2	1-3/4	15-7/8	19
12	14-7/8	4-7/16	4-7/16	1-1/8	11.45	2-1/2	2	18-1/2	22

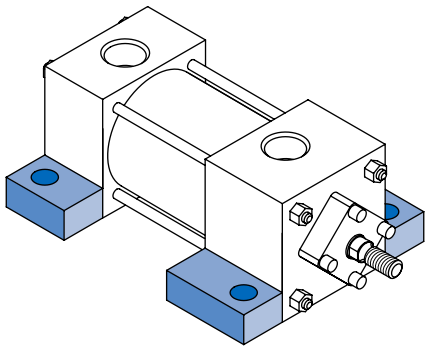
Table 2

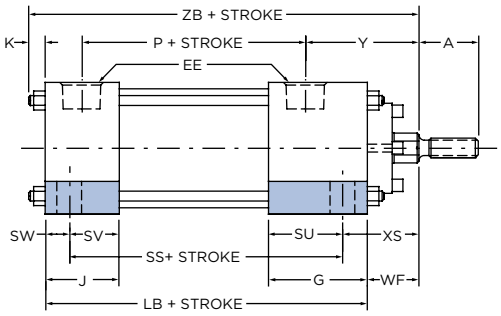
The dimensions given on this table are affected by the piston rod diameter and the stroke.

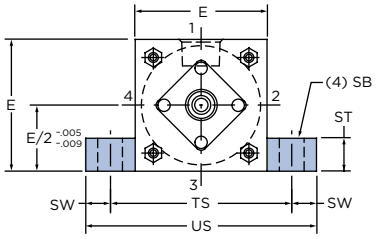
• = For piston rod dimensions see page 60.

BORE DIA.	ROD MM•	A	F	P	Y	LB	RM	WF	XF	ZB
1-1/2	5/8	3/4	3/8	2-3/4	2-1/16	4-5/8	2-1/8	1	5-5/8	6-1/8
	1	1-1/8	1/2	2-3/4	2-7/16	4-5/8	2-3/8	1-3/8	6	6-1/2
2	1	1-1/8	1/2	2-3/4	2-7/16	4-5/8	2-3/8	1-3/8	6	6-1/2
	1-3/8	1-5/8	9/16	2-3/4	2-11/16	4-5/8	3	1-5/8	6-1/4	6-3/4
2-1/2	1	1-1/8	1/2	2-7/8	2-7/16	4-3/4	2-3/8	1-3/8	6-1/8	6-3/4
	1-3/8	1-5/8	9/16	2-7/8	2-11/16	4-3/4	3	1-5/8	6-3/8	7
	1-3/4	2	9/16	2-7/8	2-15/16	4-3/4	3-1/2	1-7/8	6-5/8	7-1/4
3-1/4	1-3/8	1-5/8	9/16	3-1/4	3	5-1/2	3	1-5/8	7-1/8	7-7/8
	1-3/4	2	9/16	3-1/4	3-1/4	5-1/2	3-1/2	1-7/8	7-3/8	8-1/8
	2	2-1/4	9/16	3-1/4	3-3/8	5-1/2	4-1/8	2	7-1/2	8-1/4
4	1-3/4	2	9/16	3-1/2	3-1/4	5-3/4	3-1/2	1-7/8	7-5/8	8-3/8
	2	2-1/4	9/16	3-1/2	3-3/8	5-3/4	4-1/8	2	7-3/4	8-1/2
	2-1/2	3	3/4	3-1/2	3-5/8	5-3/4	4-5/8	2-1/4	8	8-3/4
5	2	2-1/4	9/16	4	3-3/8	6-1/4	4-1/8	2	8-1/4	9-1/4
	2-1/2	3	3/4	4	3-5/8	6-1/4	4-5/8	2-1/4	8-1/2	9-1/2
	3	3-1/2	3/4	4	3-5/8	6-1/4	5-1/2	2-1/4	8-1/2	9-1/2
	3-1/2	3-1/2	3/4	4	3-5/8	6-1/4	6-1/8	2-1/4	8-1/2	9-1/2
6	2-1/2	3	3/4	4-5/8	3-3/4	7-3/8	4-5/8	2-1/4	9-5/8	10-3/4
	3	3-1/2	3/4	4-5/8	3-3/4	7-3/8	5-1/2	2-1/4	9-5/8	10-3/4
	3-1/2	3-1/2	3/4	4-5/8	3-3/4	7-3/8	6-1/8	2-1/4	9-5/8	10-3/4
	4	4	13/16	4-5/8	3-3/4	7-3/8	6-7/8	2-1/4	9-5/8	10-3/4
7	3	3-1/2	3/4	5-3/8	3-13/16	8-1/2	5-1/2	2-1/4	10-3/4	11-7/8
	3-1/2	3-1/2	3/4	5-3/8	3-13/16	8-1/2	6-1/8	2-1/4	10-3/4	11-7/8
	4	4	13/16	5-3/8	3-13/16	8-1/2	6-7/8	2-1/4	10-3/4	11-7/8
	4-1/2	4-1/2	13/16	5-3/8	3-13/16	8-1/2	7-3/4	2-1/4	10-3/4	11-7/8
	5	5	15/16	5-3/8	3-13/16	8-1/2	8-3/8	2-1/4	10-3/4	11-7/8
8	3-1/2	3-1/2	3/4	6	4	9-1/2	6-1/8	2-1/4	11-3/4	13-1/8
	4	4	13/16	6	4	9-1/2	6-7/8	2-1/4	11-3/4	13-1/8
	4-1/2	4-1/2	13/16	6	4	9-1/2	7-3/4	2-1/4	11-3/4	13-1/8
	5	5	15/16	6	4	9-1/2	8-3/8	2-1/4	11-3/4	13-1/8
	5-1/2	5-1/2	15/16	6	4	9-1/2	9	2-1/4	11-3/4	13-1/8
10	4-1/2	4-1/2	13/16	8	5	12-1/8	7-3/4	2-15/16	15-1/16	16-3/16
	5	5	15/16	8	5-1/4	12-1/8	8-3/8	3-3/16	15-5/16	16-7/16
	5-1/2	5-1/2	15/16	8	5-1/4	12-1/8	9	3-3/16	15-5/16	16-7/16
	7	7	2-3/16	8	5-1/4	12-1/8	10-1/4	3-3/16	15-5/16	16-7/16
12	5-1/2	5-1/2	15/16	9-5/8	5-5/8	14-1/2	9	3-3/16	17-11/16	18-13/16
	7	7	2-3/16	9-5/8	5-7/8	14-1/2	10-1/4	3-7/16	17-15/16	19-1/16
	8	8	2-7/16	9-5/8	5-7/8	14-1/2	11-1/4	3-7/16	17-15/16	19-1/16

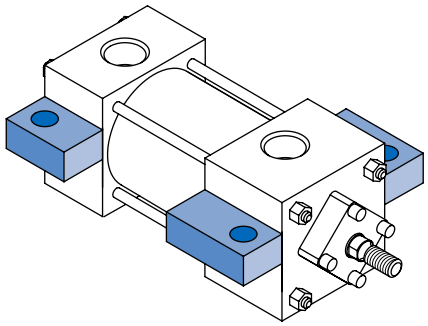
MODEL A (NFPA STD. MS2)▲

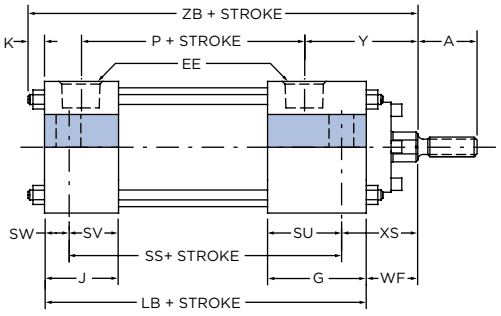


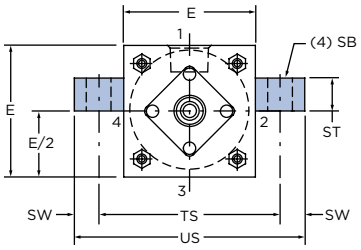




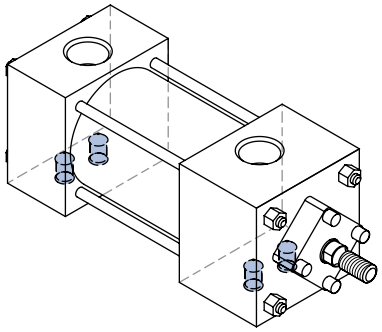
MODEL B (NFPA STD. MS3)▲

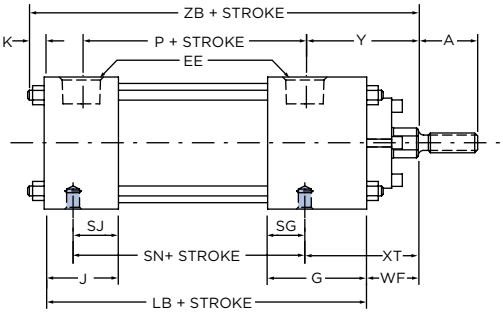


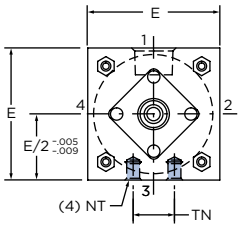




MODEL S (NFPA STD. MS4)







▲ = See Table A on page 57 for bore and rod combinations using head plates with threaded bronze glands.

Table 1 These dimensions are constant regardless of rod diameter or stroke.

For double rod end cylinders Model A and B: subtract dimensions SV from SU and add to dimension SS + Stroke. See pages 56-59.
Double rod end models are designated by letter "X" preceding the model identification. See page 56.
• = Dimensions refer to bolt diameter.

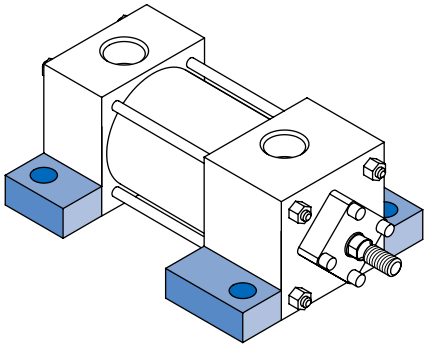
BORE DIA.	E	G	J	K	EE	NT	SB•	SG	SJ	ST	SU	SV	SW	TN	TS	US
1-1/2	2-1/2	1-3/4	1-1/2	1/2	1/2	3/8–16	3/8	3/4	3/4	1/2	1-3/8	1-1/8	3/8	3/4	3-1/4	4
2	3	1-3/4	1-1/2	1/2	1/2	1/2–13	1/2	3/4	3/4	3/4	1-1/4	1	1/2	15/16	4	5
2-1/2	3-1/2	1-3/4	1-1/2	5/8	1/2	5/8–11	3/4	3/4	3/4	1	1-1/16	13/16	11/16	1-5/16	4-7/8	6-1/4
3-1/4	4-1/2	2-1/4	1-3/4	3/4	3/4	3/4–10	3/4	1-1/8	7/8	1	1-9/16	1-1/16	11/16	1-1/2	5-7/8	7-1/4
4	5	2-1/4	1-3/4	3/4	3/4	1–8	1	1-1/8	7/8	1-1/4	1-3/8	7/8	7/8	2-1/16	6-3/4	8-1/2
5	6-1/2	2-1/4	1-3/4	1	3/4	1–8	1	1-1/8	7/8	1-1/4	1-3/8	7/8	7/8	2-15/16	8-1/4	10
6	7-1/2	2-1/2	2-1/4	1-1/8	1	1-1/4–7	1-1/4	1-1/4	1-1/4	1-1/2	1-3/8	1-1/8	1-1/8	3-5/16	9-3/4	12
7	8-1/2	2-3/4	2-3/4	1-1/8	1-1/4	1-1/2–6	1-1/2	1-13/16	1-11/16	1-3/4	1-3/8	1-3/8	1-3/8	3-3/4	11-1/4	14

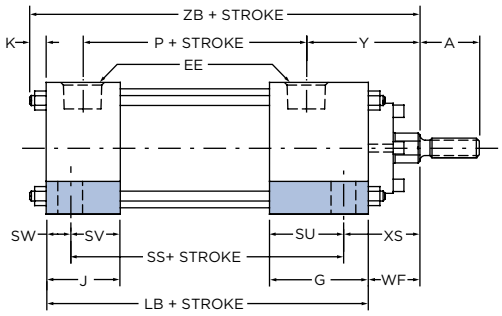
Table 2 The dimensions given on this table are affected by the piston rod diameter and the stroke.

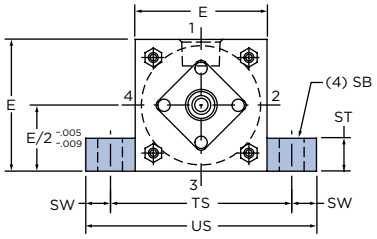
For double rod end cylinders Model S: in place of dimension SN + stroke, multiply dimension XT times 2 and to this total add the cylinder stroke. From this figure, subtract the ZM + double stroke. See pages 56-59.
• = For piston rod dimensions see page 60.

BORE DIA.	ROD MM•	A	P	Y	LB	SN	SS	WF	XS	XT	ZB
1-1/2	5/8	3/4	2-3/4	2-1/16	4-5/8	2-7/8	3-7/8	1	1-3/8	2	6-1/8
	1	1-1/8	2-3/4	2-7/16	4-5/8	–	3-7/8	1-3/8	1-3/4	–	6-1/2
2	1	1-1/8	2-3/4	2-7/16	4-5/8	2-7/8	3-5/8	1-3/8	1-7/8	2-3/8	6-1/2
	1-3/8	1-5/8	2-3/4	2-11/16	4-5/8	–	3-5/8	1-5/8	2-1/8	–	6-3/4
2-1/2	1	1-1/8	2-7/8	2-7/16	4-3/4	3	3-3/8	1-3/8	2-1/16	2-3/8	6-3/4
	1-3/8	1-5/8	2-7/8	2-11/16	4-3/4	–	3-3/8	1-5/8	2-5/16	–	7
	1-3/4	2	2-7/8	2-15/16	4-3/4	–	3-3/8	1-7/8	2-9/16	–	7-1/4
3-1/4	1-3/8	1-5/8	3-1/4	3	5-1/2	3-1/2	4-1/8	1-5/8	2-5/16	2-3/4	7-7/8
	1-3/4	2	3-1/4	3-1/4	5-1/2	–	4-1/8	1-7/8	2-9/16	-	8-1/8
	2	2-1/4	3-1/4	3-3/8	5-1/2	–	4-1/8	2	2-11/16	-	8-1/4
4	1-3/4	2	3-1/2	3-1/4	5-3/4	3-3/4	4	1-7/8	2-3/4	3	8-3/8
	2	2-1/4	3-1/2	3-3/8	5-3/4	–	4	2	2-7/8	–	8-1/2
	2-1/2	3	3-1/2	3-5/8	5-3/4	–	4	2-1/4	3-1/8	–	8-3/4
5	2	2-1/4	4	3-3/8	6-1/4	4-1/4	4-1/2	2	2-7/8	3-1/8	9-1/4
	2-1/2	3	4	3-5/8	6-1/4	–	4-1/2	2-1/4	3-1/8	–	9-1/2
	3	3-1/2	4	3-5/8	6-1/4	–	4-1/2	2-1/4	3-1/8	–	9-1/2
	3-1/2	3-1/2	4	3-5/8	6-1/4	–	4-1/2	2-1/4	3-1/8	–	9-1/2
6	2-1/2	3	4-5/8	3-3/4	7-3/8	5-1/8	5-1/8	2-1/4	3-3/8	3-1/2	10-3/4
	3	3-1/2	4-5/8	3-3/4	7-3/8	–	5-1/8	2-1/4	3-3/8	–	10-3/4
	3-1/2	3-1/2	4-5/8	3-3/4	7-3/8	–	5-1/8	2-1/4	3-3/8	–	10-3/4
	4	4	4-5/8	3-3/4	7-3/8	–	5-1/8	2-1/4	3-3/8	–	10-3/4
7	3	3-1/2	5-3/8	3-13/16	8-1/2	5-7/8	5-3/4	2-1/4	3-5/8	3-13/16	11-7/8
	3-1/2	3-1/2	5-3/8	3-13/16	8-1/2	–	5-3/4	2-1/4	3-5/8	–	11-7/8
	4	4	5-3/8	3-13/16	8-1/2	–	5-3/4	2-1/4	3-5/8	–	11-7/8
	4-1/2	4-1/2	5-3/8	3-13/16	8-1/2	–	5-3/4	2-1/4	3-5/8	–	11-7/8
	5	5	5-3/8	3-13/16	8-1/2	–	5-3/4	2-1/4	3-5/8	–	11-7/8

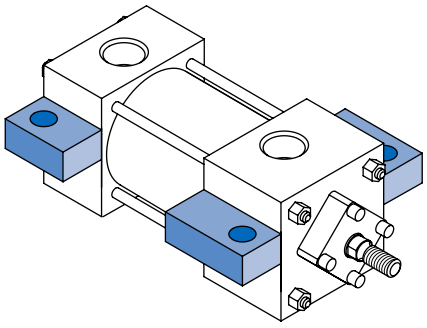
MODEL A (NFPA STD. MS2) *8" THROUGH 14" DIAMETER BORE*

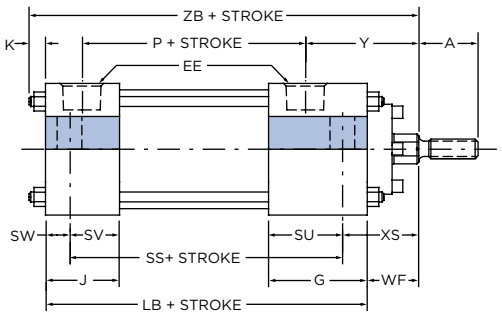


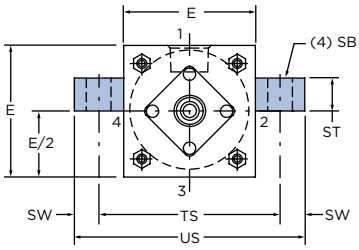




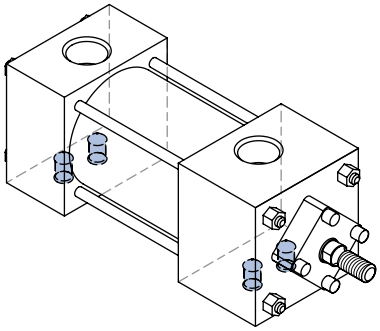
MODEL B (NFPA STD. MS3) *8" THROUGH 20" DIAMETER BORE*

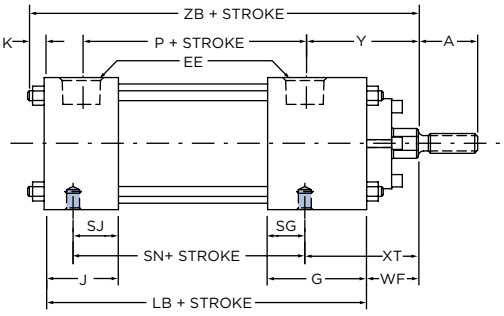


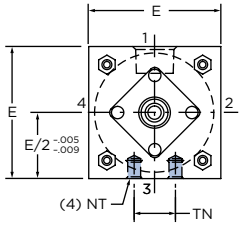




MODEL S (NFPA STD. MS4) *8" DIAMETER BORE*







NOTE: This model available in small rod only.

Table 1 These dimensions are constant regardless of rod diameter or stroke.

For double rod end cylinders Model A and B: subtract dimension SV from SU and add to dimension SS + stroke. See pages 56-59.
Double rod end models are designated by letter "X" preceding the model identification. See page 56.
• = Dimensions refer to bolt diameter.

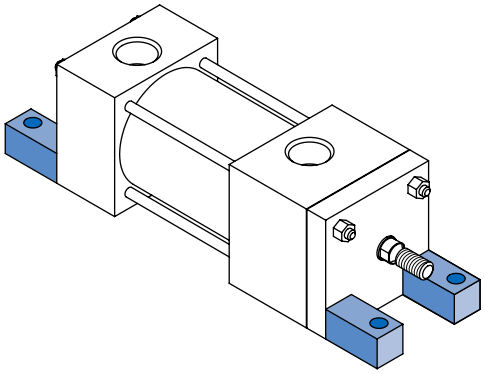
BORE DIA.	E	G	J	K	EE	NT	SB•	SG	SJ	ST	SU	SV	SW	TN	TS	US
8	9-1/2	3	3	1-3/8	1-1/2	1-1/2–6	1-1/2	1-5/16	1-13/16	1-3/4	1-5/8	1-5/8	1-3/8	4-1/4	12-1/4	15
10	12-5/8	3-11/16	3-11/16	1-1/8	2	–	1-1/2	–	–	2-1/4	2-1/16	2-1/16	1-5/8	–	15-7/8	19-1/8
12	14-7/8	4-7/16	4-7/16	1-1/8	2-1/2	–	1-1/2	–	–	3	2-7/16	2-7/16	2	–	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

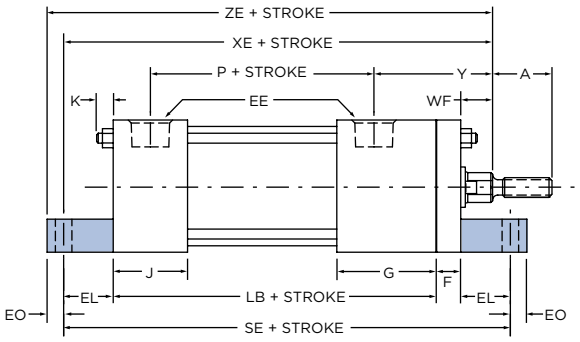
Table 2 The dimensions given on this table are affected by the piston rod diameter and the stroke.

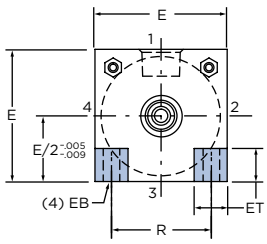
For double rod end cylinders Model S: in place of dimension SN + stroke, multiply dimension XT times 2 and to this total add the cylinder stroke. From this figure, subtract the ZM + double stroke. See pages 56-59.
• = For piston rod dimensions see page 60.

BORE DIA.	ROD MM•	A	P	Y	LB	SN	SS	WF	XS	XT	ZB
8	3-1/2	3-1/2	6	4	9-1/2	6-5/8	6-3/4	2-1/4	3-5/8	3-15/16	13-1/8
	4	4	6	4	9-1/2	–	6-3/4	2-1/4	3-5/8	–	13-1/8
	4-1/2	4-1/2	6	4	9-1/2	–	6-3/4	2-1/4	3-5/8	–	13-1/8
	5	5	6	4	9-1/2	–	6-3/4	2-1/4	3-5/8	–	13-1/8
	5-1/2	5-1/2	6	4	9-1/2	–	6-3/4	2-1/4	3-5/8	–	13-1/8
10	4-1/2	4-1/2	8	5	12-1/8	–	8-7/8	2-15/16	4-9/16	–	16-3/16
	5	5	8	5-1/4	12-1/8	–	8-7/8	3-3/16	4-13/16	–	16-7/16
	5-1/2	5-1/2	8	5-1/4	12-1/8	–	8-7/8	3-3/16	4-13/16	–	16-7/16
	7	7	8	5-1/4	12-1/8	–	8-7/8	3-3/16	4-13/16	–	16-7/16
12	5-1/2	5-1/2	9-5/8	5-5/8	14-1/2	–	10-1/2	3-3/16	5-3/16	–	18-13/16
	7	7	9-5/8	5-7/8	14-1/2	–	10-1/2	3-7/16	5-7/16	–	19-1/16
	8	8	9-5/8	5-7/8	14-1/2	–	10-1/2	3-7/16	5-7/16	–	19-1/16
14	7	7	9-7/8	6-3/8	15-5/8	–	11-1/8	3-1/2	5-3/4	–	20-1/4
	8	8	9-7/8	6-3/8	15-5/8	–	11-1/8	3-1/2	5-3/4	–	20-1/4
	10	10	9-7/8	6-3/8	15-5/8	–	11-1/8	3-1/2	5-3/4	–	20-1/4
16	8	8	11-3/8	7-3/8	18-1/8	–	12-5/8	4	6-3/4	–	23-9/16
	9	9	11-3/8	7-3/8	18-1/8	–	12-5/8	4	6-3/4	–	23-9/16
	10	10	11-3/8	7-3/8	18-1/8	–	12-5/8	4	6-3/4	–	23-9/16
18	9	9	12-3/8	8-5/8	21-1/8	–	14-5/8	4-1/4	7-1/2	–	26-13/16
	10	10	12-3/8	8-5/8	21-1/8	–	14-5/8	4-1/4	7-1/2	–	26-13/16
20	10	10	13-3/8	9-5/8	23-5/8	–	15-7/8	4-1/2	8-3/8	–	29-9/16

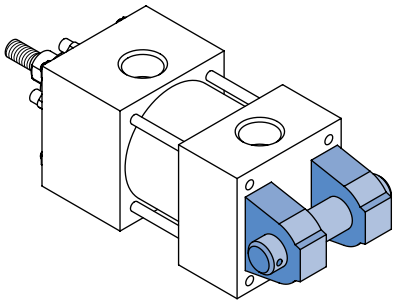
MODEL AL (NFPA STD. MS7)

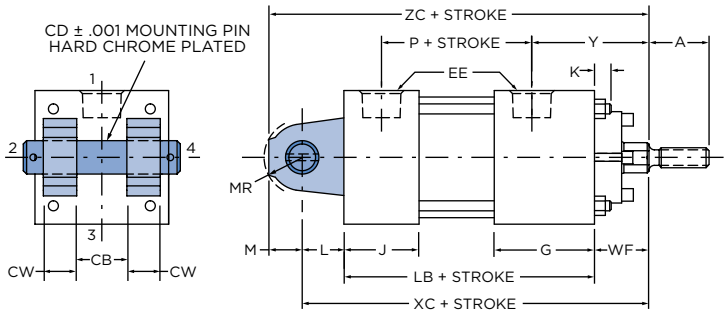


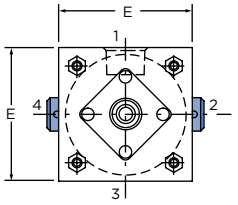




MODEL E (NFPA STD. MP1)▲

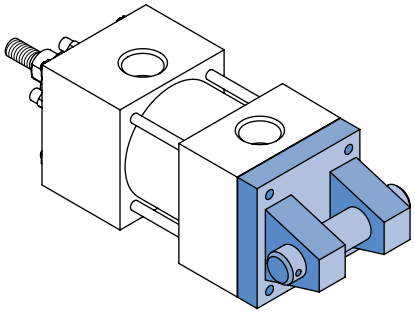


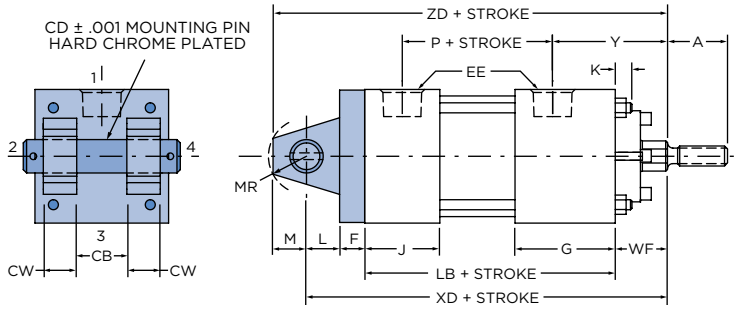


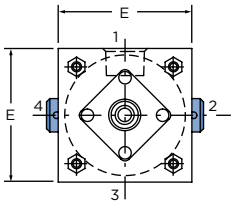


NOTE: Pin Ø is CD. Swing radius is MR.

MODEL HE (NFPA STD. MP2)▲ *1-1/2" THROUGH 7" DIAMETER BORE*







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

▲ = See Table A on page 57 for bore and rod combinations using head plates with threaded bronze glands.

Table 1 These dimensions are constant regardless of rod diameter or stroke.

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 56.
• = Dimensions refer to bolt diameter.

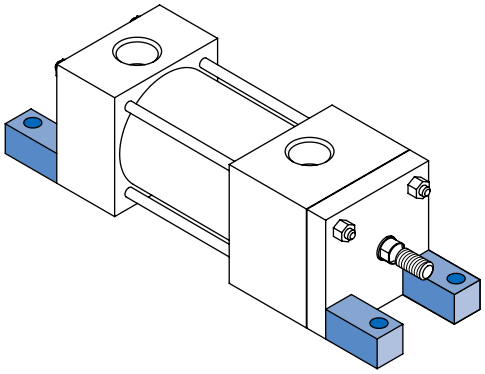
BORE DIA.	E	F		G	J	K	L	M	R	CB	CD	CW	EB•	EE	EL	EO	ET	MR
		AL	HE															
1-1/2	2-1/2	3/8	3/8	1-3/4	1-1/2	1/2	3/4	1/2	1.81	3/4	1/2	1/2	3/8	1/2	7/8	3/8	11/16	5/8
2	3	5/8	5/8	1-3/4	1-1/2	1/2	1-1/4	3/4	2.19	1-1/4	3/4	5/8	1/2	1/2	15/16	1/2	13/16	7/8
2-1/2	3-1/2	5/8	5/8	1-3/4	1-1/2	5/8	1-1/4	3/4	2.55	1-1/4	3/4	5/8	1/2	1/2	15/16	1/2	15/16	7/8
3-1/4	4-1/2	3/4	7/8	2-1/4	1-3/4	3/4	1-1/2	1	3.25	1-1/2	1	3/4	5/8	3/4	1-1/8	5/8	1-1/4	1-1/4
4	5	7/8	7/8	2-1/4	1-3/4	3/4	2-1/8	1-3/8	3.82	2	1-3/8	1	5/8	3/4	1-1/8	5/8	1-3/16	1-5/8
5	6-1/2	7/8	1-1/8	2-1/4	1-3/4	1	2-1/4	1-3/4	4.95	2-1/2	1-3/4	1-1/4	7/8	3/4	1-1/2	3/4	1-9/16	2
6	7-1/2	1	1-7/16	2-1/2	2-1/4	1-1/8	2-1/2	2	5.73	2-1/2	2	1-1/4	1	1	1-11/16	7/8	1-3/4	2-3/8
7	8-1/2	1	1-5/8	2-3/4	2-3/4	1-1/8	3	2-1/2	6.58	3	2-1/2	1-1/2	1-1/8	1-1/4	1-13/16	1	1-7/8	3

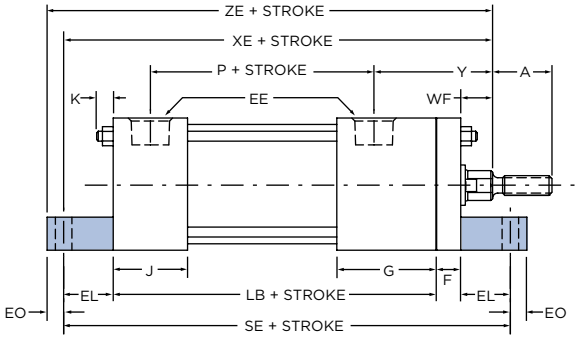
Table 2 The dimensions given on this table are affected by the piston rod diameter and the stroke.

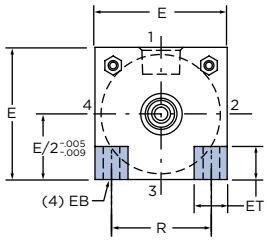
• = For piston rod dimensions see page 60.

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

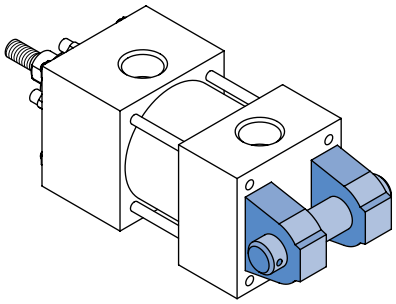
MODEL AL (NFPA STD. MS7) *8" DIAMETER BORE*

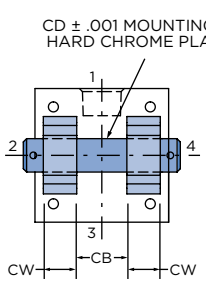


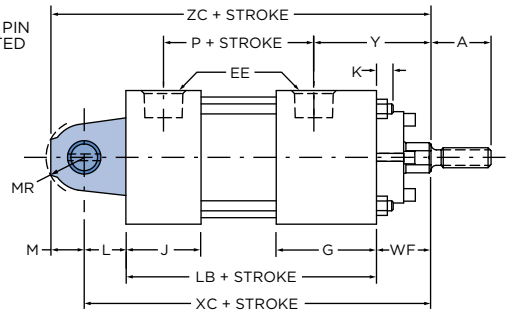


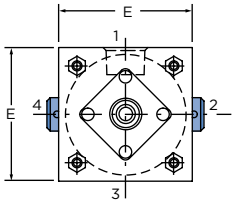


MODEL E (NFPA STD. MP1) *8" THROUGH 20" DIAMETER BORE*



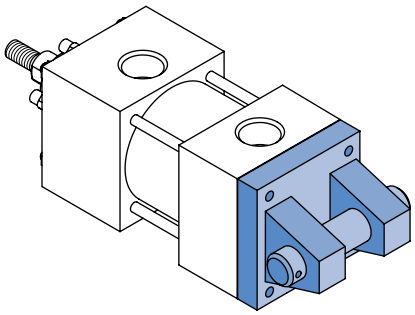


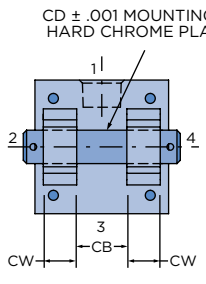


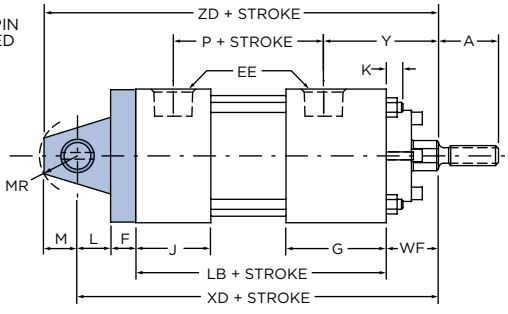


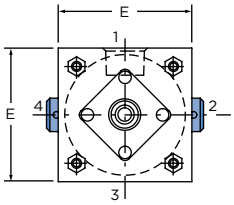
NOTE: Pin Ø is CD. Swing radius is MR.

MODEL HE (NFPA STD. MP2) *8" DIAMETER BORE*









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

Table 1 These dimensions are constant regardless of rod diameter or stroke.

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 56.
• = Dimensions refer to bolt diameter.

BORE DIA.	E	F		G	J	K	L	M	R	CB	CD	CW	EB•	EE	EL	EO	ET	MR
		AL	HE															
8	9-1/2	1	2	3	3	1-3/8	3-1/4	2-3/4	7.50	3	3	1-1/2	1-1/4	1-1/2	2	1-1/8	2	3-1/4
10	12-5/8	–	–	3-11/16	3-11/16	1-1/8	4	3-1/2	–	4	3-1/2	2	–	2	–	–	–	3-1/2
12	14-7/8	–	–	4-7/16	4-7/16	1-1/8	4-5/8	4	–	4-1/2	4	2-1/4	–	2-1/2	–	–	–	4
14	17-1/4	–	–	4-7/8	4-7/8	1-7/16	5-5/8	5	–	6	5	3	–	2-1/2	–	–	–	5
16	19-1/4	–	–	5-7/8	5-7/8	1-7/16	7	6	–	7	6	3-1/2	–	3	–	–	–	6
18	22	–	–	6-7/8	6-7/8	1-7/16	7-5/8	6-1/2	–	8	6-1/2	4	–	3	–	–	–	6-1/2
20	23-5/8	–	–	7-7/8	7-7/8	1-7/16	8-3/4	7-1/2	–	9	7-1/2	4-1/2	–	3	–	–	–	7-1/2

Table 2 The dimensions given on this table are affected by the piston rod diameter and the stroke.

• = For piston rod dimensions see page 60.

BORE DIA.	ROD MM•	A	P	W	Y	LB	SE	WF	XC	XD	XE	ZC	ZD	ZE
8	3-1/2	3-1/2	6	1-1/4	4	9-1/2	14-1/2	2-1/4	15	17	13-3/4	17-3/4	19-3/4	14-7/8
	4	4	6	1-1/4	4	9-1/2	14-1/2	2-1/4	15	17	13-3/4	17-3/4	19-3/4	14-7/8
	4-1/2	4-1/2	6	1-1/4	4	9-1/2	14-1/2	2-1/4	15	17	13-3/4	17-3/4	19-3/4	14-7/8
	5	5	6	1-1/4	4	9-1/2	14-1/2	2-1/4	15	17	13-3/4	17-3/4	19-3/4	14-7/8
	5-1/2	5-1/2	6	1-1/4	4	9-1/2	14-1/2	2-1/4	15	17	13-3/4	17-3/4	19-3/4	14-7/8
10	4-1/2	4-1/2	8	–	5	12-1/8	–	2-15/16	19-1/16	–	–	22-9/16	–	–
	5	5	8	–	5-1/4	12-1/8	–	3-3/16	19-5/16	–	–	22-13/16	–	–
	5-1/2	5-1/2	8	–	5-1/4	12-1/8	–	3-3/16	19-5/16	–	–	22-13/16	–	–
	7	7	8	–	5-1/4	12-1/8	–	3-3/16	19-5/16	–	–	22-13/16	–	–
12	5-1/2	5-1/2	9-5/8	–	5-5/8	14-1/2	–	3-3/16	22-5/16	–	–	26-5/16	–	–
	7	7	9-5/8	–	5-7/8	14-1/2	–	3-7/16	22-9/16	–	–	26-9/16	–	–
	8	8	9-5/8	–	5-7/8	14-1/2	–	3-7/16	22-9/16	–	–	26-9/16	–	–
14	7	7	9-7/8	–	6-3/8	15-5/8	–	3-1/2	24-3/4	–	–	29-3/4	–	–
	8	8	9-7/8	–	6-3/8	15-5/8	–	3-1/2	24-3/4	–	–	29-3/4	–	–
	10	10	9-7/8	–	6-3/8	15-5/8	–	3-1/2	24-3/4	–	–	29-3/4	–	–
16	8	8	11-3/8	–	7-3/8	18-1/8	–	4	29-1/8	–	–	35-1/8	–	–
	9	9	11-3/8	–	7-3/8	18-1/8	–	4	29-1/8	–	–	35-1/8	–	–
	10	10	11-3/8	–	7-3/8	18-1/8	–	4	29-1/8	–	–	35-1/8	–	–
18	9	9	12-3/8	–	8-5/8	21-1/8	–	4-1/4	33	–	–	39-1/2	–	–
	10	10	12-3/8	–	8-5/8	21-1/8	–	4-1/4	33	–	–	39-1/2	–	–
20	10	10	13-3/8	–	9-5/8	23-5/8	–	4-1/2	36-7/8	–	–	44-3/8	–	–

MODEL E3 (NFPA STD. MP3)

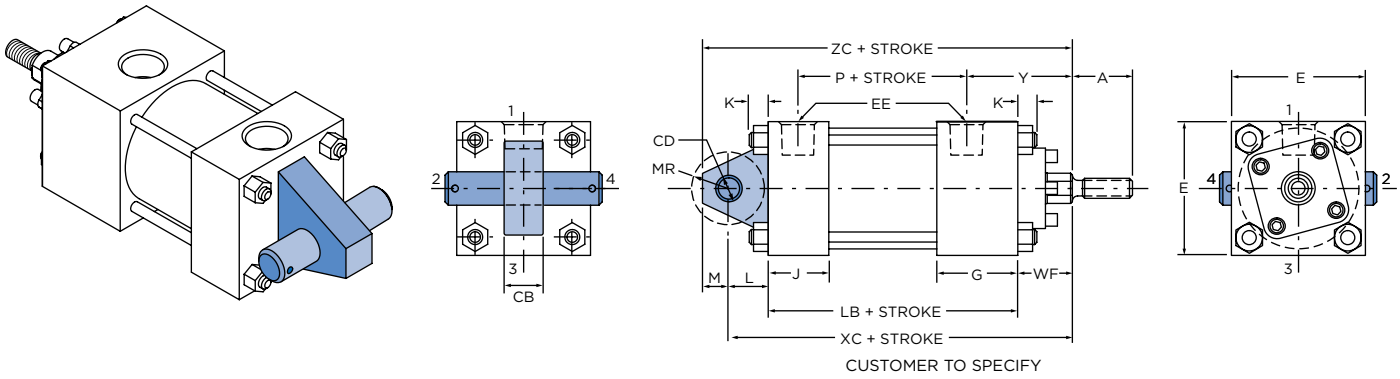


Table 1 These dimensions are constant regardless of rod diameter or stroke.

BORE DIA.	E	F	G	J	K	L	M	CB	CD	EE	MR
1-1/2	2-1/2	3/8	1-3/4	1-1/2	1/2	3/4	1/2	3/4	1/2	1/2	5/8
2	3	5/8	1-3/4	1-1/2	1/2	1-1/4	3/4	1-1/4	3/4	1/2	7/8
2-1/2	3-1/2	5/8	1-3/4	1-1/2	5/8	1-1/4	3/4	1-1/4	3/4	1/2	7/8
3-1/4	4-1/2	3/4	2-1/4	1-3/4	3/4	1-1/2	1	1-1/2	1	3/4	1-1/4
4	5	7/8	2-1/4	1-3/4	3/4	2-1/8	1-3/8	2	1-3/8	3/4	1-5/8
5	6-1/2	7/8	2-1/4	1-3/4	1	2-1/4	1-3/4	2-1/2	1-3/4	3/4	2
6	7-1/2	1	2-1/2	2-1/4	1-1/8	2-1/2	2	2-1/2	2	1	2-3/8
7	8-1/2	1	2-3/4	2-3/4	1-1/8	3	2-1/2	3	2-1/2	1-1/4	3
8	9-1/2	1	3	3	1-3/8	3-1/4	2-3/4	3	3	1-1/2	3-1/4
10	12-5/8	–	3-11/16	3-11/16	1-1/8	4	3-1/2	4	3-1/2	2	3-1/2
12	14-7/8	–	4-7/16	4-7/16	1-1/8	4-5/8	4	4-1/2	4	2-1/2	4
14	17-1/4	–	4-7/8	4-7/8	1-1/8	5-5/8	5	6	5	2-1/2	5
16	19-1/4	–	5-718	5-718	1-7/16	7	6	7	6	3	6
18	22	–	6-718	6-718	1-7/16	7-5/8	6-1/2	8	6-1/2	3	6-1/2
20	23-5/8	–	7-7/8	7-7/8	1-7/16	8-3/4	7-1/2	9	7-1/2	3	7-1/2

Table 2

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

• = For piston rod dimensions see page 60.

BORE DIA.	ROD MM•	A	P	W	Y	LB	WF	XC	ZC
1-1/2	5/8	3/4	2-3/4	5/8	2-1/16	4-5/8	1	6-3/8	6-7/8
	1	1-1/8	2-3/4	1	2-7/16	1-3/8	6-3/4	7-1/4	8
2	1	1-1/8	2-3/4	3/4	2-7/16	4-5/8	1-3/8	7-1/4	8
	1-3/8	1-5/8	2-3/4	1	2-1/1/6	4-5/8	1-5/8	7-1/2	8-1/4
2-1/2	1	1-1/8	2-7/8	3/4	2-7/16	4-3/4	1-3/8	7-3/8	8-1/8
	1-3/8	1-5/8	2-7/8	1	2-1/1/6	4-3/4	1-5/8	7-5/8	8-3/8
	1-3/4	2	2-7/8	1-1/4	2-15/16	4-3/4	1-7/8	7-7/8	8-5/8
3-1/4	1-3/8	1-5/8	3-1/4	7/8	3	5-1/2	1-5/8	8-5/8	9-5/8
	1-3/4	2	3-1/4	1-1/8	3-1/4	5-1/2	1-7/8	8-718	9-7/8
	2	2-1/4	3-1/4	1-1/4	3-3/8	5-1/2	2	9	10
4	1-3/4	2	3-1/2	1	3-1/4	5-3/4	1-7/8	9-3/4	11-1/8
	2	2-1/4	3-1/2	1-1/8	3-3/8	5-3/4	2	9-7/8	11-1/4
	2-1/2	3	3-1/2	1-3/8	3-5/8	5-3/4	2-1/4	10-1/8	11-1/2
5	2	2-1/4	4	1-1/8	3-3/8	6-1/4	2	10-1/2	12-1/4
	2-1/2	3	4	1-3/8	3-5/8	6-1/4	2-1/4	10-3/4	12-1/2
	3	3-1/2	4	1-3/8	3-5/8	6-1/4	2-1/4	10-3/4	12-1/2
	3-1/2	3-1/2	4	1-3/8	3-5/8	6-1/4	2-1/4	10-3/4	12-1/2
6	2-1/2	3	4-5/8	1-1/4	3-3/4	7-3/8	2-1/4	12-1/8	14-1/8
	3	3-1/2	4-5/8	1-1/4	3-3/4	7-3/8	2-1/4	12-1/8	14-1/8
	3-1/2	3-1/2	4-5/8	1-1/4	3-3/4	7-3/8	2-1/4	12-1/8	14-1/8
	4	4	4-5/8	1-1/4	3-3/4	7-3/8	2-1/4	12-1/8	14-1/8
7	3	3-1/2	5-3/8	1-1/4	3-13/16	8-1/2	2-1/4	13-3/4	16-1/4
	3-1/2	3-1/2	5-3/8	1-1/4	3-13/16	8-1/2	2-1/4	13-3/4	16-1/4
	4	4	5-3/8	1-1/4	3-13/16	8-1/2	2-1/4	13-3/4	16-1/4
	4-1/2	4-1/2	5-3/8	1-1/4	3-13/16	8-1/2	2-1/4	13-3/4	16-1/4
	5	5	5-3/8	1-1/4	3-13/16	8-1/2	2-1/4	13-3/4	16-1/4
8	3-1/2	3-1/2	6	1-1/4	4	9-1/2	2-1/4	15	17-3/4
	4	4	6	1-1/4	4	9-1/2	2-1/4	15	17-3/4
	4-1/2	4-1/2	6	1-1/4	4	9-1/2	2-1/4	15	17-3/4
	5	5	6	1-1/4	4	9-1/2	2-1/4	15	17-3/4
	5-1/2	5-1/2	6	1-1/4	4	9-1/2	2-1/4	15	17-3/4
10	4-1/2	4-1/2	8	–	5	12-1/8	2-15/16	19-1/16	22-9/16
	5	5	8	–	5-1/4	12-1/8	3-3/16	19-5/16	22-13/16
	5-1/2	5-1/2	8	–	5-1/4	12-1/8	3-3/16	19-5/16	22-13/16
	7	7	8	–	5-1/4	12-1/8	3-3/16	19-5/16	22-13/16
12	5-1/2	5-1/2	9-5/8	–	5-5/8	14-1/2	3-3/16	22-5/16	26-5/16
	7	7	9-5/8	–	5-7/8	14-1/2	3/7-16	22-9/16	26-9/16
	8	8	9-5/8	–	5-7/8	14-1/2	3/7-16	22-9/16	26-9/16
14	7	7	9-7/8	–	6-3/8	15-5/8	3-1/2	24-3/4	29-3/4
	8	8	9-7/8	–	6-3/8	15-5/8	3-1/2	24-3/4	29-3/4
	10	10	9-7/8	–	6-3/8	15-5/8	3-1/2	24-3/4	29-3/4
16	8	8	11-3/8	–	7-3/8	18-1/8	4	29-1/8	35-1/8
	9	9	11-3/8	–	7-3/8	18-1/8	4	29-1/8	35-1/8
	10	10	11-3/8	–	7-3/8	18-1/8	4	29-1/8	35-1/8
18	9	9	12-3/8	–	8-5/8	21-1/8	4-1/4	33	39-1/2
	10	10	12-3/8	–	8-5/8	21-1/8	4-1/4	33	39-1/2
20	10	10	13-3/8	–	9-5/8	23-5/8	4-1/2	36-7/8	44-3/8

MODEL EU3 (NFPA STD. MPU3)

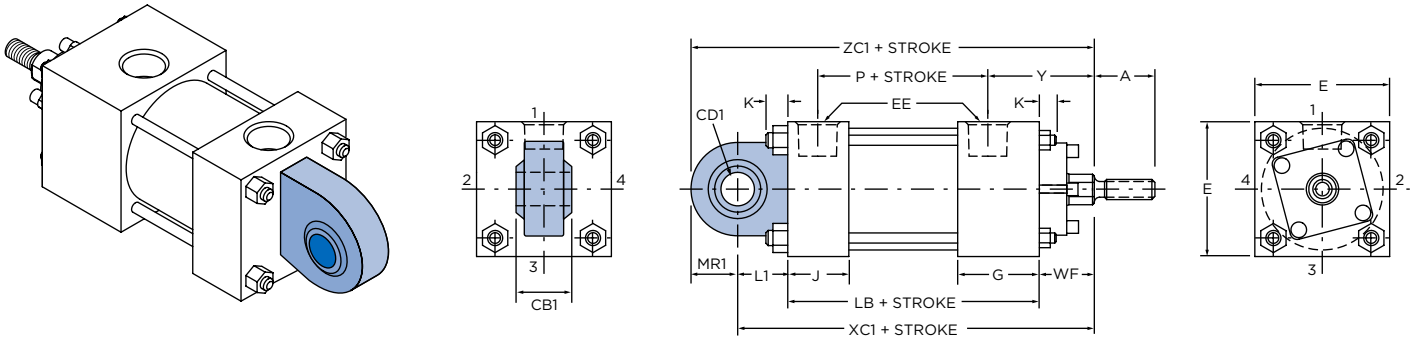


Table 1

These dimensions are constant regardless of rod diameter or stroke.

BORE DIA.	E	G	J	K	EE	L1	CB1	CD1	MR1	PRESSURE RATING
1-1/2	2-1/2	1-3/4	1-1/2	1/2	1/2	3/4	7/16	1/2	7/8	1500 PSI
2	3	1-3/4	1-1/2	1/2	1/2	1-1/4	21/32	3/4	1-1/4	2000 PSI
2-1/2	3-1/2	1-3/4	1-1/2	5/8	1/2	1-1/4	21/32	3/4	1-1/4	1400 PSI
3-1/4	4-1/2	2-1/4	1-3/4	3/4	3/4	1-1/2	7/8	1	1-1/2	1400 PSI
4	5	2-1/4	1-3/4	3/4	3/4	2-1/8	1-3/16	1-3/8	1-3/4	1600 PSI
5	61/2	2-1/4	1-3/4	1	3/4	2-1/4	1-17/32	1-3/4	2-1/4	1800 PSI
6	71/2	2-1/2	2-1/4	1-1/8	1	2-1/2	1-3/4	2	2-3/4	1700 PSI

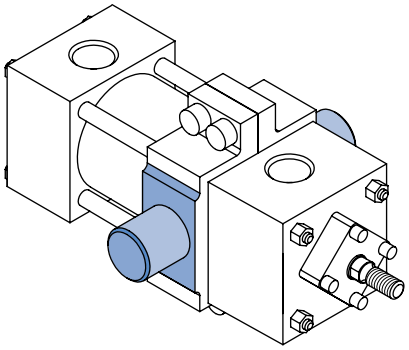
Table 2

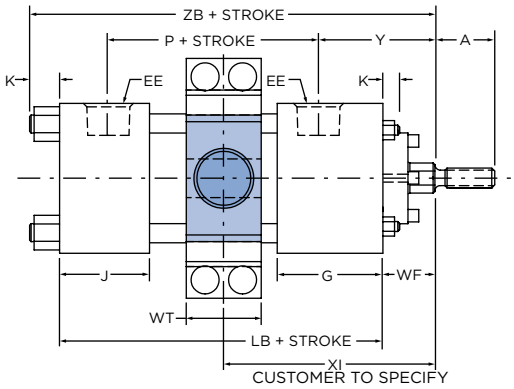
The dimensions given on this table are affected by the piston rod diameter and the stroke.

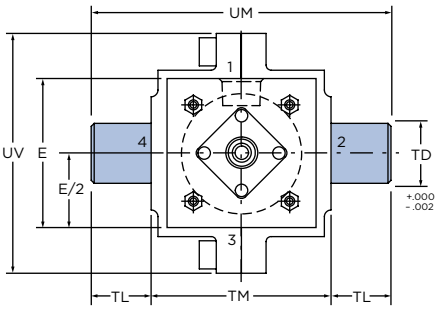
• = For piston rod dimensions see page 60.

BORE DIA.	ROD MM•	A	P	Y	LB	WF	XC1	ZC1
1-1/2	5/8	3/4	2-3/4	2-1/16	4-5/8	1	6-3/8	7-1/4
	1	1-1/8	2-3/4	2-7/16	4-5/8	1-3/8	6-3/4	7-5/8
2	1	1-1/8	2-3/4	2-7/16	4-5/8	1-3/8	7-1/4	8-1/2
	1-3/8	1-5/8	2-3/4	2-11/16	4-5/8	1-5/8	7-1/2	8-3/4
2-1/2	1	1-1/8	2-7/8	2-7/16	4-3/4	1-3/8	7-3/8	8-5/8
	1-3/8	1-5/8	2-7/8	2-11/16	4-3/4	1-5/8	7-5/8	8-7/8
	1-3/4	2	2-7/8	2-15/16	4-3/4	1-7/8	7-7/8	9-1/8
3-1/4	1-3/8	1-5/8	3-1/4	3	5-1/2	1-5/8	8-5/8	10-1/8
	1-3/4	2	3-1/4	3-1/4	5-1/2	1-7/8	8-7/8	10-3/8
	2	2-1/4	3-1/4	3-3/8	5-1/2	2	9	10-1/2
4	1-3/4	2	3-1/2	3-1/4	5-3/4	1-7/8	9-3/4	11-1/2
	2	2-1/4	3-1/2	3-3/8	5-3/4	2	9-7/8	11-5/8
	2-1/2	3	3-1/2	3-5/8	5-3/4	2-1/4	10-1/8	11-7/8
5	2	2-1/4	4	3-3/8	6-1/4	2	10-1/2	12-3/4
	2-1/2	3	4	3-5/8	6-1/4	2-1/4	10-3/4	13
	3	3-1/2	4	3.375	6-1/4	2-1/4	10-3/4	13
	3-1/2	3-1/2	4	3.375	6-1/4	2-1/4	10-3/4	13
6	2-1/2	3	4-5/8	3-3/4	7-3/8	2-1/4	12-1/8	14-7/8
	3	3-1/2	4-5/8	3.4375	7-3/8	2-1/4	12-1/8	14-7/8
	3-1/2	3-1/2	4-5/8	3.4375	7-3/8	2-1/4	12-1/8	14-7/8
	4	4	4-5/8	3.4375	7-3/8	2-1/4	12-1/8	14-7/8

MODEL F (NFPA STD. MT4)▲

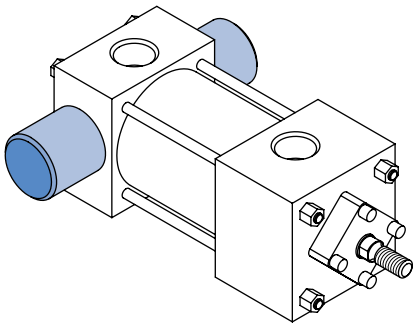


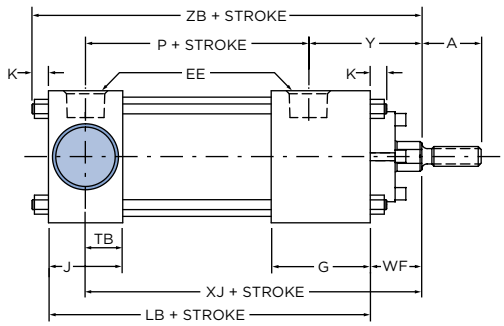


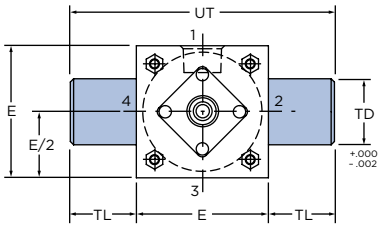


Integral trunnion pins are designed for shear, not bending, loads. The intermediate trunnion pin mounting location, being non-adjustable, is determined by the "XI" dimension which should be specified by the customer. It can be located at any point between the heads of the cylinder.

MODEL FB (NFPA STD. MT2)▲

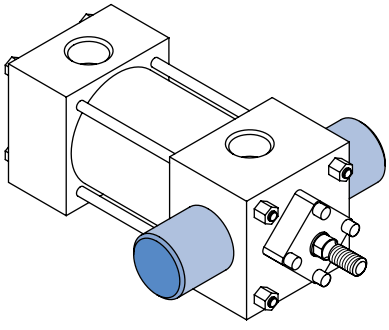


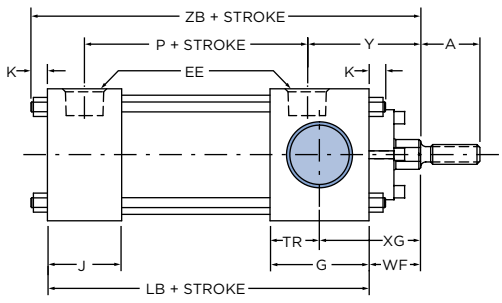


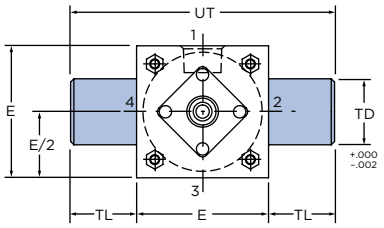


Integral trunnion pins are designed for shear, not bending, loads.

MODEL FR (NFPA STD. MT1)▲







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

▲ = See Table A on page 57 for bore and rod combinations using head plates with threaded bronze glands.

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 56.

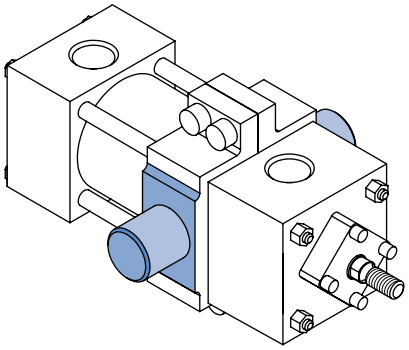
BORE DIA.	E	G	J	K	EE	TB	TD	TL	TM	TR	UM	UT	UV	WT
1-1/2	2-1/2	1-3/4	1-1/2	1/2	1/2	3/4	1	1	3	7/8	5	4-1/2	4	1-1/4
2	3	1-3/4	1-1/2	1/2	1/2	3/4	1-3/8	1-3/8	3-1/2	7/8	6-1/4	5-3/4	4-3/4	1-1/2
2-1/2	3-1/2	1-3/4	1-1/2	5/8	1/2	3/4	1-3/8	1-3/8	4	7/8	6-3/4	6-1/4	5-1/4	1-1/2
3-1/4	4-1/2	2-1/4	1-3/4	3/4	3/4	7/8	1-3/4	1-3/4	5	1-1/4	8-1/2	8	6-3/4	2
4	5	2-1/4	1-3/4	3/4	3/4	7/8	1-3/4	1-3/4	5-1/2	1-1/4	9	8-1/2	7-1/4	2
5	6-1/2	2-1/4	1-3/4	1	3/4	7/8	1-3/4	1-3/4	7	1-1/4	10-1/2	10	9	2
6	7-1/2	2-1/2	2-1/4	1-1/8	1	1	2	2	8	1-3/8	12	11-1/2	10-1/4	2-1/2
7	8-1/2	2-3/4	2-3/4	1-1/8	1-1/4	1-3/8	2-1/2	2-1/2	9	1-3/8	14	13-1/2	11-1/4	2-3/4

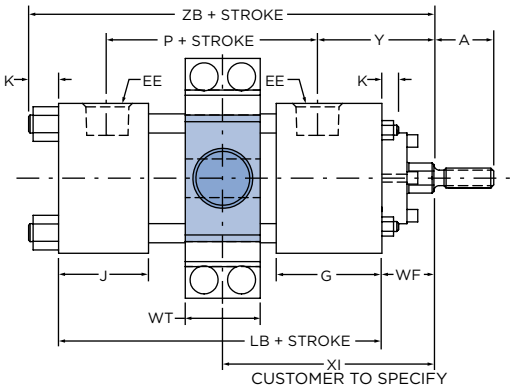
Table 2 The dimensions given on this table are affected by the piston rod diameter and the stroke.

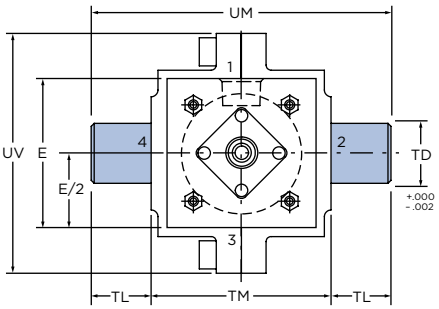
• = For piston rod dimensions see page 60.

BORE DIA.	ROD MM•	A	P	Y	LB	WF	XG	XI (MIN)	XJ	ZB
1-1/2	5/8	3/4	2-3/4	2-1/16	4-5/8	1	1-7/8	3-7/16	4-7/8	6-1/8
	1	1-1/8	2-3/4	2-7/16	4-5/8	1-3/8	2-1/4	3-13/16	5-1/4	6-1/2
2	1	1-1/8	2-3/4	2-7/16	4-5/8	1-3/8	2-1/4	3-15/16	5-1/4	6-1/2
	1-3/8	1-5/8	2-3/4	2-11/16	4-5/8	1-5/8	2-1/2	4-3/16	5-1/2	6-3/4
2-1/2	1	1-1/8	2-7/8	2-7/16	4-3/4	1-3/8	2-1/4	3-15/16	5-3/8	6-3/4
	1-3/8	1-5/8	2-7/8	2-11/16	4-3/4	1-5/8	2-1/2	4-3/16	5-5/8	7
	1-3/4	2	2-7/8	2-15/16	4-3/4	1-7/8	2-3/4	4-7/16	5-7/8	7-1/4
3-1/4	1-3/8	1-5/8	3-1/4	3	5-1/2	1-5/8	2-5/8	4-15/16	6-1/4	7-7/8
	1-3/4	2	3-1/4	3-1/4	5-1/2	1-7/8	2-7/8	5-3/16	6-1/2	8-1/8
	2	2-1/4	3-1/4	3-3/8	5-1/2	2	3	5-5/16	6-5/8	8-1/4
4	1-3/4	2	3-1/2	3-1/4	5-3/4	1-7/8	2-7/8	5-3/16	6-3/4	8-3/8
	2	2-1/4	3-1/2	3-3/8	5-3/4	2	3	5-5/16	6-7/8	8-1/2
	2-1/2	3	3-1/2	3-5/8	5-3/4	2-1/4	3-1/4	5-9/16	7-1/8	8-3/4
5	2	2-1/4	4	3-3/8	6-1/4	2	3	5-5/16	7-3/8	9-1/4
	2-1/2	3	4	3-5/8	6-1/4	2-1/4	3-1/4	5-9/16	7-5/8	9-1/2
	3	3-1/2	4	3-5/8	6-1/4	2-1/4	3-1/4	5-9/16	7-5/8	9-1/2
	3-1/2	3-1/2	4	3-5/8	6-1/4	2-1/4	3-1/4	5-9/16	7-5/8	9-1/2
6	2-1/2	3	4-5/8	3-3/4	7-3/8	2-1/4	3-3/8	6-1/16	8-3/8	10-3/4
	3	3-1/2	4-5/8	3-3/4	7-3/8	2-1/4	3-3/8	6-1/16	8-3/8	10-3/4
	3-1/2	3-1/2	4-5/8	3-3/4	7-3/8	2-1/4	3-3/8	6-1/16	8-3/8	10-3/4
	4	4	4-5/8	3-3/4	7-3/8	2-1/4	3-3/8	6-1/16	8-3/8	10-3/4
7	3	3-1/2	5-3/8	3-13/16	8-1/2	2-1/4	3-5/8	6-7/16	8-3/8	11-7/8
	3-1/2	3-1/2	5-3/8	3-13/16	8-1/2	2-1/4	3-5/8	6-7/16	9-3/8	11-7/8
	4	4	5-3/8	3-13/16	8-1/2	2-1/4	3-5/8	6-7/16	9-3/8	11-7/8
	4-1/2	4-1/2	5-3/8	3-13/16	8-1/2	2-1/4	3-5/8	6-7/16	9-3/8	11-7/8
	5	5	5-3/8	3-13/16	8-1/2	2-1/4	3-5/8	6-7/16	9-3/8	11-7/8

MODEL F (NFPA STD. MT4)

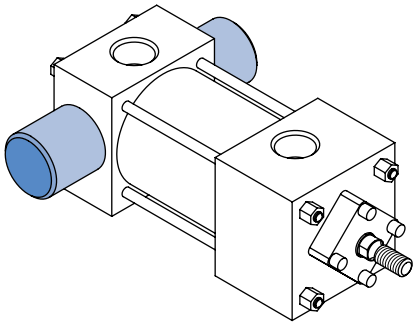


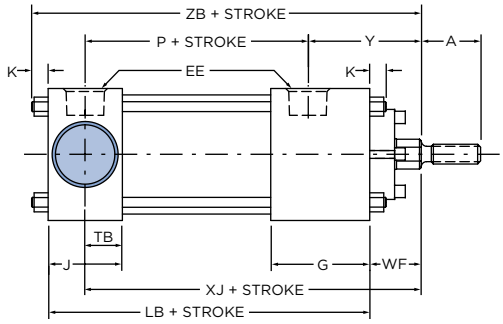


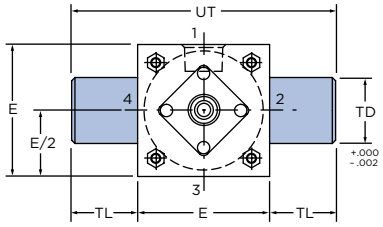


Integral trunnion pins are designed for shear, not bending, loads. The intermediate trunnion pin mounting location, being non-adjustable, is determined by the "XI" dimension which should be specified by the customer. It can be located at any point between the heads of the cylinder.

MODEL FB (NFPA STD. MT2)

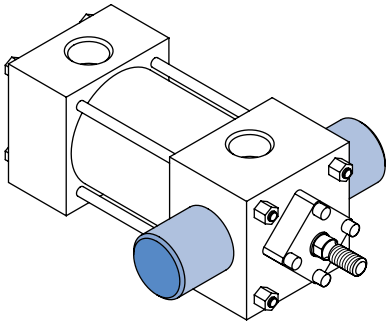


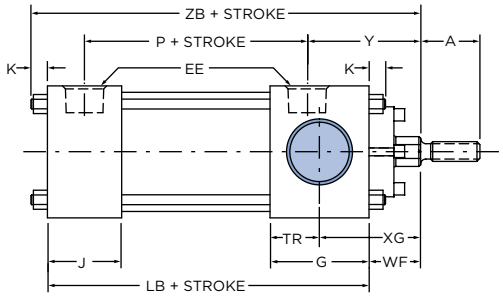


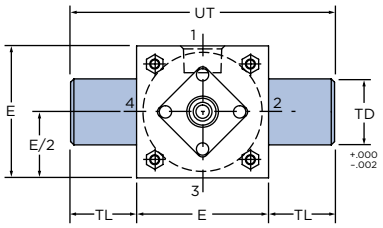


Integral trunnion pins are designed for shear, not bending, loads.

MODEL FR (NFPA STD. MT1)







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 56.

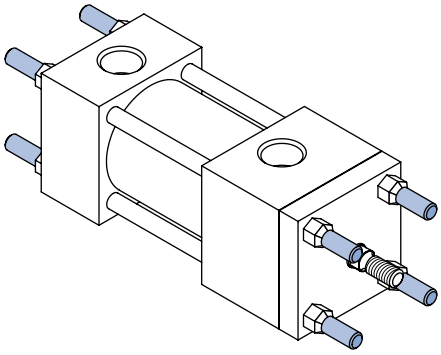
BORE DIA.	E	G	J	K	EE	TB	TD	TL	TM	TR	UM	UT	UV	WT
8	9-1/2	3	3	1-3/8	1-1/2	1-1/2	3	3	10	1-1/2	16	15-1/2	12-1/2	3-1/4
10	12-5/8	3-11/16	3-11/16	1-1/8	2	1-7/8	3-1/2	3-1/2	14	1-7/8	21	19-5/8	16-1/2	4-1/2
12	14-7/8	4-7/16	4-7/16	1-1/8	2-1/2	2-1/4	4	4	16-1/2	2-1/4	24-1/2	22-7/8	19-1/4	5-1/2
14	17-1/4	4-7/8	4-7/8	1-7/16	2-1/2	2-7/16	4-1/2	4-1/2	19-5/8	2-1/2	28-5/8	26-1/8	22-1/2	5-1/2

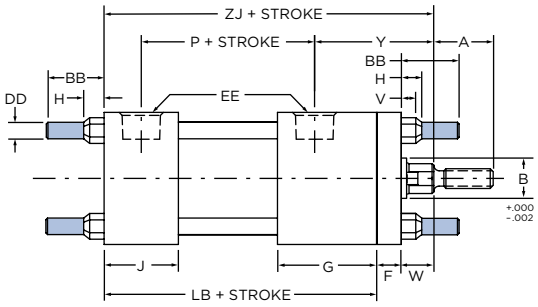
Table 2 The dimensions given on this table are affected by the piston rod diameter and the stroke.

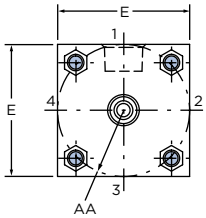
• = For piston rod dimensions see page 60.

BORE DIA.	ROD MM•	A	P	Y	LB	WF	XG	XI (MIN)	XJ	ZB
8	3-1/2	3-1/2	6	4	9-1/2	2-1/4	3-3/4	6-15/16	10-1/4	13-1/8
	4	4	6	4	9-1/2	2-1/4	3-3/4	6-15/16	10-1/4	13-1/8
	4-1/2	4-1/2	6	4	9-1/2	2-1/4	3-3/4	6-15/16	10-1/4	13-1/8
	5	5	6	4	9-1/2	2-1/4	3-3/4	6-15/16	10-1/4	13-1/8
	5-1/2	5-1/2	6	4	9-1/2	2-1/4	3-3/4	6-15/16	10-1/4	13-1/8
10	4-1/2	4-1/2	8	5	12-1/8	2-15/16	4-3/4	8-7/8	13-1/4	16-3/16
	5	5	8	5-1/4	12-1/8	3-3/16	5	9-1/8	13-1/2	16-7/16
	5-1/2	5-1/2	8	5-1/4	12-1/8	3-3/16	5	9-1/8	13-1/2	16-7/16
	7	7	8	5-1/4	12-1/8	3-3/16	5	9-1/8	13-1/2	16-7/16
12	5-1/2	5-1/2	9-5/8	5-5/8	14-1/2	3-3/16	5-3/8	10-3/8	15-1/2	18-3/16
	7	7	9-5/8	5-7/8	14-1/2	3-7/16	5-5/8	10-5/8	15-3/4	19-1/16
	8	8	9-5/8	5-7/8	14-1/2	3-7/16	5-5/8	10-5/8	15-3/4	19-1/16
14	7	7	9-7/8	6-3/8	15-5/8	3-1/2	5-7/8	11-1/8	16-3/4	20-1/4
	8	8	9-7/8	6-3/8	15-5/8	3-1/2	5-7/8	11-1/8	16-3/4	20-1/4
	10	10	9-7/8	6-3/8	15-5/8	3-1/2	5-7/8	11-1/8	16-3/4	20-1/4

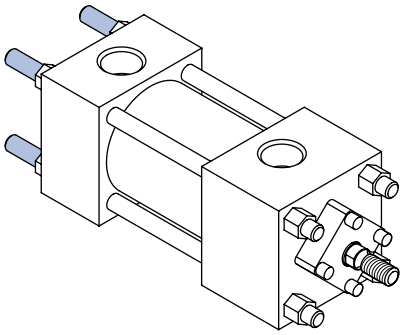
MODEL T (NFPA STD. MX1)

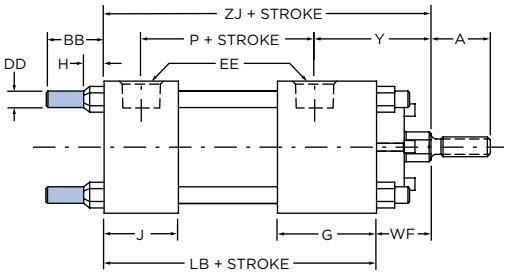


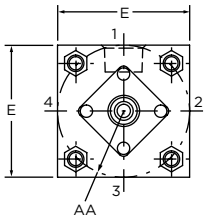




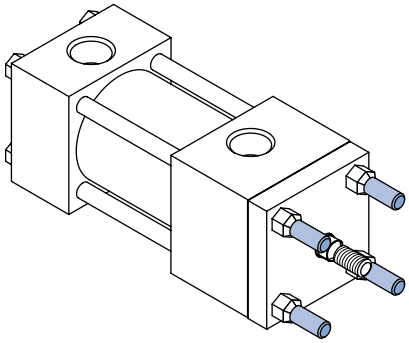
MODEL TB (NFPA STD. MX2)▲

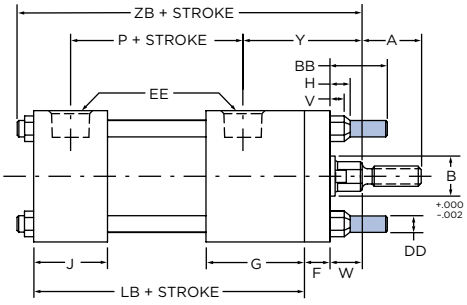


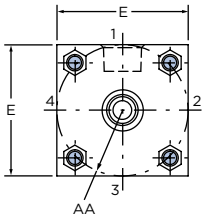




MODEL TR (NFPA STD. MX3)







▲ = See Table A on page 57 for bore and rod combinations using head plates with threaded bronze glands.

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 56.

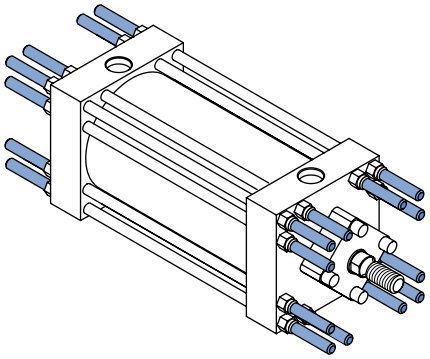
BORE DIA.	E	F	G	H	J	AA	BB	DD	EE
1-1/2	2-1/2	3/8	1-3/4	11/32	1-1/2	2.56	1-3/8	3/8–24	1/2
2	3	5/8	1-3/4	3/8	1-1/2	3.10	1-5/8	7/16–20	1/2
2-1/2	3-1/2	5/8	1-3/4	15/32	1-1/2	3.61	1-7/8	1/2–20	1/2
3-1/4	4-1/2	3/4	2-1/4	9/16	1-3/4	4.60	2-3/8	5/8–18	3/4
4	5	7/8	2-1/4	9/16	1-3/4	5.40	2-3/8	5/8–18	3/4
5	6-1/2	7/8	2-1/4	25/32	1-3/4	7.00	3-1/4	7/8–14	3/4
6	7-1/2	1	2-1/2	7/8	2-1/4	8.10	3-5/8	1–14	1
7	8-1/2	1	2-3/4	1	2-3/4	9.30	4-1/8	1-1/8–12	1-1/4
8	9-1/2	1	3	1-1/8	3	10.61	4-1/2	1-1/4–12	1-1/2

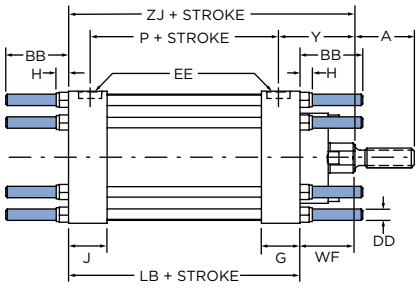
Table 2 The dimensions given on this table are affected by the piston rod diameter and the stroke.

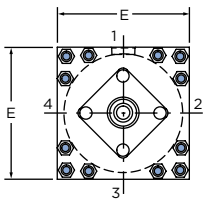
• = For piston rod dimensions see page 60.

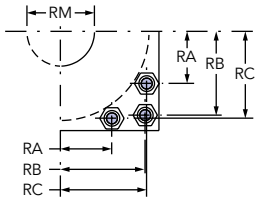
BORE DIA.	ROD MM•	A	B	P	V	W	Y	LB	WF	ZB	ZJ
1-1/2	5/8	3/4	1-1/8	2-3/4	1/4	5/8	2-1/16	4-5/8	1	6-1/8	5-5/8
	1	1-1/8	1-1/2	2-3/4	1/2	1	2-7/16	4-5/8	1-3/8	6-1/2	6
2	1	1-1/8	1-1/2	2-3/4	1/4	3/4	2-7/16	4-5/8	1-3/8	6-1/2	6
	1-3/8	1-5/8	2	2-3/4	3/8	1	2-11/16	4-5/8	1-5/8	6-3/4	6-1/4
2-1/2	1	1-1/8	1-1/2	2-7/8	1/4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

MODEL T (NFPA STD. MX1)

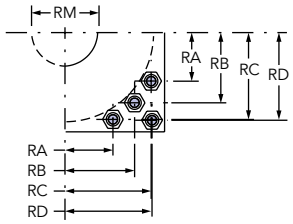




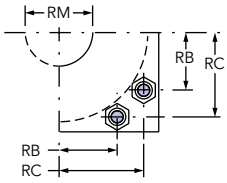




10" Bore

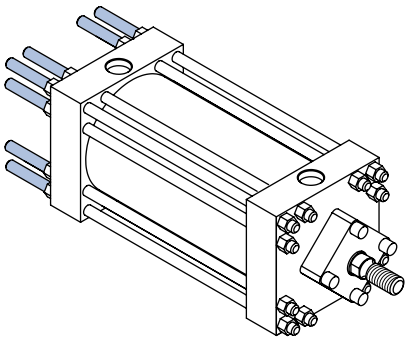


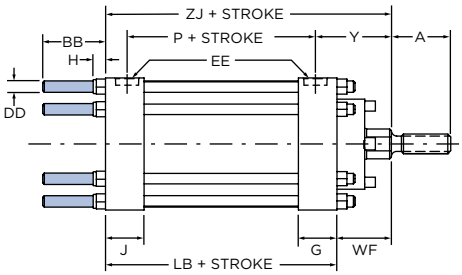
12" Bore

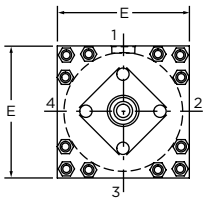


14" Bore

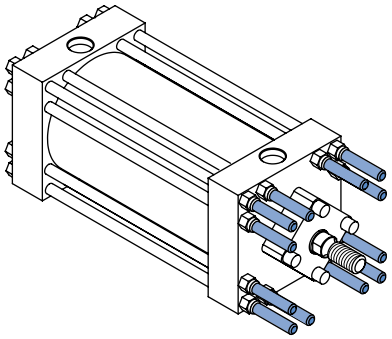
MODEL TB (NFPA STD. MX2)

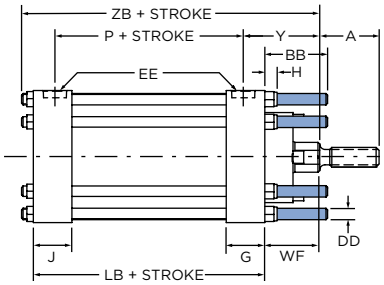


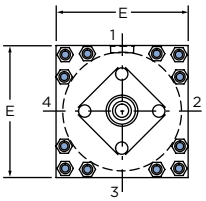


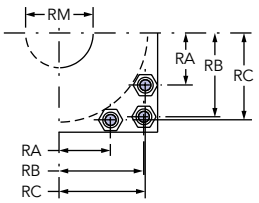


MODEL TR (NFPA STD. MX3)

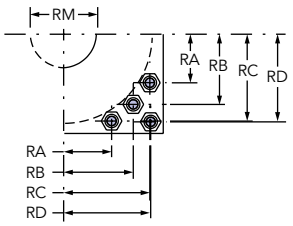




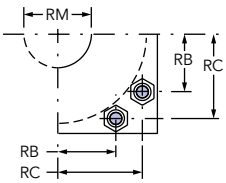




10" Bore



12" Bore



14" 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 56.

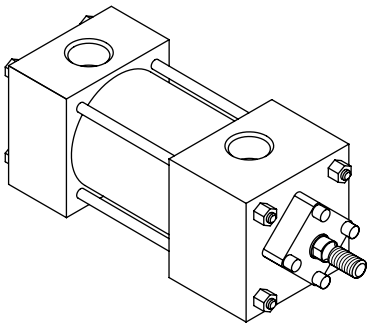
BORE DIA.	E	G	H	J	BB	DD	EE	RA	RB	RC	RD	RE
10	12-5/8	3-11/16	7/8	3-11/16	6	1–14	2	3.312	5.438	5.531	–	–
12	14-7/8	4-7/16	7/8	4-7/16	7	1–14	2-1/2	3.718	5.344	6.593	6.656	–
14	17-1/4	4-7/8	1-9/32	4-7/8	8	1-1/2–12	2-1/2	–	5	7.313	–	–

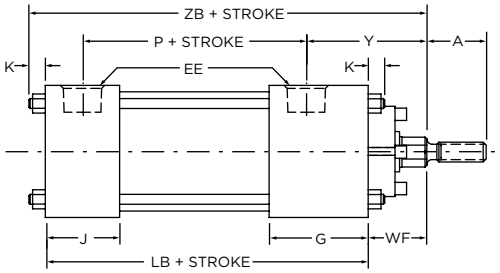
Table 2 The dimensions given on this table are affected by the piston rod diameter and the stroke.

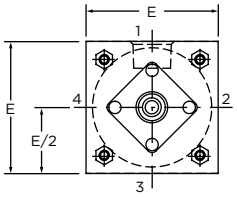
• = For piston rod dimensions see page 60.

BORE DIA.	ROD MM•	A	P	Y	LB	RM	WF	ZB	ZJ
10	4-1/2	4-1/2	8	5	12-1/8	7-3/4	2-15/16	16-3/16	15-1/16
	5	5	8	5-1/4	12-1/8	8-3/8	3-3/16	16-7/16	15-5/16
	5-1/2	5-1/2	8	5-1/4	12-1/8	9	3-3/16	16-7/16	15-5/16
	7	7	8	5-1/4	12-1/8	10-1/4	3-3/16	16-7/16	15-5/16
12	5-1/2	5-1/2	9-5/8	5-5/8	14-1/2	9	3-3/16	18-13/16	17-11/16
	7	7	9-5/8	5-7/8	14-1/2	10-1/4	3-7/16	19-1/16	17-15/16
	8	8	9-5/8	5-7/8	14-1/2	11-1/4	3-7/16	19-1/16	17-15/16
14	7	7	9-7/8	6-3/8	15-5/8	10-1/4	3-1/2	20-1/4	19-1/8
	8	8	9-7/8	6-3/8	15-5/8	11-1/4	3-1/2	20-1/4	19-1/8
	10	10	9-7/8	6-3/8	15-5/8	14	3-1/2	20-1/4	19-1/8

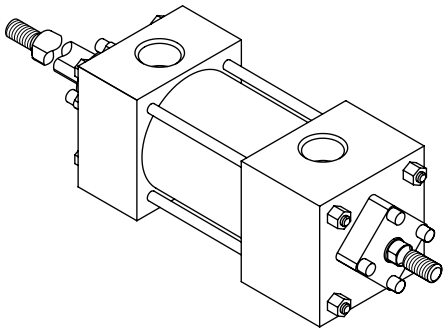
MODEL H (BASIC CYLINDER NO MOUNT)▲

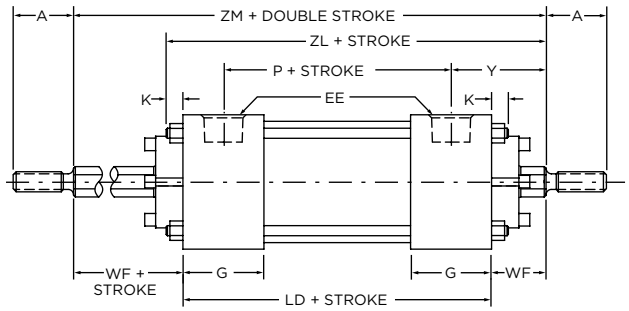


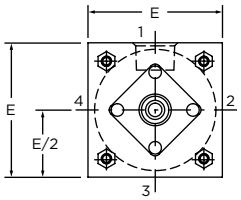




MODEL XH (BASIC CYLINDER DOUBLE ROD END)▲







▲ = See Table A on page 57 for bore and rod combinations using head plates with threaded bronze glands.

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

Table 2

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

• = For piston rod dimensions see page 60.

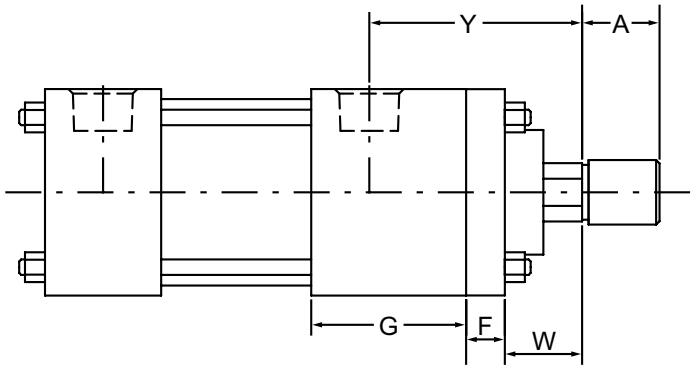
BORE DIA.	ROD MM•	A	P	Y	LB	LD	W	WF	ZB	ZL	ZM
1-1/2	5/8	3/4	2-3/4	2-1/16	4-5/8	4-7/8	5/8	1	6-1/8	6-3/8	6-7/8
	1	1-1/8	2-3/4	2-7/16	4-5/8	4-7/8	1	1-3/8	6-1/2	6-3/4	7-5/8
2	1	1-1/8	2-3/4	2-7/16	4-5/8	4-7/8	3/4	1-3/8	6-1/2	6-3/4	7-5/8
	1-3/8	1-5/8	2-3/4	2-11/16	4-5/8	4-7/8	1	1-5/8	6-3/4	7	8-1/8
2-1/2	1	1-1/8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

NOTE: Cylinder mountings, rod sizes and thread types are interchangeable on either end of double rod end cylinder assembly.

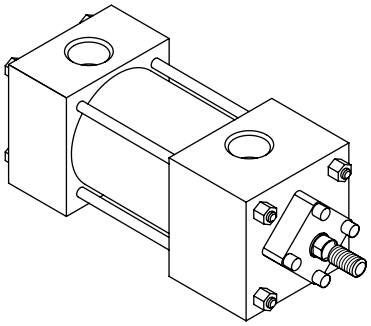
Table A

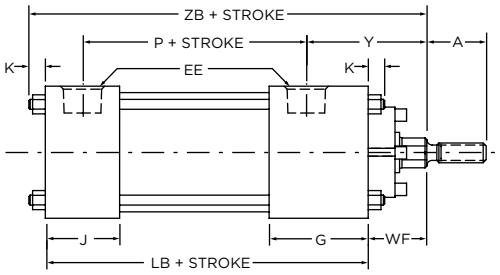
THE FOLLOWING BORE/ROD COMBINATIONS USE HEAD PLATE AND BRONZE GLANDS AS SHOWN AT RIGHT	
BORE	**ROD DIAMETER (MM)**
1-1/2	1.00"
2	1.38"
2-1/2	1.75"

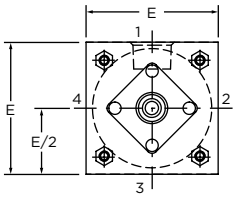
NOTE: Threaded Bronze Gland used on all Model D and DD Cylinders. Bolt-on Gland used on all Model G & DG Cylinders.



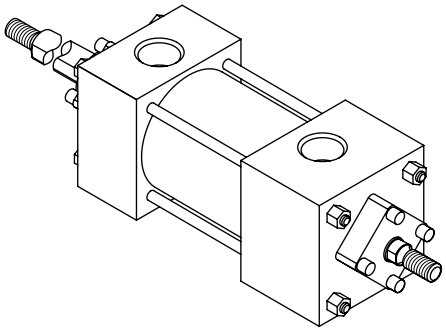
MODEL H (BASIC CYLINDER NO MOUNT)

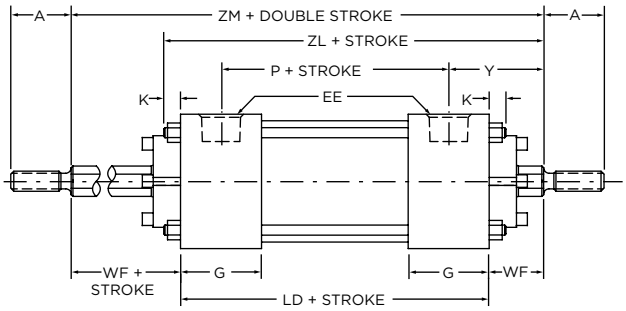






MODEL XH (BASIC CYLINDER DOUBLE ROD END)





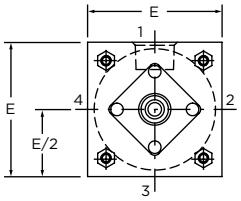


Table 1 These dimensions are constant regardless of rod diameter or stroke.

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

Table 2 The dimensions given on this table are affected by the piston rod diameter and the stroke.

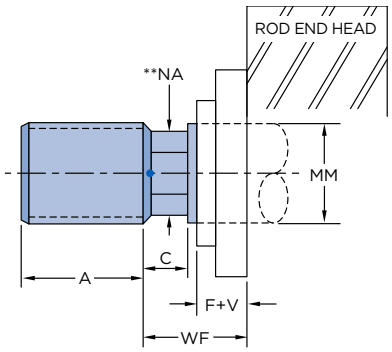
• = For piston rod dimensions see page 60.

BORE DIA.	ROD MM•	A	P	Y	LB	LD	WF	ZB	ZL	ZM
7	3	3-1/2	5-3/8	3-13/16	8-1/2	8-1/2	2-1/4	11-7/8	11-7/8	13
	3-1/2	3-1/2	5-3/8	3-13/16	8-1/2	8-1/2	2-1/4	11-7/8	11-7/8	13
	4	4	5-3/8	3-13/16	8-1/2	8-1/2	2-1/4	11-7/8	11-7/8	13
	4-1/2	4-1/2	5-3/8	3-13/16	8-1/2	8-1/2	2-1/4	11-7/8	11-7/8	13
	5	5	5-3/8	3-13/16	8-1/2	8-1/2	2-1/4	11-7/8	11-7/8	13
8	3-1/2	3-1/2	6	4	9-1/2	9-1/2	2-1/4	13-1/8	13-1/8	14
	4	4	6	4	9-1/2	9-1/2	2-1/4	13-1/8	13-1/8	14
	4-1/2	4-1/2	6	4	9-1/2	9-1/2	2-1/4	13-1/8	13-1/8	14
	5	5	6	4	9-1/2	9-1/2	2-1/4	13-1/8	13-1/8	14
	5-1/2	5-1/2	6	4	9-1/2	9-1/2	2-1/4	13-1/8	13-1/8	14
10	4-1/2	4-1/2	8	5	12-1/8	12-1/8	2-15/16	16-3/16	16-3/16	18
	5	5	8	5-1/4	12-1/8	12-1/8	3-3/16	16-7/16	16-7/16	18-1/2
	5-1/2	5-1/2	8	5-1/4	12-1/8	12-1/8	3-3/16	16-7/16	16-7/16	18-1/2
	7	7	8	5-1/4	12-1/8	12-1/8	3-3/16	16-7/16	16-7/16	18-1/2
12	5-1/2	5-1/2	9-5/8	5-5/8	14-1/2	14-1/2	3-3/16	18-13/16	18-13/16	20-7/8
	7	7	9-5/8	5-7/8	14-1/2	14-1/2	3-7/16	19-1/16	19-1/16	21-3/8
	8	8	9-5/8	5-7/8	14-1/2	14-1/2	3-7/16	19-1/16	19-1/16	21-3/8
14	7	7	9-7/8	6-3/8	15-5/8	15-5/8	3-1/2	20-1/4	20-1/4	22-5/8
	8	8	9-7/8	6-3/8	15-5/8	15-5/8	3-1/2	20-1/4	20-1/4	22-5/8
	10	10	9-7/8	6-3/8	15-5/8	15-5/8	3-1/2	20-1/4	20-1/4	22-5/8
16	8	8	11-3/8	7-3/8	18-1/8	18-1/8	4	23-9/16	23-9/16	26-1/8
	9	9	11-3/8	7-3/8	18-1/8	18-1/8	4	23-9/16	23-9/16	26-1/8
	10	10	11-3/8	7-3/8	18-1/8	18-1/8	4	23-9/16	23-9/16	26-1/8
18	9	9	12-3/8	8-5/8	21-1/8	21-1/8	4-1/4	26-13/16	26-13/16	29-5/8
	10	10	12-3/8	8-5/8	21-1/8	21-1/8	4-1/4	26-13/16	26-13/16	29-5/8
20	10	10	13-3/8	9-5/8	23-5/8	23-5/8	4-1/2	29-9/16	29-9/16	32-5/8

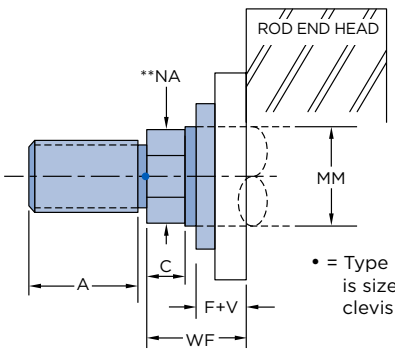
NOTE: Cylinder mountings, rod sizes and thread types are interchangeable on either end of double rod end cylinder assembly.

CLASS 3 CYLINDER PISTON ROD END DIMENSIONAL DATA

ROD END TYPE NO. 1

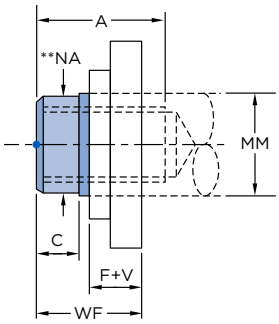


ROD END TYPE NO. 3 & NO. 4•



• = Type No. 4 thread is sized for rod clevis and eye.

ROD END TYPE NO. 5



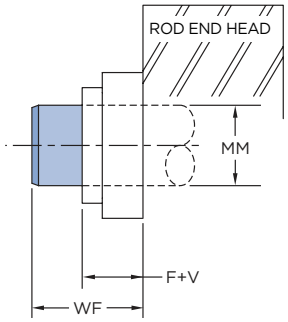
** = Dimension NA is .060 under MM diameter dimension.

DIA. ROD MM	ROD END TYPE				A	C	D■	F+V	WF
	NO. 1	NO. 3	NO. 4•	NO. 5					
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	

• = Type 4 thread sized for clevis and rod eye accessories.

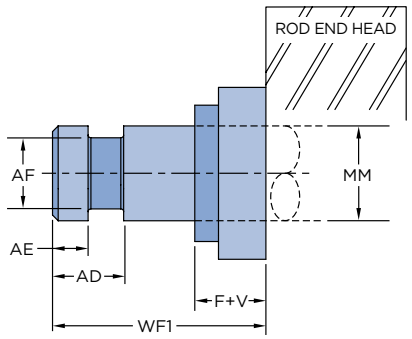
■ = Dimension D is size across wrench flats.

ROD END TYPE NO. 6



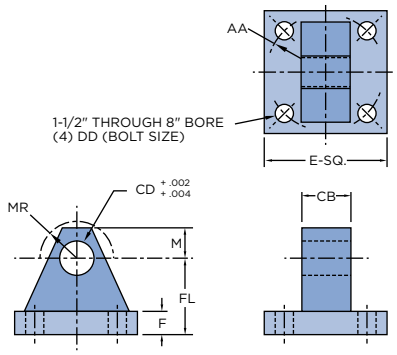
DIA. ROD MM	F+V	WF
5/8	5/8	1
1	3/4	1-3/8
1-3/8	1	1-5/8
1-3/4	3/4	1-7/8
2	7/8	2
2-1/2	1-1/16	2-1/4
3	1-1/8	2-1/4
3-1/2	1-1/8	2-1/4
4	1-1/4	2-1/4
4-1/2	1-1/4	2-1/4
5	1-1/4	2-1/4
5-1/2	1-1/4	2-1/4

ROD END TYPE NO. 7



DIA. ROD MM	F+V	WF1	AD	AE	AF
5/8	5/8	1-3/4	5/8	1/4	3/8
1	3/4	2-1/2	15/16	3/8	11/16
1-3/8	1	2-3/4	1-1/16	3/8	7/8
1-3/4	3/4	3-1/8	1-5/16	1/2	1-1/8
2	7/8	3-3/4	1-11/16	5/8	1-3/8
2-1/2	1-1/16	4-1/2	1-15/16	3/4	1-3/4
3	1-1/8	4-7/8	2-7/16	7/8	2-1/4
3-1/2	1-1/8	5-5/8	2-11/16	1	2-1/2
4	1-1/4	5-3/4	2-11/16	1	3
4-1/2	1-1/4	6-1/2	3-3/16	1-1/2	3-1/2
5	1-1/4	6-5/8	3-3/16	1-1/2	3-7/8
5-1/2	1-1/4	7-1/2	3-15/16	1-7/8	4-3/8

EYE BRACKET

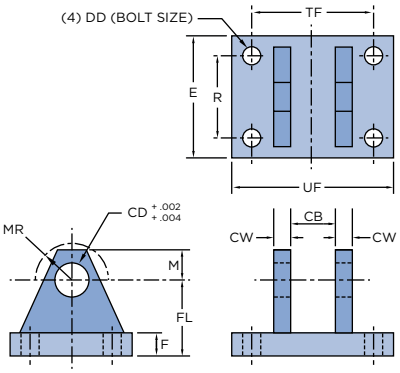


CYL. DIA.	E	F	M	AA	CB	CD	DD	FL	MR	PART NO.
1-1/2	2-1/2	3/8	1/2	2.30	3/4	1/2	3/8	1-1/8	5/8	2716 L47
2 - 2-1/2	3-1/2	5/8	3/4	3.61	1-1/4	3/4	1/2	1-7/8	7/8	2719 L32
3-1/4	4-1/2	7/8	1	4.60	1-1/2	1	5/8	2-3/8	1-1/4	2720 L33
4	5	7/8	1-3/8	5.40	2	1-3/8	5/8	3	1-5/8	2721 L34
5	6-1/2	1-1/8	1-3/4	7.00	2-1/2	1-3/4	7/8	3-3/8	2	2722 L35
6	7-1/2	1-7/16	2	8.10	2-1/2	2	1	3-15/16	2-3/8	2723 L36
7	8-1/2	1-5/8	2-1/2	9.30	3	2-1/2	1-1/8	4-5/8	3	2724 L37
8	9-1/2	2	2-3/4	10.61	3	3	1-1/4	5-1/4	3-1/4	2725 L38
10	12-5/8	2-3/8	3-1/2	•	4	3-1/2	1	6-3/8	3-1/2	2726 L39
12	14-7/8	2-7/8	4	•	4-1/2	4	1	7-1/2	4	2727 L40
14	17-1/4	3-3/8	5	•	6	5	1	9	5	2728 L41

For clevis bracket reference see models on page 40 and page 42.

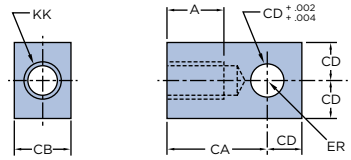
• = See page 54 for bolt hole location.

MOUNTING BRACKET



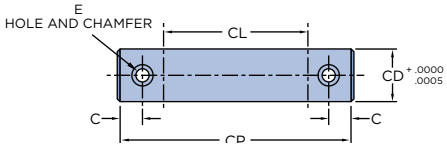
CYL. DIA.	E	F	M	R	CB	CD	CW	DD	FL	MR	TF	UF	PART NO.
1-1/2	2-1/2	3/8	1/2	1.63	3/4	1/2	1/2	3/8	1-1/8	5/8	2-3/4	3-1/2	2683 L47
2 - 2-1/2	3-1/2	5/8	3/4	2.55	1-1/4	3/4	5/8	1/2	1-7/8	7/8	3-3/4	4-3/4	2684 L47
3-1/4	4-1/2	7/8	1	3.25	1-1/2	1	3/4	5/8	2-3/8	1-1/4	4-1/2	5-3/4	2685 L47
4	5	7/8	1-3/8	3.82	2	1-3/8	1	5/8	3	1-5/8	5-1/2	6-3/4	2686 L47
5	6-1/2	1-1/8	1-3/4	4.95	2-1/2	1-3/4	1-1/4	7/8	3-3/8	2	7	8-1/2	2687 L47
6	7-1/2	1-7/16	2	5.73	2-1/2	2	1-1/4	1	3-15/16	2-3/8	7-1/2	9-1/4	2688 L47
7	8-1/2	1-5/8	2-1/2	6.58	3	2-1/2	1-1/2	1-1/8	4-5/8	3	8-1/2	10-1/2	2689 L47
8	9-1/2	2	2-3/4	7.50	3	3	1-1/2	1-1/4	5-1/4	3-1/4	8-3/4	10-3/4	2690 L47
10	12-5/8	2-3/8	3-1/2	9.62	4-1/8	3-1/2	2	1-3/4	6-3/8	3-1/2	12	15	2691 L47
12	14-7/8	2-7/8	4	11.45	4-5/8	4	2-1/4	2	7-1/2	4	14	18	2692 L47
14	17-1/4	3-3/8	5	13.36	6-1/8	5	3	2-1/4	9	5	17-3/4	22-1/2	2693 L47

EYE (FEMALE)



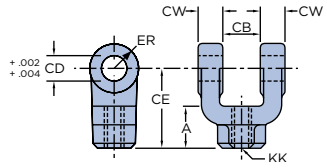
KK	A	CA	CB	CD	ER	PART NO.
7/16-20	3/4	1-1/2	3/4	1/2	5/8	1810 L59
3/4-16	1-1/8	2-1/16	1-1/4	3/4	1-1/16	1812 L59
1-14	1-5/8	2-13/16	1-1/2	1	1-7/16	1813 L59
1-1/4-12	2	3-7/16	2	1-3/8	2	1814 L59
1-1/2-12	2-1/4	4	2-1/2	1-3/4	2-1/16	1815 L59
1-7/8-12	3	5	2-1/2	2	2-1/4	1817 L59
2-1/4-12	3-1/2	5-13/16	3	2-1/2	2-7/8	1820 L59
2-1/2-12	3-1/2	6-1/8	3	3	3-1/8	1821 L59
3-1/4-12	4-1/2	7-5/8	4	3-1/2	3-7/8	1824 L59
4-12	5-1/2	9-1/8	4-1/2	4	4-7/16	1825 L59
5-1/2-12	7	11-7/8	6	5	5	1826 L59

PIVOT – PIN



CYL. DIA.	C	E	CD	CP	CL	PART NO.
1-1/2	3/16	1/8	1/2	2-3/8	1.8	3222 L47-1
2 - 2-1/2	1/4	3/16	3/4	3-1/4	2.6	3222 L47-2
3-1/4	1/4	3/16	1	3-3/4	3.1	3222 L47-3
4	1/4	3/16	1-3/8	4-7/8	4.1	3222 L47-4
5	1/4	3/16	1-3/4	5-7/8	5.1	3222 L47-5
6	5/16	1/4	2	6-1/8	5.2	3222 L47-6
7	5/16	1/4	2-1/2	7-1/8	6.3	3222 L47-8
8	5/16	1/4	3	7-1/8	6.3	3222 L47-7
10	3/8	1/4	3-1/2	9-1/4	8.0	3222 L47-9
12	3/8	1/4	4	10-1/4	9.0	3222 L47-10
14	3/8	1/4	5	13-1/2	12.3	3222 L47-11

CLEVIS (FEMALE)



KK	A	CB	CD	CE	CW	ER	PART NO.
7/16-20	3/4	3/4	1/2	1-1/2	1/2	1/2	2834 L59
3/4-16	1-1/8	1-1/4	3/4	2-3/8	5/8	3/4	2835 L59
1-14	1-5/8	1-1/2	1	3-1/8	3/4	1	2836 L59
1-1/4-12	2	2	1-3/8	4-1/8	1	1-3/8	2837 L59
1-1/2-12	2-1/4	2-1/2	1-3/4	4-1/2	1-1/4	1-3/4	2838 L59
1-7/8-12	3	2-1/2	2	5-1/2	1-1/4	2	2839 L59
2-1/4-12	3-1/2	3	2-1/2	6-1/2	1-1/2	2-1/2	2840 L59
2-1/2-12	3-1/2	3	3	6-3/4	1-1/2	3	2841 L59
3-1/4-12	4-1/2	4	3-1/2	8-1/2	2	3-1/2	2842 L59
4-12	5-1/2	4-1/2	4	10	2-1/4	4	2843 L59
5-1/2-12	7	6	5	12-3/4	3	5	2844 L59

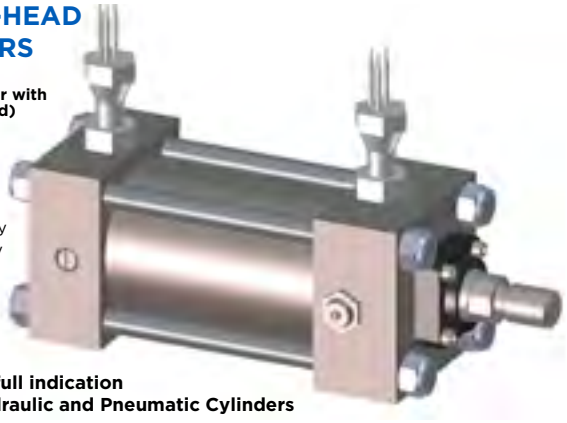
PROXIMITY POSITION INDICATOR SWITCH

HYDRAULIC OR PNEUMATIC CYLINDER OPERATIONS

SQUARE-HEAD CYLINDERS

NOPAK Cylinder with Switch (pictured)

- Non-contact design
- Long life
- Pressures to 3000 PSI
- High reliability
- Versatile, easy operation



For positive full indication of stroke Hydraulic and Pneumatic Cylinders

WORKING PRINCIPLE

NOPAK Position Indicator Switches are easily mounted in both hydraulic and pneumatic cylinder heads to confirm the position of the piston in either extended or retracted positions. Designed for versatility, NOPAK switches can be mounted in virtually any position. When inserted in the cylinder head, the switch senses the cushion sleeve's position at end of stroke. NOPAK's threaded switch screws easily into the cylinder heads making it a natural for accurate confirmation. Totally self-contained, the switch will not be contaminated by dirt, oil, grease, and most corrosive atmospheres. The non-contact design also eliminates the need for linkage or external actuators. Heavy-duty construction allows the switch to withstand up to 3000 PSI of external pressure (higher pressure available upon request).

DESIGN FEATURES

- **Very Economical –** Easy to install, NOPAK Position Indicator Switches are totally self-contained, eliminating external power supply requirements.
- **Enclosure –** 300 Series Stainless Steel provides reliable performance under even the most adverse conditions.
- **Hermetically Sealed –** To ensure a clean, stable contact environment, the entire assembly is completely evacuated, then back-filled under pressure.
- **Long Life –** Tested to over 1,000,000 cycles. (Actual life varies with load.)
- **High Contact Pressure –** Heavy vibrations will not cause false operations of the switch. Good electrical characteristics for dry circuit and low load applications.

SPECIFICATIONS

CONTACT ARRANGEMENT:
Single Pole Double Throw SPDT (Form C)

CONTACT RATINGS:
UL Rated (NEMA Type 1)
240 VAC @ 2A
250 VDC @ 0.5A Resistive

Although not UL General Purpose, switch is suitable for:
24 VDC @ 50 mA

TEMPERATURE RANGE:
-40°F (-40°C) to 221°F (105°C)

RESPONSE TIME: 8 milliseconds

REPEATABILITY:
0.002" (0.05 mm) of setpoint under identical operating conditions.

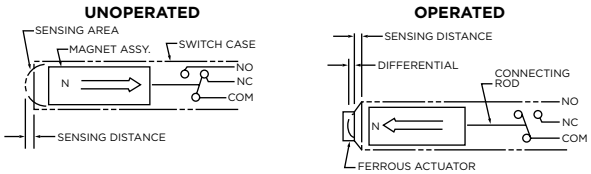
Consult Factory for other contact arrangements, ratings, terminations, and approvals.

PROXIMITY POSITION INDICATOR SWITCH PRINCIPLES OF OPERATION

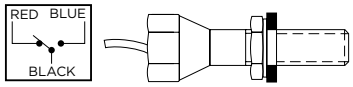
The NOPAK Proximity Limit Switch is based on an operating principle which utilizes "new," high energy, rare earth magnets to provide an end sensing range fixed at approximately .072" (1.83 mm) with a ferrous actuator. Use of an external magnet increases this appreciably. The differential (hysteresis) is approximately half of the sensing range.

When time, accuracy, and dependability count... you can count on a NOPAK Indicator Switch. Maintenance free: engineered for precision, performance and reliability.

NOTE: This is not a 'reed' type switch.

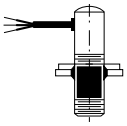


Wiring Color Code: Black = Common, Red = Normally Closed; Blue = Normally Open



Switch enclosure incorporates a 1/2–14 NPT conduit connection. Switch wire connections are a potted 3 wire cable 18" long. External mounting threads are locked to cylinder head port with a hex jam nut and seal.

Where installation height is limited some switches are available with side-potted leads. Consult factory.



AVAILABLE IN:
CLASS 6
(pictured)
CLASS 3

DESIGN AND PERFORMANCE FEATURES

- Non-contacting design – no wear, no friction, no noise and no adjustments.
- Completely solid state.
- Both analog and digital outputs are available.
- Quartz crystal time reference.
- Withstands corrosive environments and pressures up to 3000 PSI.
- Feedback sensor inside cylinder is protected from debris and mechanical damage.
- Absolute output, not incremental – no loss of position at restart.

NOPAK has a linear displacement transducer that is designed for use in air or hydraulic cylinder actuators. The transducer, available in lengths up to thirty feet, is threaded into the cylinder and sealed to withstand the pressures of hydraulic fluid. A permanent magnet is mounted on the piston end of the cylinder rod, and is used to determine the position of the piston inside the cylinder. Double ended rods not applicable.

HERE'S HOW IT WORKS: It simply measures the time interval required for an electric current pulse to travel between two points. The two points of measurement are the fixed magnet located on the piston position and the sensor at the end of the transducer probe. This concept has been successful in eliminating considerable expense for potentiometers, tach generators, encoders, racks, pinions, and other special hardware.

ADVANTAGES PLUS: Includes a non-contact operation, no wear, no noise generation, high reliability, infinite resolution (analog), high linearity (.05%), excellent repeatability (.002%), and direct digital output if required.

LDT Systems can be adapted to all NOPAK P6, H6 and H3 cylinder diameters with a 1-3/8" diameter rod or larger.

We welcome the opportunity to discuss your applications and help you supply your needs.

NLDT SPECIFICATIONS	
Electrical stroke	Standard - up to 25 feet.
Null	Positioned as required.
Null adjustment	2% of total stroke nominal.
Scale adjustment	1% of total stroke nominal.
Non-linearity	Less than ±0.05% of full range.
Repeatability	Better than ±0.001% of full range.
Temperature coefficient of scale factor	Transducer: less than 0.00011 inch/°F + [3 ppm/°F per inch of full stroke]. Analog Output Module: 20 ppm/°F.
Frequency response	Stroke dependent. 200 Hz to 50 Hz is typical for lengths of 12 inch to 100 inch respectively – wider response frequencies are available upon request. For digital systems, output is updated at discrete intervals.
Hysteresis	Less than 0.0008 in. maximum.
Output	Analog: 0 to +10 VDC, 4 to 20 mA ungrounded (others available). Digital: pulse width modulated signal, TTL compatible.
Operating impendance	10 ohms.
Operating temperature range	-35°F to 150°F (transducer probe to 180°F).
Storage temperature range	-40°F to 180°F.
Operation in hydraulic fluid	The .375 inch dia. transducer probe is capable of operating in hydraulic fluid and will withstand 3,000 PSI operating pressure.

HOW TO ORDER

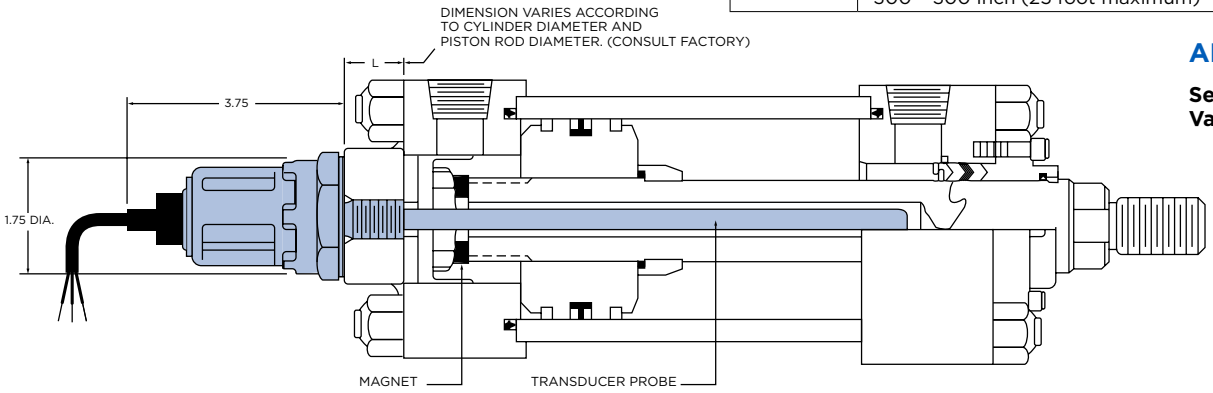
DIGIT _ 1 2
CODE NO. T-1-30

SERIES
OUTPUT
STROKE IN INCHES

When ordering: Code Number must be completed using options listed at right.

For further detailed information contact your NOPAK distributor.

DIGIT	DESCRIPTION
FIRST	**OUTPUT** 1. 0 to +10 VDC w/Analog Output Module 2. 0 to +10 VDC w/built-in Analog Personality Module (Eliminates separate Analog Output Module) 3. 4 to 20 MA grounded w/Analog Output Module 4. Half digital w/Digital Personality Module 5. Full digital w/Digital Personality Module and Digital Counter Card. Specify Binary or BCD. 6. Digital with RS422 Personality Module 7. Others (specify)
SECOND	**ELECTRICAL STROKE IN INCHES (Example: 12.75 inches)** 1 – 1 Inch through 300 – 300 Inch (25 foot maximum)



ALSO AVAILABLE

Servo or Proportional Valve Footprint

NOPAK Class 3 pressure-rated cylinders are designed for hydraulic service. For reference to basic pressure ratings, see table page 26. Cylinders 1-1/2″ 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 = FLUOROCARBON**
-40°F to +225°F Std. Hyd. Oil	-20°F to +325°F Std. Hyd. Oil
Air	Air
Water (not steam)	
Water Glycol Fire Resistant Fluid	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. 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. Cushion adjusting screws serve to bypass 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.

CYLINDER PORT TYPES & LOCATION

Standard ports are NPT. SAE O-ring boss ports are available. 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.

PRE-STRESSING TIE RODS

Some of the tie rod torque values shown in Table A 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.	1-1/2	2	2-1/2	3-1/4	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	1-1/8	1-1/4	1	1	1-1/2	1-1/2	1-1/2	1-1/2
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	1178	1570	2355	.785	.0034
1-3/8	1.485	743	1114	1485	1856	2228	2970	4455	1.485	.0064
1-3/4	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
2-1/2	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
3-1/2	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
4-1/2	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
5-1/2	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 = $.7854\ d^2$

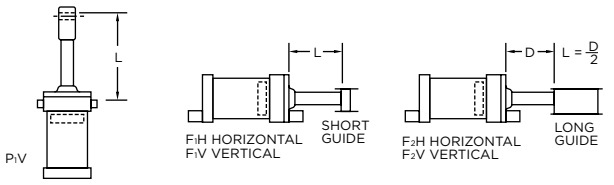
$$\text{Piston Speed (In./Min.)} = \frac{\text{Pressure Source Delivery (GPM)}}{\text{Cylinder Displacement (Gal./In.)}}$$

TABLE C – THRUST FORCE AND DISPLACEMENT

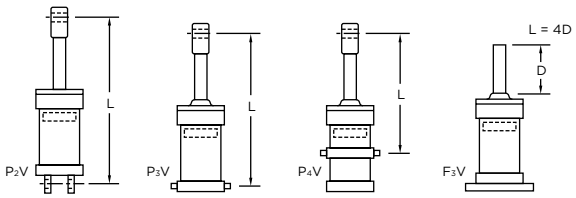
BORE SIZE	PISTON AREA SQ. IN.	CYLINDER THRUST FORCE IN POUNDS FOR VARIOUS LINE PRESSURES							DISPLACEMENT PER INCH OF STROKE	
		500	750	1000	1250	1500	2000	3000	CU. INCH	GALLONS
1-1/2	1.767	884	1,325	1,767	2,209	2,650	3,534	5,301	1.767	.00765
2	3.142	1,571	2,357	3,142	3,928	4,713	6,284	9,426	3.142	.0136
2-1/2	4.909	2,455	3,682	4,909	6,137	7,364	9,818	14,727	4.909	.0213
3-1/4	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	.666
16	201.06	100,530	150,795	201,060	251,325	301,590	402,120	603,180	201.06	.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

INFORMATION TO PREVENT EXCESSIVE BEARING WEAR AND PISTON ROD COLUMN FAILURES

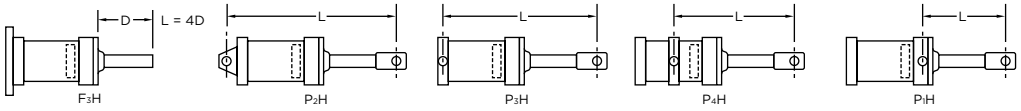
GROUP A – WITH PISTON RODS EXTENDED



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 long 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 A – Minimum and Maximum Stop Tube Lengths on page 67 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 extent than unnecessarily large oversize rods.

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

a. Determine your push stroke thrust from TABLE C – Thrust Force and Displacement on page 65.

b. Find your push stroke thrust "T" in TABLE B – Value of "L" In Inches on page 67. 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 A – MINIMUM AND MAXIMUM STOP TUBE LENGTHS

"L" INCHES	MINIMUM STOP TUBE LENGTH (INCHES)	MAXIMUM STOP TUBE LENGTH (INCHES)
5-10	–	1
11-20	–	2
21-30	–	3
31-40	–	4
41-50	1	5
51-60	2	6
61-70	3	7
71-80	4	8
81-90	5	9
91-100	6	10
101-110	7	11

"L" INCHES	MINIMUM STOP TUBE LENGTH (INCHES)	MAXIMUM STOP TUBE LENGTH (INCHES)
111-120	8	12
121-130	9	13
131-140	10	14
141-150	11	15
151-160	12	16
161-170	13	17
171-180	14	18
181-190	15	19
191-200	16	20
201-210	17	21

"L" INCHES	MINIMUM STOP TUBE LENGTH (INCHES)	MAXIMUM STOP TUBE LENGTH (INCHES)
211-220	18	22
221-230	19	23
231-240	20	24
241-250	21	25
251-260	22	26
261-270	23	27
271-280	24	28
281-290	25	29
291-300	26	30
301-310	27	31

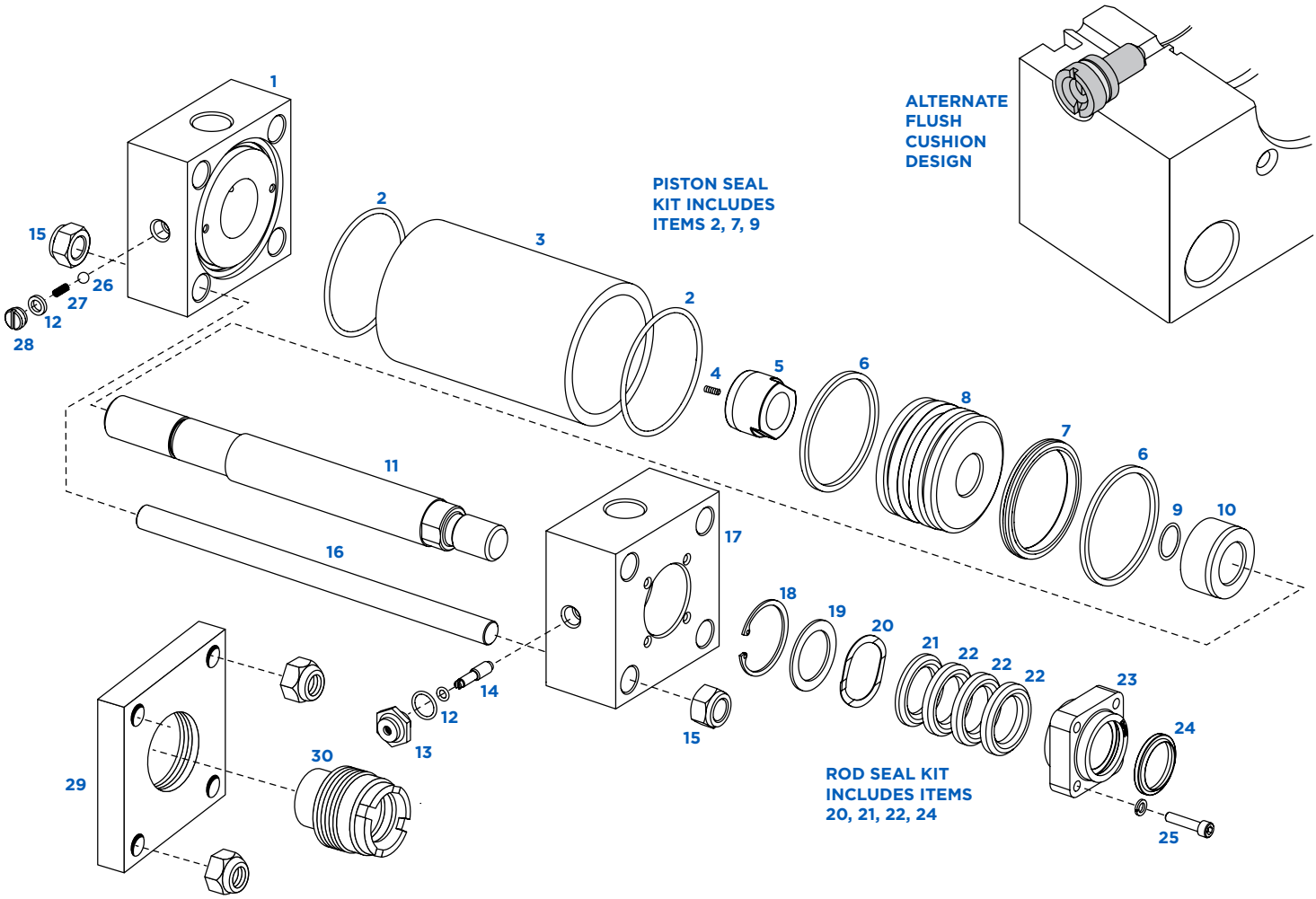
NOTE: Using stop tube lengths greater than "Maximum Stop Tube" has diminishing effect on reducing bearing loads.

TABLE B – 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 ÷ 1/4 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 B 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.

EXPLODED VIEW



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 Retainer 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 through 16" diameter bore; 18" and 20" fitted with piston rings.

▲ = For 7" diameter rods and larger:
Part 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 69 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 and mounting
- Serial number shown on NOPAK label

NOTE: Isometric view of Double Rod cylinders available at N/C. Consult factory or an 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.

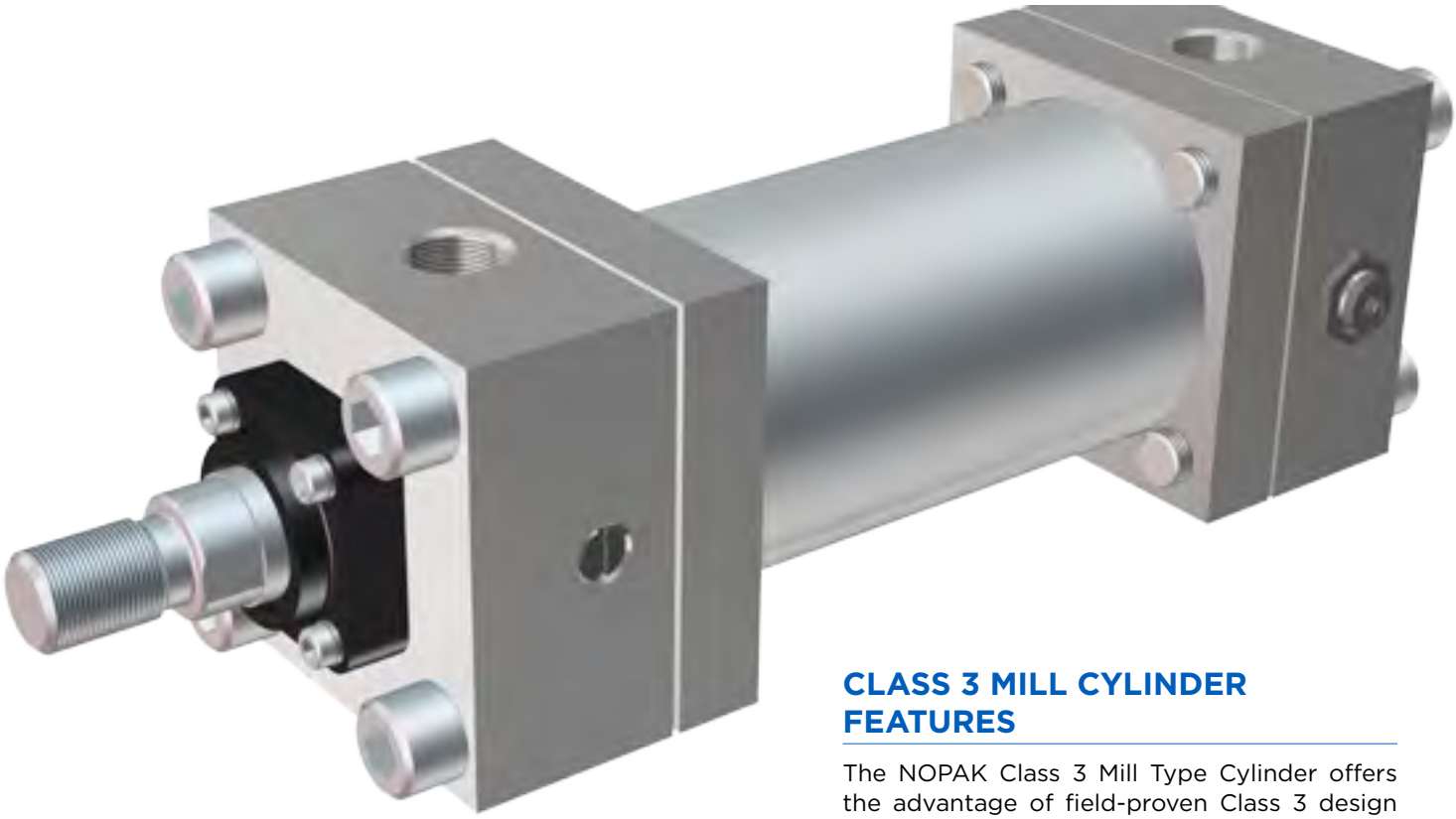
■ = When ordering, specify Type “A” or Type “B” seals.
Type “A” = Buna-N (NITRILE)
Type “B” = Fluorocarbon

PACKING GLANDS – CLASS 3

ROD DIA.	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 packing gland 2859G73 for 1.50″ cyl. with 1.00″ Ø rod
Use packing gland 2858G75 for 2.00″ cyl. with 1.38″ Ø rod
Use packing gland 2857G77 for 2.50″ cyl. with 1.75″ Ø rod

■ = For Models AL, T and TR, consult factory.



CLASS 3 MILL CYLINDER FEATURES

The NOPAK Class 3 Mill Type Cylinder offers the advantage of field-proven Class 3 design integrity in a non-tie-rod unit. Using Grade 8 fasteners we bolt NOPAK production cylinder heads to square flanges that have been welded to both ends of the cylinder tube.

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.