



ML SERIES

3000 psi

Longevity Under the Harshest Environments

- Heavy Duty NFPA Hydraulic
- Bore up to 24"
- Piston Rod sizes from 5/8" to 10"
- 23 Mounting Options available

Design & Materials

Cushion Plunger

Floating cushion plunger provides maximum cushioning effect combined with a quick start for optimum performance

High Strength Nylon Wear Rings

BZ-PTFE for high temp version

High Load Piston Seal Standard

Excellent wear resistance and sealing

High Strength Piston to rod joint

featuring oversized threads. Ideal for high cycle applications.

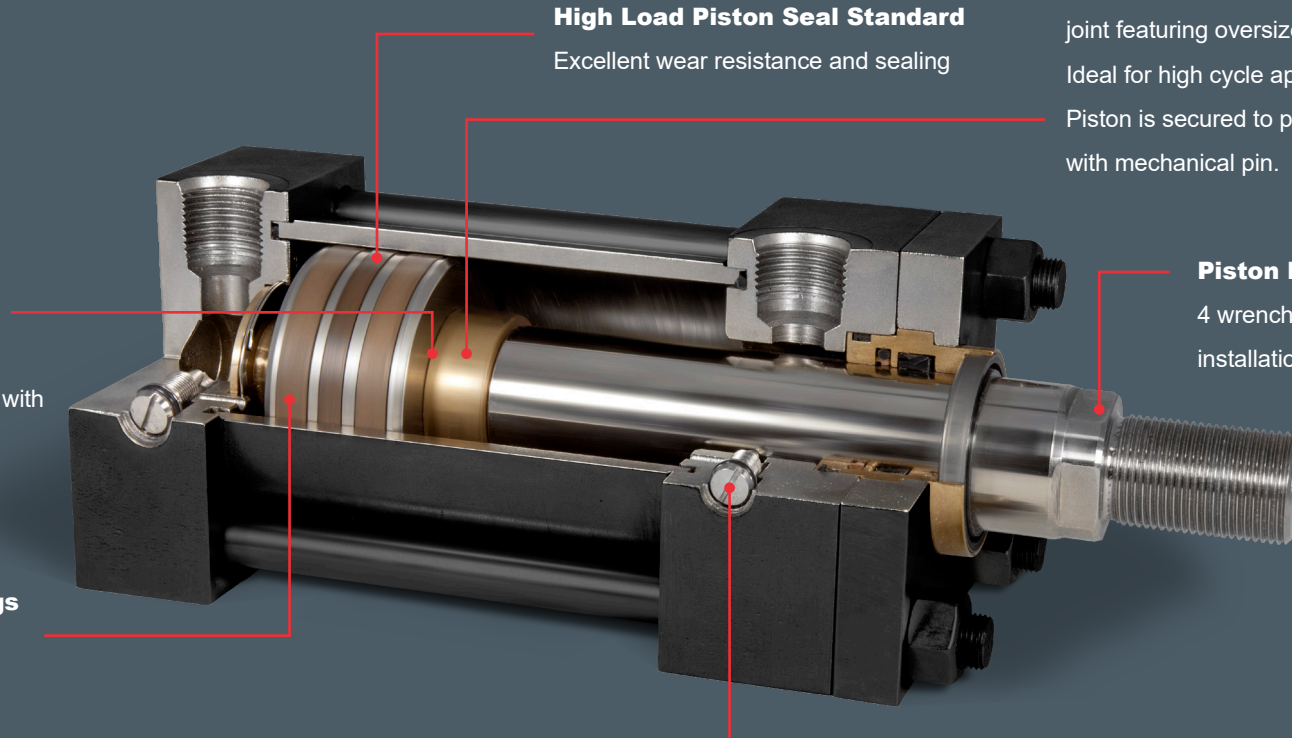
Piston is secured to piston rod with mechanical pin.

Piston Rod Flats

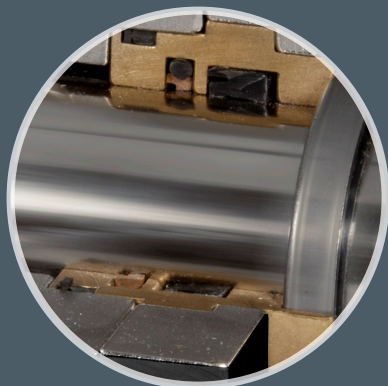
4 wrench flats for easy installation

Cushion Screw

(Optional) Fully adjustable



Gland Seal Configuration



Triple Seal Gland Standard

Gland Bushing: Cartridge type, no special tools required for removal

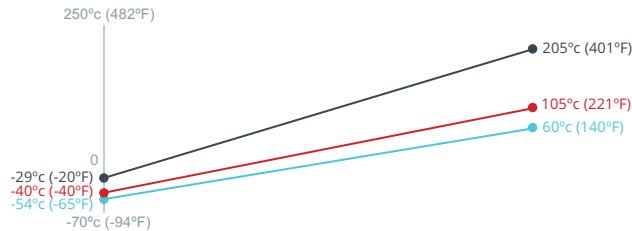
Buffer Seal: Protects primary seal from pressure spikes. PTFE for low friction and long service life.

Primary Seal: Heavy Duty Polyurethane “U”-cup for excellent seal ability and long service life.

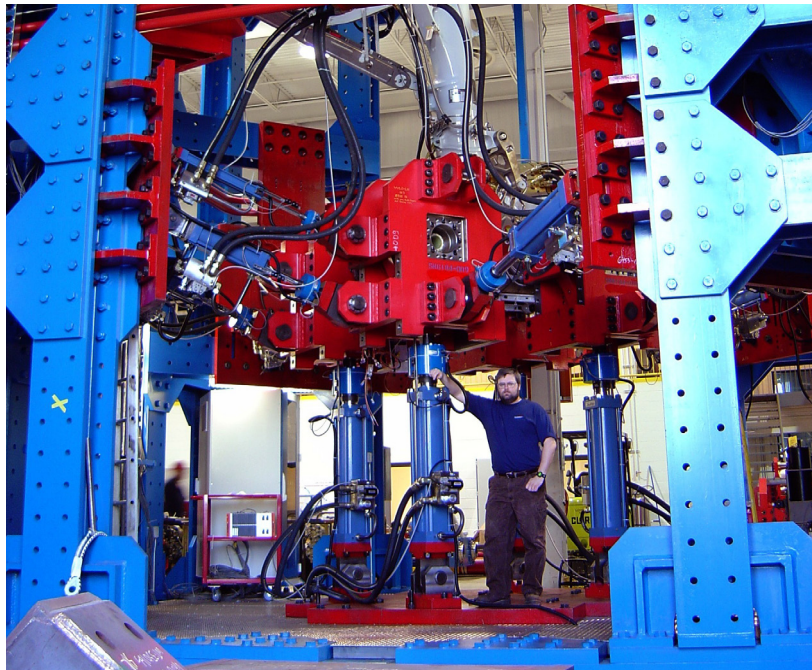
Encased Rod Wiper: Rugged wiper deflects contamination away for the rod seals for long service.

Material Breakdown	STANDARD
Head & cap	Machined Steel
Barrel	Honed Seamless Steel Tubing *Optional Chrome Plating available
Piston	Ductile Iron
Piston rod	1045
Gland	SAE 660 Bronze
Tie Rod	Stress-proof Steel

Specifications



- **Heavy Duty NFPA Hydraulic**
- **Up to 24" Bore**
- **Piston Rod sizes from 5/8" to 10"**
- **23 Mounting Options available**



Cowan 14" bore ML Series on A380 Landing Gear Test Rig

Add-Ons



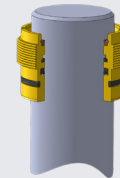
Limit Switches

Mechanical Limit Switch SPDT, for Open & Close Indication. Inductive switches also available. Solid State, Reed and inductive type also available. Specify brand and part number



Available in 316 Stainless Construction

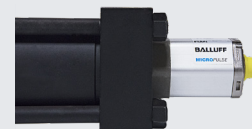
for corrosive applications. Includes attachments such as Rod clevis and Eye brackets.



GT3 Gland for Harsh Environments

Triple-seal gland with dual wipers. Rugged metallic scraper and urethane double-acting wiper deflect contamination away from the rod seal for long service life.

- Low Temp
- Cast iron construction for applications where yellow metals are not allowed



Balluff LDT

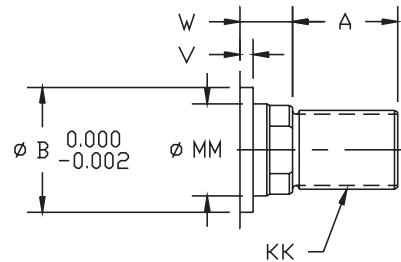
Optional Balluff LDT for continuous position feedback. 4-20mA, 0-10V and digital outputs available.

Rod Thread Size

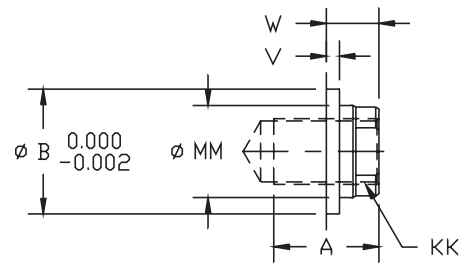
1½" - 6" Bore

Actuation Solutions and Systems for the World's Most Challenging Environments

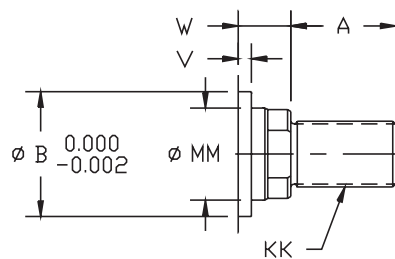
INTERMEDIATE MALE (N2)



SMALL FEMALE (N4)



SMALL MALE (N1)

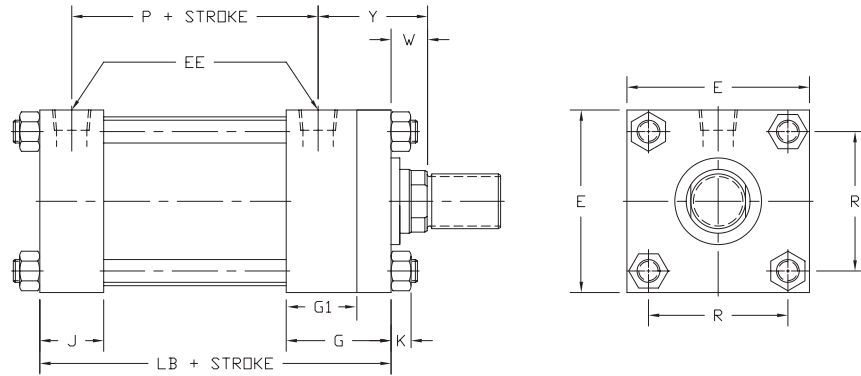


Dimensions (in)								
Bore	Rod Ø MM	Thread (KK)		A	B	V	W	Y
		N2	N1 or N4					
1½	0.63	½-20	⅞-20	0.75	1.13	0.25	0.88	2.00
	1.00	⅞-14	¾-16	1.13	1.50	0.50	1.00	2.38
2	1.00	⅞-14	¾-16	1.13	1.50	0.25	0.75	2.38
	1.38	1¼-12	1-14	1.63	2.00	0.38	1.00	2.63
2½	1.00	⅞-14	¾-16	1.13	1.50	0.25	0.75	2.38
	1.38	1¼-12	1-14	1.63	2.00	0.38	1.00	2.63
	1.75	1½-12	1¼-12	2.00	2.38	0.50	1.25	2.88
¾	1.38	1¼-12	1-14	1.63	2.00	0.25	0.88	2.75
	1.75	1½-12	1¼-12	2.00	2.38	0.38	1.13	3.00
4	2.00	1¾-12	1½-12	2.25	2.63	0.38	1.25	3.13
	2.50	2¼-12	1⅞-12	3.00	3.13	0.38	1.38	3.38
5	1.75	1½-12	1¼-12	2.00	2.38	0.25	1.00	3.00
	2.00	1¾-12	1½-12	2.25	2.63	0.25	1.13	3.13
	2.50	2¼-12	1⅞-12	3.00	3.13	0.38	1.38	3.38
	3.00	2¾-12	2¼-12	3.50	3.75	0.38	1.38	3.38
6	3.50	3¼-12	2½-12	3.50	4.25	0.38	1.38	3.38
	2.50	2¼-12	1⅞-12	3.00	3.13	0.25	1.25	3.50
	3.00	2¾-12	2¼-12	3.50	3.75	0.25	1.25	3.50
	3.50	3¼-12	2½-12	3.50	4.25	0.25	1.25	3.50
6	4.00	3¾-12	3-12	4.00	4.75	0.25	1.25	3.50

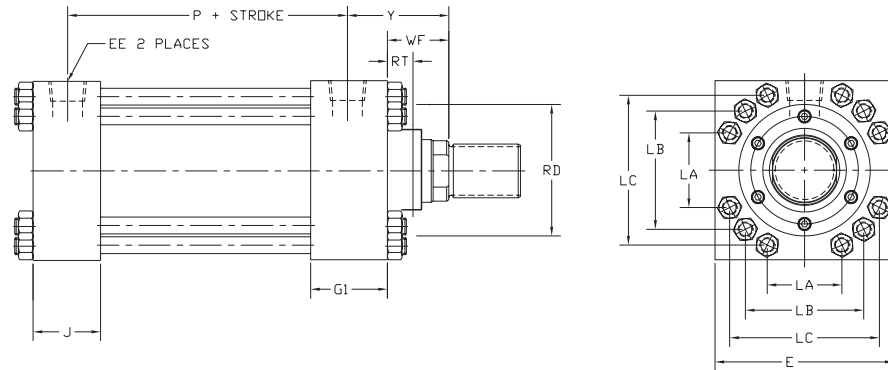
Master Chart

Actuation Solutions and Systems for the World's Most Challenging Environments

1½"-8" Bore Only



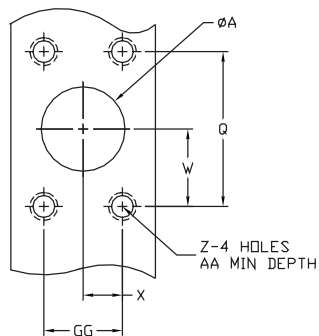
10"-14" Bore Only



Dimensions (in)											
BORE	E	EE			F	G1	J	K	RA	R	P
		NPT	SAE	SAE-61							
1½	2.50	0.50	08	N/A	0.38	1.75	1.50	0.38	N/A	1.63	2.88
2	3.00	0.50	08	N/A	0.63	1.75	1.50	0.44	N/A	2.05	2.88
2½	3.50	0.50	08	0.50	0.63	1.75	1.50	0.44	N/A	2.55	3.00
3¼	4.50	0.75	12	0.75	0.75	2.00	1.75	0.56	N/A	3.25	3.50
4	5.00	0.75	12	0.75	0.86	2.00	1.75	0.56	N/A	3.82	3.75
5	6.50	0.75	12	0.75	0.86	2.00	1.75	0.81	N/A	4.95	4.25
6	7.50	1.00	16	1.00	1.00	2.25	2.25	0.88	N/A	5.73	4.88
7	8.50	1.25	20	1.25	1.00	2.75	2.75	1.25	N/A	6.58	5.50
8	9.50	1.50	24	1.50	1.00	3.00	3.00	1.50	N/A	7.50	6.25
10	12.63	N/A	24	2.00	1.44	3.69	3.69	1.31	N/A	9.89	8.50
12	14.88	N/A	24	2.50	1.69	4.44	4.44	1.50	N/A	11.75	10.13
14	17.13	N/A	24	2.50	1.94	4.88	4.88	1.50	N/A	12.90	10.88
16	19.00	N/A	24	3.00	1.94	5.88	5.88	1.94	8.00	15.50	12.13
18	22.00	N/A	24	3.00	1.94	6.88	6.88	1.94	7.25	18.00	15.13
20	24.00	N/A	24	3.00	1.94	7.88	7.88	1.94	8.00	20.00	17.63

Flange Size

SAE CODE #1 FLANGE PORT PATTERN



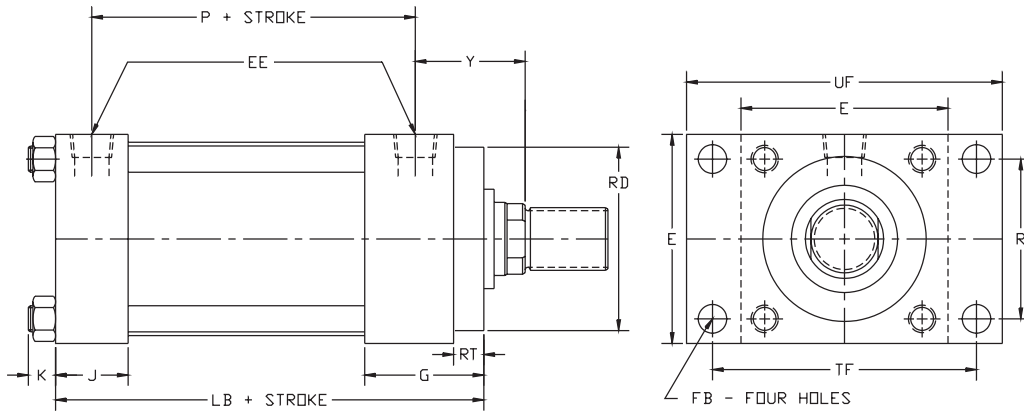
Dimensions (in)							
Flange Size	A	GG	Q	W	X	Z-UNC	AA
½	0.50	0.69	1.50	0.74	0.38	⅝-18	½
¾	0.75	0.88	1.88	0.94	0.44	⅞-16	½
1	1.00	1.03	2.06	1.03	0.52	⅞-16	¾
1¼	1.25	1.19	2.31	1.16	0.59	7/16-14	¾
1½	1.50	1.41	2.75	1.38	0.70	½-13	1⅛
2	2.00	1.69	3.06	1.53	0.84	½-13	1⅛
2½	2.50	2.00	3.50	1.75	1.00	½-13	1⅜
3	3.00	2.44	4.19	2.09	1.22	⅝-11	1⅜

Mounting Style NFPA

1½" - 6" Bore

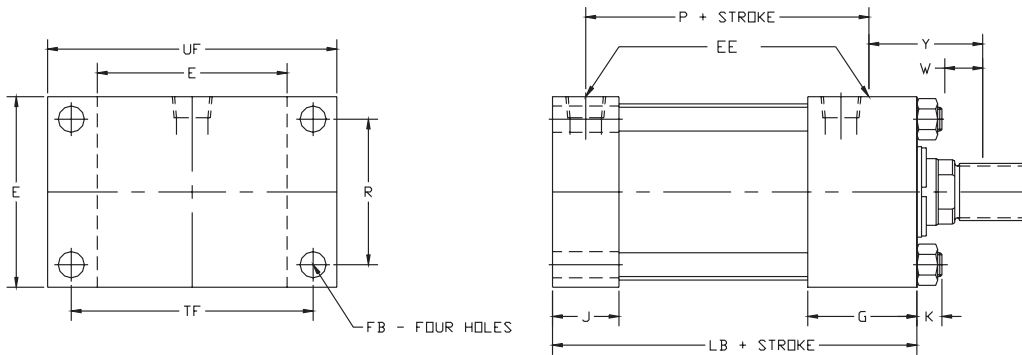
Actuation Solutions and Systems for the World's Most Challenging Environments

ME5



Dimensions (in)						
BORE	FB	G1	R	TF	UF	LB
1½	0.44	1.75	1.63	3.44	4.25	4.63
2	0.56	1.75	2.05	4.13	5.13	4.63
2½	0.56	1.75	2.55	4.63	5.63	4.75
3¼	0.69	2.00	3.25	5.88	7.13	5.50
4	0.69	2.00	3.82	6.38	7.63	5.75
5	0.94	2.00	4.95	8.19	9.75	6.25
6	1.06	2.25	5.73	9.44	11.25	7.38
7	1.19	2.75	N/A	10.63	12.63	9.50
8	1.31	3.00	N/A	11.81	14.00	10.50

ME6



Dimensions (in)					
BORE	FB	R	TF	UF	LB
1½	0.44	1.63	3.44	4.25	5.00
2	0.56	2.05	4.13	5.13	5.25
2½	0.56	2.55	4.63	5.63	5.38
3¼	0.69	3.25	5.88	7.13	6.25
4	0.69	3.82	6.38	7.63	6.63
5	0.94	4.95	8.19	9.75	7.13
6	1.06	5.73	9.44	11.25	8.38
7	1.19	4.95	10.63	9.75	9.50
8	1.31	5.73	11.81	11.25	10.50

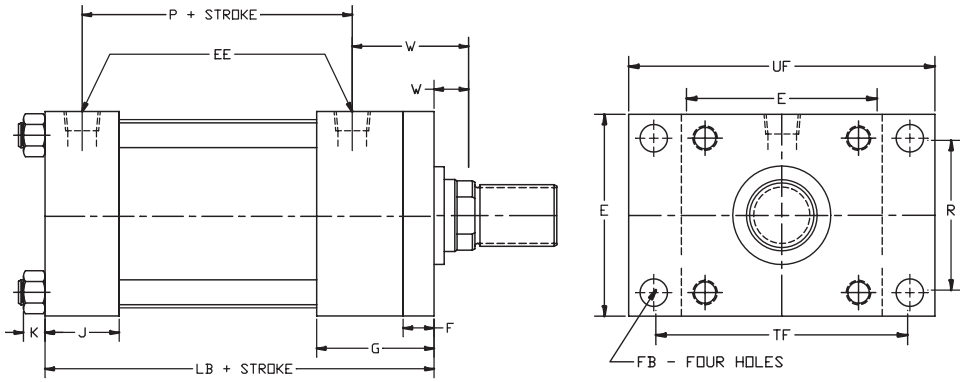
Rod Thread Table

BORE	ROD Ø MM	RD	RT
1½	0.63	2.13	0.38
	1.00	2.50	0.38
2	1.00	2.50	0.38
	1.38	3.00	0.63
2½	1.00	2.50	0.38
	1.38	3.00	0.63
	1.75	3.50	0.63
3¼	1.38	3.00	0.63
	1.75	3.50	0.63
	2.00	4.00	0.75
4	1.75	3.50	0.63
	2.00	4.00	0.75
	2.50	4.50	0.88
5	2.00	4.00	0.75
	2.50	4.50	0.88
	3.00	5.25	0.88
	3.50	5.75	0.88
6	2.50	4.50	0.88
	3.00	5.25	0.88
	3.50	5.75	0.88
	4.00	6.50	1.00
7	3.00	5.25	0.63
	3.50	5.75	0.63
	4.00	6.50	0.75
	4.50	7.00	0.75
	5.00	7.25	1.00
8	3.50	5.75	0.63
	4.00	6.50	0.75
	4.50	7.00	0.75
	5.00	7.25	1.00
	5.50	8.25	1.00

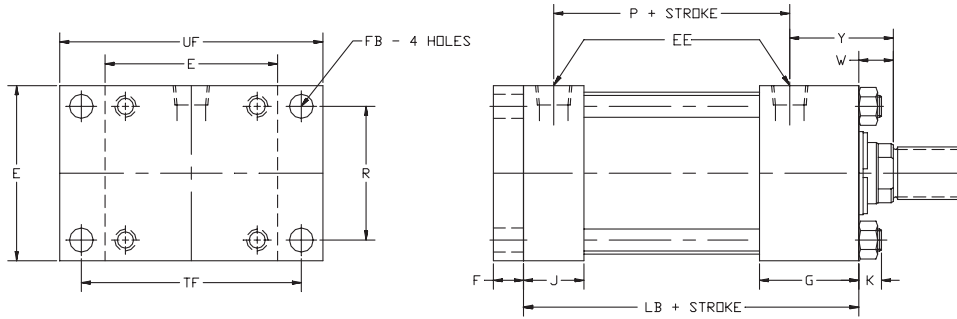
For other values and diagram, please see chart on page 3

For other values and diagram, please see chart on page 11

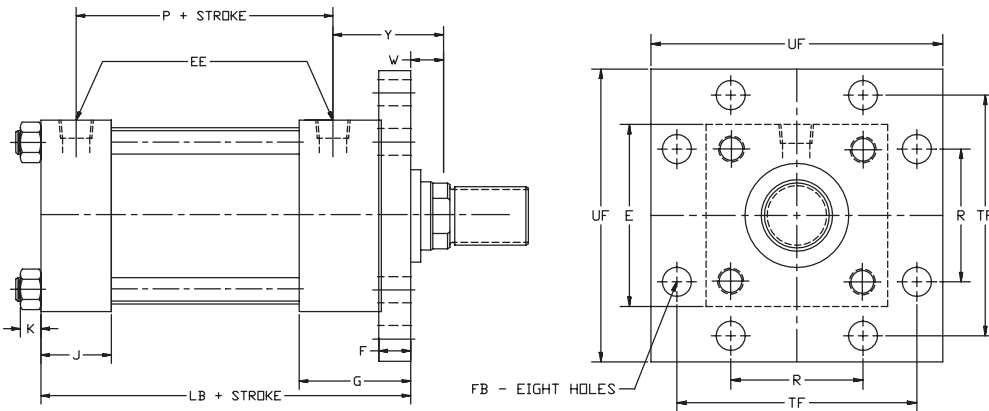
MF1



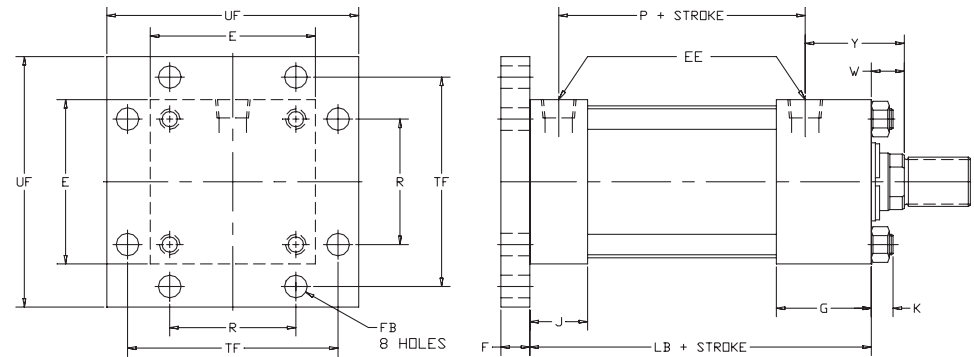
MF2



MF5



MF6



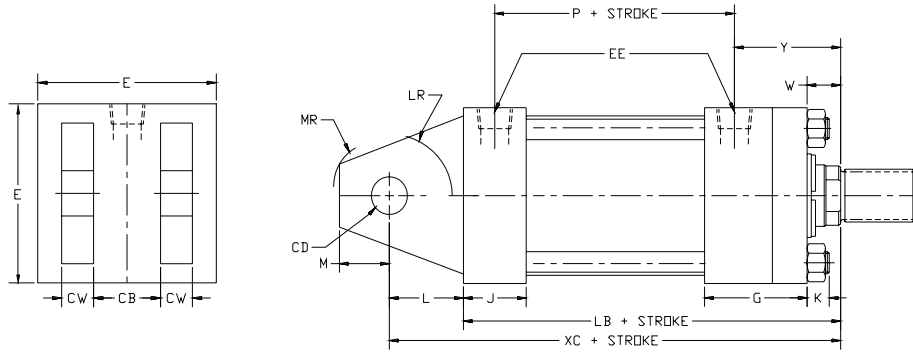
MF1, MF2, MF5, MF6

Dimensions (in)						
BORE	MAX PSI		FB	TF	UF	LB
	MF1	MF2				
1½	2500	3000	0.44	3.44	4.25	5.00
2	2500	3000	0.56	4.13	5.13	5.25
2½	2500	3000	0.56	4.63	5.63	5.38
3¼	2500	3000	0.69	5.88	7.13	6.25
4	2500	2500	0.69	6.38	7.63	6.63
5	2200	2500	0.94	8.19	9.75	7.13
6	1800	2500	1.06	9.44	11.25	8.38

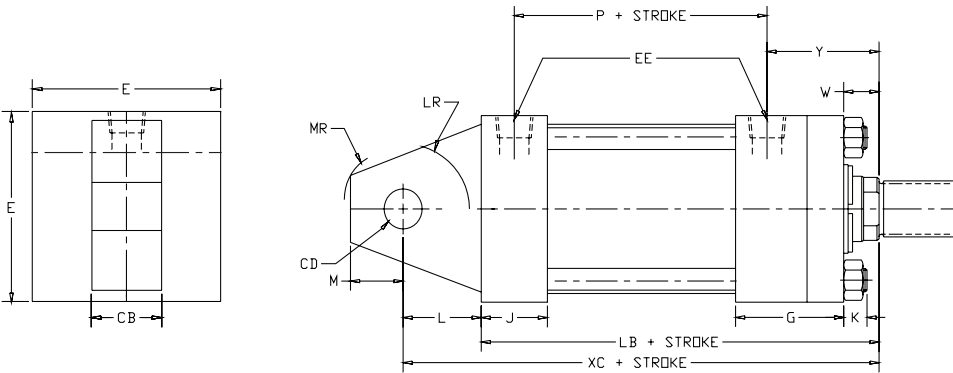
Rod Thread Table

Bore	Rod Φ MM	W
1½	0.63	For other values, please see chart on page 3
	1.00	
2	1.00	
	1.38	
2½	1.00	
	1.38	
	1.75	
3¼	1.38	
	1.75	
	2.00	
4	1.75	
	2.00	
	2.50	
5	2.00	
	2.50	
	3.00	
6	3.50	
	2.50	
	3.00	
	4.00	

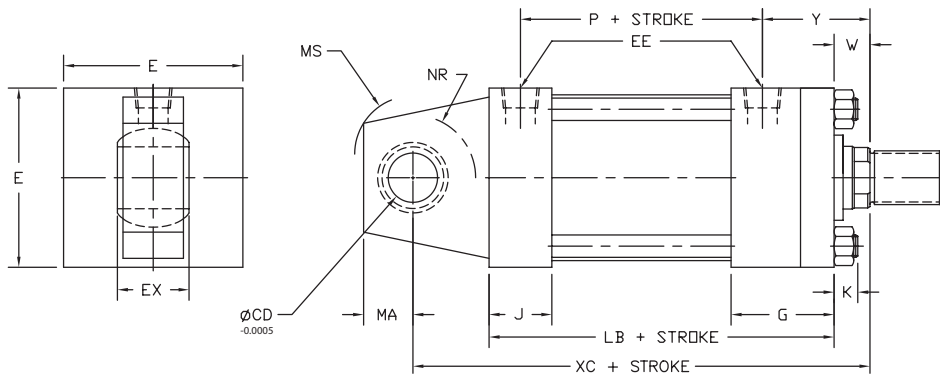
MP1



MP3



MP5



MP1, MP3

Dimensions (in)									
BORE	CB	CD	CW	L	LR	M	MR	LB	XC
1½	0.75	0.50	0.50	0.75	0.56	0.50	0.56	5.00	See Rod Thread Table
2	1.25	0.75	0.63	1.25	1.00	0.75	0.88	5.25	
2½	1.25	0.75	0.63	1.25	1.31	0.75	0.88	5.38	
3¼	1.50	1.00	0.75	1.50	1.25	1.00	1.19	6.25	
4	2.00	1.38	1.00	2.13	1.75	1.38	1.63	6.63	
5	2.50	1.75	1.25	2.25	2.06	1.75	2.13	7.13	
6	2.50	2.00	1.25	2.50	2.31	2.00	2.38	8.38	

MP5

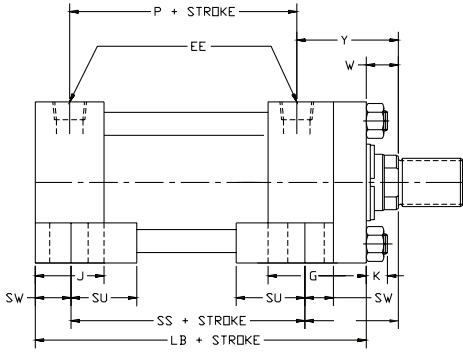
Dimensions (in)								
BORE	CD	EA	EX	MA	MS	NR	LB	XC
1½	0.50	2.50	0.44	0.75	0.94	0.63	5.00	See Rod Thread Table
2	0.75	3.00	0.66	1.00	1.38	1.00	5.25	
2½	0.75	3.50	0.66	1.00	1.38	1.00	5.38	
3¼	1.00	4.50	0.88	1.25	1.69	1.25	6.25	
4	1.38	5.00	1.19	1.88	2.44	1.63	6.63	
5	1.75	6.50	1.53	2.50	2.88	2.06	7.13	
6	2.00	7.50	1.75	2.50	3.31	2.38	8.38	

Rod Thread Table

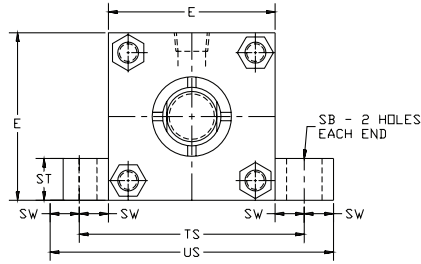
Bore	Rod Φ MM	XC
1½	0.63	6.38
	1.00	6.75
2	1.00	7.25
	1.38	7.50
2½	1.00	7.38
	1.38	7.63
	1.75	7.88
3¼	1.38	8.63
	1.75	8.88
	2.00	9.00
4	1.75	9.75
	2.00	9.88
	2.50	10.13
5	2.00	10.50
	2.50	10.75
	3.00	10.75
6	3.50	10.75
	2.50	12.13
	3.00	12.13
6	3.50	12.13
	4.00	12.13

For other values and diagram, please see chart on page 3

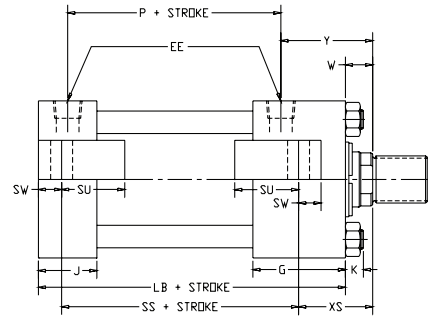
MS2



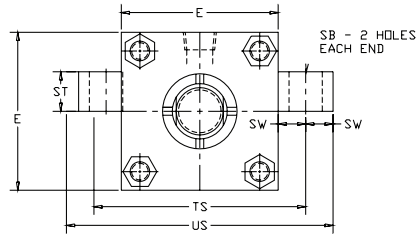
NOTE: Both the mounting lugs and the cylinder end caps must rest on a firm flat surface



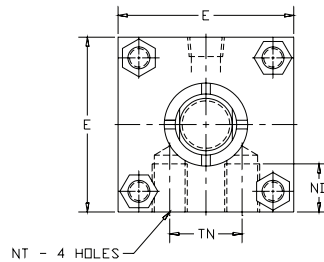
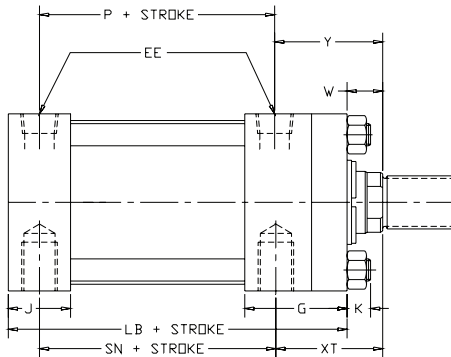
MS3



NOTE: Lugs must rest on a firm flat surface



MS4



MS2, MS3

Dimensions (in)								
BORE	SB	ST	SU	SW	TS	US	LB	SS
1½	0.44	0.50	0.94	0.38	3.25	4.00	5.00	3.88
2	0.56	0.75	1.25	0.50	4.00	5.00	5.25	3.63
2½	0.81	1.00	1.56	0.69	4.88	6.25	5.38	3.38
3¼	0.81	1.00	1.56	0.69	5.88	7.25	6.25	4.13
4	0.69	1.25	2.00	0.88	6.75	8.50	6.63	4.00
5	0.69	1.25	2.00	0.88	8.25	10.00	7.13	4.50
6	0.94	1.50	2.50	1.13	9.75	12.00	8.38	5.13

MS4

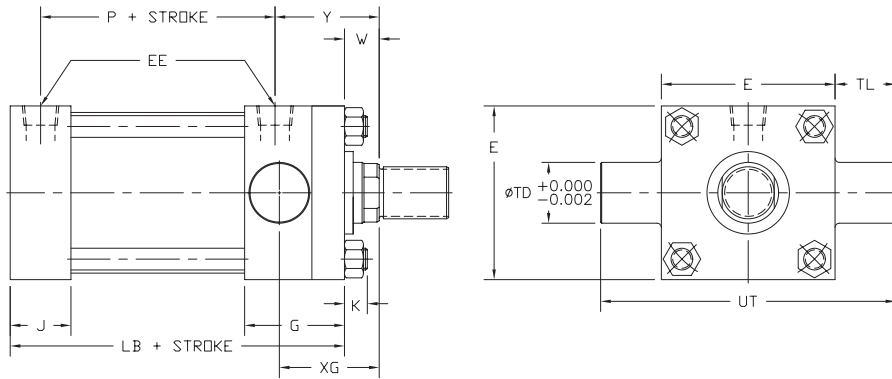
Dimensions (in)					
BORE	ND	NT	TN	SN	XT
1½	0.38	¾-16	0.75	2.88	See Rod Thread Table
2	0.44	½-13	0.94	2.88	
2½	0.50	⅝-11	1.31	3.00	
3¼	0.69	¾-10	1.50	3.50	
4	0.69	1-8	2.06	3.75	
5	1.00	1-8	2.94	4.25	
6	1.25	1¼-7	3.31	5.13	

Rod Thread Table

BORE	Rod Ø MM	XS	XT
1½	0.63	6.38	2.00
	1.00	6.75	2.38
2	1.00	7.25	2.38
	1.38	7.50	2.63
2½	1.00	7.38	2.38
	1.38	7.63	2.63
	1.75	7.88	2.88
3¼	1.38	8.63	2.75
	1.75	8.88	3.00
	2.00	9.00	3.13
4	1.75	9.75	3.00
	2.00	9.88	3.13
	2.50	10.13	3.38
5	2.00	10.50	3.13
	2.50	10.75	3.38
	3.00	10.75	3.38
6	2.50	12.13	3.50
	3.00	12.13	3.50
	3.50	12.13	3.50
	4.00	12.13	3.50

For other values and diagram, please see chart on page 3

MT1



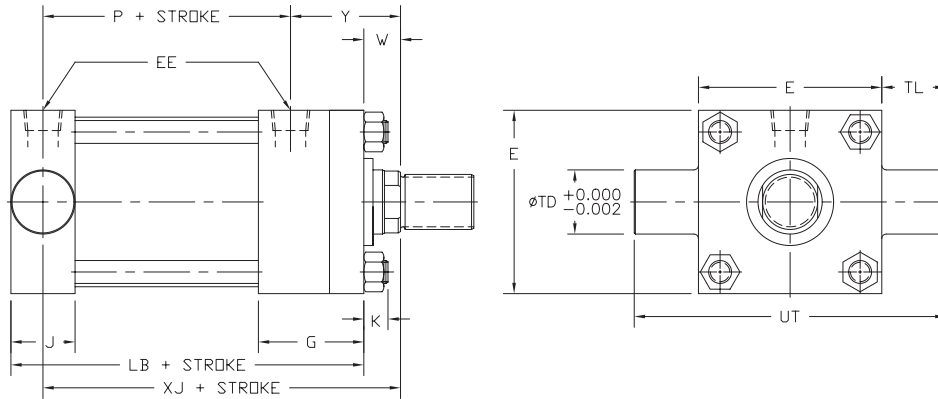
Dimensions (in)					
BORE	TD	TL	UT	XG	LB
1½	1.00	1.00	4.50	See Rod Thread Table	5.00
2	1.38	1.38	5.75		5.25
2½	1.38	1.38	6.25		5.38
3¼	1.75	1.75	8.00		6.25
4	1.75	1.75	8.50		6.63
5	1.75	1.75	10.00		7.13
6	2.00	2.00	11.50	8.38	

Rod Thread Table

Bore	Rod Φ MM	XG	XJ	XI Min*
1½	0.63	1.88	4.88	3.44
	1.00	2.25	5.25	3.69
2	1.00	2.25	5.25	3.94
	1.38	2.50	5.50	4.19
2½	1.00	2.25	5.38	3.94
	1.38	2.50	5.63	4.44
	1.75	2.75	5.88	4.81
3¼	1.38	2.63	6.25	4.69
	1.75	2.88	6.50	4.94
	2.00	3.00	6.63	5.06
4	1.75	2.88	6.75	4.94
	2.00	3.00	6.88	5.06
	2.50	3.25	7.13	5.31
5	2.00	3.00	7.38	5.06
	2.50	3.25	7.63	5.31
	3.00	3.25	7.63	5.31
	3.50	3.25	7.63	5.31
6	2.50	3.38	8.38	6.06
	3.00	3.38	8.38	6.00
	3.50	3.38	8.38	6.00
	4.00	3.38	8.38	6.00

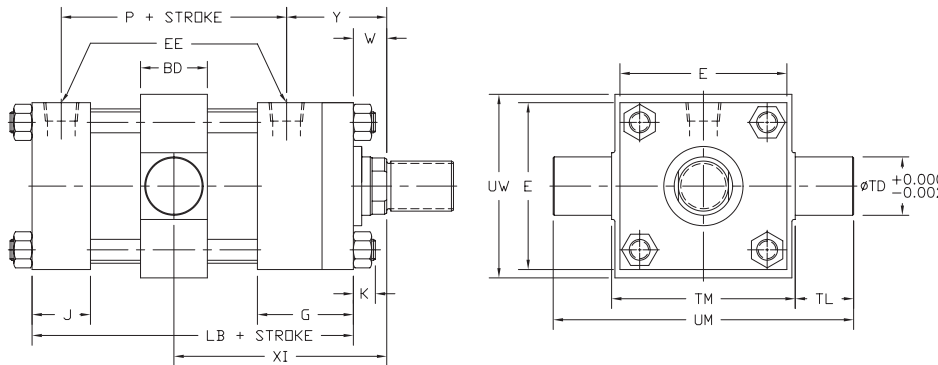
For other values and diagram, please see chart on page 3

MT2



Dimensions (in)				
BORE	TD	TL	UT	LB
1½	1.00	1.00	4.50	5.00
2	1.38	1.38	5.75	5.25
2½	1.38	1.38	6.25	5.38
3¼	1.75	1.75	8.00	6.25
4	1.75	1.75	8.50	6.63
5	1.75	1.75	10.00	7.13
6	2.00	2.00	11.50	8.38

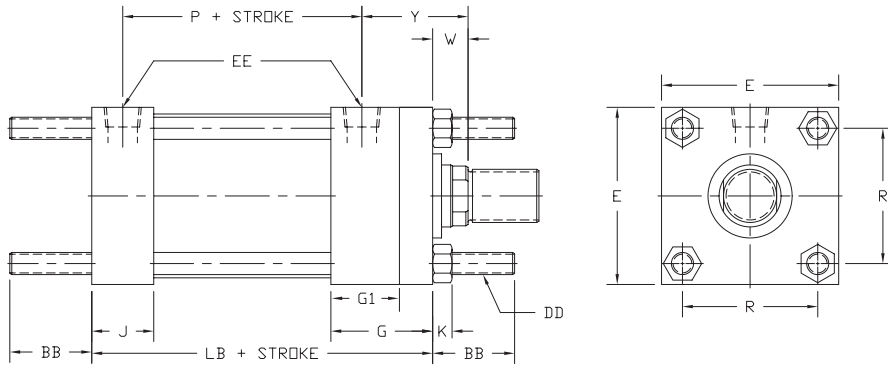
MT4



Dimensions (in)							
BORE	TD	TM	BD	UM	UW	MIN STR.	LB
1½	1.00	3.00	1.25	5.00	3.38	0.00	5.00
2	1.38	3.50	1.50	6.25	4.13	0.25	5.25
2½	1.38	4.00	1.50	6.75	4.63	0.13	5.38
3¼	1.75	5.00	2.00	8.50	5.81	0.38	6.25
4	1.75	5.50	2.00	9.00	6.38	0.13	6.63
5	1.75	7.00	2.00	10.50	7.75	0.00	7.13
6	2.00	8.50	3.00	12.50	10.38	0.25	8.38

* Minimum values, to be specified by customer

MX1, MX2, MX3



Dimensions (in)				
BORE	BB	DD	R	LB
1½	1.38	¾-24	1.63	5.00
2	1.81	½-20	2.05	5.25
2½	1.81	½-20	2.55	5.38
3¼	2.31	5/8-18	3.25	6.25
4	2.31	5/8-18	3.82	6.63
5	3.19	7/8-14	4.95	7.13
6	3.63	1-14	5.73	8.38
7	4.25	1¼-12	6.58	9.50
8	4.50	1¼-12	7.50	10.50

Rod Thread Table

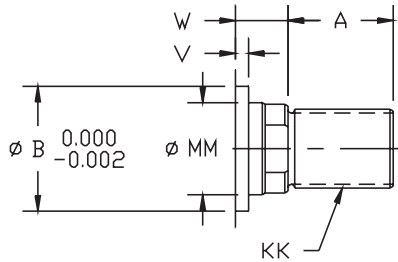
Bore	Rod Ø MM
1½	0.63
	1.00
2	1.00
	1.38
2½	1.00
	1.38
	1.75
3¼	1.38
	1.75
	2.00
4	1.75
	2.00
	2.50
5	2.00
	2.50
	3.00
6	3.50
	2.50
	3.00
	3.50
8	4.00
	4.00

For other values and diagram, please see chart on page 3

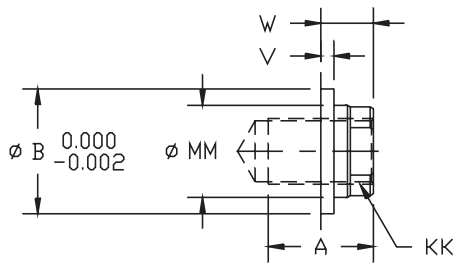
Rod Thread Size

7" - 20" Bore

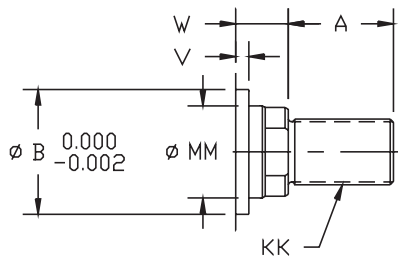
INTERMEDIATE MALE (N2)



SMALL FEMALE (N4)



SMALL MALE (N1)



Dimensions (in)									
Bore	Rod Ø MM	Thread (KK)		A	B	V	WF	W	Y
		N2	N1 or N4						
7	3.00	2¾-12	2¼-12	3.50	3.75	0.25	2.25	1.25	3.75
	3.50	3¼-12	2½-12	3.50	4.25	0.25	2.25	1.25	3.75
	4.00	3¾-12	3-12	4.00	4.75	0.25	2.25	1.25	3.75
	4.50	4¼-12	3¼-12	4.50	5.25	0.25	2.25	1.25	3.75
	5.00	4¾-12	3½-12	5.00	5.75	0.25	2.25	1.25	3.75
8	3.50	3¼-12	2½-12	3.50	4.25	0.25	2.25	1.25	3.88
	4.00	3¾-12	3-12	4.00	4.75	0.25	2.25	1.25	3.88
	4.50	4¼-12	3¼-12	4.50	5.25	0.25	2.25	1.25	3.88
	5.00	4¾-12	3½-12	5.00	5.75	0.25	2.25	1.25	3.88
	5.50	5¼-12	4-12	5.50	6.25	0.25	2.25	1.25	3.88

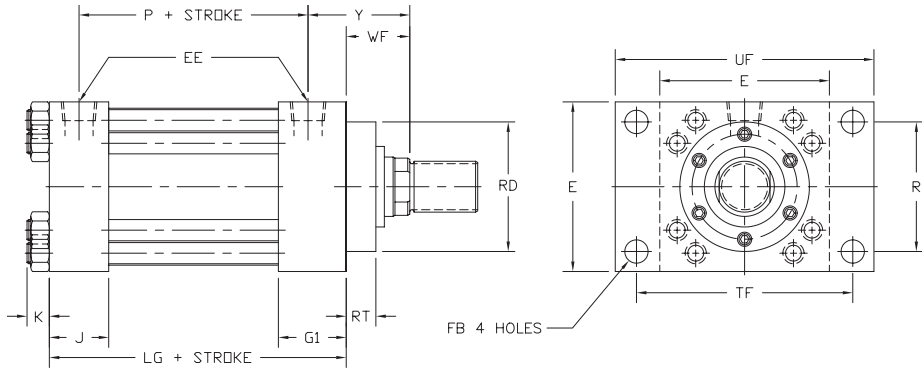
Dimensions (in)								
Bore	Rod Ø MM	Thread (KK)	A	B	V	WF	W	Y
10	4.50	3¼-12	4.50	5.25	0.25	2.94	1.50	4.75
	5.00	3½-12	5.00	5.75	0.25	3.19	1.75	5.00
	5.50	4-12	5.50	6.25	0.25	3.19	1.75	5.00
	7.00	5-12	7.00	8.00	0.38	3.50	2.06	5.31
12	5.50	4-12	5.50	6.25	0.25	3.19	1.50	5.38
	7.00	5-12	7.00	8.00	0.38	3.50	1.81	5.69
	8.00	5¾-12	8.00	9.00	0.38	4.00	2.31	6.19
14	7.00	5-12	7.00	8.00	0.38	3.50	1.56	5.88
	8.00	5¾-12	8.00	9.00	0.38	4.00	2.06	6.38
	10.00	7¼-12	10.00	11.00	0.38	4.50	2.56	6.88
16	8.00	5¾-12	8.00	9.00	0.38	4.00	2.06	7.00
	9.00	6½-12	9.00	10.00	0.38	4.25	2.31	7.25
	10.00	7¼-12	10.00	11.00	0.38	4.50	2.56	7.50
18	9.00	6½-12	9.00	10.00	0.38	4.25	2.31	7.25
	10.00	7¼-12	10.00	11.00	0.38	4.50	2.56	7.50
20	10.00	7¼-12	10.00	11.00	0.38	4.50	2.56	7.50

Mounting Style NFFA

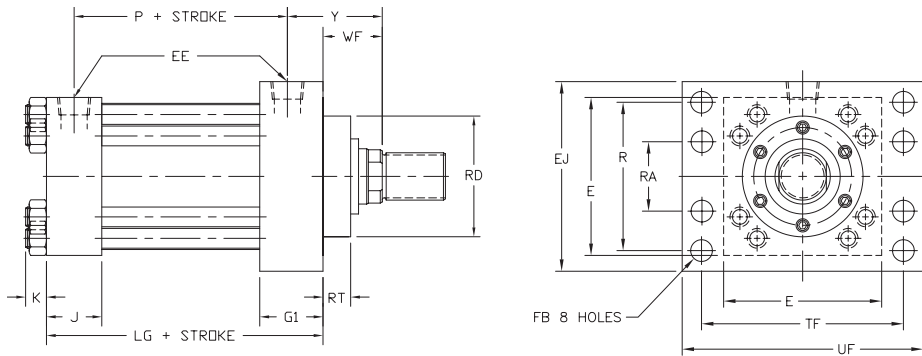
7" to 20" Bore

ME5

10"-14" Bore Only

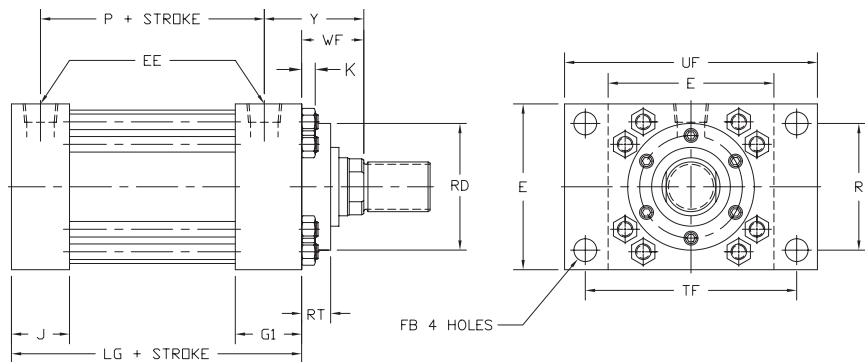


16"-20" Bore Only

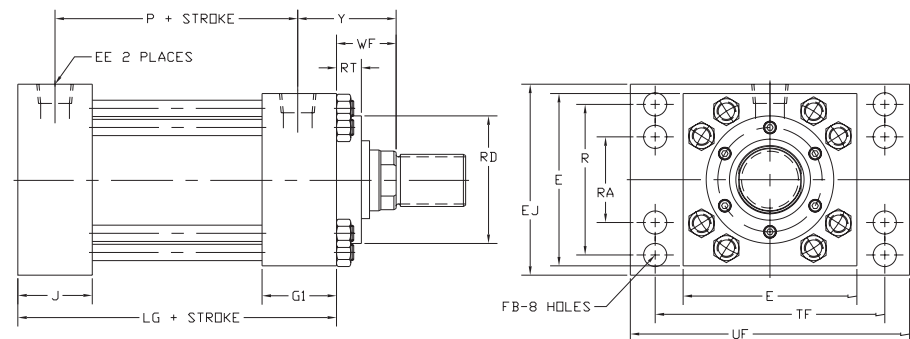


ME6

10"-14" Bore Only



16"-20" Bore Only



Actuation Solutions and Systems for the World's Most Challenging Environments

Rod Thread Table

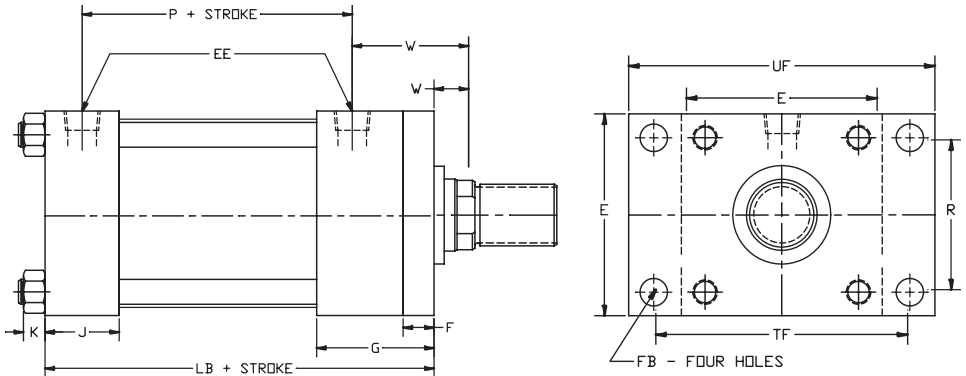
Dimensions (in)									
BORE	EJ	F	FB	RA	RT	R	TF	UF	LG
10	N/A	1.44	1.81	N/A	1.44	9.89	15.88	19.00	12.13
12	N/A	1.69	2.06	N/A	1.69	11.75	18.50	22.00	14.50
14	N/A	1.94	2.31	N/A	1.94	12.90	21.00	25.00	15.63
16	20	1.94	1.81	8.00	1.94	15.50	21.00	24.50	18.13
18	23	1.94	2.06	7.25	1.94	18.00	24.25	28.25	21.13
20	25	1.94	2.06	8.00	1.94	20.00	26.50	30.50	23.63

*For Bore sizes 7" and 8" please see chart on page 6

BORE	Rod Φ MM	RD
7	3.00	5.25
	3.50	5.75
	4.00	6.50
	4.50	7.00
8	5.00	7.25
	3.50	5.75
	4.00	6.50
	4.50	7.00
10	5.00	7.25
	5.50	8.25
	4.50	8.25
	5.00	8.88
12	5.50	9.38
	7.00	10.50
	8.00	12.50
14	7.00	10.50
	8.00	12.50
	10.00	14.50
16	8.00	12.50
	9.00	13.50
	10.00	14.50
18	9.00	13.50
	10.00	14.50
20	10.00	14.50

For other values and diagram, please see chart on page 12

MF1



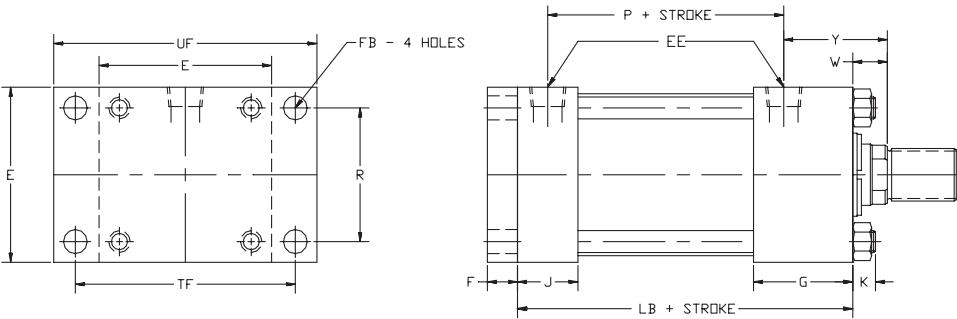
Rod Thread Table

Dimensions (in)						
BORE	F	FB	R	TF	UF	LB
7	1	1.19	6.58	10.63	12.63	9.50
8	1	1.31	7.50	11.81	14.00	10.50

Bore	Rod Φ MM
7	3.00
	3.50
	4.00
	4.50
8	5.00
	3.50
	4.00
	4.50
	5.00
	5.50

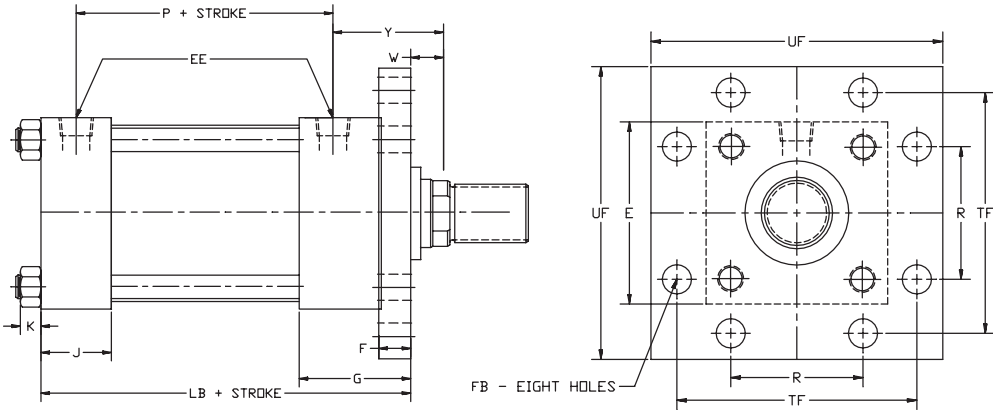
For other values and diagram, please see chart on page 12

MF2

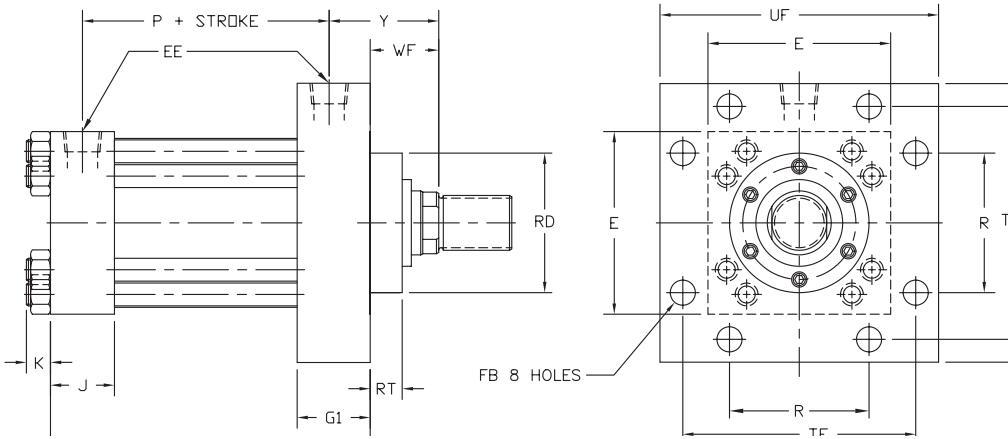


MF5

7"-8" Bore Only

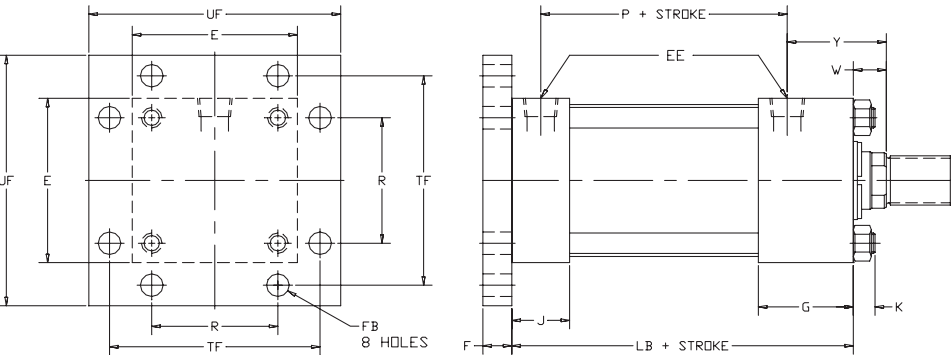


10"-20" Bore Only



MF6

7"-8" Bore Only



Rod Thread Table

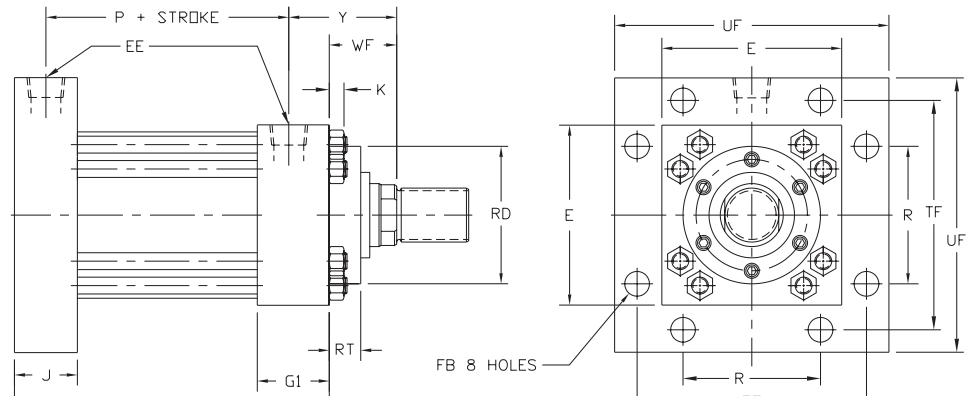
Dimensions (in)						
BORE	F	FB	R	TF	UF	LB
7	1	1.19	6.58	10.63	12.63	9.50
8	1	1.31	7.50	11.81	14	10.50

Dimensions (in)						
BORE	F	FB	R	TF	UF	LG
10	1.44	1.81	9.89	14.13	16.63	12.13
12	1.69	2.06	11.75	16.79	19.75	14.50
14	1.94	2.31	12.90	18.43	21.75	15.63
16	1.94	1.82	15.28	21.03	24.50	18.13
18	1.94	2.06	16.45	22.65	26.50	21.13
20	1.94	2.06	18.07	24.78	29.00	23.63

Bore	Rod Ø MM
7	3.00
	3.50
	4.00
	4.50
8	5.00
	3.50
	4.00
10	4.50
	5.00
	5.50
	7.00
12	4.50
	5.00
	5.50
14	7.00
	8.00
	10.00
	8.00
16	9.00
	10.00
	8.00
18	9.00
	10.00
20	10.00

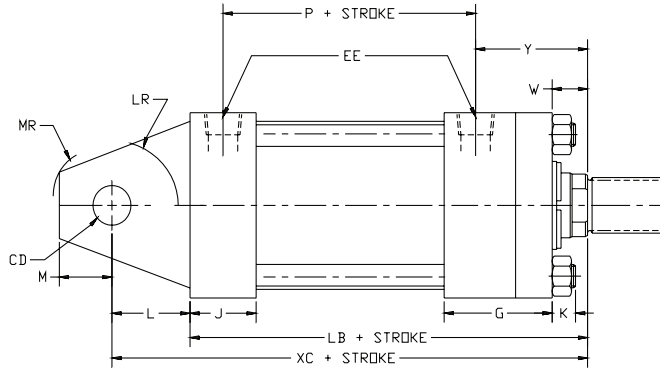
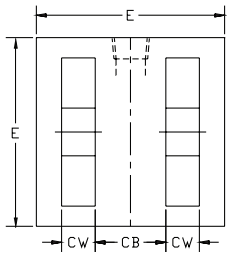
For other values and diagram, please see chart on page 12

10"-20" Bore Only

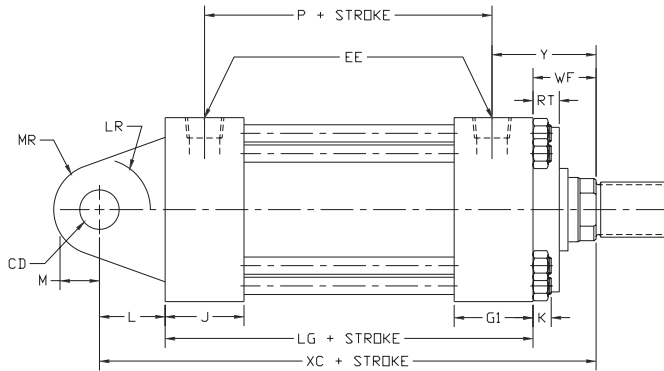
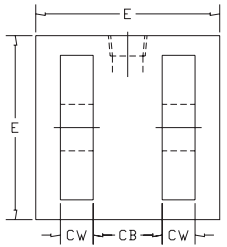


MP1

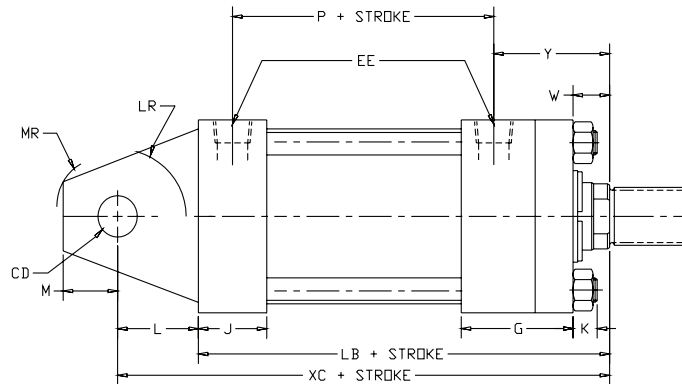
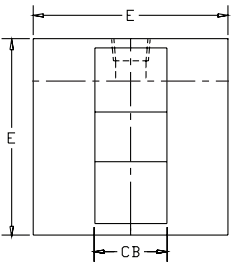
7"-8" Bore Only



10"-20" Bore Only



MP3



MP1

Dimensions (in)								
BORE	CB	CD	CW	L	LM	M	MR	LB
7	3.00	2.50	1.50	3.00	2.75	2.50	2.88	9.50
8	3.00	3.00	1.50	3.25	3.25	2.75	3.13	10.50

Dimensions (in)							
BORE	CB	CD	CW	L	LR	MR	LG
10	4.00	3.50	2.00	4.00	3.38	3.50	12.13
12	4.50	4.00	2.25	4.50	3.88	4.00	14.50
14	6.00	5.00	3.00	5.75	4.19	5.00	15.63
16	7.00	6.00	3.50	7.00	6.25	6.00	18.13
18	8.00	6.50	4.00	7.63	6.75	6.50	21.13
20	9.00	7.50	4.50	8.75	7.75	7.50	23.63

MP3

Dimensions (in)							
BORE	CB	CD	L	LM	M	MR	LB
7	3.00	2.50	3.00	2.75	2.50	2.88	9.50
8	3.00	3.00	3.25	3.25	2.75	3.13	10.50

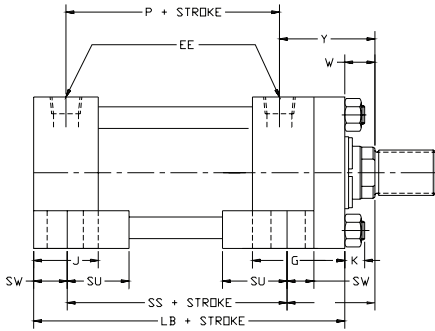
Rod Thread Table

Bore	Rod Φ MM	WF
7	3.00	2.25
	3.50	2.25
	4.00	2.25
	4.50	2.25
8	5.00	2.25
	3.50	2.25
	4.00	2.25
	4.50	2.25
10	5.00	2.25
	4.50	2.25
	5.50	2.25
	4.50	2.94
12	5.00	3.19
	5.50	3.19
	7.00	3.50
	7.00	4.00
14	8.00	4.00
	7.00	3.50
	10.00	4.50
16	8.00	4.00
	9.00	4.25
	10.00	4.50
18	9.00	4.25
	10.00	4.50
20	10.00	4.50

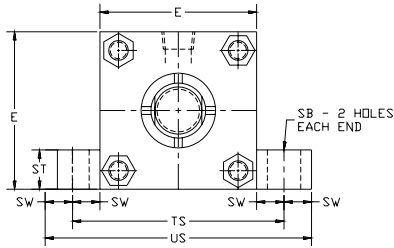
For other values and diagram, please see chart on page 12

MS2

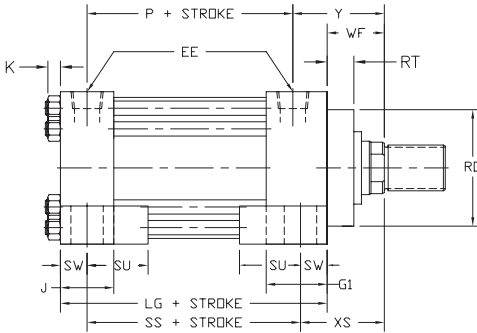
7"-8" Bore Only



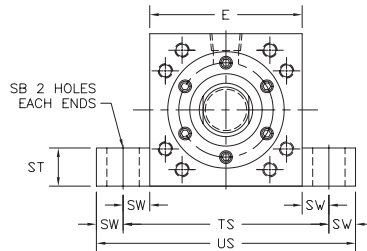
NOTE: Both the mounting lugs and the cylinder end caps must rest on a firm flat surface



10"-14" Bore Only

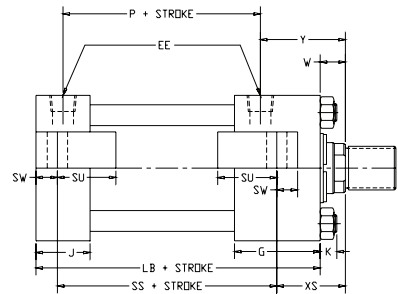


NOTE: Both the mounting lugs and the cylinder end caps must rest on a firm flat surface

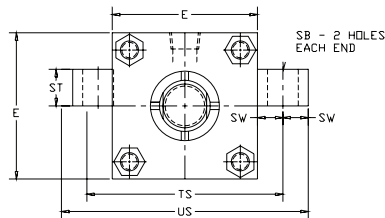


MS3

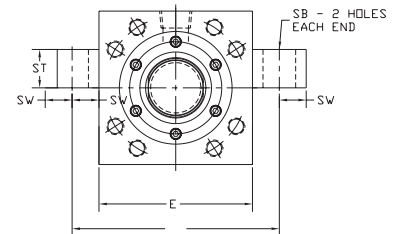
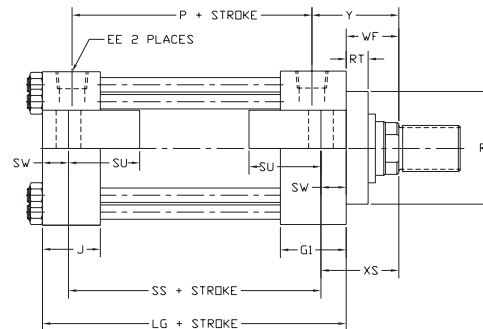
7"-8" Bore Only



NOTE: Lugs must rest on a firm flat surface



10"-14" Bore Only



NOTE: Both lugs must rest on a firm flat surface

Rod Thread Table

Dimensions (in)								
BORE	SB	ST	SU	SW	TS	US	LB	SS
7	1.56	1.75	2.88	1.38	11.25	14.00	9.50	5.75
8	1.56	1.75	2.88	1.38	12.25	15.00	10.50	6.75

Dimensions (in)								
BORE	F	SB	ST	SU	SW	TS	LG	SS
10	1.44	1.56	2.25	3.50	1.63	15.88	12.13	8.88
12	1.69	1.56	3.00	4.25	2.00	18.88	14.50	10.50
14	1.81	2.31	4.00	4.75	2.25	21.63	15.63	11.13

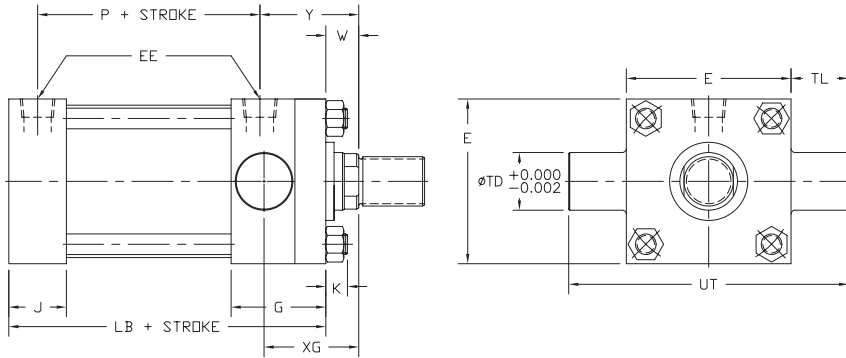
* For larger bore, consult factory

BORE	ROD Ø MM	WF
7	3.00	2.25
	3.50	2.25
	4.00	2.25
	4.50	2.25
	5.00	2.25
8	3.50	2.25
	4.00	2.25
	4.50	2.25
	5.00	2.25
10	4.50	2.94
	5.00	3.19
	5.50	3.19
12	7.00	3.50
	8.00	4.00
	10.00	4.50
14	8.00	4.00
	10.00	4.50
16	9.00	4.25
	10.00	4.50
18	9.00	4.25
	10.00	4.50
20	10.00	4.50

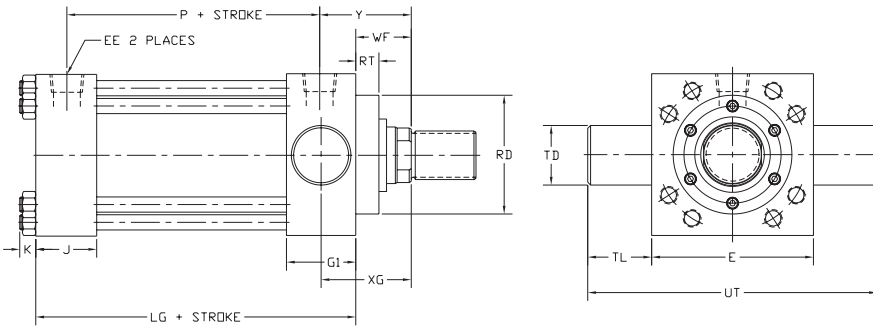
For other values and diagram, please see chart on page 12

MT1

7"-8" Bore Only



10"-20" Bore Only



Dimensions (in)				
BORE	TD	TL	UT	LB
7	2.50	2.50	13.50	9.50
8	3.00	3.00	15.50	10.50

Dimensions (in)					
BORE	F	TD	TL	UT	LG
10	1.44	3.50	3.50	19.63	12.13
12	1.69	4.00	4.00	22.88	14.50
14	1.94	4.50	4.50	26.13	15.63

* For larger bore, consult factory

Rod Thread Table

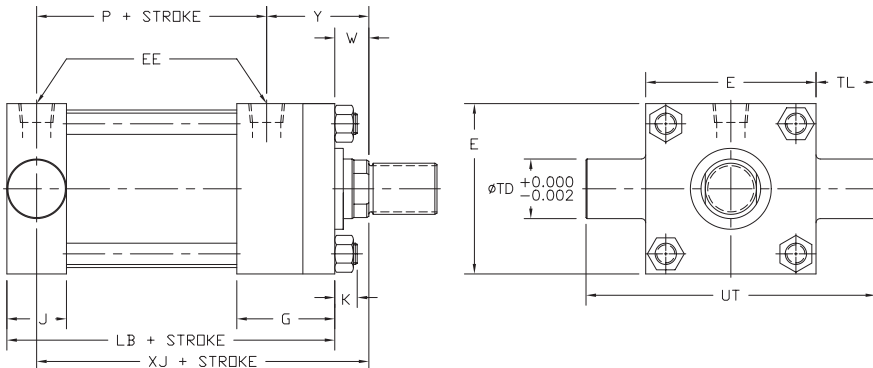
Bore	Rod Φ MM	XG	XJ
7	3.00	3.63	9.38
	3.50	3.63	9.38
	4.00	3.63	9.38
	4.50	3.63	9.38
8	3.50	3.75	10.25
	4.00	3.75	10.25
	4.50	3.75	10.25
	5.00	3.75	10.25
10	4.50	4.75	13.38
	5.00	5.00	13.63
	5.50	5.00	13.63
	7.00	5.31	13.94
12	5.50	5.38	15.50
	7.00	5.69	15.81
	8.00	6.19	16.31
14	7.00	5.94	16.69
	8.00	6.44	17.19
	10.00	5.94	17.69

For other values and diagram, please see chart on page 12

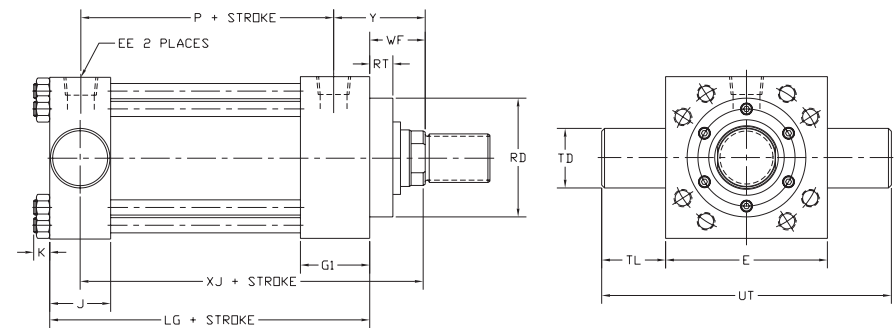
*Minimum value shown, please specify

MT2

7"-8" Bore Only

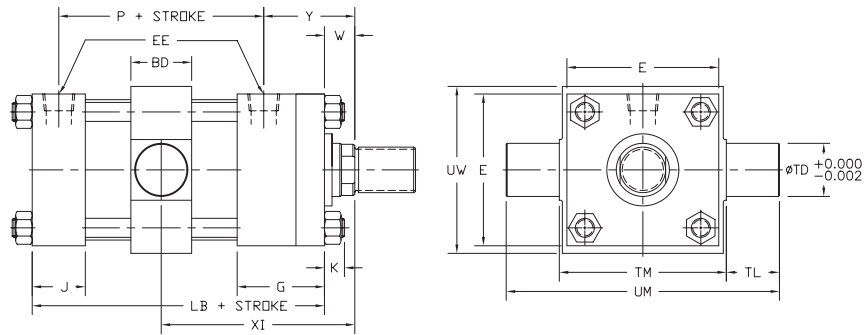


10"-20" Bore Only

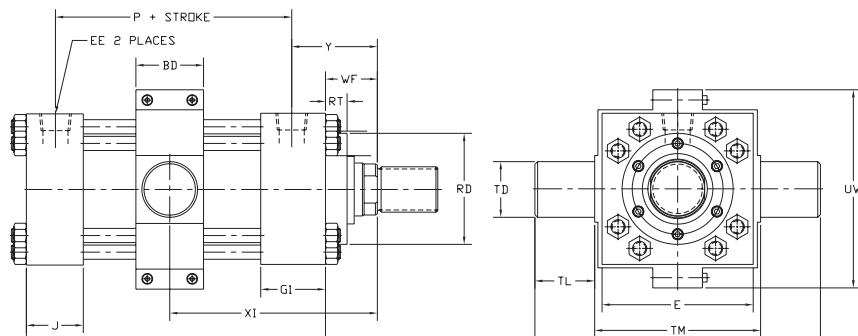


MT4

7"-8" Bore Only

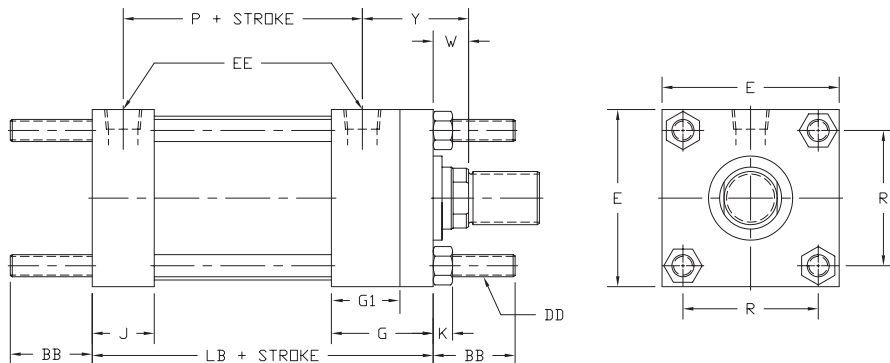


10"-14" Bore Only

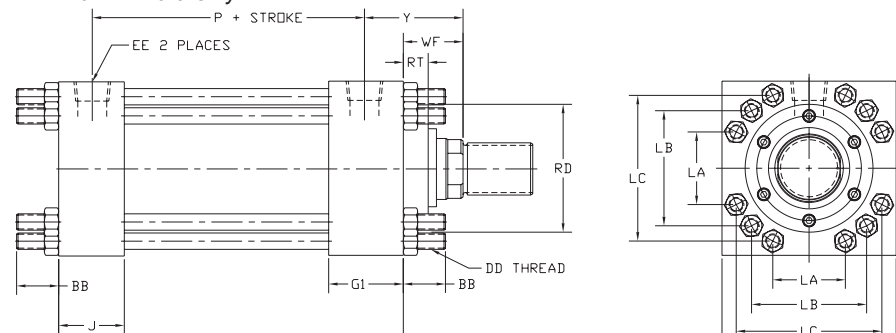


MX1, MX2, MX3

7"-8" Bore Only



10"-14" Bore Only



MT4

Dimensions (in)						
BORE	TD	TL	TM	UM	UW	LB
7	2.50	2.50	9.75	14.75	9.75	9.50
8	3.00	3.00	11.00	17.00	11.00	10.50

Dimensions (in)								
BORE	F	BD	TD	TL	TM	UM	UW	LG
10	1.44	4.50	3.50	3.50	14.00	21.00	17.50	12.13
12	1.69	5.50	4.00	4.00	16.50	21.50	20.75	14.50
14	1.94	5.50	4.50	4.50	19.50	28.50	24.75	15.63

* For larger bore, consult factory

MX1, MX2, MX3

Dimensions (in)				
BORE	BB	DD	R	LB
7	4.25	1 1/8-12	6.58	9.50
8	4.50	1 1/4-12	7.50	10.50

Dimensions (in)						
BORE	BB	DD	LA	LB	LC	LG
10	4.13	1 1/8-12	-*	7.55	10.58	12.13
12	4.50	1 1/4-12	-*	9.11	12.54	14.50
14	4.50	1 1/4-12	8.82	12.28	14.97	15.63

* 10 and 12 bore have 8 tie rods, 14 bore have 12 tie rods
** For larger bore, consult factory

Rod Thread Table

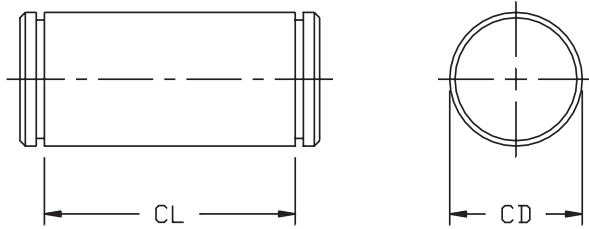
Bore	Rod ϕ MM	XI*
7	3.00	6.56
	3.50	6.56
	4.00	6.56
	4.50	6.56
	5.00	6.56
8	3.50	7.06
	4.00	7.06
	4.50	7.06
	5.00	7.06
	5.50	7.06
10	4.50	9.06
	5.00	9.31
	5.50	9.31
	7.00	9.63
12	5.50	10.63
	7.00	10.94
	8.00	11.50
14	7.00	11.88
	8.00	11.94
	10.00	12.44

*Minimum value shown, please specify

For other values and diagram, please see chart on page 3

Mounting Accessories

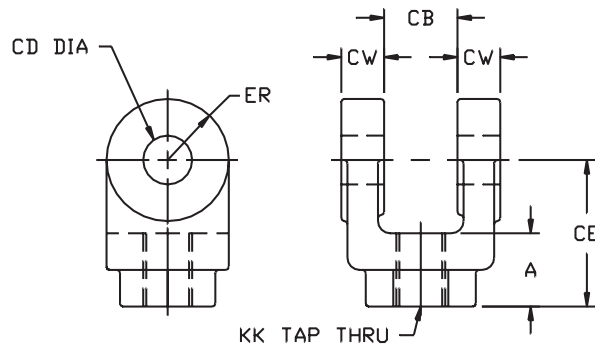
Pivot Pins



COMES WITH TWO RETAINING RINGS

Dimensions (in)		
Part #	CD	CL
81-001	0.50	1.88
81-002	0.75	2.63
81-003	1.00	3.13
81-004	1.38	4.19
81-005	1.75	5.19
81-006	2.00	5.19
81-007	2.50	6.19
81-008	3.00	6.25
81-009	3.50	8.13
81-010	4.00	9.13

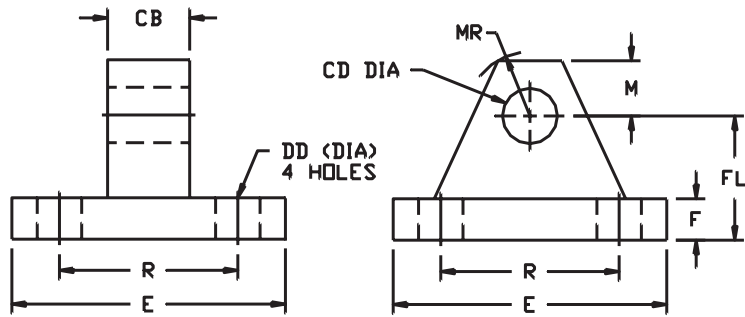
Rod Clevises



Dimensions (in)							
Part #	KK	A	CB	CD	CE	CW	ER
82-001	7/16-20	0.75	0.75	0.50	1.50	0.50	0.50
82-002	1/2-20	0.75	0.75	0.50	1.50	0.50	0.50
82-003	3/4-16	1.13	1.25	0.75	2.13	0.63	0.75
82-004	3/4-16	1.13	1.25	0.75	2.38	0.63	0.75
82-005	7/8-14	1.63	1.50	1.00	2.94	0.75	1.00
82-006	1-14	1.63	1.50	1.00	2.94	0.75	1.00
82-007	1-14	1.63	1.50	1.00	3.13	0.75	1.00
82-008	1 1/4-12	2.00	2.00	1.38	3.75	1.00	1.38
82-009	1 1/4-12	2.00	2.00	1.38	4.13	1.00	1.38
82-010	1 1/2-12	2.25	2.50	1.75	4.50	1.25	1.75
82-011	1 3/4-12	3.00	2.50	2.00	5.50	1.25	2.00
82-012	1 7/8-12	3.00	2.50	2.00	5.50	1.25	2.00
82-013	2 1/4-12	3.50	3.00	2.50	6.50	1.50	2.50
82-014	2 1/2-12	3.50	3.00	3.00	6.75	1.50	2.75
82-015	2 3/4-12	3.50	3.00	3.00	6.75	1.50	2.75
82-016	3 1/4-12	3.50	4.00	3.50	7.75	2.00	3.50
82-017	3 1/4-12	4.50	4.00	3.50	8.50	2.00	3.50
82-018	3 1/2-12	5.50	4.50	4.00	10.00	2.25	4.00
82-019	4-12	5.50	4.50	4.00	10.00	2.25	4.00

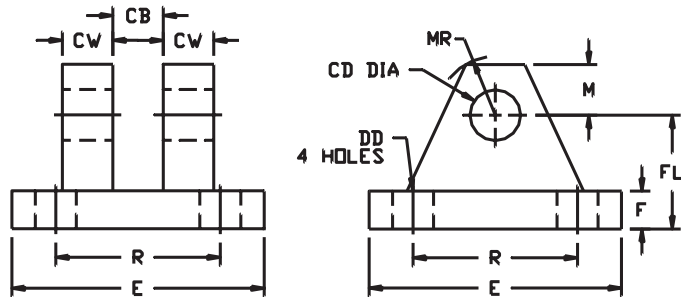
Mounting Accessories

Eye Brackets



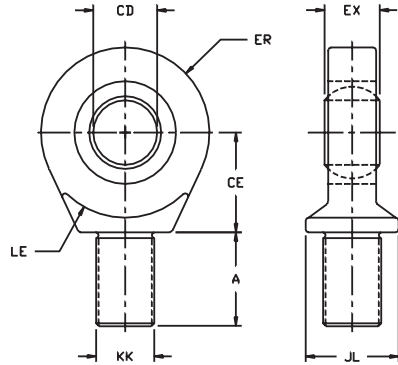
Dimensions (in)									
Part #	CD	CB	DD	E	F	FL	M	MR	R
85-001	0.50	0.75	0.41	2.50	0.38	1.13	0.50	0.56	1.63
85-002	0.75	1.25	0.53	3.50	0.63	1.88	0.75	0.88	2.56
85-003	1.00	1.50	0.66	4.50	0.88	2.38	1.00	1.25	3.25
85-004	1.38	2.00	0.66	5.00	0.88	3.00	1.38	1.63	3.44
85-005	1.75	2.50	0.91	6.50	1.13	3.38	1.75	2.13	4.94
85-006	2.00	2.50	1.06	7.50	1.50	4.00	2.00	2.44	5.75
85-007	2.00	2.50	1.06	7.50	1.50	4.00	2.00	2.44	5.75
85-008	2.50	3.00	1.19	8.50	1.75	4.75	2.50	3.00	6.59
85-009	3.00	3.00	1.31	9.50	2.00	5.25	3.00	3.25	7.50
85-010	3.50	4.00	1.81	12.63	1.69	5.69	3.50	4.13	9.63
85-011	4.00	4.50	2.06	14.88	1.94	6.44	4.00	5.25	11.50

Clevis Brackets



Dimensions (in)										
Part #	CD	R	CB	CW	DD	E	F	FL	M	MR
86P-001	0.50	1.63	0.75	0.50	3/8-24	2.50	0.38	1.13	0.50	0.56
86P-002	0.75	2.56	1.25	0.63	1/2-20	3.50	0.63	1.88	0.75	1.06
86P-003	1.00	3.25	1.50	0.75	5/8-18	4.50	0.75	2.25	1.00	1.13
86P-004	1.38	3.44	2.00	1.00	5/8-18	5.00	0.88	3.00	1.38	1.75
86P-005	1.75	4.94	2.50	1.25	7/8-14	6.50	0.88	3.13	1.75	1.88
86P-006	2.00	5.75	2.50	1.25	1-14	7.50	1.00	3.50	2	2.13
86P-007	2.50	6.59	3.00	1.50	1 1/8-12	8.50	1.00	4.00	2.50	2.50
86P-008	3.00	7.50	3.00	1.50	1 1/4-12	9.50	1.00	4.25	2.75	2.75
86P-009	3.50	9.63	4.00	2.00	1 3/4-12	12.63	1.69	5.69	3.50	3.50
86P-010	4.00	11.50	4.50	2.25	2-12	14.88	1.69	6.44	4.00	4.00

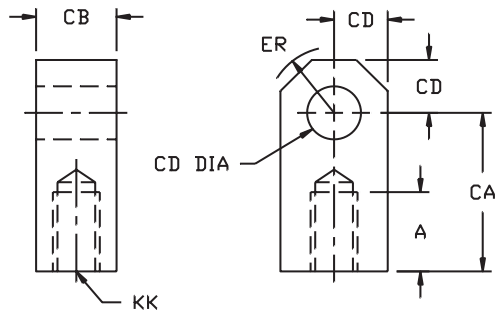
Spherical Rod Eye



Dimensions (in)								
Part #	KK	A	CD	CE	ER	EX	JL	LE
83SP-001	7/16-20	0.69	0.50	0.88	0.88	0.44	0.88	0.75
83SP-002	3/4-16	1.00	0.75	1.25	1.25	0.66	1.31	1.06
83SP-003	1-14	1.50	1.00	1.88	1.38	0.88	1.50	1.44
83SP-004	1 1/4-12	2.00	1.38	2.13	1.44	1.19	2.00	1.88
83SP-005	1 1/2-12	2.13	1.75	2.50	2.19	1.53	2.25	2.13
83SP-006	1 7/8-12	2.88	2.00	2.75	2.63	1.75	2.75	2.50

* For larger dimensions consult factory

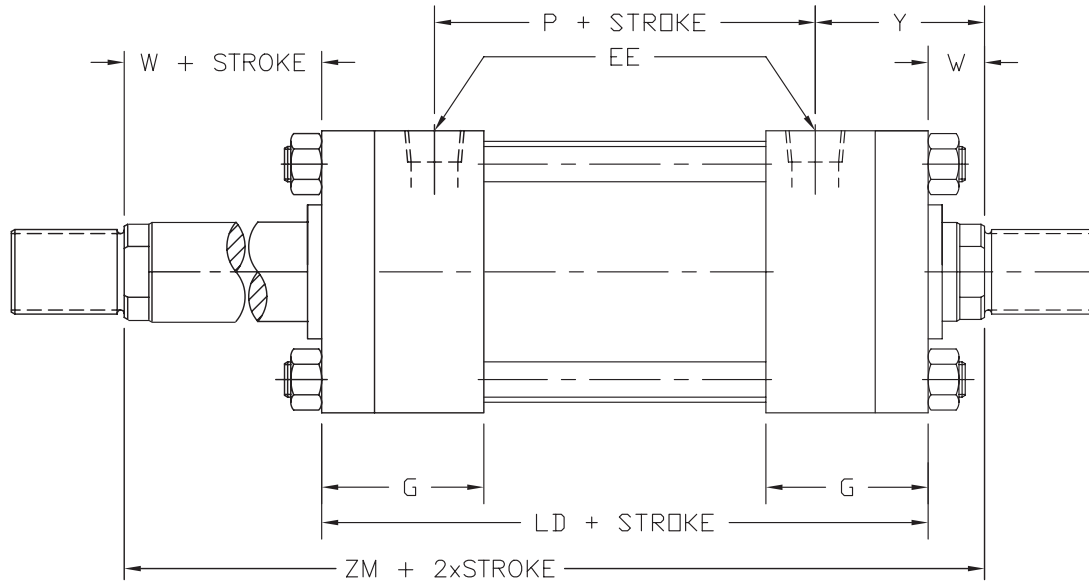
Rod Eyes



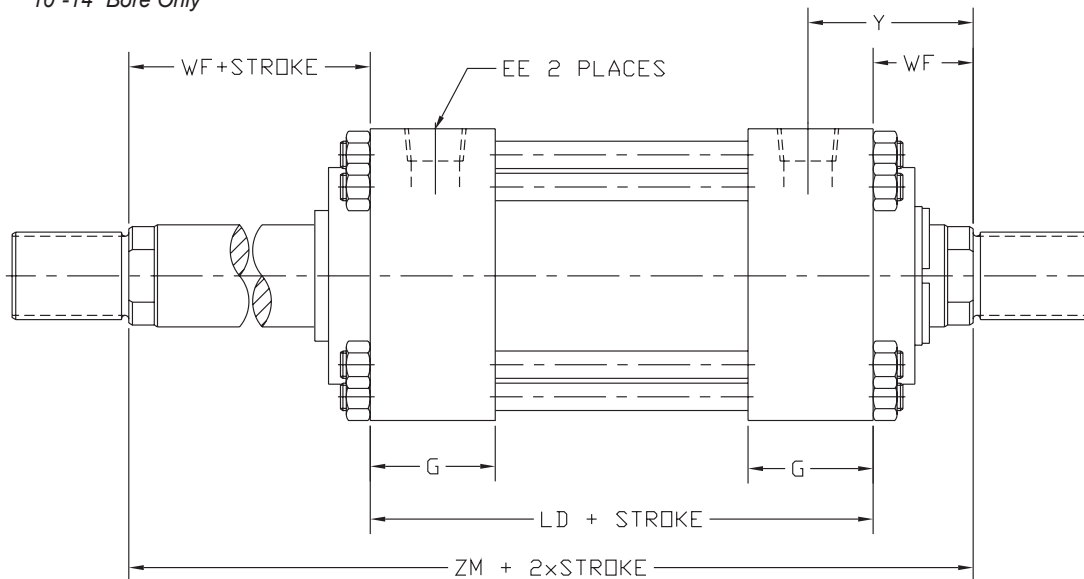
Dimensions (in)						
Part #	KK	A	CB	CD	CA	ER
83-001	7/16-20	0.75	0.75	0.50	1.50	0.63
83-002	1/2-20	0.75	0.75	0.50	1.50	0.63
83-003	3/4-16	1.13	1.25	0.75	2.06	0.88
83-004	7/8-14	1.13	1.50	1.00	2.38	1.44
83-005	1-14	1.63	1.50	1.00	2.44	1.19
83-006	1 1/4-12	2.00	2.00	1.38	3.44	1.56
83-007	1 1/2-12	2.25	2.50	1.75	4.00	2.00
83-008	1 3/4-12	2.25	2.50	2.00	4.38	2.88
83-009	1 7/8-12	3.00	2.50	2.00	5.00	2.50
83-010	2 1/4-12	3.50	3.00	2.5	.631	2.81
83-011	2 1/2-12	3.50	3.00	3.00	6.13	3.25
83-012	2 3/4-12	3.63	3.50	3.00	6.50	3.25
83-013	3 1/4-12	4.50	4.00	3.50	7.63	3.88
83-014	3 1/2-12	5.00	4.00	3.50	7.63	3.88
83-015	4-12	5.50	4.50	4.00	9.13	4.44
83-016	4 1/2-12	5.75	5.00	4.00	9.13	4.44

Double Ended Cylinder

1½"-8" Bore Only



10"-14" Bore Only

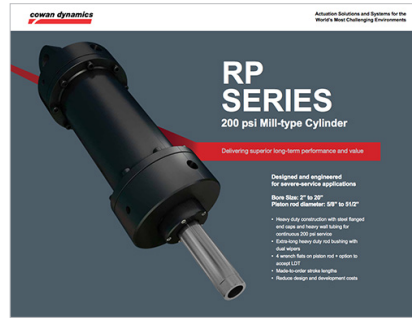


Dimensions (in)			
Bore	Rod Ø MM	LD	ZM
1½	0.63	5.63	6.88
2	1.00	6.13	7.63
2½	1.00	6.25	7.75
3¼	1.38	7.25	9.00
4	1.75	7.75	9.75
5	2.00	8.25	10.50
6	2.50	9.38	11.88
7	3.00	8.50	13.00
8	3.50	9.50	14.00
10	4.50	12.13	18.00
12	5.50	14.50	20.88
14	7.00	15.63	22.63
16	8.00	18.13	26.13
18	9.00	21.13	29.63
20	10.00	23.63	32.63

*All dimensions apply to the smallest rod size only. For alternate rod sizes, determine all envelope dimensions (within LD dimensions) as described above and then use appropriate rod end dimensions for appropriate rod size from single rod cylinder.

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