INDEX AND SPECIFICATIONS

3000PSI Series

NOTE: Prior to selecting a cylinder, take a few moments to read through this catalogue. It is highly recommended that particular attention be given to the pages concerning Fluids and Temperature, Pressure and Mounting Information. Be sure to read the notes appearing on the Mounting Dimension page regarding any limitations for the mounting style selected.

Index

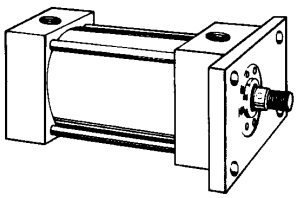
Standard Specifications

- Heavy Duty Service to JIC Specifications
- Envelope & Mounting dimensions to ANSI Standard B93-15-1971
- Dimension codes to NFPA (National Fluid Power Association USA)
- Construction to square end tie rod design
- Bores sizes $1^{1}/_{8}$"–14"
- Rod diameters $^{5}/_{8}$"–12"
- Standard pressures to 3000 psi (210 bar) 5000 psi non shock
- Standard fluids – Hydraulic Oil
- Choice of 18 mounting styles
- Strokes in any practical length
- Rod ends – choice of 4 standard specials to order
- Cushions optional at either or both ends of stroke
- Temperatures – 55°F to +200°F

MOUNTING STYLES

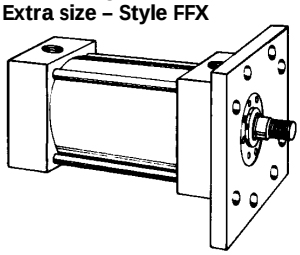
Available mountings and where to find them

Front Flange Mount – Style FF



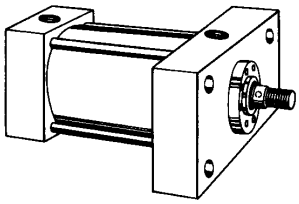
(NFPA style MF1) page 20

Front Flange Mount Extra size – Style FFX



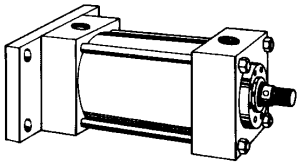
(NFPA style MF5) page 20

Front Head Flange Mount – Style FHF



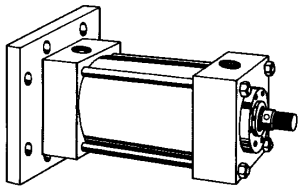
(NFPA style ME5) page 20

Rear Flange Mount – Style RF



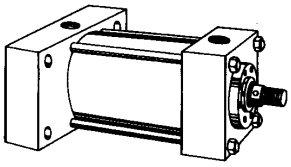
(NFPA style MF2) page 22

Rear Flange Mount Extra size – Style RFX



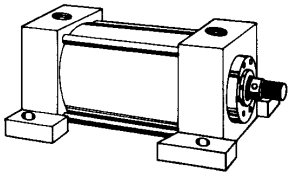
(NFPA style MF6) page 22

Rear Head Flange Mount – Style RHF



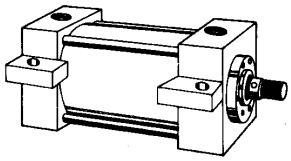
(NFPA style ME6) page 22

Side Lug Mount – Style SL



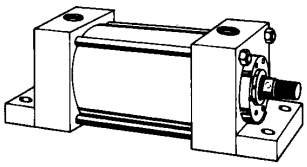
(NFPA style MS2) page 24

Centre Line Lug Mount – Style CL



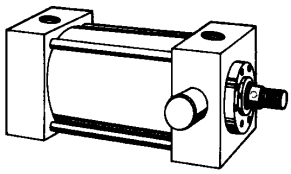
(NFPA style MS3) page 24

End Lug Mount – Style EL



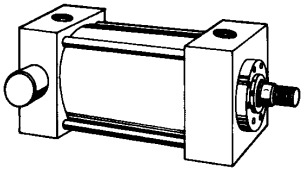
(NFPA style MS7) page 24

Trunnion Front Mount – Style TF



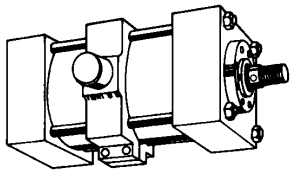
(NFPA style MT1) page 26

Trunnion Rear Mount – Style TR



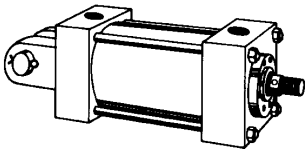
(NFPA style MT2) page 26

Trunnion Mount – Style T



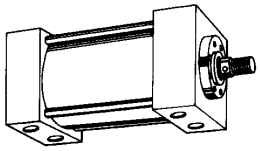
(NFPA style MT4) page 26

Clevis Mount – Style C



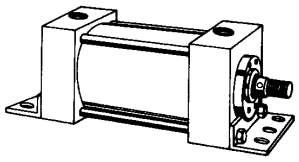
(NFPA style MP1) page 28

Side Flush Mount – Style SF



(NFPA style MS4) page 28

Foot Bracket Mount – Style FB



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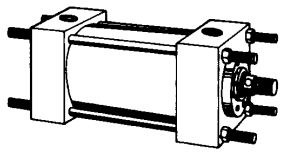
Tie Rod EXtended



NX–Neither RX–Rear (MX2)
BX–Both (MX1) FX–Front (MX3)

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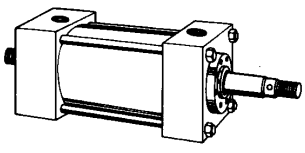
Double Rod Extension



Available in all except “C”, “RF”, “RFX” and “RHF” mounts

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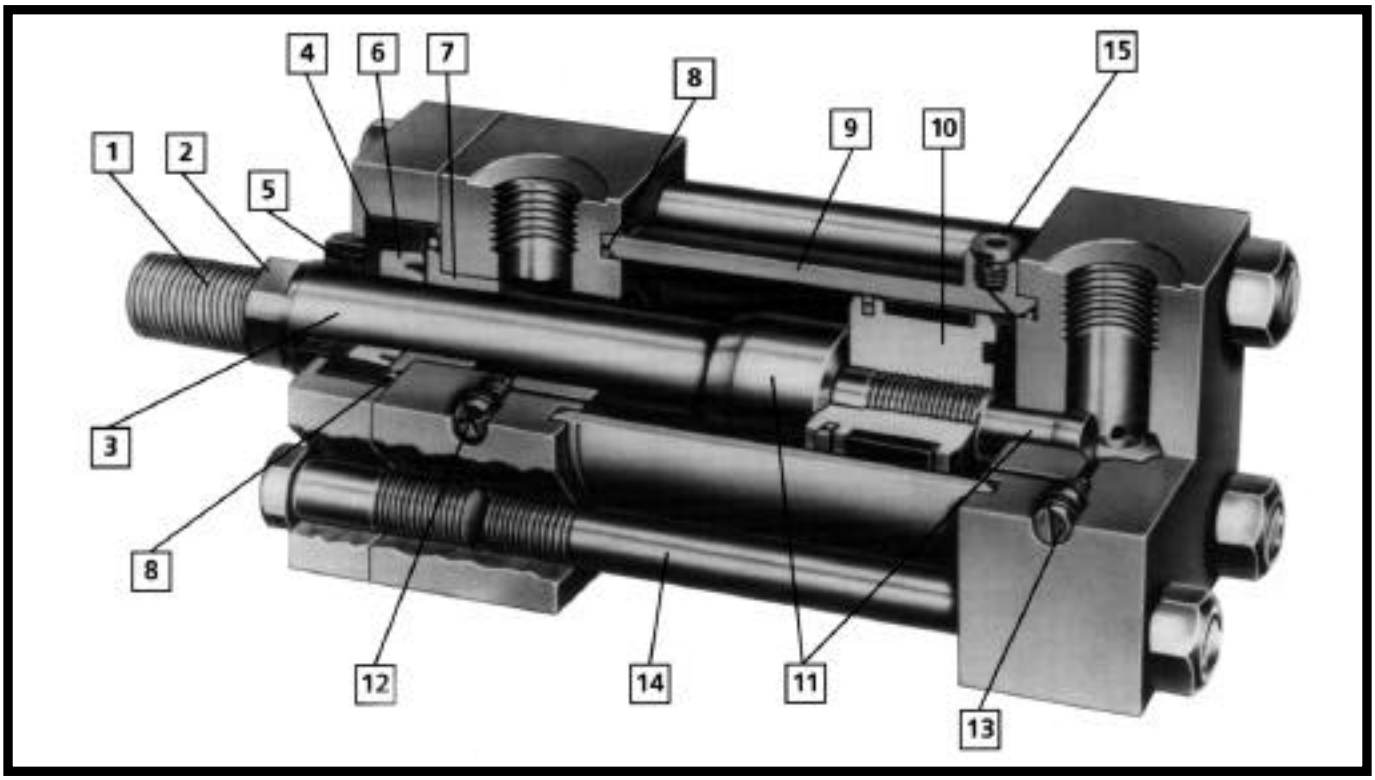
CONSTRUCTION



1 Studded Rod End

Offers much longer fatigue life through elimination of thread relief stress concentration point. Standard as Style 2 rod ends on all rod sizes upto 2" diameter. Studs are pretorqued and locked in to prevent loosening. They are machined from 125,000 psi yield steel. Some piston rod end threads are machined from solid due to the increasing number of thread form variations. Whether machined from solid or fitted with a stud, the mechanical strength is adequate for the maximum cylinder duty.

2 Wrench Flats

Four wrench flats are provided as standard for easy attachment. Spanner holes, in lieu of flats, are standard on large diameter rods.
See page 37.

3 Piston Rod

Piston rods through 4" diameter have a minimum expected yield of 100,00 psi. They are hard chrome plated for wear and corrosion resistance. Larger diameter rods have an expected minimum yield of 50,000 to 60,000 psi depending on diameter and are hard chrome plated.

4 Rod Gland

Easily removable for replacement of rod packings and wiper. In most cases it is not necessary to demount or disassemble the cylinder. Easier to service since, on removal of the ductile iron gland, the piston rod remains supported by the separate rod bearing.

5 Rod Wiper

Synthetic wiper is designed to wipe off abrasive dust and contaminants on the retract stroke to ensure long life for packings, rod bearing, and piston rod. Where the rod will be exposed to gummy materials such as "road tar", a metallic rod scraper is available.

6 Rod Seal

The polyurethane rod seal has a unique design which incorporates the optimum sealing properties of a "U" configuration with the elastomeric properties of a compression-type seal. The polyurethane material was selected for toughness, abrasion resistance, and the ability to resist extrusion under rough service conditions.

7 Rod Bearing

High load bearing bronze piloted into the head. Located inboard of the seals to ensure a well lubricated bearing for the fastest cycling applications. It need not be removed for rod seal replacement.

8 Static Seals

Pressure activated "O" ring seals are used at rod gland and tube ends. Located to eliminate extrusion and to provide positive leak tight seal.

9 Tube

The steel tube is honed to an 8 to 16 microinch finish for low friction and long seal and piston bearing life. Tube ends are machined on the O.D. concentric with the I.D. They are confined by the close tolerance machining of the head and cap which provides greater hoop strength.

10 Pistons and Piston Seals

All pistons are machined from a fine grain alloy cast iron. They are threaded directly onto the piston rod, torqued and sealed. **The special piston seal** is an endless glass filled Teflon material with an "O", ring expander. One or more (depending on bore size) bronze filled Teflon bearing strips are also employed on this type piston to eliminate metal-to-metal contact. This type of piston offers long life, low friction, near zero leakage, and great tolerance for side loading. It can be used successfully on virtually any application

11 12 13 Cushions

Cushion pistons (11) are tapered to provide gradual deceleration and eliminate shock upon entrance. The adjusting screw with fine threads (12) provides a wide range of adjustment. It is interchangeable with the ball check (13) permitting field changes of position. Neither the adjusting screw nor ball check plug project beyond the head or cap surface.

14 Tie Rod Construction

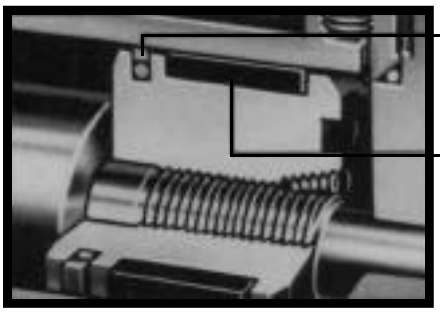
Maximum strength is obtained through a prestressed tie rod assembly. The use of high strength steel tie rods eliminates axial loading of tubes and permits higher shock loading.

15 Air Bleeds (Optional)

When required, air bleeds are located where they can be employed most successfully - at the tube and head juncture. The straight thread plugs are equipped with metallic "O" rings so they can be used repeatedly with a good seal every time.

PISTON DESIGN

Why a Slipper Seal Piston?



BECAUSE IT IS NEEDED!!!!
For years there has been a demand for a hydraulic cylinder piston that exhibited the long life of cast iron rings, the leak-tight sealing of cup seals, and the low friction of Teflon. A piston that would tolerate considerable sideloading without galling or scoring the tube; that would permit easy, but infrequent, maintenance, and would be economically feasible. A near perfect piston for virtually any application. The Slipper Seal Piston, standard on the HH Series, meets these requirements to a degree that is astounding ... and at no extra cost!

Near Zero Leakage

A completely honest statement of facts causes us to use this term. We know of no dynamic seal that is completely leak-tight under ALL operating conditions, but for all practical purposes, the slipper seal is leaktight. Since the higher the pressure, the better the seal, we conducted some of our Slipper Seal tests under low pressures to simulate the worst operating conditions. A good example was the testing of a six inch bore cylinder with trapped pressure of only 18 psi. The leakage past the piston permitted average movement of .010" per 24 hours. That represents an average piston leakage of .0001625 cu. inches per min. This test was conducted over 13 days. Other tests with pressures ranging from 500 to 7000 psi showed no leakage whatever.

Long Life – Low Friction

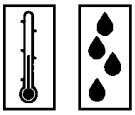
The two are closely related. Friction causes wear which determines life. We cannot state how long a Slipper Seal will last because the life of a dynamic seal depends on too many operational and environmental conditions. We can state, however, that both laboratory and field test have demonstrated a longevity that far exceeds any seal we have tested or used with the possible exception of metallic rings. Although this type of piston has been introduced recently as a special option at extra cost by our competitors, we have been using the Slipper Seal piston, as standard for many years on our cylinders.

No Metal-To-Metal Contact

The use of the Slipper Seal and the bronze filled Teflon bearing strip eliminates metal-to-metal contact between the piston and the tube. This feature alone will resolve many problems experienced by cylinders users.

Results? At no additional cost, you can obtain a cylinder that will give you outstanding service on all normal applications as well as holding or locking circuits, servo circuits, modulating operations, side loaded conditions, rapid cycling operations, and most other problem applications.

FLUIDS AND TEMPERATURES



Temperatures

Standard cylinders may be operated at temperatures of -55 to +200°F. For temperatures over 200°F consult the factory for specific recommendations giving operating temperature, source and characteristics of the heat, medium and cycle time. It should be noted that many seal compounds exhibit reduced life as the temperature nears their stated limit. In such applications, it is a good practice to specify high-temperature seals to assure long, satisfactory life.

Fluids

Seal materials employed in standard HH Series cylinders are Buna-N, Polyurethane and Teflon. As such, standard cylinders are particularly suited for use with any good grade petroleum base hydraulic oil. For normal temperature ranges, an oil having a viscosity range of 250-300 S.S.U. at 100°F is recommended. The oil should be maintained at SAE Level 3-4 cleanliness, normally accomplished with a 10 micron filtration system. Standard seals are also compatible with most Water-Glycol and Water-Oil Emulsion fluids with temperatures limited to a maximum of 140°F. Whenever there is a question of compatibility, contact the factory or the fluid manufacturer. NEVER change system fluid or MIX fluids until a careful check as to compatibility has been made.

Fire Resistant Fluids such as Phosphate Esters and Chlorinated Hydrocarbons require special seal compounds. These can be supplied in lieu of the standard seals at a moderate extra charge. The specific fluid and/or seal compounds should always be given on your order.

Cylinders to be operated with raw water as the fluid medium require special plating and/or special materials. There are two general classifications of cylinders made for use with water: (1) Water-Fitted Cylinders and (2) Water-Hydraulic Cylinders.

(1) Water-Fitted Cylinders are standard cylinders that have been adapted for raw water service by plating the internal metal surfaces. This usually consists of electroless nickel plating the head, cap and piston and hard chrome plating the tube I.D. While this is the least expensive method of modifying a cylinder for water service, it is frequently inadequate for long, trouble-free service. Because water conditions vary greatly, we cannot accept responsibility for water-fitted cylinders where failure is caused by corrosion, electrolysis or mineral deposits. When a customer has had experience with local water conditions and finds waterfitted cylinders to work well, he should continue to specify them. If such is not the case, it is recommended that the use of Water-Hydraulic Cylinders be seriously considered.

(2) Water-Hydraulic Cylinders are cylinders designed and manufactured specifically for water service. Non-corrosive materials, such as brass, bronze and stainless steel are used instead of plating. While the initial cost is higher, this type of cylinder is invariably the least expensive in the long run. When requirements exist, request a quotation.

FLUIDS AND TEMPERATURES

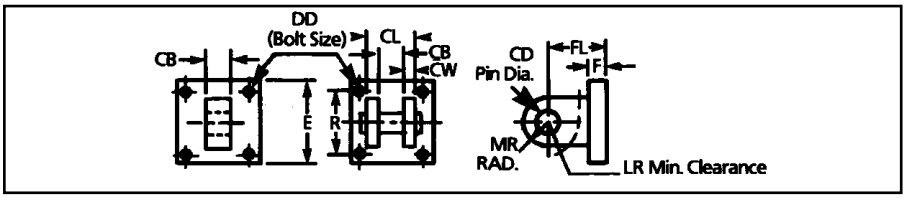
Standard HH Cylinders Without Modifications Can Be Used With Water Base Fluids to 140˚F. Compatibility Chart for Some Fluids and Seal Compounds									
			Type of Seal Compound						
Fluid Name	Mil. Spec.	Trade Name	Buna-N	Butyl	Poly-ure'ne	Neo-prene	EP	Viton®	Teflon®
Brake Fluid			U	U	U	U	R	U	R
Gasoline			R	U	U	U	U	R	R
Transmission Fluid (ATF)			R	U	R	S	U	R	R
Petroleum Base	MIL-H-6083	Preservative Oil	R	U	R	R	U	R	R
Petroleum Base	MIL-H-5606	Aircraft Hydraulic Fluid	R	U	R	U	U	R	R
HWBF (95-5)			R	U	*R	R	U	M	R
Water-Glycol		Houghto-Safe 600 Series	R	S/M	*R	S	R	R	R
		Houghto-Safe 500 Series	R	R	*R	S	R	R	R
	MIL-H-22072	Houghto-Safe 271	R	S	*R	S	R	S	R
		Unicon Hydrolube-J4	R	R	*R	S	R	R	R
		Celluguard	R	R	*R	R	R	R	R
Water/Oil Emulsion		Houghto-Safe 5000 Series	R	U	*R	S	U	R	R
		Gulf FR	R	U	*R	S	U	R	R
		Iris 902	R	U	*R	S	U	R	R
		Pyrogard C & D	R	U	U	S	U	R	R
Water-Soluble Oil			R	M	*R	S	R	R	R
Phosphate Ester		Houghto-Safe 1000 Series	U	R	U	U	R	R	R
	MIL-H-19457B	Houghto-Safe 1120	U	R	U	U	R	R	R
		Fyrquell (Cellulube)	U	R	U	U	R	R	R
		Pyrogard 42, 43, 53, 55, 190, 600	U	R	U	U	R	R	R
		Skydrol 500 Type 2	U	S	U	U	R	U	R
		Skydrol 7000 Type 2	U	R	U	U	R	S	R
		Pydraul 312C, 230C, 540C	U	U	U	U	U	R	R
		Pydraul 10E	U	R	U	U	R	U	R
		Pydraul 29ELT, 30E, 50E, 65E	U	R	U	U	R	R	R
Chlorinated Hydrocarb		Pydraul A-200	U	U	U	U	U	R	R
Silicate Ester		OS-45 Types 3 & 4	S	U	U	R	U	R	R
	MLO-8200	Oronite 8200	S	U	R	R	U	R	R
	MLO-8515	Oronite 8515	S	U	R	R	U	R	R
	MIL-H-8446B	Brayco 846	S	U	R	R	U	R	R

R = Recommended S = Satisfactory M = Marginal U = Unsatisfactory * Maximum Temperature 140°F

NOTE: The above material is for general information and should not be construed as a warranty or representation for which legal responsibility is assumed.

® Registered Trade Mark.

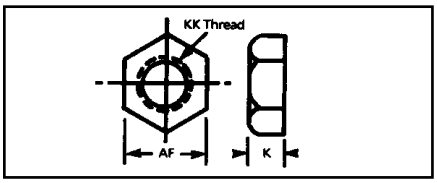
MOUNTING ACCESSORIES



Steel Pivot and Clevis Mounting Brackets (Black Oxided)

Clevis Mounting Bracket	Pivot Mounting Bracket	For Bore Size	Matching Rod Eye REF or REM	CB	CD	CL	CW	DD (Bolt Size)	E	F	FL	LR	MR	R
MBC-A30510	MBP-305	1 1/8	-70305	5/8	3/8	1 1/4	5/16	1/4 - 28*	1 5/8	5/16	15/16	9/16	3/8	1.19
MBC-A40614	MBP-406	1 1/2	-70406	3/4	1/2	1 3/4	1/2	3/8	2 1/2	3/8	1 1/8	1/2	1/2	1.63
MBC-A61020	MBP-610	2, 2 1/2	-120610	1 1/4	3/4	2 1/2	5/8	1/2	3 1/2	5/8	1 7/8	15/16	3/4	2.55
MBC-A81224	MBP-812	3 1/4	-160812	1 1/2	1	3	3/4	5/8	4 1/2	3/4	2 1/4	1 3/16	1	3.25
MBC-A111632	MBP-1116	4	-201116	2	1 3/8	4	1	5/8	5	7/8	3	1 3/4	1 3/8	3.82
MBC-A142040	MBP-1420	5	-241420	2 1/2	1 3/4	5	1 1/4	7/8	6 1/2	7/8	3 1/8	1 7/8	1 3/4	4.95
MBC-A162040	MBP-1620	6	-301620	2 1/2	2	5	1 1/4	1	7 1/2	1	3 1/2	2 1/16	2	5.73
MBC-A202448	MBP-2024	7	-362024	3	2 1/2	6	1 1/2	1 1/8	8 1/2	1	4	2 1/2	2 1/2	6.58
MBC-A242448	MBP-2424	8	-402424	3	3	6	1 1/2	1 1/4	9 1/2	1	4 1/4	2 3/4	2 3/4	7.50
MBC-A242856			-482428	3 1/2	3	7	1 3/4	1 1/4	10	1 1/4	5	3 1/4	3	8.00
MBC-A283264	MBP-2832	10	-522832 -562832	4	3 1/2	8	2	1 3/4	12 5/8	1 11/16	5 11/16	3 1/2	3 1/2	9.62
MBC-A323672	MBP-3236	12	-643236	4 1/2	4	9	2 1/4	2	14 7/8	1 15/16	6 7/16	4	4	11.45
MBC-A404896	MBP-4048	14	-844048	6	5	12	3	2 1/4	17 1/4	2 7/16	8 15/16	5 1/4	5	13.34

NOTE: Hard chrome plated pins and retainers supplied with Clevis Mounting Brackets.
* Indicates tapped holes; other "DD" dim. are clearance holes for indicated bolt sizes.



Jam Nuts (Black Oxided)

Part Number	KKThread	AF	K
3JN-43	7/16-20	11/16	1/4
3JN-50	1/2-20	3/4	5/16
3JN-75	3/4-16	1 1/16	3/8
3JN-87	7/8-14	1 1/4	7/16
3JN-100	1-14	1 7/16	1/2
3JN-125	1 1/4-12	1 13/16	5/8
3JN-150	1 1/2-12	2 3/16	13/16
3JN-175	1 3/4-12	2 5/8	31/32
3JN-187	1 7/8-12	2 3/4	1 1/32
3JN-200	2-12	3	1 3/32
3JN-225	2 1/4-12	3 3/8	1 13/64
3JN-250	2 1/2-12	3 3/4	1 29/64
3JN-275	2 3/4-12	4 1/8	1 37/64
3JN-300	3-12	4 1/2	1 45/64
3JN-325	3 1/4-12	5	1 13/16
3JN-350	3 1/2-12	5 3/8	1 15/16
3JN-375	3 3/4-12	5 3/4	2 1/16
3JN-400	4-12	6 1/8	2 3/16

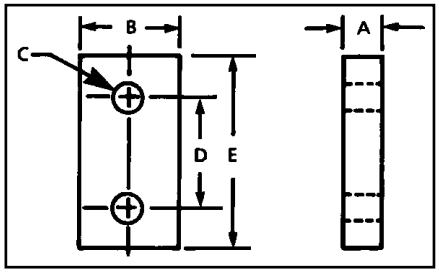
Front Head Flange Spacer Bars

Part No.	Bore	A	B	C	D	E
SB-3	3 1/4*	3/4	1 1/4	11/16	3.25	4 1/2
SB-4	4	7/8	1 1/4	11/16	3.82	5
SB-5	5	7/8	1 9/16	15/16	4.95	6 1/2
SB-6	6	1	1 13/16	1 1/16	5.73	7 1/2
SB-7	7	1	2	1 3/16	6.58	8 1/2
SB-8	8	1	2 3/16	1 5/16	7.50	9 1/2
SB-10	10	1 11/16	3 1/8	1 13/16	9.62	12 5/8
SB-12	12	1 15/16	3 1/2	2 1/16	11.45	14 7/8
SB-14	14	2 7/16	4 1/8	2 5/16	13.34	17 1/4

* 1 3/8" and 1 3/4" rod sizes only.

Front Head Flange Spacer Bars

Used with Front Head Flange Mount (FHF) to provide mounting interchangeability with old Front Flange Mount (FF) – sold in pairs.



MOUNTING ACCESSORIES

S•A•F•E Self-Aligning Flange End Coupling

With the S•A•F•E (Self-Aligning Flange End) Coupling, close radial alignment between cylinder rod end and machine member is easily and quickly achieved, making cylinder installation faster and cylinder life longer.

The flange is made from solid steel, black oxide and chrome finished. High tensile, socket head cap screws, designed to take full loading with a safety factor, are provided. S•A•F•E Coupling is for use with Style 6 rod ends. For bolt circle dimensions refer to chart below.

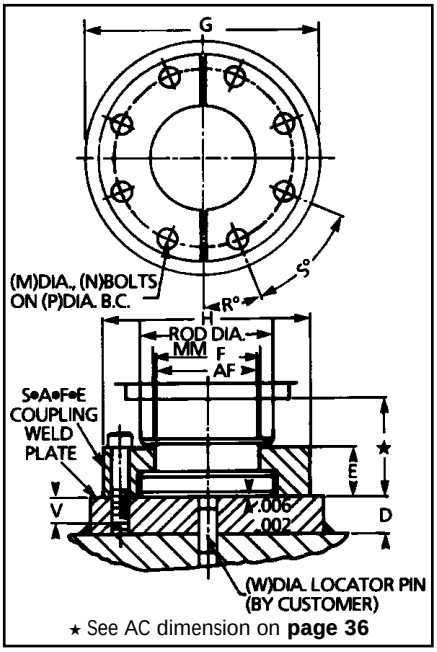
Weld Plate

The Weld Plate, a convenient accessory to match each S•A•F•E Coupling, is optional at extra cost. Shown on the drawing below, the Weld Plate a pre-drilled and tapped, properly sized plate to the machine member rather than laying out, drilling and tapping each hole in the member itself. It contains an accurately drilled locator pin hole for fast, close tolerance positioning. For welding, use Lincoln LH70-7018 welding rod or equivalent.

Self-Aligning Flange End Coupling

Part No.	Rod Dia. MM	AF †	E	F †	H	M	N	P	R	S	V	Weld Plate No.	D	G	W	Bolt Torq. ft.lb.
S.A.F.E. 0062	5/8	3/8	9/16	13/32	1 1/2	10-24	4	1 1/8	45	90	3/8	WP-0062	1/2	2	1/4	5
S.A.F.E. 0100	1	11/16	7/8	3/4	2	1/4-20	6	1 1/2	30	60	3/8	WP-0100	1/2	2 1/2	1/4	13
S.A.F.E. 0112	1 1/8	3/4	7/8	13/16	2 1/8	1/4-20	6	1 5/8	30	60	3/8	WP-0112	1/2	2 1/2	1/4	13
S.A.F.E. 0125	1 1/4	13/16	7/8	7/8	2 1/4	1/4-20	6	1 3/4	30	60	3/8	WP-0125	1/2	3	1/4	13
S.A.F.E. 0137	1 3/8	7/8	1	15/16	2 1/2	5/16-18	6	2	30	60	1/2	WP-0137	5/8	3	1/4	27
S.A.F.E. 0175	1 3/4	1 1/8	1 1/4	1 3/16	3	5/16-18	8	2 3/8	22 1/2	45	1/2	WP-0175	5/8	4	1/4	27
S.A.F.E. 0200	2	1 3/8	1 5/8	1 7/16	3 1/2	3/8-16	12	2 11/16	15	30	5/8	WP-0200	3/4	4	3/8	48
S.A.F.E. 0250	2 1/2	1 3/4	1 7/8	1 7/8	4	3/8-16	12	3 3/16	15	30	5/8	WP-0250	3/4	4 1/2	3/8	48
S.A.F.E. 0300	3	2 1/4	2 3/8	2 3/8	5	1/2-13	12	4	15	30	7/8	WP-0300	1	5 1/2	3/8	118
S.A.F.E. 0350	3 1/2	2 1/2	2 5/8	2 5/8	5 7/8	5/8-11	12	4 11/16	15	30	7/8	WP-0350	1	7	3/8	235
S.A.F.E. 0400	4	3	2 5/8	3 1/8	6 3/8	5/8-11	12	5 3/16	15	30	7/8	WP-0400	1	7	3/8	235
S.A.F.E. 0450	4 1/2	3 1/2	3 1/8	3 5/8	6 7/8	5/8-11	12	5 11/16	15	30	7/8	WP-0450	1	8	3/8	235
S.A.F.E. 0500	5	3 7/8	3 1/8	4	7 3/8	5/8-11	12	6 3/16	15	30	7/8	WP-0500	1	8	3/8	235
S.A.F.E. 0550	5 1/2	4 3/8	3 7/8	4 1/2	8 1/4	3/4-10	12	6 7/8	15	30	1 1/8	WP-0550	1 1/4	9	3/8	415

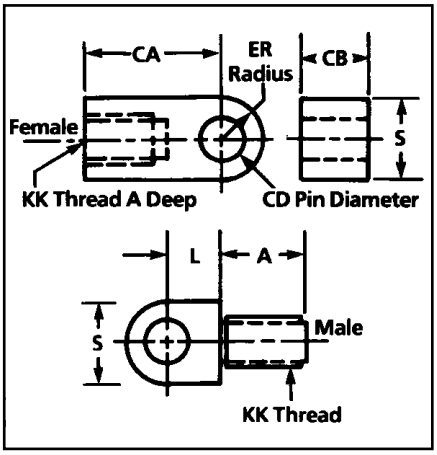
† "F" dimension minus "AF" dimension is radial clearance.



★ See AC dimension on **page 36**

Steel Rod Eyes (Black Oxided)

Male Rod Eye	Female Rod Eye	ER	CD	CB	KK Thread	A	S	CA	L	For Style 2 or 4 Rods	Matching Clevis Mounting Bracket
REM-70305	REF-70305	3/8	3/8	5/8	7/16-20	3/4	3/4	1 1/4	1/2	11/16	MBC-A30510
REM-70406	REF-70406	1/2	1/2	3/4	7/16-20	3/4	1	1 1/2	5/8	5/8	MBC-A40614
REM-120610	REF-120610	3/4	3/4	1 1/4	3/4-16	1 1/8	1 1/2	2 1/16	7/8	1	MBC-A61020
REM-160812	REF-160812	1	1	1 1/2	1-14	1 5/8	2	2 13/16	1 1/8	1 3/8	MBC-A81224
REM-201116	REF-201116	1 3/8	1 3/8	2	1 1/4-12	2	2 3/4	3 7/16	1 5/8	1 3/4	MBC-A111632
REM-241420	REF-241420	1 3/4	1 3/4	2 1/2	1 1/2-12	2 1/4	3 1/2	4	2	2	MBC-A142040
REM-301620	REF-301620	2	2	2 1/2	1 7/8-12	3	4	5	2 1/4	2 1/2	MBC-A162040
REM-362024	REF-362024	2 1/2	2 1/2	3	2 1/4-12	3 1/2	5	5 13/16	2 3/4	3	MBC-A202448
REM-402424	REF-402424	2 3/4	2 3/4	3	2 1/2-12	3 1/2	5 1/2	6 1/8	4 1/4	3 1/2	MBC-A242448
REM-482428	REF-482428	3	3	3 1/2	3-12	4	6	7	4 1/4	4	MBC-A242856
REM-522832	REF-522832	3 1/2	3 1/2	4	3 1/4-12	4 1/2	7	7 5/8	5	4 1/2	MBC-A283264
REM-562832	REF-562832	3 1/2	3 1/2	4	3 1/2-12	5	7	8 3/8	5	5	MBC-A283264
REM-643236	REF-643236	4	4	4 1/2	4-12	5 1/2	8	9	5 3/4	5 1/2	MBC-A323672
REM-844048	REF-844048	5	5	6	5 1/4-12	7	10	11 1/4	5 1/4	7	MBC-A404896

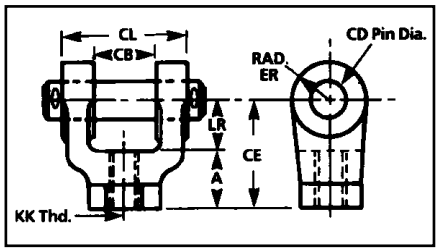


MOUNTING ACCESSORIES

Steel Rod Clevises and Pins

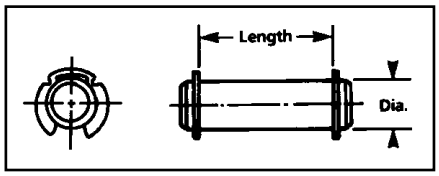
Part Number	KK Thread	A Thread Depth	CB	CD Pin Dia.	CE	CL	ER Rad.	LR
CLS-A10430	7/16-20	3/4	3/4	1/2	1 1/2	1 1/2	1/2	3/4
CLS-A1050	1/2-20	3/4	3/4	1/2	1 1/2	1 1/2	1/2	3/4
CLS-A10750	3/4-16	1 1/8	1 1/4	3/4	2 1/8	2 1/2	3/4	1
CLS-A10870	7/8-14	1 1/8	1 1/4	3/4	2 1/8	2 1/2	3/4	1
CLS-A11000	1-14	1 5/8	1 1/2	1	2 15/16	3	1	1 5/16
CLS-A11250	1 1/4-12	2	2	1 3/8	3 3/4	4	1 3/8	1 3/4
CLS-A11500	1 1/2-12	2 1/4	2 1/2	1 3/4	4 1/2	5	1 3/4	2 1/4
CLS-A11750	1 3/4-12	3	2 1/2	2	5 1/2	5	2	2 1/2
CLS-A11870	1 7/8-12	3	2 1/2	2	5 1/2	5	2	2 1/2
CLS-A12250	2 1/4-12	3 1/2	3	2 1/2	6 1/2	6	2 1/2	3
CLS-A12500	2 1/2-12	3 1/2	3	3	6 3/4	6	2 3/4	3 1/4
CLS-A12750	2 3/4-12	3 1/2	3	3	6 3/4	6	2 3/4	3 1/4
CLS-A13000	3-12	4 1/2	3	3	8 1/2	8	3 1/2	4
CLS-A13250	3 1/4-12	4 1/2	4	3 1/2	8 1/2	8	3 1/2	4
CLS-A13500	3 1/2-12	5	4	3 1/2	9	8	3 1/2	4
CLS-A14000	4-12	5 1/2	4 1/2	4	10	9	4	4 1/2

NOTE: Finish is Black Oxided.



Pin and Retainer Assemblies

Part Number	Pin Size Nominal		Bore Size	To Match Clevis Mounting Bracket	To Match Rod Eyes
	Dia.	Length			REM or REF
PC-A310	3/8	1 1/4	1 1/8	MBC-A30510	-50305 -70305
PC-A414	1/2	1 3/4	1 1/2	MBC-A40614	-70406
PC-A620	3/4	2 1/2	2,2 1/2	MBC-A61020	-120610
PC-A824	1	3	3 1/4	MBC-A81224	-160812
PC-A1132	1 3/8	4	4	MBC-A111632	-201116
PC-A1440	1 3/4	5	5	MBC-A142040	-241420
PC-A1640	2	5	6	MBC-A162040	-301620
PC-A2048	2 1/2	6	7	MBC-A202448	-362024
PC-A2448	3	6	8	MBC-A242448	-402424
PC-A2864	3 1/2	8	10	MBC-A283264	-522832 -562832
PC-A3272	4	9	12	MBC-A323672	-643236
PC-A4096	5	12	14	MBC-A404896	-844048

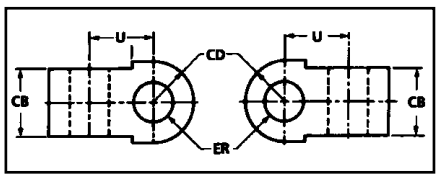


Universal Alignment Mounting Accessory

Unilign Part No.	HH Series Cyl. Bore	Clevis Mounting Bracket No.	Rod Clevis Part No.	Dimensions			
				CB	CD Pin	ER Rad.	U
UL-10	1 1/8	MBC-A30510		5/8	3/8	3/8	5/8
UL-14	1 1/2	MBC-A40614	CLS-A10430	3/4	1/2	1/2	7/8
UL-19	2,2 1/2	MBC-A61020	CLS-A10750	1 1/4	3/4	3/4	1 3/16
UL-27	3 1/4	MBC-A81224	CLS-A11000	1 1/2	1	1	1 11/16
UL-38	4	MBC-A111632	CLS-A11250	2	1 3/8	1 3/8	2 3/8
UL-49	5	MBC-A142040	CLS-A11500	2 1/2	1 3/4	1 3/4	3 1/16
UL-58	6	MBC-A162040	CLS-A11870	2 1/2	2	2	3 5/8

UNI-LIGN Universal Alignment Mounting Accessory

Simplifies machine designing problems by reducing cylinder binding and side loading, bearing and tube wear and piston blow-by from misalignment. Supplies free range of mounting positions without critical machining or special fitting. Works with standard mounting accessories. Black oxided finish.

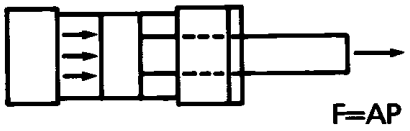


THEORETICAL FORCES DEVELOPED BY CYLINDERS

Bore	MM Rod Dia.	Effective Area Push	Effective Area Pull	Theoretical Force in Pounds at Various Pressures (in psi)															
				100 psi		250 psi		500 psi		750 psi		1000 psi		1500 psi		2000 psi		3000 psi	
				Push	Pull	Push	Pull	Push	Pull	Push	Pull	Push	Pull	Push	Pull	Push	Pull	Push	Pull
1 1/8	5/8 std.	.994	.687	99	68	248	171	497	343	745	515	994	687	1491	1030	1988	1374	2982	2061
1 1/2	5/8 std.	1.767	1.460	177	146	442	365	883	730	1325	1095	1767	1460	2650	2190	3534	2920	5301	4380
	1 2:1	1.767	.982	177	98	442	245	883	491	1325	736	1767	982	2650	1473	3534	1964	5301	2946
2	1 std.	3.14	2.36	314	236	785	590	1570	1180	2355	1770	3140	2360	4710	3540	6280	4720	9420	7080
	1 3/8 2:1	3.14	1.66	314	166	785	415	1570	830	2355	1245	3140	1660	4710	2490	6280	3320	9420	4980
2 1/2	1 std.	4.91	4.12	491	412	1227	1030	2455	2060	3682	3090	4910	4120	7365	6180	9820	8240	14730	12360
	1 3/8	4.91	3.43	491	343	1227	857	2455	1715	3682	2572	4910	3430	7365	5145	9820	6860	14730	10290
	1 3/4 2:1	4.91	2.51	491	251	1227	627	2455	1255	3682	1882	4910	2510	7365	3765	9820	5020	14730	7530
3 1/4	1 3/8 std.	8.30	6.82	830	682	2075	1705	4150	3410	6225	5115	8300	6820	12450	10230	16600	13640	24900	20460
	1 3/4	8.30	5.90	830	590	2075	1475	4150	2950	6225	4425	8300	5900	12450	8850	16600	11800	24900	17700
	2 2:1	8.30	5.16	830	516	2075	1290	4150	2580	6225	3870	8300	5160	12450	7740	16600	10320	24900	15480
4	1 3/4	12.57	10.17	1257	1017	3142	2542	6285	5085	9427	7627	12570	10170	18855	15255	25140	20340	37710	30510
	2	12.57	9.43	1257	943	3142	2357	6285	4715	9427	7072	12570	9430	18855	14145	25140	18860	37710	28290
	2 1/2 2:1	12.57	7.66	1257	766	3142	1915	6285	3830	9427	5745	12570	7660	18855	11490	25140	15320	37710	22980
5	2 std.	19.64	16.50	1964	1650	4910	4125	9820	8250	14730	12375	19640	16500	29460	24750	39280	33000	58920	49500
	2 1/2	19.64	14.73	1964	1473	4910	3682	9820	7365	14730	11047	19640	14730	29460	22095	39280	29460	58920	44190
	3	19.64	12.57	1964	1257	4910	3142	9820	6285	14730	9427	19640	12570	29460	18855	39280	25140	58920	37710
	3 1/2 2:1	19.64	10.02	1964	1002	4910	2505	9820	5010	14730	7515	19640	10020	29460	15030	39280	20040	58920	30060
6	2 1/2 std.	28.27	23.36	2827	2336	7067	5840	14135	11680	21202	17520	28270	23360	42405	35040	56540	46720	84810	70080
	3	28.27	21.20	2827	2120	7067	5300	14135	10600	21202	15900	28270	21200	42405	31800	56540	42400	84810	63600
	3 1/2	28.27	18.65	2827	1865	7067	4662	14135	9325	21202	13987	28270	18650	42405	27975	56540	37300	84810	55950
	4 2:1	28.27	15.70	2827	1570	7067	3925	14135	7850	21202	11775	28270	15700	42405	23550	56540	31400	84810	47100
7	3 std.	38.49	31.42	3849	3142	9622	7855	19245	15710	28867	23565	38490	31420	57735	47130	76980	62840	115470	94260
	3 1/2	38.49	28.87	3849	2887	9622	7217	19245	14435	28867	21652	38490	28870	57735	43305	76980	57740	115470	86610
	4	38.49	25.92	3849	2592	9622	6480	19245	12960	28867	19440	38490	25920	57735	38880	76980	51840	115470	77760
	4 1/2	38.49	22.59	3849	2259	9622	5647	19245	11295	28867	16942	39490	22590	57735	33885	76980	45180	115470	67770
	5 2:1	38.49	18.85	3849	1885	9622	4712	19245	9425	28867	14137	38490	18850	57735	28275	76980	37700	115470	56550
8	3 1/2 std.	50.27	40.65	5027	4065	12567	10162	25135	20325	37702	30487	50270	40650	75405	60975	100540	81300	150810	121950
	4	50.27	37.70	5027	3770	12567	9425	25135	18850	37702	28270	50270	37700	75405	56550	100540	75400	150810	113100
	4 1/2	50.27	34.37	5027	3437	12567	8592	25135	17185	37702	25777	50270	34370	75405	51555	100540	68740	150810	103110
	5	50.27	30.63	5027	3063	12567	7657	25135	15315	37702	22972	50270	30630	75405	45945	100540	61260	150810	91890
	5 1/2 2:1	50.27	26.51	5027	2651	12567	6627	25135	13255	37702	19882	50270	26510	75405	39765	100540	53020	150810	79530
10	4 1/2 std.	78.54	62.64	7854	6264	19635	15660	39270	31320	58905	46980	78540	62640	117810	93960	157080	125280	235620	187920
	5	78.54	58.90	7854	5890	19635	14725	39270	29450	58905	44175	78540	58900	117810	88350	157080	117800	235620	176700
	5 1/2	78.54	54.78	7854	5478	19635	13695	39270	27390	58905	41085	78540	54780	117810	82170	157080	109560	235620	164340
	7 2:1	78.54	40.05	7854	4005	19635	10012	39270	20025	58905	30037	78540	40050	117810	60075	157080	80100	235620	120150
12	5 1/2 std.	113.10	89.34	11310	8934	28275	22335	56550	44670	84825	67005	113100	89340	169650	134010	226200	178680	339300	268020
	7	113.10	74.61	11310	7461	28275	18652	56550	37305	84825	55957	113100	74610	169650	111915	226200	149220	339300	223830
	8 2:1	113.10	62.83	11310	6283	28275	15707	56550	31415	84825	47122	113100	62835	169650	94245	226200	125660	339300	188490
14	7 std.	153.94	115.45	15394	11545	38485	28862	76970	57725	115455	86587	153940	115450	230910	173175	307880	230900	461820	346350
	10 2:1	153.94	75.40	15394	7540	38485	18850	76970	37700	115455	56550	153940	75400	230910	113100	307880	150800	461820	226200
16	8	201.06	150.795	20106	15079	50265	37698	100530	75397	150795	113096	201060	150795	301590	226192	402120	301590	603180	452385
	9	201.06	137.443	20106	13744	50265	34360	100530	68721	150795	103082	201060	137443	301590	206164	402120	274886	603180	412329
	10	201.06	122.520	20106	12252	50265	30630	100530	61260	150795	91890	201060	122520	301590	183780	402120	245040	603180	367560
18	9	254.47	190.853	25447	19085	63617	47713	127235	95426	190852	143139	254470	190853	381705	286279	508940	381706	763410	572559
	10	254.47	175.930	25447	17593	63617	43982	127235	87965	190852	131947	254470	175930	381705	263895	508940	351860	763410	527790
20	10	314.16	235.62	31416	23562	78540	58905	157080	117810	235620	176715	314160	235620	471240	353430	628320	471240	942480	706860
24	12	452.39	339.29	45239	33929	113097	84822	226195	169645	339292	254467	452390	339290	678585	508935	904780	678580	1357170	1017870

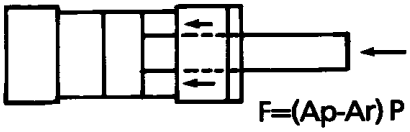
THEORETICAL FORCES DEVELOPED BY CYLINDERS

Force Developed on Push Stroke



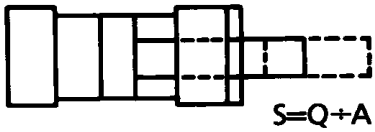
Force (in lbs.) = Area of Piston (in sq. inches) x Pressure (in psi)

Force Developed on Pull Stroke



Force (in lbs.) = Area of Piston (in sq. inches) minus Area of Rod (in sq. inches) x Pressure (in psi)

Speed of Cylinder Travel



S = Speed in inches per minute
Q = Pump delivery in cubic inches per minute
A = Area of Piston in square inches - Rod Extend
or
A = Area of Piston minus Area of Rod - Rod Retract
To convert gallons to cubic inches, multiply by 277

PRESSURE

Maximum Pressure Ratings

Bore Size	Heavy Duty Service psi	Max. Shock Service psi	3:1 Safety Factor (yield) psi
1 1/8	3000	5000	3612
1 1/2	3000	5000	3058
2	3000	5000	3412
2 1/2	3000	5000	2783
3 1/4	3000	5000	2842
4	3000	5000	2667
5	3000	5000	2778
6	3000	5000	2760
7	3000	5000	2558
8	3000	5000	2391
10	3000	5000	2936
12	3000	5000	2549
14	3000	5000	2443

All above figures are based on the cylinder as a pressure vessel. Some styles of mountings will not withstand the thrust generated at these pressures. See information on specific mounts.

Pressure and Shock

HH Series Cylinders are suitable for working pressures to 3000 psi and maximum pressure including any shock to 5000 psi. **See page 39** for complete range of Cylinders for pressures to 8000 psi. The adjacent chart shows the maximum operating pressure that can be used with 3:1 safety factor based on yield. It is felt that this is an adequate safety factor for any well designed hydraulic system where shock conditions have been considered and reduced to an acceptable level. Not all mounting styles will take the thrust generated at these pressures.
See pages 12 and 13.

The following factors in shock loading should be considered:

- Relief valves in the circuit do not protect the components from shock because of the time lag.
- Gauges do not necessarily register shock conditions, either because of their position in the circuit, or the short duration of shock.
- The two general types of shock loading to be considered are pressure rise caused by quick stop of the flow in the circuit and quick pressure drop. Decompression shock is particularly important in large bore cylinders and can be as destructive as compression shock.
- The magnitude of the pressure difference and the duration that the maximum pressure exists are the factors that determine the damage from shock.

CUSHIONS

Cushions

Tapered cushions, designed to provide gradual deceleration and eliminate shock upon entrance of the cushion pistons, have now been considerably improved. The tapered cushion has been married with a fine thread, wide range, adjusting screw. This new combination offers a positive, low-shock deceleration and a method to adjust the cushioning effect for speeds and loads.

The adjusting screw is identified by a crossslot in the head of the screw. It does not project beyond the surface of the head (or cap) through its full range of adjustment so no clearance need be considered on close fit installations. The adjusting screw and the cushion check can be interchanged in the same cylinder end. This flexibility can be important if, after installation, it is discovered that the adjusting screw is inaccessible.

The cushion check, which does not require adjustment, has a single slot in its head. It does not project beyond the surface of the head (or cap). The cushion check plus the tapered cushion piston provides rapid acceleration out of cushioning. There is no spring in the cushion check to fatigue, hence, no worry of mechanical failure.

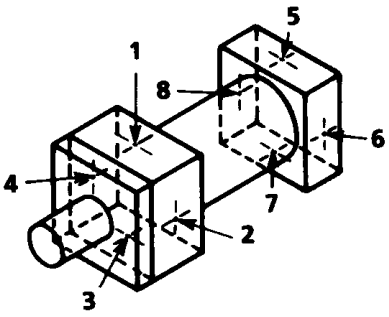
Cushioning is designed to properly cushion the cylinder and is not intended to cushion large inertia loads. Cushions do not substitute for speed controls or deceleration valves.

Cushion Lengths

Bore	Rod	Cushion Length Head	Cap
1 1/8	5/8	5/8	3/4
1 1/2	5/8	7/8	23/32
	1	7/8	15/16
2	ALL	7/8	1
2 1/2	ALL	7/8	1
3 1/4	ALL	1	1
4	ALL	1	1 1/16
5	ALL	1	1
6	ALL	1 1/4	1 1/4
7	ALL	1 1/4	1 1/4
8	ALL	1 1/4	1 1/4

For larger bore sizes consult factory.

As indicated the standard positions for ports are 1 and 5. Where possible, the standard for cushion adjusting screws will be 2 and 6 and the standard positions for cushion checks will be 4 and 8.



POSITION DIAGRAM FOR CUSHION ADJUSTING SCREWS AND CUSHION CHECKS.

With some mounting styles, it is not possible to so locate the adjusting screws and checks. For example, a Trunnion Front Mount has the trunnion pins located in positions 2 and 4 on the head. With the port in position 1, the only side available for both adjusting screw and check is position 3. Since both will then be located on the same side, they will be located off-centre. This example would hold true with the TR, CL, FHF and RHF Mounts. See Chart A for standard positions that will be supplied unless otherwise specified.

Chart A

Mount	Cush. Adj Screw	Cush. Check
TF and FHF	3 and 6	3 and 8
CL	3 and 7	3 and 7
TR and RHF	2 and 7	4 and 7
All Other Mounts	2 and 6	4 and 8

When requested, other positions can be supplied so long as there is no interference with mounting.

Where access to an adjusting Screw or check could be made difficult because of proximity to a mount, the locations of the screws will be slightly off-centre. An example of this would be a small bore cylinder with a side lug mount.

Note:

Because of space limitations, neither cushion adjusting screws nor cushion ball checks can be put into 1 1/2, 2 and 2 1/2 bore sizes for cushioned front when they are specified with 2:1 rod diameters.

MOUNTING INFORMATION

Fixed Centreline Mounts

Centreline mounts are generally considered to be the best type of fixed mounting since the thrust from the piston rod is taken at a mounting surface that is coincident with the cylinder centreline. Use of this type of mount can eliminate possible problems resulting from cylinder sway and flexure of cylinder components.

Flange Mounts

Although flange mounts are considered to be of the centreline type, caution must be exercised as they can be applied in such manner as to cause them to be of a non-centreline nature. Whenever a cylinder is mounted by the backside of a flange, a condition exists where flexure of the flange resulting in fatique failure of the mounting bolts or flange retainer fasteners is possible.
(See Fig. A)

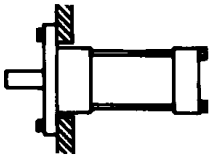
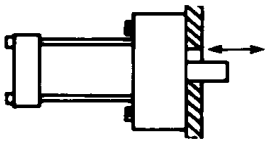


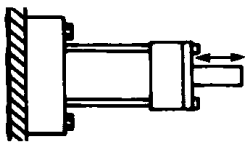
Fig. A

Backside Flange Mount

The only type of flange recommended for backside mounting is the style where the full thickness of the head or the cap serves as the flange (Styles FHF or RHF).



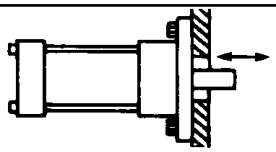
Front Head Flange Style FHF



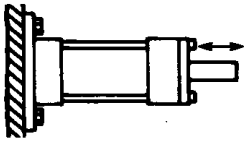
Rear Head Flange Style FHF

Selection of a flange mounting style depends, in part, upon whether the major force applied to the machine member will result in tension or compression of the cylinder rod. Rear flange mounting styles are best for thrust loads (rod in compression and front flange mounting styles are best where the rod is stressed in tension).

Rectangular flange mounts (Styles FF and RF) are not recommended for use with pressures in excess of 1000 psi nor should they be used with strokes longer than 36 inches.



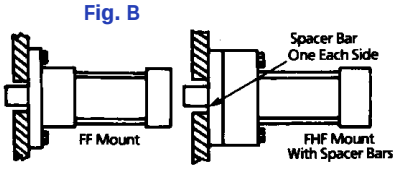
Front Flange Styles FF & FFX



Rear Flange Styles RF & RFX

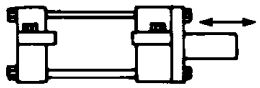
Regardless of mount, whenever a long stroke cylinder is employed, consideration should be given to additional support – **see page 16** for long stroke cylinder data. Where the larger size of the square flange can be accommodated (Styles FFX and RFX), they may be used with full pressure rating of the cylinder and with long strokes. The best styles of flange mount, regardless of application, are the FHF and RHF Mounts. The RHF Mount has the same mounting hole pattern and the same rectangular flange dimension as the RF Mount **(see pages 22 and 23),** therefore, with longer mounting screws and consideration for a slightly shorter overall length, the RHF Mount can be substituted for the RF. The FHF Mount has the same hole pattern and rectangular flange dimensions as the FF Mount. To substitute the FHF Mount for that of the FF, it may be necessary to use spacers to fill in the dimensions previously occupied by the flange. See our accessory page **(page 6)** for Front Head Flange Spacer Bars. The spacers are employed as shown in Fig.B. Front Flange styles of mounting are dimensioned on **pages 20 and 21.**

Fig. B



Centreline Lug Mounts

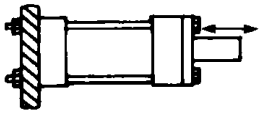
This style of mount is one of the best fixed mounts. It is not, however, one of the more popular mounts since it is not the most convenient to utilise. When used at higher pressure ranges or under shock conditions, the lugs should be dowelled to the machine. This style of mount has room for dowel pins in the mounting lugs. Doewlling should be done at one end of the cylinder only (especially important on long strokes) due to the deflection that takes place under load. Cylinders should never be pinned across corners. This can result in severe warping when the cylinder is subjected to operating temperatures and pressures. Dimensions for Centreline Lug Mounts are given on **pages 24 and 25**.



Centreline Lug Style CL

Tie Rod Extended Mounts

Tie Rod Extended cylinders are available with the tie rods extended front (Style FX), with the tie rods extended rear (Style RX) or both ends (Style BX). Frequently cylinders are ordered with tie rods extended on one end in addition to another mount. The extended tie rods are then utilised for the mounting of other systems or machine components.



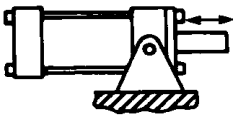
Tie Rod Extended
Styles FX, RX, & BX

Should the mounting be such that the overhung weight of the cylinder is borne by the extended tie rods, additional support may be required, especially if the cylinder has a long stroke **(see page 16)**. From a thrust standpoint, tie rod extended mounts are good, stable ones. Dimensions for tie rod extended mounts are shown on **pages 30 and 31**.

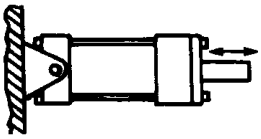
MOUNTING INFORMATION

Pivoted Centreline Mounts

If the machine member moved by the piston rod travels in a curvilinear path, a pivot mount cylinder is the obvious choice. Pivot mounts are available with the pivot points at the head (TF Mount), at the cap (TR, & C Mounts), or centrally located at some position between the head and the cap (T Mount). In most cases, a layout of the rod end path will determine the best pivot mounting style to be used. In general, pivot mounted cylinders with the pivot points near the head (TF and T Mounts) can use smaller diameter rods without the danger of buckling than similar cylinders with the pivot points at the cap. This can be verified by consulting our column strength chart on **page 15.**



Trunnion Front Style TF



Trunnion Front Style TR

There are times when a fixed mounting style might be indicated by an application but a pivot mount is selected to compensate for any misalignment that might occur - if the misalignment is in one plane. Where misalignment can occur in multiple planes, the cylinder should be equipped with UNILIGN acessories **(see page 8)** or with Spherical Bearings **(see page 15)**.

Trunnion Mounts

Pillow blocks of ample size and rigidity should be provided and should be mounted as close to the head (or cap) as possible. Bearing should be provided for the full length of the trunnion pin. Pins are intended for shear loads only, not bending loads. SELF-ALIGNING MOUNTS should NOT BE USED TO SUPPORT THE TRUNNIONS SINCE BENDING FORCES CAN ALSO BE SET UP (See Fig. C). Lubrication should be provided to the pins.

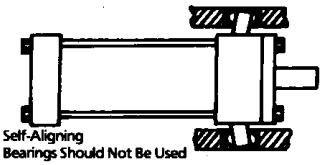
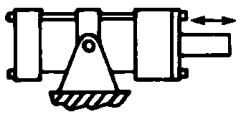


Fig. C

An intermediate trunnion (T Mount) can be located at any position between the head and cap (within limitations) at the time of cylinder manufacture, but cannot be easily changed once produced. The trunnion location (dimension XI) must be specified on the order. **See pages 26 and 27** for trunnion mount dimensions.

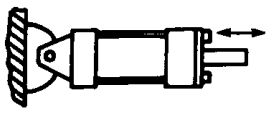


Intermediate Trunnion Style T

Clevis Mount

All Clevis Mount cylinders need provision on both ends for pivoting in one direction. A clevis pin of proper length and of sufficient diameter to withstand the maximum shear load generated by the cylinder at rated operating pressure is provided. Should a rod end accessory such as a rod eye or rod clevis **(see pages 7 and 8)** be desired, select one with a pin size (or pin hole) with the same diameter as the clevis pin. You can then specify a rod end thread to match the accessory.

Selecting the accessory on the basis of the rod end thread normally supplied can result in an expensive and unsightly miss-match, especially when the cylinder has a large oversize or 2:1 diameter rod. Clevis mount cylinder dimensions are given on **pages 28 and 29**.



Clevis Style C

Fixed Non-Centreline Mounts

Cylinders with non-centreline styles of mounts tend to sway when under load. Relatively short fixed, non-centreline mounted cylinders can subject mounting bolts to large tension forces which, when combined with shear forces, can over stress standard bolts. High tensile cap screws are recommended. See Fig. D.

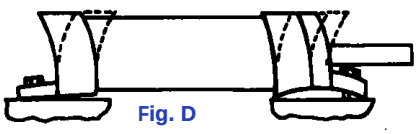


Fig. D

The rigidity of the machine frame should be considered when using cylinders with a non-centreline mount since stronger machine members are often required to resist bending moments. See Fig. E.

Fixed mounted cylinders should be held in place by keying or pinning. Cylinders with integral key mounts may be used where a keyway can be milled in a machine member **(see page 15)**. This type of arrangement takes up shear loads and provides accurate alignment of the cylinder. Shear keys should be placed at the proper end of the cylinder: at the head, if major loads are in thrust or at the cap if major loads are in tension. See Fig. F.

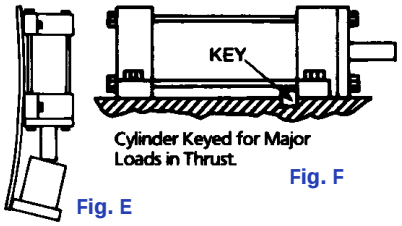
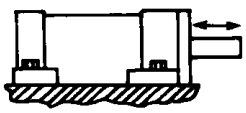


Fig. F

Fig. E

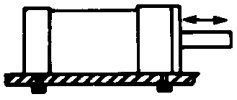
Only one end of the cylinder should be keyed. Dowel pins can be used instead of keys to help take shear loads and to obtain alignment. The side lug mount has room for dowel pins in the lugs. Cylinders may be pinned together at either end but NOT AT BOTH ENDS.

It should be noted that the Foot Bracket Mount (Style FB), which is not illustrated on this page, should not be used with pressures in excess of 1000 psi. Dimensions for SL and EL Mounts are given on **pages 24 and 25**. FB and SF Mounts dimensions can be found on **pages 28 and 29**.



Side Lug Style SL

End Lug Style EL

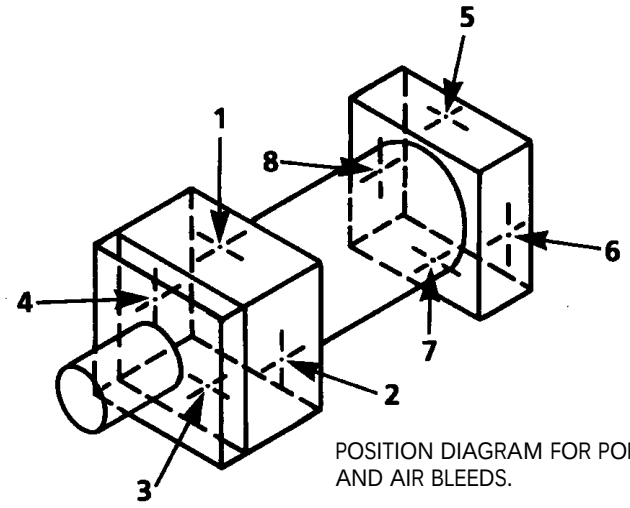


Side Flush Style SF

PORTING AND AIR BLEEDS

1	2	3	4	5
Bore	MM Rod Dia.	Std. Port	Max. Port	Max. S.A.E. ST THD. Port
1 1/8	5/8 std.	1/4	3/8*	-6
1 1/2	5/8 std.	1/2	3/4	-10
	1 2:1	1/2	3/4	-10
2	1 std.	1/2	3/4*	-10
	1 3/8 2:1	1/2	3/4*	-10
2 1/2	1 std.	1/2	3/4*	-10
	1 3/8	1/2	3/4*	-10
	1 3/4 2:1	1/2	3/4*	-10
3 1/4	1 3/8 std.	3/4	3/4	-12
	1 3/4	3/4	3/4	-12
	2 2:1	3/4	1*	-12
4	1 3/4 std.	3/4	3/4	-14
	2	3/4	3/4	-14
	2 1/2 2:1	3/4	1*	-14
5	2 std.	3/4	3/4	-14
	2 1/2	3/4	1*	-14
	3	3/4	1*	-14
	3 1/2 2:1	3/4	1*	-14
6	2 1/2 std.	1	1 1/4*	-16
	3	1	1 1/4*	-16
	3 1/2	1	1 1/4*	-16
	4 2:1	1	1 1/4*	-16
7	3 std.	1 1/4	1 1/2	-24
	3 1/2	1 1/4	1 1/2	-24
	4	1 1/4	1 1/2	-24
	4 1/2	1 1/4	1 1/2	-24
	5 2:1	1 1/4	1 1/2	-24
8	3 1/2 std.	1 1/2	2	-24
	4	1 1/2	2	-24
	4 1/2	1 1/2	2	-24
	5	1 1/2	2	-24
	5 1/2 2:1	1 1/2	2	-24
10	4 1/2 std.	2	2 1/2	-32
	5	2	2 1/2	-32
	5 1/2	2	2 1/2	-32
	7 2:1	2	2 1/2	-32
12	5 1/2 std.	2 1/2	3	-32
	7	2 1/2	3	-32
	8 2:1	2 1/2	3	-32
14	7 std.	2 1/2	3	-32
	10 2:1	2 1/2	3	-32

* "Y" and "P" dimensions as shown on mounting dimensions pages change to accommodate these port sizes.



POSITION DIAGRAM FOR PORTS AND AIR BLEEDS.

Porting

BSP Ports, located in positions 1 and 5 (See "Position Diagram for Ports") are standard and will be furnished unless otherwise specified. Other types and sizes of ports are available on request.

Port Positions

Where mounting clearances permit, the ports can be had in any of four positions in the head and in the cap at no extra cost. Indicate both port positions desired by position number. If no preference is stated, ports will be furnished in positions 1 and 5. NOTE: The head and cap can be rotated in relation to each other as long as mounting and porting are convenient for installation.

Port Sizes

Standard port sizes are as shown in Column 3 on the adjacent chart. Unless otherwise specified, those sizes are what will be furnished. Smaller than standard ports can be supplied at no extra cost. It is recommended that cylinders be ordered with ports no larger than needed so that the trouble and expense of obtaining and installing reducing fittings can be avoided. At a modest cost, larger than standard ports, as shown in Column 4, can be furnished. While these larger ports can be put in a standard cylinder, it is necessary in some cases to slightly alter the "Y" and the "P" dimensions shown on our mounting dimension pages. Contact the factory for those dimensional changes.

S.A.E. Straight Thread Ports

S.A.E. straight thread "O" ring sealed ports are available at no extra cost. This type of port offers positive seal with full thread engagement. It also eliminates the problem of faulty pipe threads since sealing takes place independently of the thread. No messy pipe dope to bother with or to contaminate the hydraulic system. No wedging, distortion, or breakage due to over-tightening. Alignment and full sealing are both assured since the fittings can be tightened after "lining up". Straight thread fittings may be re-used, indefinitely. Column 5 shows the maximum size of S.A.E. port that can be furnished in a standard cylinder.

Air Bleeds

An air bleed may be ordered at either or both ends of the cylinder as an option. To provide for maximum bleeding of air from the cylinder, air bleeds are placed in the tube to bleed air from the tube/head or tube/cap juncture. The air is bled from the cylinder by backing out the straight thread metallic seal plug to allow air to pass by the threads. When air bubbles stop and oil starts to flow, re-tighten plug. It is recommended that bleeding be done with pressure on the opposite end of the cylinder so that the bleed plug is not subjected to pump pressure when being backed out. Air bleeds should always be positioned at the highest point of the cylinder tube. Please specify positions of air bleeds by position number from the chart. NOTE: Since air bleeds are placed in the cylinder tube, position can be changed by loosening the tie rods and rotating the tube. Line drawing shows ports in positions 1 and 5.

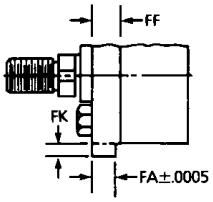
SPECIAL VARIATIONS

Many cylinders are manufactured with variations to meet special customer needs. In addition to those illustrated below, some of the more popular variations are:

- **Cylinders With Gaiters**
- **Combination Mount Cylinders**
- **Locking Cylinders**
- **Precision Stroke Cylinders**
- **Precision Mount Cylinders**
- **Cylinders With Built-In Switch Actuators & Feed Back Devices**

Thrust Key

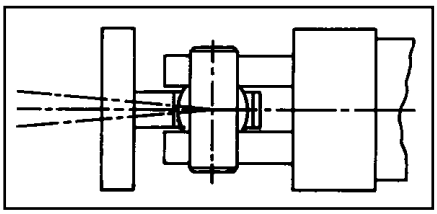
Thrust keys should be considered for heavy loads or high shock conditions on all side mounted cylinders (styles SF, FB, EL and SL). Thrust keys are available in bore sizes $1^1/_8$" through 6". Extending the rod gland retainer, as shown, provides a key which fits into a milled slot in the mounting surface of the machine member. Combined with the mount this key assures that the cylinder will not shift in severe service.



Bore	FA	FK	FF
$1^1/_8$	.3120	$^3/_{16}$	$^1/_2$
$1^1/_2$	.3120	$^3/_{16}$	$^5/_8$
2	.5620	$^5/_{16}$	$^3/_4$
$2^1/_2$	.5620	$^5/_{16}$	$^3/_4$
$3^1/_4$	.6870	$^3/_8$	$^3/_4$
4	.8120	$^7/_{16}$	$^7/_8$
5	.8120	$^7/_{16}$	$^7/_8$
6	.9370	$^1/_2$	1

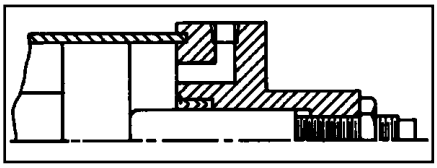
Spherical Bearings

Pivot mounting brackets and pivot rod eyes can be provided with spherical bearings to compensate for misalignment on both ends of cylinders. Consider also the use of the Uni-Lign described on **page 8**.



Adjustable Stroke

Shown is an integral stroke adjustment (externally adjusted) that is accomplished by the use of a bump rod threaded into the cylinder cap. Seals are incorporated to prevent external leakage and a lock nut is included.



Non-Rotating Piston Rod

Two methods of non-rotating piston rods are employed. The internal rod type (Fig. A.) is generally used since it requires less space and is neater. The type shown in Fig. B. must be used on small bore cylinders where internal space is limited.

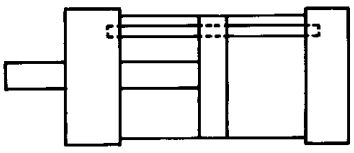


Fig. A

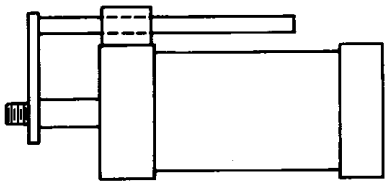
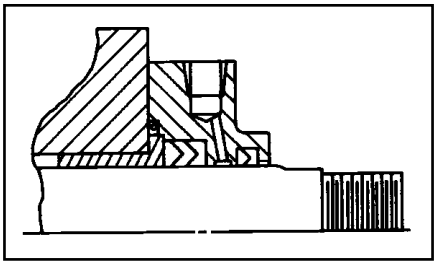


Fig. B

Rod Gland Drain

When not even a drop of external leakage can be tolerated, the rod gland drain back provides a signal that the rod seal set has worn to the point of replacement - without the danger of contamination from leakage.



Tandem Cylinders and Multi-Stage Cylinders

The tandem cylinder (Fig. C.) has two pistons connected to a common rod, resulting in twice the force output of a single cylinder. Multi-stage cylinders (Fig. D) offer multiple, positive strokes by pressurising one cylinder, the other, or both. Contact the factory for other variations.

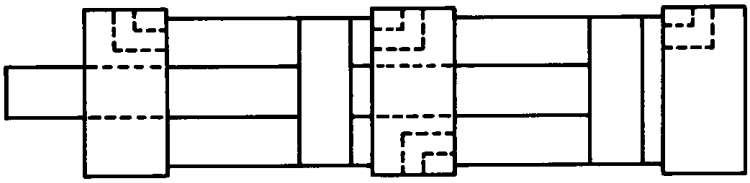


Fig. C

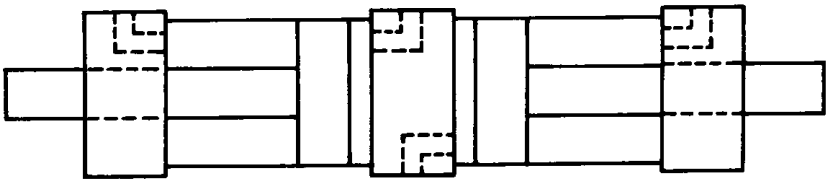
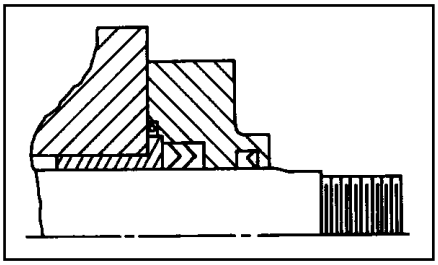


Fig. D

Vacuum Rod Seal

When a cylinder is to be operated under water, provision is made to prevent the water from being drawn into the cylinder at the time of valve shift or pressure differential.



Subsea Cylinders

Subsea cylinders can be offered with a choice of rod and external treatments. Please discuss your application with our factory.

Stainless Steel Piston Rods

Many applications, especially those subjected to water spray, require the use of stainless steel piston rods. We stock 431-S29T hard chrome plated, stainless steel and will furnish that type unless otherwise specified. Other types of stainless steel can be provided on request.

Limit Switch Cylinders

Mechanically operated switches are available on square head cylinders Please request brochure.

Feedback Cylinders

Cylinders can be supplied with various feedback devices either internally or externally. Consult factory.

PLEASE REQUEST A QUOTATION FOR ANY SPECIAL CYLINDER REQUIREMENTS.

SEE PAGES 4 AND 5 FOR INFORMATION CONCERNING HIGH TEMPERATURE AND WATER HYDRAULIC CYLINDERS

LONG STROKE CYLINDERS

Stroke Limitations

There are several considerations that may fix the Practical stroke limit of a cylinder such as mounting style, mounting attitude, column strength of the piston rod, etc. These will be discussed later in this section. There are, however, definite stroke limitations imposed by the basic design of tie rod cylinders. Because of the tube loading required to properly prestress (torque) tie rods, the following bore size cylinders are limited to the corresponding strokes in standard, catalogued construction. Should you require a cylinder with a stroke in excess of that charted below, contact the factory for information concerning changes in construction and dimensions.

Bore Size	Maximum Stroke
1 1/8	30
1 1/2	55
2	105
2 1/2	125
3 1/4 and larger	170

Supports

Relatively long cylinders often require supports to prevent excessive sag or vibration which could severely reduce the operational life of the cylinder. Depending upon bore size and mounting style, it may be necessary to specify either an intermediate mount or a tie rod support bracket. If the cylinder selected has a fixed, non-centreline mount such as side lug, the type of support to select should be an intermediate mount (see Fig. 1). This additional mount provides support for the cylinder tube and support for the tie rods. If a pivotal mount such as clevis or trunnion is selected, a tie rod support bracket should be considered (see Fig. 2). When a long stroke cylinder, with a fixed centreline mount such as a front or rear flange is specified, some form of support should be provided. An intermediate mount is often the most convenient way of doing so (see Fig. 3). The following chart provides a guide for determining the need for an additional support. It should be noted that neither a tie rod support bracket nor an intermediate mount is designed to absorb the thrust of the cylinder. They provide support only.

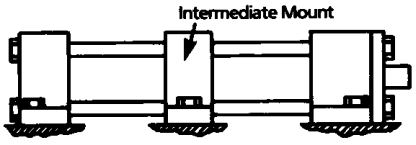


Figure 1

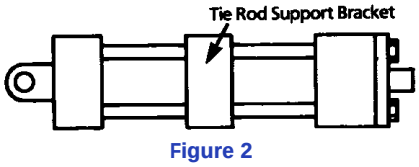


Figure 2

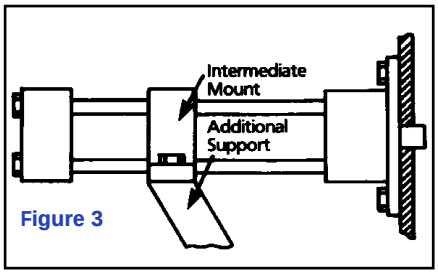


Figure 3

Bore	Stroke Requiring Additional Support
2	85
2 1/2	85
3 1/4	100
4	100
5	120
6	135
7	145
8	155
10	180
12	240

Rod Column Strength

When considering a long stroke cylinder, it is necessary to select a piston rod size of sufficient diameter to provide the necessary column strength. If the cylinder will be performing work on the pull stroke only (rod in tension), selection of the standard rod diameter for that bore size will provide sufficient strength for operation at rated pressure or lower. If, however, the cylinder will be performing work on the push stroke (rod in compression), careful consideration must be given to column strength. Factors are the stroke length, rod extension length, mounting style, mounting attitude, force potential and rod end connection. This is simplified for you by using the charts on **pages 17 and 19**. The mounting class chart on **page 17** assigns a mounting class reference number that corresponds to the mounting style, mounting attitude and rod end connection of the cylinder selected. Referencing that number and the sum of the gross stroke plus rod extension (if any), the column strength chart on **page 19** indicates the maximum allowable force for each available rod diameter. You may find the theoretical force chart on **page 9** helpful in calculating the force requirements.

Stop Tube and Dual Piston

A stop tube is a tube or sleeve assembled in the cylinder between the head and the piston. It provides a spread between the bearings of the rod bushing and the piston when the rod is fully extended (see Fig. 4). The use of a stop tube is an accepted method for reducing bearing pressures on long stroke cylinders and cylinders subjected to excessive side loading. A stop tube does not afford additional bearing surface, nor does it provide any benefit during operation except at full extension of effective stroke. While we will equip cylinders with stop tubes, our strong recommendation is for an alternate and superior method for reducing bearing pressures - the dual piston.

The dual piston is an assembly of two pistons on the piston rod. They are separated by a spacer of calculated length. Both pistons are equipped with bearing strips thus avoiding the metal to metal contact that causes most operational problems with competitive cylinders when subjected to side loading (see Fig. 5). The dual piston not only provides bearing spread at all times throughout the stroke cycle, but also provides important additional bearing surface. The dual piston concept was originally developed to successfully solve the most severe side loading problems when other methods had failed.

Both dual piston and stop tube equipped cylinders will be longer by the length of the stop tube or dual piston than standard cylinders of the same stroke without those devices. The desired stroke (effective stroke) must be added to the length of stop tube or dual piston to obtain the gross stroke for determining cylinder dimensions. Since the dual piston offers much greater effectiveness than a stop tube, it is usually shorter than the corresponding stop tube, hence the total cylinder length will be less; frequently a most important factor in total machine design.

To determine the length of stop tube or dual piston required, first consult the mounting class chart on **page 17** to obtain a Mounting Class Reference Number. Referencing that number and the net stroke of the cylinder, the required stop tube or dual piston length can be obtained from the chart on **page 17**.

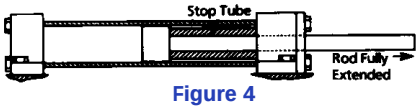


Figure 4

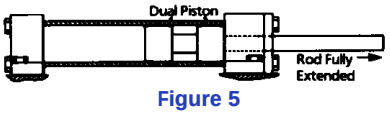
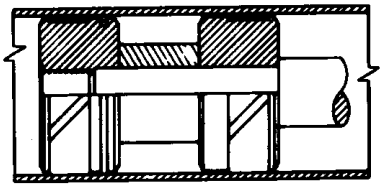
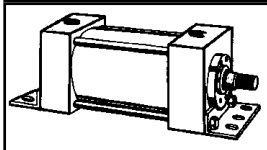
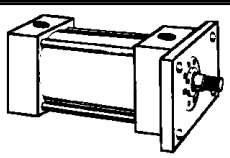
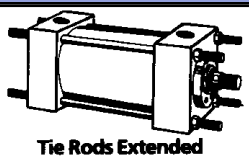
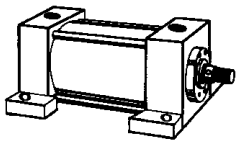
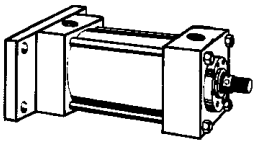
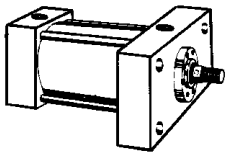
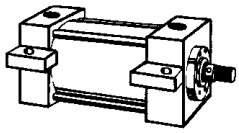
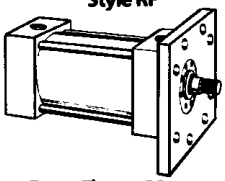
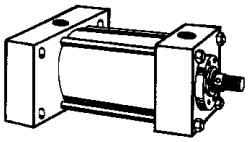
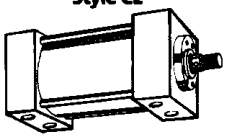
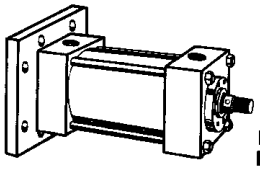
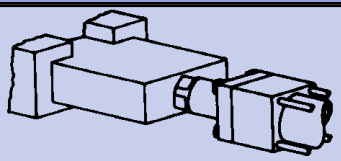
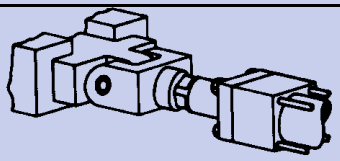
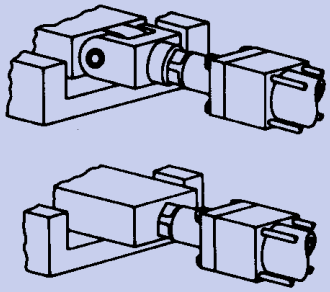
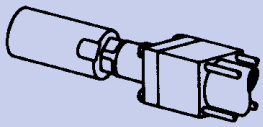


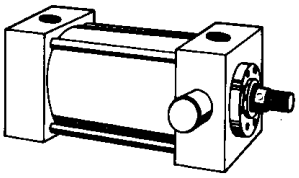
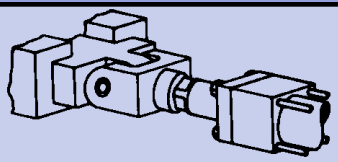
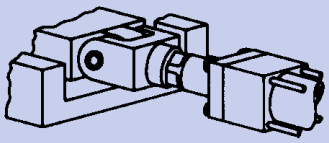
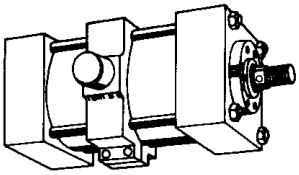
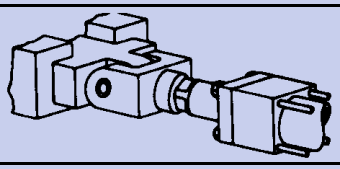
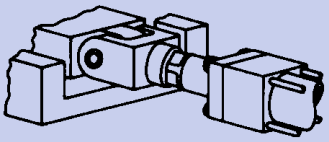
Figure 5

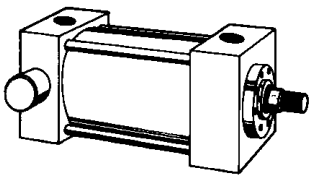
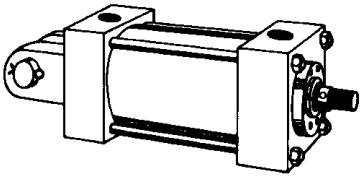
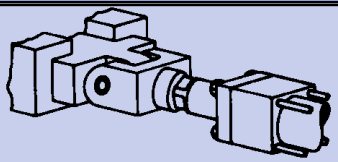
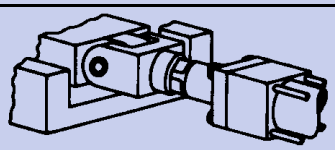


Dual Piston Detail

MOUNTING CLASSES

Fixed Mountings	Rod Support		Class
 Foot Bracket Mount Style FB  Front Flange Mount Style FF  Tie Rods Extended NX-Neither RX-Rear BX-Both FX-Front  Side Lug Mount Style SL  Rear Flange Mount Style RF  Front Head Flange Mount Style FHF  Centre Line Lug Mount Style CL  Front Flange Mount Extra Size-Style FFX  Rear Head Flange Mount Style RHF  Side Flush Mount Style SF  Rear Flange Mount Extra Size-Style RFX		Fixed Supported, Guided	1
		Pivoted Supported, Guided	2
		Pivoted or Fixed Supported, Unguided	3
		Fixed Un-Supported, Unguided	6

Head or Intermediate Pivot Mountings	Rod Support		Class
 Trunnion Front Mount Style TF	 	Pivoted Supported, Guided or Unguided	3
 Trunnion Mount Style T Intermediate – Between Heads	 	Pivoted Supported Guided or Unguided	4

Cap Pivot Mountings	Rod Support		Class
 Trunnion Rear Mount Style TR  Clevis Mount Style C	 	Pivoted Supported, Guided or Unguided	5

STOP TUBE AND DUAL PISTON

See page 16 for information on stop tubes and dual pistons and instructions for determination of length.

Net Stroke	Class 1		Class 2		Class 3		Class 4		Class 5		Class 6	
	Stop Tube	Dual Piston	Stop Tube	Dual Piston	Stop Tube	Dual Piston	Stop Tube	Dual Piston	Stop Tube	Dual Piston	Stop Tube	Dual Piston
16											1	■
20											2	■
24											3	■
25									1	■	3	■
26									1	■	4	■
28									2	■	4	■
32									2	■	5	3
34							1	■	3	■	6	4
36							1	■	3	■	7	5
38							2	■	3	■	7	5
42							2	■	4	■	8	5
44							2	■	5	3	9	6
46					1	■	3	■	5	3	10	7
48					1	■	3	■	6	4	10	7
52					1	■	4	■	6	4	11	7
54					1	■	4	■	7	5	12	8
56					2	■	4	■	7	5	13	9
58					2	■	5	3	8	5	13	9
62					2	■	5	3	8	5	14	9
64			1	■	2	■	6	4	9	6	15	10
68			1	■	3	■	6	4	9	6	16	11
72			1	■	3	■	7	5	10	7	17	11
74			2	■	3	■	7	5	11	7	18	12
78			2	■	4	■	7	5	11	7	19	13
82			2	■	4	■	8	5	12	8	20	13
84			2	■	4	■	8	5	13	9	21	14
88			3	■	5	3	9	6	13	9	22	15
90			3	■	5	3	9	6	14	9	23	15
92			3	■	5	3	10	7	14	9	23	15
94	1	■	3	■	5	3	10	7	15	10	24	16
98	1	■	3	■	6	4	11	7	15	10	25	17
100	1	■	4	■	6	4	11	7	16	11	26	17
102	1	■	4	■	6	4	11	7	16	11	26	17
104	1	■	4	■	6	4	12	8	17	11	27	18
108	1	■	4	■	7	5	12	8	18	12	28	19
110	1	■	4	■	7	5	12	8	18	12	29	19
112	2	■	4	■	7	5	13	9	18	12	30	20
114	2	■	5	3	7	5	13	9	19	13	30	20
116	2	■	5	3	8	5	13	9	19	13	31	21
118	2	■	5	3	8	5	14	9	20	13	31	21
120	2	■	5	3	8	5	14	9	20	13	32	21
125	2	■	5	3	9	6	15	10	21	14	34	23
130	3	■	6	4	9	6	16	11	22	15	35	23
135	3	■	6	4	10	7	16	11	23	15	37	25
140	3	■	7	5	10	7	17	11	24	16	38	25
145	3	■	7	5	11	7	18	12	25	17	40	27
150	4	■	7	5	11	7	19	13	26	17	41	27
155	4	■	8	5	12	8	19	13	27	18	43	29
160	4	■	8	5	12	8	20	13	28	19	44	29
165	4	■	8	5	13	9	21	14	29	19	46	31
170	5	3	9	6	13	9	22	15	30	20	47	31
175	5	3	9	6	14	9	22	15	31	21	49	33
180	5	3	10	7	14	9	23	15	32	21	50	33
185	5	3	10	7	15	10	24	16	33	22	52	35
190	6	4	10	7	15	10	25	17	34	23	53	35
195	6	4	11	7	16	11	25	17	35	23	55	37
200	6	4	11	7	16	11	26	17	36	24	56	37
205	6	4	11	7	17	11	27	18	37	25	58	39
210	7	5	12	8	17	11	28	19	38	25	59	39
215	7	5	12	8	18	12	28	19	39	26	61	41
220	7	5	13	9	18	12	29	19	40	27	62	41
225	7	5	13	9	19	13	30	20	41	27	64	43
230	8	5	13	9	19	13	31	21	42	28	65	43
235	8	5	14	9	20	13	31	21	43	29	67	45
240	8	5	14	9	20	13	32	21	44	29	68	45
245	8	5	14	9	21	14	33	22	45	30	70	47
250	9	6	15	10	21	14	34	23	46	31	71	47
255	9	6	15	10	22	15	34	23	47	31	73	49
260	9	6	16	11	22	15	35	23	48	32	74	49
265	9	6	16	11	23	15	35	24	49	33	76	51
270	10	7	16	11	23	15	37	25	50	33	77	51
275	10	7	17	11	24	16	37	25	51	34	79	53
280	10	7	17	11	24	16	38	25	52	35	80	53
285	10	7	17	11	25	17	39	26	53	35	82	55
290	11	7	18	12	25	17	40	27	54	36	83	55
295	11	7	18	12	26	17	40	27	55	37	85	57
300	11	7	19	13	26	17	41	27	56	37	86	57
310	12	8	19	13	27	18	43	29	58	39	89	59
320	12	8	20	13	28	19	44	29	60	40	92	61
325	12	8	20	13	29	19	45	30	61	41	94	63

■ Dual piston not available – use Stop Tube.

COLUMN STRENGTH CHART

See page 16 for instructions in the use of this chart.

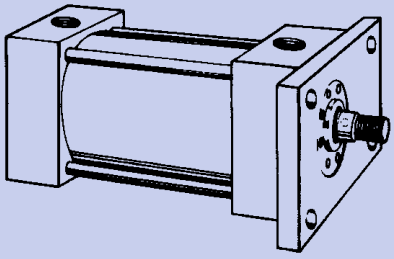
Stroke Plus Rod Ext.	Mount Class	Piston Rod Diameter														
		5/8	1	1 3/8	1 3/4	2	2 1/2	3	3 1/2	4	4 1/2	5	5 1/2	7	8	10
10	1	9340														
	2	8010														
	3	6690	22640	45960												
	4	3280	18220	41540	72220											
	5	1850	12110	35350	66030	90570										
	6	820	5380	19240	48340	72890	131790	230790								
15	1	8010														
	2	6010	21760	45070												
	3	3280	18220	41540	72220											
	4	1850	10370	32160	62840	87390										
	5	820	5380	19240	37090	72890	131790	230790								
	6	360	2390	8550	22440	38280	92000	164000	249080	347260	292300					
20	1	6690	22640	45960												
	2	3280	18220	41540	72220											
	3	1850	12110	35350	66030	90570										
	4	820	5380	19240	48340	72890	131790	203790								
	5	460	3030	10820	28400	48450	107030	179030	264110	362290						
	6	200	1340	4810	12620	21530	52570	109000	193380	291550	272250	346880	429330			
25	1	4990	20430	43750												
	2	2420	14550	37820	68500											
	3	1180	7750	27390	58070	82610	141520									
	4	540	3580	12810	33610	56210	114990	186990	272070							
	5	290	1940	6920	18170	31000	75700	147200	232280	330460	286250	360870				
	6	130	860	3080	8080	13780	33640	69760	129240	219930	246460	321080	403540	645370		
30	1	3280	18220	41540	72220											
	2	1580	10370	32160	62840	87390										
	3	820	5380	19240	48340	72890	131790	203790								
	4	360	2390	8550	22440	38280	92000	164000	249080	347260	292300					
	5	200	1340	4810	12620	21530	52570	109000	193380	291550	272250	346860	429330			
	6	90	600	2140	5610	9570	23360	48450	89750	153120	214950	289560	372030	618890	834870	
40	1	1850	12110	35350	66030	90570										
	2	820	5380	19240	48340	72890	131790	203790								
	3	460	3030	10820	28400	48450	107030	179030	264110	362290						
	4	200	1340	4810	12620	21530	52570	109000	193380	291550	272250	346860	429330			
	5	110	750	2700	7100	12110	29570	61310	113590	193790	236600	311210	393680	637080	853060	
	6	50	330	100	3150	5380	13140	27250	50480	86130	137960	209350	291820	551490	767470	1285830
50	1	1180	7750	27390	58070	82610	141520									
	2	540	3580	12810	33610	56210	114990	186990	272070							
	3	290	1940	6920	18170	31000	75700	147200	232280	330460	286250	360870				
	4	130	860	3080	8080	13780	33640	69760	129240	219930	246460	321080	403540	645370		
	5	70	480	1730	4540	7750	18920	39240	72700	124020	190760	265370	347840	598560	814540	1332910
	6	30	210	770	2020	3440	8410	17440	32310	55120	88290	134570	197030	464830	680810	1199170
60	1	820	5380	19240	48340	72890	131790	203790								
	2	360	2390	8550	22440	38280	92000	164000	249080	347260	292300					
	3	200	1340	4810	12620	21530	52570	109000	193380	291550	272250	346860	429330			
	4	90	600	2140	5610	9570	23360	48450	89750	153120	214950	289560	372030	618890	834870	
	5	50	330	1200	3150	5380	13140	27250	50480	86130	137960	209350	291820	551490	767470	1285830
	6	20	150	530	1400	2390	5840	12110	22440	38280	61310	93450	136830	358910	574890	1093260
70	1	600	3950	14130	37090	61390	120300	192290	277380							
	2	270	1800	6440	16910	28850	70440	139770	224860	323030	283580	358190				
	3	150	990	3530	9270	15820	38620	80080	148370	245570	255700	330310	412780	653120		
	4	70	440	1570	4120	7030	17160	35590	65940	112490	177710	252320	334790	587590	803580	1321940
	5	40	250	880	2320	3950	9650	20020	37090	63280	101360	154490	226180	495850	711840	1230200
	6	10	110	390	1030	1760	4290	8900	16480	28120	45050	68660	100520	263770	449980	9680800
80	1	460	3030	10820	28400	48450	107030	179030	264110	362290						
	2	200	1340	4810	12620	21530	52570	109000	193380	291550	272250	346860	429330			
	3	110	750	2700	7100	12110	29570	61310	113590	193790	236600	311210	393680	637080	853060	
	4	50	330	1200	3150	5380	13140	27250	50480	86130	137960	209350	291820	551490	767470	1285830
	5	30	190	670	1770	3030	7390	15330	28400	48450	77600	118280	173170	431660	647640	1166010
	6	10	80	300	790	1340	3280	6810	12620	21530	34490	52570	76960	201950	344510	8236500
90	1	360	2390	8550	22440	38280	92000	164000	249080	347260	292300					
	2	160	1080	3870	10160	17330	42320	87760	162110	259900	260850	335460	417930			
	3	90	600	2140	5610	9570	23360	48450	89750	153120	214950	289560	372030	618890	834870	
	4	40	260	950	2490	4250	10380	21530	39890	68050	109000	166140	243120	510560	726550	1244910
	5	20	150	530	1400	2390	5840	12110	22440	38280	61310	93450	136830	358910	574890	1093260
	6	10	60	240	620	1060	2590	5380	9970	17010	27250	41530	60810	159560	272210	664570
100	1	290	1940	6920	18170	31000	75700	147200	232280	330460	286250	360870				
	2	130	860	3080	8080	13780	33640	69760	129240	219930	246460	321080	403540	645370		
	3	70	480	1730	4540	7750	18920	39240	72700	124020	190760	26370	347840	598560	814540	1332910
	4	30	210	770	2020	3440	8410	17440	32310	55120	88290	134570	197030	464830	680810	1199170
	5	20	120	430	1130	1940	4730	9810	18170	31000	49660	75700	110830	290800	493580	1011940
	6		50	190	500	860	2100	4360	8080	13780	22070	33640	49260	129240	220490	538300
110	1	240	1600	5720	15020	25620	62560	128630	213710	311890	279570	354180	436650			
	2	110	720	2580	6770	11560	28220	58510	108410	184940	232400	307010	389470	633540	849540	
	3	60	400	1430	3750	6400	15640	32430	60080	102500	164020	238640	321100	576090	792080	1310440
	4	30	180	630	1670	2850	6950	14410	26700	45550	72970	111220	162830	414270	630260	1148620
	5	10	100	360	940	1600	3910	8110	15020	25620	41040	62560	91590	240330	410000	922080
	6		40	160	420	710	1740	3600	6670	11390	18240	27800	40710	106810	182220	444880
120	1	200	1340	4810	12620	21530	52570	109000	193380	291550	272250	346860	429330			
	2	90	600	2140	5610	9570	23360	48450	89750	153120	214950	289560	372030	618890	834870	
	3	50	330	1200	3150	5380	13140	27250	50480	86130	137960	209350	291820	551490	767470	1285830
	4	20	150	530	1400	2390	5840	12110	22440	38280	61310	93450	136830	358910	574890	1093260
	5	10	80	300	790	1340	3280	6810	12620	21530	34490	52570	76960	201950	344510	823650
	6		40	130	350	600	1460	3030	5610	9570	15330	23360	34210	89750	153120	373820

Loads given in lbs/force

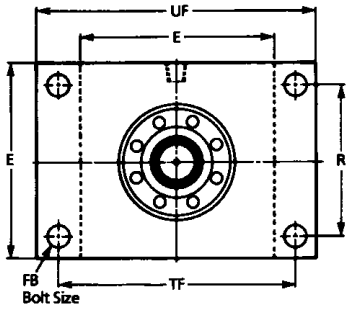
FRONT FLANGE

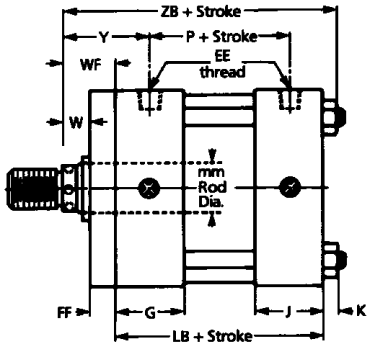
Mountings

Front Flange Mount – Style FF



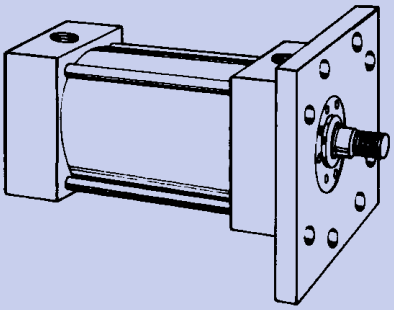
(NFPA style MF1)



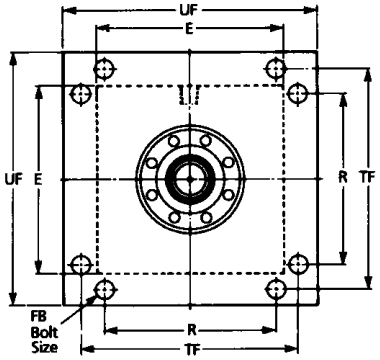


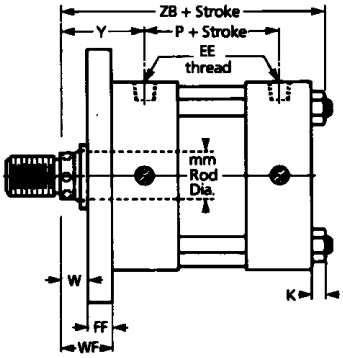
See note opposite re pressure limitation

Front Flange Extra Mount – Style FFX

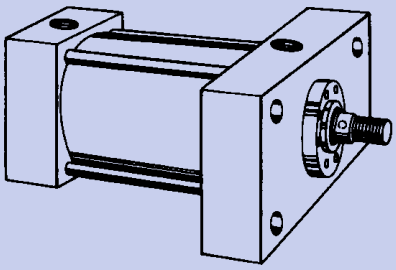


(NFPA style MF5)

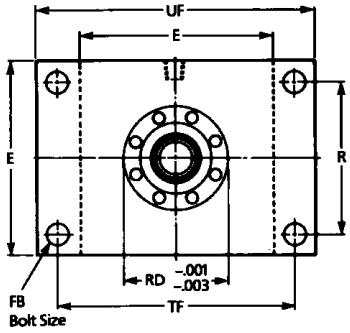


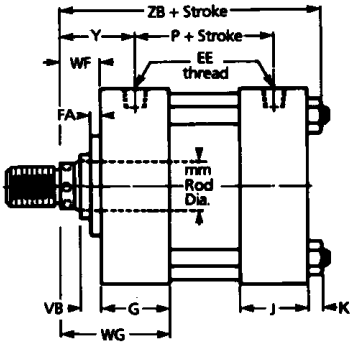


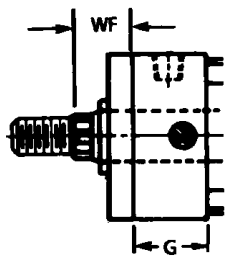
Front Head Flange Mount – Style FHF



(NFPA style ME5)







Drawing A

Important Notice

There is a construction variance in $1^1/_8$", $1^1/_2$", 2" and $2^1/_2$" bore sizes and in the $3^1/_4$" bore with a 2" diameter rod. On the Front Flange (FF) and Front Flange Extra (FFX) Mounts, in these sizes, the round retainer shown above is not used. The tie rods thread into the flange, and the flange serves as the rod gland retainer. Hence, in these sizes, the gland cannot be removed without loosening the tie rods. The basic cylinder dimensions shown above do not change. See drawing A.

On the Front Head Flange Mount (FHF), in these sizes, the retainer is the same rectangular size as the head. Tie rods thread into the retainer and the retainer holds in the packing gland. Hence, in these sizes the gland cannot be removed without loosening the tie rods. Dimensions for these sizes of the FHF Mount Cylinders can be obtained from the Front Flange Mount (FF) charting. Mounting bolts will clear through both the flange (FF dimension) and the head (G dimension).

FRONT FLANGE

Dimensions 1 1/8" through 14" bores

Be sure to add Stroke to this Dimension

Bore	MM Rod Dia.	FA	RD ■	VB	W	WF	WG	Y	ZB
1 1/8	5/8 std.	–	–	–	5/8	1 1/8	2 1/4	1 23/32	4 5/8
1 1/2	5/8 std.	–	–	–	5/8	1 1/4	2 3/4	2	5 15/16
	1 2:1	–	–	–	1	1 5/8	3 1/8	2 3/8	6 5/16
2	1 std.	–	–	–	3/4	1 1/2	3 1/8	2 3/8	6 7/16
	1 3/8 2:1	–	–	–	1	1 3/4	3 3/8	2 5/8	6 11/16
2 1/2	1 std.	–	–	–	3/4	1 1/2	3 1/8	2 3/8	6 9/16
	1 3/8	–	–	–	1	1 3/4	3 3/8	2 5/8	6 13/16
	1 3/4 2:1	–	–	–	1 1/4	2	3 5/8	2 7/8	7 1/16
3 1/4	1 3/8 std.	11/16	3.187	1	7/8	1 5/8	3 5/8	2 3/4	7 11/16
	1 3/4	11/16	3.50	1 1/8	1 1/8	1 7/8	3 7/8	3	7 15/16
	2 2:1	–	–	–	1 1/4	2	4	3 1/8	8 1/16
4	1 3/4 std.	11/16	3.50	1 1/8	1	1 7/8	3 7/8	3	8 3/16
	2	13/16	4.00	1 1/8	1 1/8	2	4	3 1/8	8 5/16
	2 1/2 2:1	13/16	4.312	1 1/4	1 3/8	2 1/4	4 1/4	3 3/8	8 9/16
5	2 std.	13/16	4.00	1 1/8	1 1/8	2	4	3 1/8	9
	2 1/2	13/16	4.312	1 1/4	1 3/8	2 1/4	4 1/4	3 3/8	9 1/4
	3	13/16	5.25	1 1/4	1 3/8	2 1/4	4 1/4	3 3/8	9 1/4
	3 1/2 2:1	13/16	5.625	1 1/4	1 3/8	2 1/4	4 1/4	3 3/8	9 1/4
6	2 1/2 std.	13/16	4.312	1 1/4	1 1/4	2 1/4	4 5/8	3 1/2	10 1/2
	3	13/16	5.25	1 1/4	1 1/4	2 1/4	4 5/8	3 1/2	10 1/2
	3 1/2	13/16	5.625	1 1/4	1 1/4	2 1/4	4 5/8	3 1/2	10 1/2
	4 2:1	15/16	6.25	1 1/4	1 1/4	2 1/4	4 5/8	3 1/2	10 1/2
7	3 std.	13/16	5.25	1 1/4	1 1/4	2 1/4	5 1/8	3 13/16	11 3/4
	3 1/2	13/16	5.625	1 1/4	1 1/4	2 1/4	5 1/8	3 13/16	11 3/4
	4	15/16	6.25	1 1/4	1 1/4	2 1/4	5 1/8	3 13/16	11 3/4
	4 1/2	15/16	6.625	1 1/4	1 1/4	2 1/4	5 1/8	3 13/16	11 3/4
	5 2:1	15/16	7.312	1 1/4	1 1/4	2 1/4	5 1/8	3 13/16	11 3/4
8	3 1/2 std.	13/16	5.625	1 1/4	1 1/4	2 1/4	5 1/2	3 15/16	12 13/16
	4	15/16	6.25	1 1/4	1 1/4	2 1/4	5 1/2	3 15/16	12 13/16
	4 1/2	15/16	6.625	1 1/4	1 1/4	2 1/4	5 1/2	3 15/16	12 13/16
	5	15/16	7.312	1 1/4	1 1/4	2 1/4	5 1/2	3 15/16	12 13/16
	5 1/2 2:1	15/16	7.812	1 1/4	1 1/4	2 1/4	5 1/2	3 15/16	12 13/16
10	4 1/2 std.	1 5/8	6.625	1 15/16	1 1/4	2 15/16	6 13/16	5	16 9/16
	5	1 5/8	7.312	2 3/16	1 1/2	3 3/16	7 1/16	5 1/4	16 13/16
	5 1/2	1 5/8	7.812	2 3/16	1 1/2	3 3/16	7 1/16	5 1/4	16 13/16
	7 2:1	1 5/8	10.00	2 3/16	2	3 11/16	7 9/16	5 3/4	17 5/16
12	5 1/2 std.	1 5/8	7.812	2 3/16	1 1/4	3 3/16	8 1/16	5 3/4	19 7/16
	7	1 5/8	10.00	2 3/16	1 7/8	3 13/16	8 11/16	6 3/8	20 1/16
	8 2:1	1 7/8	11.50	2 7/16	2 7/16	4 3/8	9 1/4	6 15/16	20 5/8
14	7 std.	2 3/8	10.00	2 13/16	1 7/8	4 5/16	9 11/16	7 7/16	23 1/4
	10 2:1	2 3/8	13.75	2 15/16	2 1/2	4 15/16	10 5/16	8 1/16	23 7/8

■ Close pilot tolerances on the FHF Mount only.

Front Flange Mount

GOOD

While this style of mount is a widely used one, its use should be restricted to pressures under 1000 psi, short strokes (under 36") and standard rod diameters for push applications. Note that the Front Head Flange mount has the same mounting hole pattern.

Front Flange Extra Mount

BETTER

Satisfactory for maximum operating pressure and long strokes if properly applied. **See pages 12 and 13** for detailed mounting data and **page 16** for long stroke information.

Front Head Flange Mount

BEST

Highly recommended. This is the best style of flange mounting. With this style, the cylinder can be mounted on the back face of the Head Flange if desired. This mounting style is used extensively on high tonnage presses and other heavy duty applications. To dimensionally interchange with the FF Mount, **see page 6** for Front Head Flange Spacer Bars.

We highly recommend that consideration be given to the use of a Style 6 rod end **(see page 36)** and S.A.F.E. Coupling **(page 7)** to achieve good radial alignment.

Selection of piston rod diameter can be determined by consulting **page 19**.

Note:
Pressure Limitations
For mounting style FF in a push application, the maximum working pressure is 1000 psi.

See pages 12–13 for information concerning the application of Flange Mount cylinders.

Be sure to add Stroke to these Dimensions

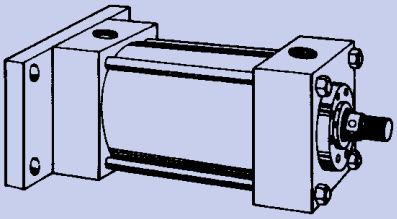
Bore	E	EE Thread	FB ■	FF	G	J	K	LB	P	R	TF	UF
1 1/8	1 3/4	1/4	1/4	1/2	1 1/8	1	1/4	3 1/4	2 3/16	1.19	2 3/8	3
1 1/2	2 1/2	1/2	3/8	5/8	1 1/2	1 1/2	5/16	4 3/8	2 7/8	1.63	3 7/16	4 1/4
2	3	1/2	1/2	3/4	1 5/8	1 1/2	7/16	4 1/2	2 7/8	205	4 1/8	5 1/8
2 1/2	3 1/2	1/2	1/2	3/4	1 5/8	1 1/2	7/16	4 5/8	3	2.55	4 5/8	5 5/8
3 1/4	4 1/2	3/4	5/8	3/4	2	1 3/4	9/16	5 1/2	3 1/2	3.25	5 7/8	7 1/8
4	5	3/4	5/8	7/8	2	1 3/4	9/16	5 3/4	3 3/4	3.82	6 3/8	7 5/8
5	6 1/2	3/4	7/8	7/8	2	1 3/4	3/4	6 1/4	4 1/4	4.95	8 3/16	9 3/4
6	7 1/2	1	1	1	2 3/8	2 3/8	7/8	7 3/8	4 7/8	5.73	9 7/16	11 1/4
7	8 1/2	1 1/4	1 1/8	1	2 7/8	2 7/8	1	8 1/2	5 3/8	6.58	10 5/8	12 5/8
8	9 1/2	1 1/2	1 1/4	1	3 1/4	3 1/4	1 1/16	9 1/2	6 1/8	7.50	11 13/16	14
10	12 5/8	2	1 3/4	1 11/16	3 7/8	3 7/8	1 1/2	12 1/8	8	9.62	15 7/8	19
12	14 7/8	2 1/2	2	1 15/16	4 7/8	4 7/8	1 3/4	14 1/2	9 3/8	11.45	18 1/2	22
14	17 1/4	2 1/2	2 1/4	2 7/16	5 3/8	5 3/8	1 15/16	17	10 3/4	13.34	21 1/8	25 1/4

■ Clearance holes for indicated bolt size.

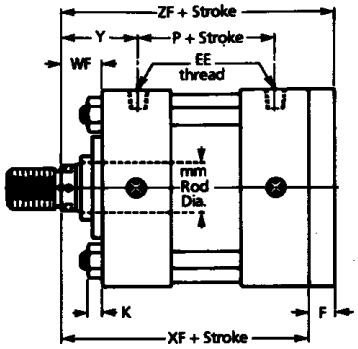
REAR FLANGE

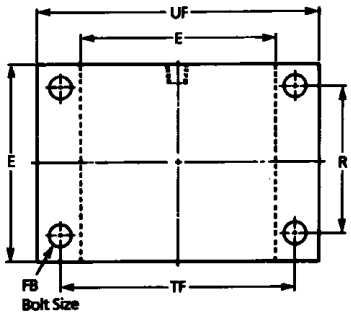
Mountings

Rear Flange Mount – Style RF



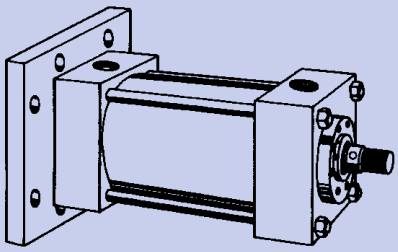
(NFPA style MF2)



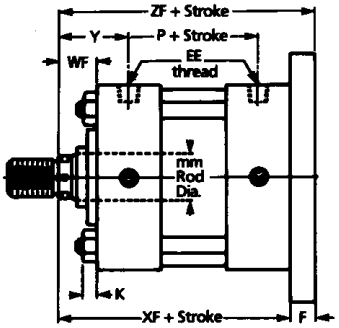


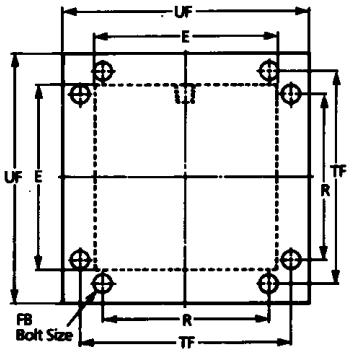
See note opposite re pressure limitation

Rear Flange Extra Mount – Style RFX

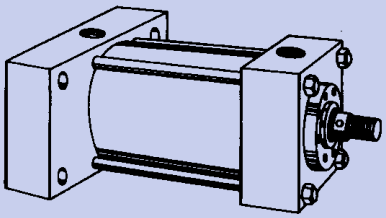


(NFPA style MF6)

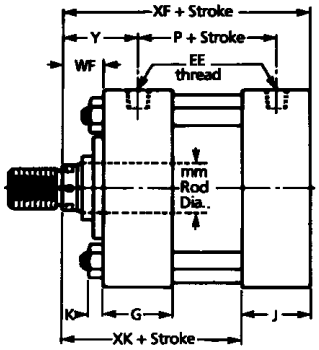


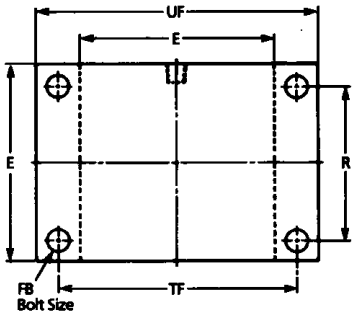


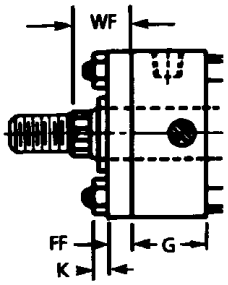
Rear Head Flange Mount – Style RHF



(NFPA style ME6)







Drawing A

Important Notice

There is a construction variance in $1^1/_8$", $1^1/_2$", 2" and $2^1/_2$" bore sizes and in the $3^1/_4$" bore with a 2" diameter rod. The round retainer shown above is not used on these sizes. A square retainer, the same square size as the head is employed. The retainer is cleared for the tie rods and held in place with the tie rod nuts.

In these sizes, the rod gland cannot be removed without loosening the tie rods.

Dimensions are shown on the adjacent drawing A.

On all other sizes, a round rod gland retainer is used. It is held in place by retainer screws – independent of the tie rods, hence, the rod gland can be removed without loosening the tie rods.

REAR FLANGE

Dimensions 1 1/8" through 14" bores

Be sure to add Stroke to these Dimensions

Bore	MM Rod Dia.	WF	XF	XK	Y	ZF
1 1/8	5/8 std.	1 1/8	4 3/8	3 3/8	1 23/32	4 3/4
1 1/2	5/8 std.	1 1/4	5 5/8	4 1/8	2	6
	1 2:1	1 5/8	6	4 1/2	2 3/8	6 3/8
2	1 std.	1 1/2	6	4 1/2	2 3/8	6 5/8
	1 3/8 2:1	1 3/4	6 1/4	4 3/4	2 5/8	6 7/8
2 1/2	1 std.	1 1/2	6 1/8	4 5/8	2 3/8	6 3/4
	1 3/8	1 3/4	6 3/8	4 7/8	2 5/8	7
	1 3/4 2:1	2	6 5/8	5 1/8	2 7/8	7 1/4
3 1/4	1 3/8 std.	1 5/8	7 1/8	5 3/8	2 3/4	7 7/8
	1 3/4	1 7/8	7 3/8	5 5/8	3	8 1/8
	2 2:1	2	7 1/2	5 3/4	3 1/8	8 1/4
4	1 3/4 std.	1 7/8	7 5/8	5 7/8	3	8 1/2
	2	2	7 3/4	6	3 1/8	8 5/8
	2 1/2 2:1	2 1/4	8	6 1/4	3 3/8	8 7/8
5	2 std.	2	8 1/4	6 1/2	3 1/8	9 1/8
	2 1/2	2 1/4	8 1/2	6 3/4	3 3/8	9 3/8
	3	2 1/4	8 1/2	6 3/4	3 3/8	9 3/8
	3 1/2 2:1	2 1/4	8 1/2	6 3/4	3 3/8	9 3/8
6	2 1/2 std.	2 1/4	9 5/8	7 1/4	3 1/2	10 5/8
	3	2 1/4	9 5/8	7 1/4	3 1/2	10 5/8
	3 1/2	2 1/4	9 5/8	7 1/4	3 1/2	10 5/8
	4 2:1	2 1/4	9 5/8	7 1/4	3 1/2	10 5/8
7	3 std.	2 1/4	10 3/4	7 7/8	3 13/16	11 3/4
	3 1/2	2 1/4	10 3/4	7 7/8	3 13/16	11 3/4
	4	2 1/4	10 3/4	7 7/8	3 13/16	11 3/4
	4 1/2	2 1/4	10 3/4	7 7/8	3 13/16	11 3/4
	5 2:1	2 1/4	10 3/4	7 7/8	3 13/16	11 3/4
8	3 1/2 std.	2 1/4	11 3/4	8 1/2	3 15/16	12 3/4
	4	2 1/4	11 3/4	8 1/2	3 15/16	12 3/4
	4 1/2	2 1/4	11 3/4	8 1/2	3 15/16	12 3/4
	5	2 1/4	11 3/4	8 1/2	3 15/16	12 3/4
	5 1/2 2:1	2 1/4	11 3/4	8 1/2	3 15/16	12 3/4
10	4 1/2 std.	2 15/16	15 1/16	11 3/16	5	16 3/4
	5	3 3/16	15 5/16	11 7/16	5 1/4	17
	5 1/2	3 3/16	15 5/16	11 7/16	5 1/4	17
	7 2:1	3 11/16	15 13/16	11 15/16	5 3/4	17 1/2
12	5 1/2 std.	3 3/16	17 11/16	12 13/16	5 3/4	19 5/8
	7	3 13/16	18 5/16	13 7/16	6 3/8	20 1/4
	8 2:1	4 3/8	18 7/8	14	6 15/16	20 13/16
14	7 std.	4 5/16	21 5/16	15 15/16	7 7/16	23 3/4
	10 2:1	4 15/16	21 15/16	16 9/16	8 1/16	24 3/8

Rear Flange Mount

GOOD

While this style of mount is a widely used one, its use should be restricted to pressures under 1000 psi, short strokes (under 36") and standard rod diameters for pull applications. Note that the Rear Head Flange mount has the same mounting hole pattern.

Rear Flange Extra Mount

BETTER

Satisfactory for maximum operating pressure and long strokes if properly applied. **See pages 12 and 13** for detailed mounting data and **page 16** for long stroke information.

Rear Head Flange Mount

BEST

Highly recommended. This is the best style of flange mounting. With this style, the cylinder can be mounted on the back face of the flange if desired. This mounting style is used extensively on high tonnage presses and other heavy duty applications.

We highly recommend that consideration be given to the use of a Style 6 rod end **(see page 36)** and S.A.F.E. Coupling **(page 7)** to achieve good radial alignment.

Selection of piston rod diameter can be determined by consulting **page 19**.

Note:
Pressure Limitations
For mounting style RF in a pull application, the maximum working pressure is 1000 psi.

See pages 12–13 for information concerning the application of Flange Mount cylinders.

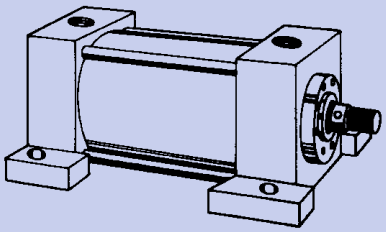
Be sure to add Stroke to this Dimension

Bore	E	EE Thread	F	FB ■	FF	G	J	K	P	R	TF	UF
1 1/8	1 3/4	1/4	3/8	1/4	1/2	1 1/8	1	1/4	2 3/16	1.19	2 3/8	3
1 1/2	2 1/2	1/2	3/8	3/8	5/8	1 1/2	1 1/2	5/16	2 7/8	1.63	3 7/16	4 1/4
2	3	1/2	5/8	1/2	3/4	1 5/8	1 1/2	7/16	2 7/8	2.05	4 1/8	5 1/8
2 1/2	3 1/2	1/2	5/8	1/2	3/4	1 5/8	1 1/2	7/16	3	2.55	4 5/8	5 5/8
3 1/4	4 1/2	3/4	3/4	5/8	3/4	2	1 3/4	9/16	3 1/2	3.25	5 7/8	7 1/8
4	5	3/4	7/8	5/8	–	2	1 3/4	9/16	3 3/4	3.82	6 3/8	7 5/8
5	6 1/2	3/4	7/8	7/8	–	2	1 3/4	3/4	4 1/4	4.95	8 3/16	9 3/4
6	7 1/2	1	1	1	–	2 3/8	2 3/8	7/8	4 7/8	5.73	9 7/16	11 1/4
7	8 1/2	1 1/4	1	1 1/8	–	2 7/8	2 7/8	1	5 3/8	6.58	10 5/8	12 5/8
8	9 1/2	1 1/2	1	1 1/4	–	3 1/4	3 1/4	1 1/16	6 1/8	7.50	11 13/16	14
10	12 5/8	2	1 11/16	1 3/4	–	3 7/8	3 7/8	1 1/2	8	9.62	15 7/8	19
12	14 7/8	2 1/2	1 15/16	2	–	4 7/8	4 7/8	1 3/4	9 3/8	11.45	18 1/2	22
14	17 1/4	2 1/2	2 7/16	2 1/4	–	5 3/8	5 3/8	1 15/16	10 3/4	13.34	21 1/8	25 1/4

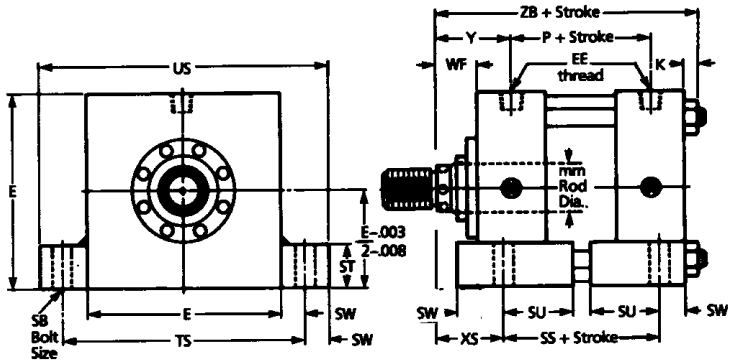
■ Clearance holes for indicated bolt size.

LUG MOUNTINGS

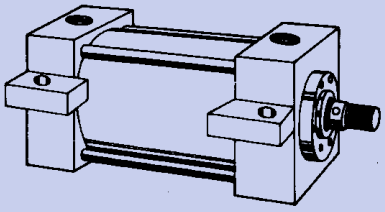
Side Lug Mount – Style SL



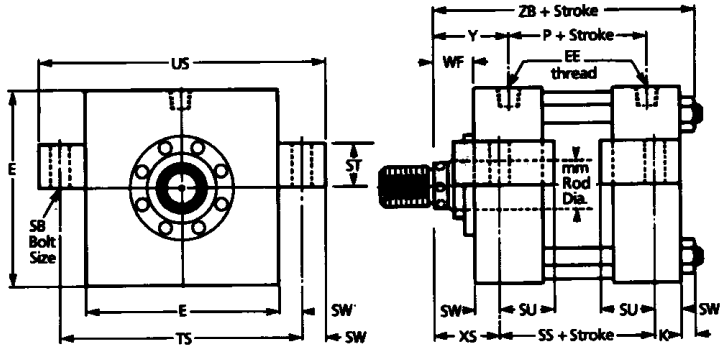
(NFPA style MS2)



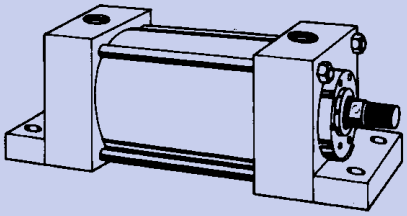
Centre Line Lug Mount – Style CL



(NFPA style MS3)

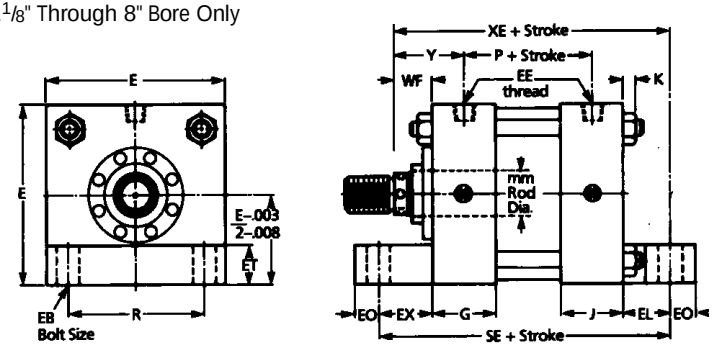


End Lug Mount – Style EL

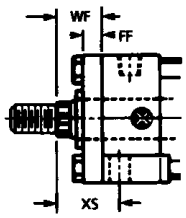


(NFPA style MS7)

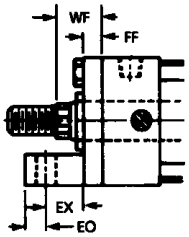
Available 1 1/8" Through 8" Bore Only



DWG. A



DWG. B



Important Notice

There is a construction variance in 1 1/8", 1 1/2", 2" and 2 1/2" bore sizes and in the 3 1/4" bore with a 2" diameter rod. The round retainer shown above is not used on these sizes. A square retainer, the same square size as the head, is employed. In the SL and CL Mounts, the retainer is held in place with retainer screws that thread into the head. The rod gland can be removed without loosening the tie rods in all bore sizes. See Dwg. A.

The EL Mount also employs a square retainer in these sizes. The bottom two tie rods thread into the lug and the top two tie rods have tie rod nuts. This assembly method is used on all bore sizes. The rod gland cannot be removed without loosening the tie rods in any bore size. See adjacent Dwg. B for details on 1 1/8", 1 1/2" and 2 1/2" bore sizes and in the 3 1/4" bore with a 2" diameter rod.

For Mounting styles SL and EL see note on page 15 concerning Thrust key.

LUG DIMENSIONS

Dimensions 1 1/8" through 14" bores

Be sure to add Stroke to these Dimensions

Bore	MM Rod Dia.	EX	WF	XE	XS	Y	ZB
1 1/8	5/8 std.	3/4	1 1/8	5 1/8	1 3/8	1 23/32	4 5/8
1 1/2	5/8 std.	7/8	1 1/4	6 1/2	1 3/8	2	5 15/16
	1 2:1	7/8	1 5/8	6 7/8	1 3/4	2 3/8	6 5/16
2	1 std.	15/16	1 1/2	6 15/16	1 7/8	2 3/8	6 7/16
	1 3/8 2:1	15/16	1 3/4	7 3/16	2 1/8	2 5/8	6 11/16
2 1/2	1 std.	15/16	1 1/2	7 1/16	2 1/16	2 3/8	6 9/16
	1 3/8	15/16	1 3/4	7 5/16	2 5/16	2 5/8	6 13/16
	1 3/4 2:1	15/16	2	7 9/16	2 9/16	2 7/8	7 1/16
3 1/4	1 3/8 std.	1 7/8	1 5/8	8 1/4	2 5/16	2 3/4	7 11/16
	1 3/4	1 7/8	1 7/8	8 1/2	2 9/16	3	7 15/16
	2 2:1	1 1/8	2	8 5/8	2 11/16	3 1/8	8 1/16
4	1 3/4 std.	2	1 7/8	8 3/4	2 3/4	3	8 3/16
	2	2	2	8 7/8	2 7/8	3 1/8	8 5/16
	2 1/2 2:1	2	2 1/4	9 1/8	3 1/8	3 3/8	8 9/16
5	2 std.	2 3/8	2	9 3/4	2 7/8	3 1/8	9
	2 1/2	2 3/8	2 1/4	10	3 1/8	3 3/8	9 1/4
	3	2 3/8	2 1/4	10	3 1/8	3 3/8	9 1/4
	3 1/2 2:1	2 3/8	2 1/4	10	3 1/8	3 3/8	9 1/4
6	2 1/2 std.	2 11/16	2 1/4	11 5/16	3 3/8	3 1/2	10 1/2
	3	2 11/16	2 1/4	11 5/16	3 3/8	3 1/2	10 1/2
	3 1/2	2 11/16	2 1/4	11 5/16	3 3/8	3 1/2	10 1/2
	4 2:1	2 11/16	2 1/4	11 5/16	3 3/8	3 1/2	10 1/2
7	3 std.	2 13/16	2 1/4	12 9/16	3 5/8	3 13/16	11 3/4
	3 1/2	2 13/16	2 1/4	12 9/16	3 5/8	3 13/16	11 3/4
	4	2 13/16	2 1/4	12 9/16	3 5/8	3 13/16	11 3/4
	4 1/2	2 13/16	2 1/4	12 9/16	3 5/8	3 13/16	11 3/4
	5 2:1	2 13/16	2 1/4	12 9/16	3 5/8	3 13/16	11 3/4
8	3 1/2 std.	3	2 1/4	13 3/4	3 5/8	3 15/16	12 13/16
	4	3	2 1/4	13 3/4	3 5/8	3 15/16	12 13/16
	4 1/2	3	2 1/4	13 3/4	3 5/8	3 15/16	12 13/16
	5	3	2 1/4	13 3/4	3 5/8	3 15/16	12 13/16
	5 1/2 2:1	3	2 1/4	13 3/4	3 5/8	3 15/16	12 13/16
10	4 1/2 std.	–	2 15/16	–	4 9/16	5	16 9/16
	5	–	3 3/16	–	4 13/16	5 1/4	16 13/16
	5 1/2	–	3 3/16	–	4 13/16	5 1/4	16 13/16
	7 2:1	–	3 11/16	–	5 5/16	5 3/4	17 5/16
12	5 1/2 std.	–	3 3/16	–	5 3/16	5 3/4	19 7/16
	7	–	3 13/16	–	5 13/16	6 3/8	20 1/16
	8 2:1	–	4 3/8	–	6 3/8	6 15/16	20 5/8
14	7 std.	–	4 5/16	–	6 9/16	7 7/16	23 1/4
	10 2:1	–	4 15/16	–	7 3/16	8 1/16	23 7/8

Lug Mountings

CAUTION

When specifying a Side Lug Mount with ports on the Side (port positions 2, 4, 6 or 8), be sure that there will be enough clearnce between the port fitting and the lug to insert a bolt or capscrew into the lug. In small bore sizes, it may even be necessary to employ a pipe nipple to easily pipe the port.

When specifying an End Lug Mount, carefully check the distance between the rod end and the lug to determine sufficient clearance for rod end attachment. It may be necessary to add extra plain rod extension to move the threaded rod end out beyond the lug. When using a rod eye or rod clevis, we recommend the following extra plain rod extensions be specified:

Bore	Rod Dia.	Extra Plain Rod Ext.
1 1/8	5/8	1/2
1 1/2	5/8	3/4
	1	3/8
2	1	13/16
	1 3/8	9/16
2 1/2	1	13/16
	1 3/8	9/16
	1 3/4	5/16
3 1/4	1 3/8	1
	1 3/4	3/4
	2	5/8
4	1 3/4	7/8
	2	3/4
	2 1/2	1/2
5	2	1 1/4
	2 1/2	1
	3	1
	3 1/2	1
6	ALL	1 7/16
7	ALL	1 11/16
8	ALL	2

Consult **pages 12 and 13** for information concerning the selection and application of lug mount cylinders. See **page 16** for long stroke cylinder data. Selection of piston rod diameter can be determined from inforamtion on **page 19**.

Be sure to add Stroke to these Dimensions

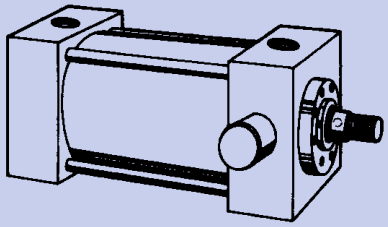
Bore	E	EB ■	EE Thrd	EL	EO	ET	FF	G	J	K	P	R	SB ■	SE *	SS	ST	SU	SW	TS	US
1 1/8	1 3/4	1/4	1/4	3/4	1/4	1/2	1/2	1 1/8	1	1/4	2 3/16	1.19	5/16	5 1/4	2 5/8	1/2	15/16	3/8	2 1/2	3 1/4
1 1/2	2 1/2	3/8	1/2	7/8	3/8	7/8	5/8	1 1/2	1 1/2	5/16	2 7/8	1.63	3/8	6 3/4	3 7/8	1/2	15/16	3/8	3 1/4	4
2	3	1/2	1/2	15/16	1/2	1	3/4	1 5/8	1 1/2	7/16	2 7/8	2.05	1/2	7 1/8	3 5/8	3/4	1 1/4	1/2	4	5
2 1/2	3 1/2	1/2	1/2	15/16	1/2	1	3/4	1 5/8	1 1/2	7/16	3	2.55	3/4	7 1/4	3 3/8	1	1 9/16	11/16	4 7/8	6 1/4
3 1/4	4 1/2	5/8	3/4	1 1/8	5/8	1 1/4	3/4	2	1 3/4	9/16	3 1/2	3.25	3/4	8 1/2	4 1/8	1	1 9/16	11/16	5 7/8	7 1/4
4	5	5/8	3/4	1 1/8	5/8	1 1/4	–	2	1 3/4	9/16	3 3/4	3.82	1	8 7/8	4	1 1/4	2	7/8	6 3/4	8 1/2
5	6 1/2	7/8	3/4	1 1/2	3/4	1 1/2	–	2	1 3/4	3/4	4 1/4	4.95	1	10 1/8	4 1/2	1 1/4	2	7/8	8 1/4	10
6	7 1/2	1	1	1 11/16	7/8	1 3/4	–	2 3/8	2 3/8	7/8	4 7/8	5.73	1 1/4	11 3/4	5 1/8	1 1/2	2 1/2	1 1/8	9 3/4	12
7	8 1/2	1 1/8	1 1/4	1 13/16	1	2	–	2 7/8	2 7/8	1	5 3/8	6.58	1 1/2	13 1/8	5 3/4	1 3/4	2 7/8	1 3/8	11 1/4	14
8	9 1/2	1 1/4	1 1/2	2	1 1/8	2	–	3 1/4	3 1/4	1 1/16	6 1/8	7.50	1 1/2	14 1/2	6 3/4	1 3/4	2 7/8	1 3/8	12 1/4	15
10	12 5/8	–	2	–	–	–	–	3 7/8	3 7/8	1 1/2	8	–	1 1/2	–	8 7/8	2 1/4	3 1/2	1 5/8	15 7/8	19 1/8
12	14 7/8	–	2 1/2	–	–	–	–	4 7/8	4 7/8	1 3/4	9 3/8	–	1 1/2	–	10 1/2	3	4 1/4	2	18 7/8	22 7/8
14	17 1/4	–	2 1/2	–	–	–	–	5 3/8	5 3/8	1 15/16	10 3/4	–	2 1/4	–	12 1/2	3 1/2	4 3/4	2 1/4	21 3/4	26 1/4

■ Clearance holes for indicated bolt size.

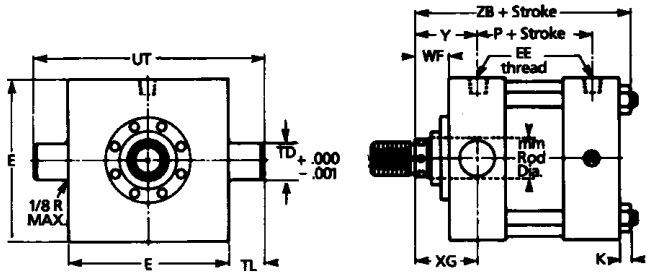
* Consult factory for dimension change if EL mounting is used with a thrust key.

TRUNNION MOUNTINGS

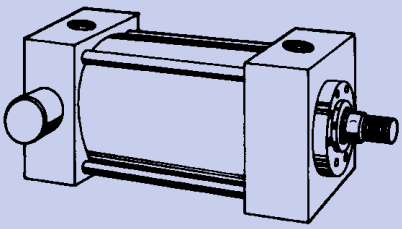
Trunnion Front Mount – Style TF



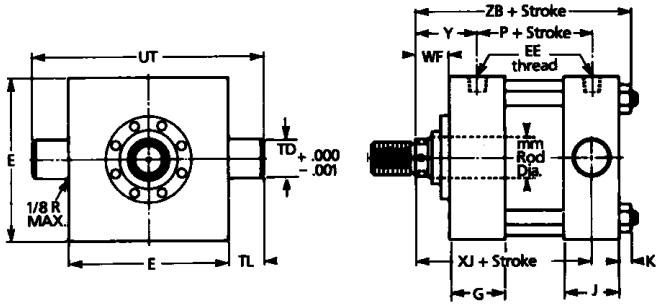
(NFPA style MT1)



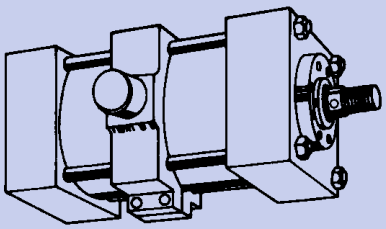
Trunnion Rear Mount – Style TR



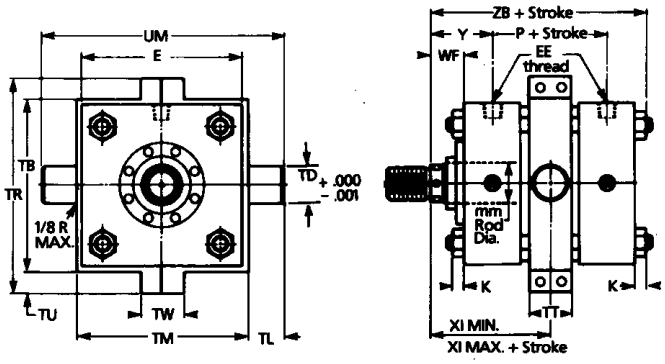
(NFPA style MT2)

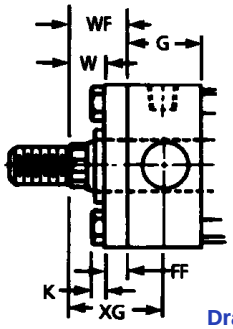


Trunnion Mount – Style T



(NFPA style MT4)





Drawing A

Important Notice

There is a construction variance in $1^1/_8$", $1^1/_2$", 2" and $2^1/_2$" bore sizes and in the $3^1/_4$" bore with a 2" diameter rod. The round retainer shown above is not used on these sizes. A square retainer, the same square size as the head, is employed. In the TF and TR Mounts, the retainer is held in place with retainer screws that thread into the head. The rod gland can be removed without loosening the tie rods in all bore sizes.

The T Mount also employs a square gland retainer in these sizes but it is held in place with tie rod nuts. The rod gland cannot be removed without loosening the tie rods in these sizes.

See adjacent drawing A for deatils regarding these sizes.

X1 dimension is to be specified by customer. Position is not adjustable.

TRUNNION DIMENSIONS

Dimensions 1 1/8" through 14" bores

Be sure to add Stroke to these Dimensions

Bore	MM Rod Dia.	W	WF	XI MIN	XI MAX	XG	XJ	Y	ZB
1 1/8	5/8 std.	5/8	1 1/8	2 3/4	2 7/8	1 23/32	3 29/32	1 23/32	4 5/8
1 1/2	5/8 std.	5/8	1 1/4	3 3/8	3 1/2	2	4 7/8	2	5 15/16
	1 2:1	1	1 5/8	3 3/4	3 7/8	2 3/8	5 1/4	2 3/8	6 5/16
2	1 std.	3/4	1 1/2	3 7/8	3 3/4	2 3/8	5 1/4	2 3/8	6 7/16
	1 3/8 2:1	1	1 3/4	4 1/8	4	2 5/8	5 1/2	2 5/8	6 11/16
2 1/2	1 std.	3/4	1 1/2	3 7/8	3 7/8	2 3/8	5 3/8	2 3/8	6 9/16
	1 3/8	1	1 3/4	4 1/8	4 1/8	2 5/8	5 5/8	2 5/8	6 13/16
	1 3/4 2:1	1 1/4	2	4 3/8	4 3/8	2 7/8	5 7/8	2 7/8	7 1/16
3 1/4	1 3/8 std.	–	1 5/8	4 5/8	4 3/8	2 3/4	6 1/4	2 3/4	7 11/16
	1 3/4	–	1 7/8	4 7/8	4 5/8	3	6 1/2	3	7 15/16
	2 2:1	–	2	5	4 3/4	3 1/8	6 5/8	3 1/8	8 1/16
4	1 3/4 std.	–	1 7/8	5	4 3/4	3	6 3/4	3	8 3/16
	2	–	2	5 1/8	4 7/8	3 1/8	6 7/8	3 1/8	8 5/16
	2 1/2 2:1	–	2 1/4	5 3/8	5 1/8	3 3/8	7 1/8	3 3/8	8 9/16
5	2 std.	–	2	5 1/8	5 3/8	3 1/8	7 3/8	3 1/8	9
	2 1/2	–	2 1/4	5 3/8	5 5/8	3 3/8	7 5/8	3 3/8	9 1/4
	3	–	2 1/4	5 3/8	5 5/8	3 3/8	7 5/8	3 3/8	9 1/4
	3 1/2 2:1	–	2 1/4	5 3/8	5 5/8	3 3/8	7 5/8	3 3/8	9 1/4
6	2 1/2 std.	–	2 1/4	6 1/8	5 3/4	3 1/2	8 3/8	3 1/2	10 1/2
	3	–	2 1/4	6 1/8	5 3/4	3 1/2	8 3/8	3 1/2	10 1/2
	3 1/2	-	2 1/4	6 1/8	5 3/4	3 1/2	8 3/8	3 1/2	10 1/2
	4 2:1	–	2 1/4	6 1/8	5 3/4	3 1/2	8 3/8	3 1/2	10 1/2
7	3 std.	–	2 1/4	6 5/8	6 3/8	3 5/8	9 3/8	3 13/16	11 3/4
	3 1/2	–	2 1/4	6 5/8	6 3/8	3 5/8	9 3/8	3 13/16	11 3/4
	4	–	2 1/4	6 5/8	6 3/8	3 5/8	9 3/8	3 13/16	11 3/4
	4 1/2	–	2 1/4	6 5/8	6 3/8	3 5/8	9 3/8	3 13/16	11 3/4
	5 2:1	–	2 1/4	6 5/8	6 3/8	3 5/8	9 3/8	3 13/16	11 3/4
8	3 1/2 std.	–	2 1/4	7 1/4	6 3/4	3 3/4	10 1/4	3 15/16	12 13/16
	4	–	2 1/4	7 1/4	6 3/4	3 3/4	10 1/4	3 15/16	12 13/16
	4 1/2	–	2 1/4	7 1/4	6 3/4	3 3/4	10 1/4	3 15/16	12 13/16
	5	–	2 1/4	7 1/4	6 3/4	3 3/4	10 1/4	3 15/16	12 13/16
	5 1/2 2:1	–	2 1/4	7 1/4	6 3/4	3 3/4	10 1/4	3 15/16	12 13/16
10	4 1/2 std.	–	2 15/16	9 1/16	8 15/16	4 3/4	13 1/4	5	16 9/16
	5	–	3 3/16	9 5/16	9 3/16	5	13 1/2	5 1/4	16 13/16
	5 1/2	–	3 3/16	9 5/16	9 3/16	5	13 1/2	5 1/4	16 13/16
	7 2:1	–	3 11/16	9 13/16	9 11/16	5 1/2	14	5 3/4	17 5/16
12	5 1/2 std.	–	3 3/16	10 13/16	10 1/16	5 3/8	15 1/2	5 3/4	19 7/16
	7	–	3 13/16	11 7/16	10 11/16	6	16 1/8	6 3/8	20 1/16
	8 2:1	–	4 3/8	12	11 1/4	6 9/16	16 11/16	6 15/16	20 5/8
14	7 std.	–	4 5/16	12 11/16	12 15/16	6 27/32	18 25/32	7 7/16	23 1/4
	10 2:1	–	4 15/16	13 5/16	13 9/16	7 15/32	19 13/32	8 1/16	23 7/8

Trunnion Mountings

CAUTION

Trunnion mount cylinders in bore sizes 5" through 8" with oversize piston rods and bore sizes 10", 12" and 14" with all piston rod diameters should not be used over 2000 psi. If your application demands higher pressure, consult factory.

Trunnion pins are an integral part of the head (TF Mount), the cap (TR Mount), or the ring on the intermediate trunnion mount (T). Even though machining the pins as an integral part is the strongest, and most fatigue-resistant method, some attention should be given to proper mounting of trunnion cylinders.

Pillow blocks of ample size and rigidity should be provided and should be mounted as close to the head or cap as possible. Bearing should be provided for the full length of the trunnion pin. Pins are designed for shear loads only, not bending loads. Lubrication should be provided to the pins.

All trunnion cylinders need provision on both ends of pivoting in one direction. Alignment in the other direction is essential in order to avoid excessive side loading. Where two-direction pivoting is necessary, contact factory for specific recommendations.

Note:
Selection of piston rod diameter can be determined by consulting **page 19**.

See page 16 for information concerning the application of long stroke cylinders.

See pages 12 and 13 for additional data on cylinder mounting.

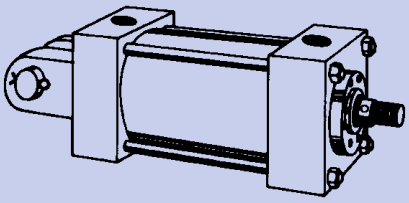
Be sure to add Stroke to this Dimension

Bore	E	EE Thread	FF	G	J	K	P	TB	TD	TL	TM	TR	TT	TU	TW	UM	UT
1 1/8	1 3/4	1/4	1/2	1 1/8	1	1/4	2 3/16	2 3/4	3/4	3/4	1 3/4		1			3 1/4	3 1/4
1 1/2	2 1/2	1/2	5/8	1 1/2	1 1/2	5/16	2 7/8	3 1/2	1	1	3		1 1/4			5	4 1/2
2	3	1/2	3/4	1 5/8	1 1/2	7/16	2 7/8	4	1 3/8	1 3/8	3 1/2		1 1/2			6 1/4	5 3/4
2 1/2	3 1/2	1/2	3/4	1 5/8	1 1/2	7/16	3	5	1 3/8	1 3/8	4		1 1/2			6 3/4	6 1/4
3 1/4	4 1/2	3/4	3/4	2	1 3/4	9/16	3 1/2	–	1 3/4	1 3/4	5	7	2	1	2 1/2	8 1/2	8
4	5	3/4	–	2	1 3/4	9/16	3 3/4	–	1 3/4	1 3/4	6	7 1/4	2 1/4	1	2 1/2	9 1/2	8 1/2
5	6 1/2	3/4	–	2	1 3/4	3/4	4 1/4	–	1 3/4	1 3/4	7	8 3/4	2 1/4	1	2 1/2	10 1/2	10
6	7 1/2	1	–	2 3/8	2 3/8	7/8	4 7/8	–	2	2	8 1/2	10 1/4	3	1	2 1/2	12 1/2	11 1/2
7	8 1/2	1 1/4	–	2 7/8	2 7/8	1	5 3/8	–	2 1/2	2 1/2	9 3/4	12	3	1 1/4	3	14 3/4	13 1/2
8	9 1/2	1 1/2	–	3 1/4	3 1/4	1 1/16	6 1/8	–	3	3	11	13	3 1/2	1 1/4	3 1/2	17	15 1/2
10	12 5/8	2	–	3 7/8	3 7/8	1 1/2	8	–	3 1/2	3 1/2	14	16 1/2	4 1/2	1 3/8	4	21	19 5/8
12	14 7/8	2 1/2	–	4 7/8	4 7/8	1 3/4	9 3/8	–	4	4	16 1/2	19 1/4	5 1/2	1 1/2	5	24 1/2	22 7/8
14	17 1/4	2 1/2	–	5 3/8	5 3/8	1 15/16	10 3/4	–	5	5	19 5/8	22 1/2	6	1 1/2	5	29 5/8	27 1/4

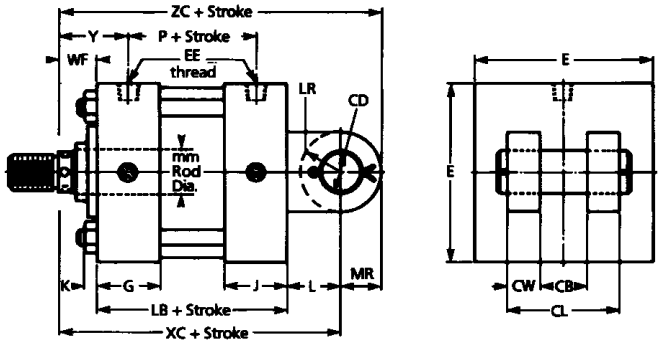
CLEVIS, SIDE FLUSH AND FOOT BRACKET

Mountings

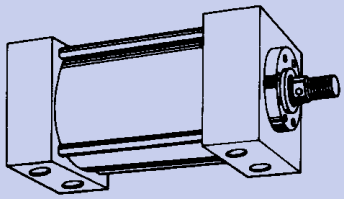
Clevis Mount – Style C



(NFPA style MP1)

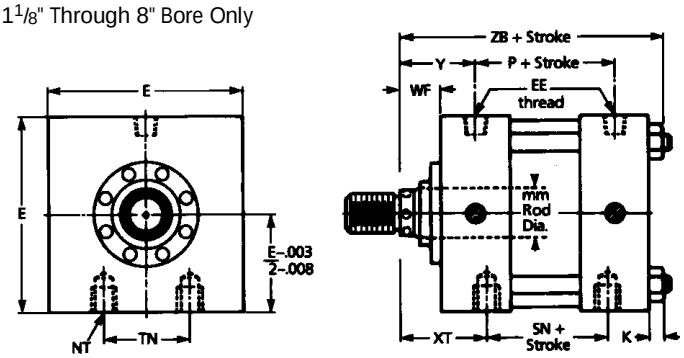


Side Flush Mount – Style SF

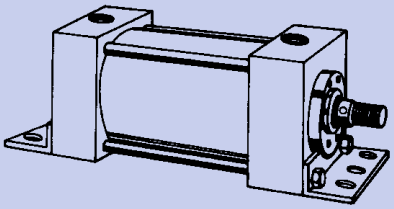


(NFPA style MS4)

Available $1^1/_8$" Through 8" Bore Only

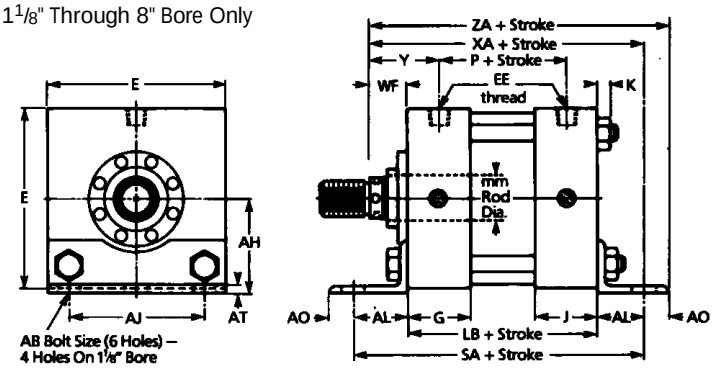


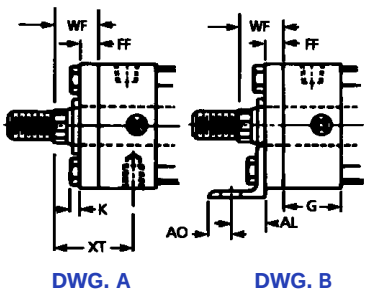
Foot Bracket Mount – Style FB



(NFPA style MS1)

Available $1^1/_8$" Through 8" Bore Only





DWG. A DWG. B

Important Notice

There is a construction variance in $1^1/_8$", $1^1/_2$", 2" and $2^1/_2$" bore sizes and in the $3^1/_4$" bore with a 2" diameter Piston rod.

The round rod gland retainer shown above is not used on these sizes. A square retainer the same square size as the head, is employed.

In the Clevis Mount, the retainer is held in place with tie rod nuts and the rod gland cannot be removed without loosening the tie rods. Retainer thickness is shown in adjacent Dwg. A.

In the Side Flush Mount, the retainer is held in place by retainer screws that thread into the head. The rod gland can be removed without loosening the tie rods. See Dwg. A.

In the Foot Bracket Mount, the retainer is held in place by retainer screws that thread into the head. The rod gland can be removed without loosening the tie rods. However, the front bracket must also be removed. See Dwg. B.

CLEVIS, SIDE FLUSH AND FOOT BRACKET

Dimensions 1 1/8" through 14" bores

Be sure to add Stroke to these Dimensions

Bore	MM Rod Dia.	SA	WF	XA	XC	XT	Y	ZA	ZB	ZC	Side flush thread depth
1 1/8	5/8 std.	5 3/4	1 1/8	5 3/8	5 5/16	1 25/32	1 23/32	5 3/4	4 5/8	5 3/4	3/8
1 1/2	5/8 std.	7	1 1/4	6 5/8	6 3/8	2	2	7	5 15/16	6 7/8	7/16
	1 2:1	7	1 5/8	7	6 3/4	2 3/8	2 3/8	7 3/8	6 5/16	7 1/4	7/16
2	1 std.	7 3/4	1 1/2	7 1/4	7 1/4	2 3/8	2 3/8	7 3/4	6 7/16	8	7/16
	1 3/8 2:1	7 3/4	1 3/4	7 1/2	7 1/2	2 5/8	2 5/8	8	6 11/16	8 1/4	7/16
2 1/2	1 std.	7 3/4	1 1/2	7 5/16	7 3/8	2 3/8	2 3/8	7 7/8	6 9/16	8 1/8	3/4
	1 3/8	7 3/4	1 3/4	7 9/16	7 5/8	2 5/8	2 5/8	8 1/8	6 13/16	8 3/8	3/4
	1 3/4 2:1	7 3/4	2	7 13/16	7 7/8	2 7/8	2 7/8	8 3/8	7 1/16	8 5/8	N.A.
3 1/4	1 3/8 std.	9 1/8	1 5/8	8 15/16	8 5/8	2 3/4	2 3/4	9 5/8	7 11/16	9 5/8	1
	1 3/4	9 1/8	1 7/8	9 3/16	8 7/8	3	3	9 7/8	7 15/16	9 7/8	7/8
	2 2:1	9 7/8	2	9 5/16	9	3 1/8	3 1/8	10	8 1/16	10	3/4
4	1 3/4 std.	10	1 7/8	9 3/4	9 3/4	3	3	10 5/8	8 3/16	11 1/8	1 1/8
	2	10	2	9 7/8	9 7/8	3 1/8	3 1/8	10 3/4	8 5/16	11 1/4	1
	2 1/2 2:1	10	2 1/4	10 1/8	10 1/8	3 3/8	3 3/8	11	8 9/16	11 1/2	N.A.
5	2 std.	10 1/2	2	10 3/8	10 1/2	3 1/8	3 1/8	11 1/4	9	12 1/4	1 3/8
	2 1/2	10 1/2	2 1/4	10 5/8	10 3/4	3 3/8	3 3/8	11 1/2	9 1/4	12 1/2	1 3/8
	3	10 1/2	2 1/4	10 5/8	10 3/4	3 3/8	3 3/8	11 1/2	9 1/4	12 1/2	1 1/4
	3 1/2 2:1	10 1/2	2 1/4	10 5/8	10 3/4	3 3/8	3 3/8	11 1/2	9 1/4	12 1/2	1
6	2 1/2 std.	12 1/4	2 1/4	12 1/16	12 1/8	3 1/2	3 1/2	13 1/8	10 1/2	14 1/8	1 3/4
	3	12 1/4	2 1/4	12 1/16	12 1/8	3 1/2	3 1/2	13 1/8	10 1/2	14 1/8	1 3/4
	3 1/2	12 1/4	2 1/4	12 1/16	12 1/8	3 1/2	3 1/2	13 1/8	10 1/2	14 1/8	1 1/2
	4 2:1	12 1/4	2 1/4	12 1/16	12 1/8	3 1/2	3 1/2	13 1/8	10 1/2	14 1/8	1 1/8
7	3 std.	14 7/8	2 1/4	13 15/16	13 3/4	3 13/16	3 13/16	15 1/4	11 3/4	16 1/4	2
	3 1/2	14 7/8	2 1/4	13 15/16	13 3/4	3 13/16	3 13/16	15 1/4	11 3/4	16 1/4	2
	4	14 7/8	2 1/4	13 15/16	13 3/4	3 13/16	3 13/16	15 1/4	11 3/4	16 1/4	1 5/8
	4 1/2	14 7/8	2 1/4	13 15/16	13 3/4	3 13/16	3 13/16	15 1/4	11 3/4	16 1/4	1 1/4
	5 2:1	14 7/8	2 1/4	13 15/16	13 3/4	3 13/16	3 13/16	15 1/4	11 3/4	16 1/4	N.A.
8	3 1/2 std.	15 7/8	2 1/4	14 15/16	15	3 15/16	3 15/16	16 1/4	12 13/16	17 3/4	2 1/4
	4	15 7/8	2 1/4	14 15/16	15	3 15/16	3 15/16	16 1/4	12 13/16	17 3/4	1 3/4
	4 1/2	15 7/8	2 1/4	14 15/16	15	3 15/16	3 15/16	16 1/4	12 13/16	17 3/4	1 3/4
	5	15 7/8	2 1/4	14 15/16	15	3 15/16	3 15/16	16 1/4	12 13/16	17 3/4	1 5/8
	5 1/2 2:1	15 7/8	2 1/4	14 15/16	15	3 15/16	3 15/16	16 1/4	12 13/16	17 3/4	1 1/2
10	4 1/2 std.	–	2 15/16	–	19 1/16	–	5	–	–	22 9/16	–
	5	–	3 3/16	–	19 5/16	–	5 1/4	–	–	22 13/16	–
	5 1/2	–	3 3/16	–	19 5/16	–	5 1/4	–	–	22 13/16	–
	7 2:1	–	3 11/16	–	19 13/16	–	5 3/4	–	–	23 5/16	–
12	5 1/2 std.	–	3 3/16	–	22 3/16	–	5 3/4	–	–	26 3/16	–
	7	–	3 13/16	–	22 13/16	–	6 3/8	–	–	26 13/16	–
	8 2:1	–	4 3/8	–	23 3/8	–	6 15/16	–	–	27 3/8	–
14	7 std.	–	4 5/16	–	27 13/16	–	7 7/16	–	–	32 13/16	–
	10 2:1	–	4 15/16	–	28 7/16	–	8 1/16	–	–	33 7/16	–

Side Flush Mount

Available 1 1/8" through 8" bore sizes only. Some bore and rod combinations are not available in this mount. See "Side Flush Thread depth" on adjacent chart. "NA" means not available.

The 1 1/8" bore has only one tapped hole in the head and in the cap.

Foot Bracket Mount

Available 1 1/8" through 8" bore sizes only. This style of mount is not recommended for pressures in excess of 1000 psi or strokes over 36 inches. Consider the use of an End Lug Mount shown on **page 24.**

Note:
For mounting style SF and FB, see note on **page 15** concerning Thrust Key

Note:
Selection of piston rod diameter can be determined by consulting **page 19**.

See page 16 for information concerning the application of long stroke cylinders.

See pages 12 and 13 for additional data on cylinder mounting.

Be sure to add Stroke to this Dimension

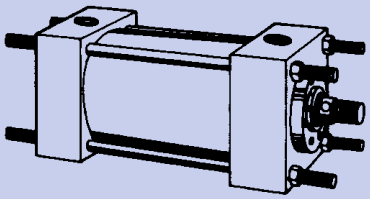
Bore	AB ■	AH	AJ	AL	AO	AT	CB	CD	CL	CW	E	EE Thrd	FF	G	J	K	L	LB	LR	MR	NT	P	SN	TN
1 1/8	5/16	1 1/16	1 1/8	1	3/8	1/8	5/8	3/8	1 1/4	5/16	1 3/4	1/4	1/2	1 1/8	1	1/4	15/16	3 1/4	9/16	3/8	5/16-18	2 3/16	2 1/16	–
1 1/2	3/8	1 3/8	1 3/4	1	3/8	1/8	3/4	1/2	1 3/4	1/2	2 1/2	1/2	5/8	1 1/2	1 1/2	5/16	3/4	4 3/8	1/2	1/2	3/8-16	2 7/8	2 7/8	3/4
2	1/2	1 11/16	2	1 1/4	1/2	1/8	1 1/4	3/4	2 1/2	5/8	3	1/2	3/4	1 5/8	1 1/2	7/16	1 1/4	4 1/2	3/4	3/4	1/2-13	2 7/8	2 7/8	15/16
2 1/2	5/8	1 15/16	2 3/8	1 3/16	9/16	1/8	1 1/4	3/4	2 1/2	5/8	3 1/2	1/2	3/4	1 5/8	1 1/2	7/16	1 1/4	4 5/8	3/4	3/4	5/8-11	3	3	1 5/16
3 1/4	3/4	2 9/16	3 1/8	1 13/16	11/16	1/4	1 1/2	1	3	3/4	4 1/2	3/4	3/4	2	1 3/4	9/16	1 1/2	5 1/2	1	1	3/4-10	3 1/2	3 1/2	1 1/2
4	1	2 13/16	3 1/4	2 1/8	7/8	1/4	2	1 3/8	4	1	5	3/4	–	2	1 3/4	9/16	2 1/8	5 3/4	1 3/8	1 3/8	1-8	3 3/4	3 3/4	2 1/16
5	1	3 11/16	4 3/4	2 1/8	7/8	5/16	2 1/2	1 3/4	5	1 1/4	6 1/2	3/4	–	2	1 3/4	3/4	2 1/4	6 1/4	1 3/4	1 3/4	1-8	4 1/4	4 1/4	2 15/16
6	1 1/4	4 1/4	5 3/8	2 7/16	1 1/16	3/8	2 1/2	2	5	1 1/4	7 1/2	1	–	2 3/8	2 3/8	7/8	2 1/2	7 3/8	2	2	1 1/4-7	4 7/8	5 1/8	3 5/16
7	1 1/2	4 15/16	5 7/8	3 3/16	1 5/16	1/2	3	2 1/2	6	1 1/2	8 1/2	1 1/4	–	2 7/8	2 7/8	1	3	8 1/2	2 1/2	2 1/2	1 1/2-6	5 3/8	5 7/8	3 3/4
8	1 1/2	5 1/2	6 7/8	3 3/16	1 5/16	1/2	3	3	6	1 1/2	9 1/2	1 1/2	–	3 1/4	3 1/4	1 1/16	3 1/4	9 1/2	2 3/4	2 3/4	1 1/2-6	6 1/8	6 5/8	4 1/4
10	–	–	–	–	–	–	4	3 1/2	8	2	12 5/8	2	–	3 7/8	3 7/8	1 1/2	4	12 1/8	3 1/2	3 1/2	–	8	–	–
12	–	–	–	–	–	–	4 1/2	4	9	2 1/4	14 7/8	2 1/2	–	4 7/8	4 7/8	1 3/4	4 1/2	14 1/2	4	4	–	9 3/8	–	–
14	–	–	–	–	–	–	6	5	12	3	17 1/4	2 1/2	–	5 3/8	5 3/8	1 15/16	6 1/2	17	5	5	–	10 3/4	–	–

■ Clearance holes for indicated bolt size.

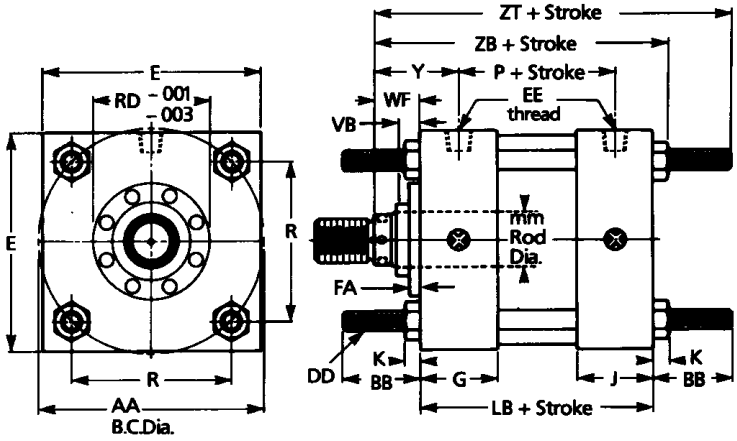
TIE ROD AND DOUBLE ROD

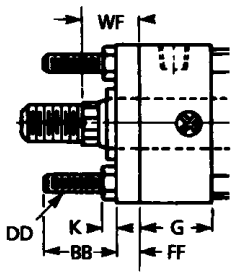
Mountings

Tie Rods Extended



NX–Neither
BX–Both (MX1)
RX–Rear (MX2)
FX–Front (MX3)





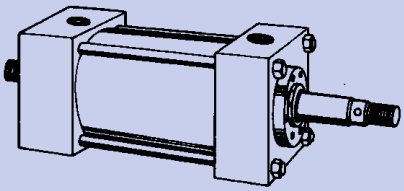
Drawing A

Important Notice

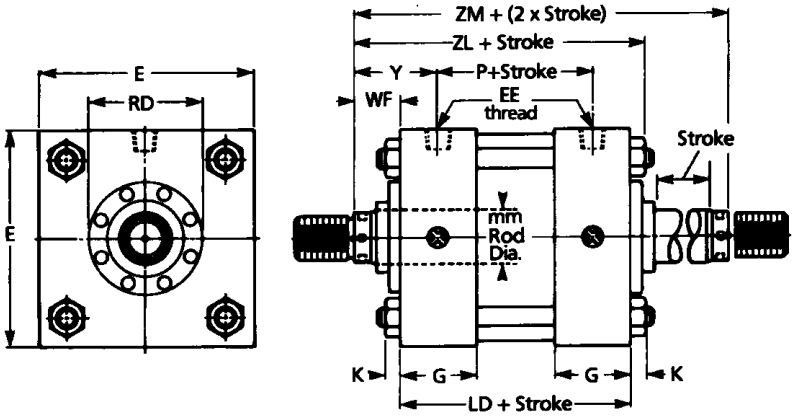
There is a construction variance in $1\frac{1}{8}$", $1\frac{1}{2}$", 2" and $2\frac{1}{2}$" bore sizes and in the $3\frac{1}{4}$" bore with a 2" diameter rod. The round rod gland retainer shown above is not used on these sizes. A square retainer, the same square size as the head, is employed. The tie rod nuts are therefore tightened against the retainer instead of against the head on the FX and BX Mounts and the rod gland cannot be removed without loosening the tie rods. See adjacent drawing A.

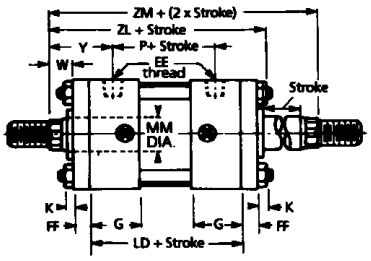
On the NX and RX Mounts, the square retainer is also used as shown on the adjacent drawing, but the retainer is held in place with retainer screws. The tie rods thread into the head. The rod gland can be removed without loosening the tie rods in these mounts.

Basic Double Rod Extension



Available in all except "C" mounts.





Drawing B

Important Notice

There is a construction variance in $1\frac{1}{8}$", $1\frac{1}{2}$", 2" and $2\frac{1}{2}$" bore sizes and in the $3\frac{1}{4}$" bore with a 2" diameter rod. The round rod gland retainers shown above are not used on these sizes. A square retainer, the same square size as the head, is employed on each end. The retainers are held in place by the tie rod nuts and therefore cannot be removed without loosening the tie rods. See adjacent drawing B for dimension details.

For dimensions on specific mounting styles, consult other pages in this catalogue. Dimensions shown on the above and adjacent drawings are for basic cylinder only.

Double rod extension cylinders are available in every mounting style except Clevis.

TIE ROD AND DOUBLE ROD

Dimensions 1 1/8" through 14" bores

Be sure to add Stroke to these Dimensions
Add 2X Stroke to ZM Dimensions

Bore	MM Rod Dia.	FA	VB	RD ■	W	WF	Y	ZB	ZL	ZM	ZT
1 1/8	5/8 std.	–			5/8	1 1/8	1 23/32	4 5/8	5 1/4	5 5/8	5 3/8
1 1/2	5/8 std.	–			5/8	1 1/4	2	5 15/16	6 9/16	6 7/8	7
	1 2:1	–			1	1 5/8	2 3/8	6 5/16	6 15/16	7 5/8	7 3/8
2	1 std.	–			3/4	1 1/2	2 3/8	6 7/16	7 5/16	7 5/8	7 13/16
	1 3/8 2:1	–			1	1 3/4	2 5/8	6 11/16	7 9/16	8 1/8	8 1/16
2 1/2	1 std.	–			3/4	1 1/2	2 3/8	6 9/16	7 7/16	7 3/4	7 15/16
	1 3/8	–			1	1 3/4	2 5/8	6 13/16	7 11/16	8 1/4	8 3/16
	1 3/4 2:1	–			1 1/4	2	2 7/8	7 1/16	7 15/16	8 3/4	8 7/16
3 1/4	1 3/8 std.	11/16	1	3.187	–	1 5/8	2 3/4	7 11/16	7 15/16	9	9 7/16
	1 3/4	11/16	1 1/8	3.50	–	1 7/8	3	7 15/16	8 3/16	9 1/2	9 11/16
	2 2:1	–	–	–	1 1/4	2	3 1/8	8 1/16	9 1/16	9 3/4	9 13/16
4	1 3/4 std.	11/16	1 1/8	3.50	–	1 7/8	3	8 3/16	8 7/16	9 3/4	9 15/16
	2	13/16	1 1/8	4.00	–	2	3 1/8	8 5/16	8 9/16	10	10 1/16
	2 1/2 2:1	13/16	1 1/4	4.312	–	2 1/4	3 3/8	8 9/16	8 13/16	10 1/2	10 5/16
5	2 std.	13/16	1 1/8	4.00	–	2	3 1/8	9	9 1/4	10 1/2	11 7/16
	2 1/2	13/16	1 1/4	4.312	–	2 1/2	3 3/8	9 1/4	9 1/2	11	11 11/16
	3	13/16	1 1/4	5.25	–	2 1/4	3 3/8	9 1/4	9 1/2	11	11 11/16
	3 1/2 2:1	13/16	1 1/4	5.625	–	2 1/4	3 3/8	9 1/4	9 1/2	11	11 11/16
6	2 1/2 std.	13/16	1 1/4	4.312	–	2 1/4	3 1/2	10 1/2	10 1/2	11 7/8	13 1/4
	3	13/16	1 1/4	5.25	–	2 1/4	3 1/2	10 1/2	10 1/2	11 7/8	13 1/4
	3 1/2	13/16	1 1/4	5.625	–	2 1/4	3 1/2	10 1/2	10 1/2	11 7/8	13 1/4
	4 2:1	15/16	1 1/4	6.25	–	2 1/4	3 1/2	10 1/2	10 1/2	11 7/8	13 1/4
7	3 std.	13/16	1 1/4	5.25	–	2 1/4	3 13/16	11 3/4	11 3/4	13	14 7/8
	3 1/2	13/16	1 1/4	5.625	–	2 1/4	3 13/16	11 3/4	11 3/4	13	14 7/8
	4	15/16	1 1/4	6.25	–	2 1/4	3 13/16	11 3/4	11 3/4	13	14 7/8
	4 1/2	15/16	1 1/4	6.625	–	2 1/4	3 13/16	11 3/4	11 3/4	13	14 7/8
	5 2:1	15/16	1 1/4	7.312	–	2 1/4	3 13/16	11 3/4	11 3/4	13	14 7/8
8	3 1/2 std.	13/16	1 1/4	5.625	–	2 1/4	3 15/16	12 13/16	12 13/16	14	16 1/4
	4	15/16	1 1/4	6.25	–	2 1/4	3 15/16	12 13/16	12 13/16	14	16 1/4
	4 1/2	15/16	1 1/4	6.625	–	2 1/4	3 15/16	12 13/16	12 13/16	14	16 1/4
	5	15/16	1 1/4	7.312	–	2 1/4	3 15/16	12 13/16	12 13/16	14	16 1/4
	5 1/2 2:1	15/16	1 1/4	7.812	–	2 1/4	3 15/16	12 13/16	12 13/16	14	16 1/4
10	4 1/2 std.	1 5/8	1 15/16	6.625	–	2 15/16	5	16 9/16	16 9/16	18	21 1/16
	5	1 5/8	2 3/16	7.312	–	3 3/16	5 1/4	16 13/16	16 13/16	18 1/2	21 5/16
	5 1/2	1 5/8	2 3/16	7.812	–	3 3/16	5 1/4	16 13/16	16 13/16	18 1/2	21 5/16
	7 2:1	1 5/8	2 3/16	10.00	–	3 11/16	5 3/4	17 5/16	17 5/16	19 1/2	21 13/16
12	5 1/2 std.	1 5/8	2 3/16	7.812	–	3 3/16	5 3/4	19 7/16	19 7/16	20 7/8	24 11/16
	7	1 5/8	2 3/16	10.00	–	3 13/16	6 3/8	20 1/16	20 1/16	22 1/8	25 5/16
	8 2:1	1 7/8	2 7/16	11.50	–	4 3/8	6 15/16	20 5/8	20 5/8	23 1/4	25 7/8
14	7 std.	2 3/8	2 13/16	10.00	–	4 5/16	7 7/16	23 1/4	23 1/4	25 5/8	29 5/16
	10 2:1	2 3/8	2 15/16	13.75	–	4 15/16	8 1/16	23 7/8	23 7/8	26 7/8	29 15/16

■ Close Pilot Tolerances on FX and BX Mounts only.

Be sure to add Stroke to these Dimensions

Bore	AA	BB	DD	E	EE Thread	FF	G	J	K	LB	LD	P	R
1 1/8	1.68	1	1/4-28	1 3/4	1/4	1/2	1 1/8	1	1/4	3 1/4	3 3/8	2 3/16	1.19
1 1/2	2.3	1 3/8	3/8-24	2 1/2	1/2	5/8	1 1/2	1 1/2	5/16	4 3/8	4 3/8	2 7/8	1.63
2	2.9	1 13/16	1/2-20	3	1/2	3/4	1 5/8	1 1/2	7/16	4 1/2	4 5/8	2 7/8	2.05
2 1/2	3.6	1 13/16	1/2-20	3 1/2	1/2	3/4	1 5/8	1 1/2	7/16	4 5/8	4 3/4	3	2.55
3 1/4	4.6	2 5/16	5/8-18	4 1/2	3/4	3/4	2	1 3/4	9/16	5 1/2	5 3/4	3 1/2	3.25
4	5.4	2 5/16	5/8-18	5	3/4	–	2	1 3/4	9/16	5 3/4	6	3 3/4	3.82
5	7.0	3 3/16	7/8-14	6 1/2	3/4	–	2	1 3/4	3/4	6 1/4	6 1/2	4 1/4	4.95
6	8.1	3 5/8	1-4	7 1/2	1	–	2 3/8	2 3/8	7/8	7 3/8	7 3/8	4 7/8	5.73
7	9.3	4 1/8	1 1/8-12	8 1/2	1 1/4	–	2 7/8	2 7/8	1	8 1/2	8 1/2	5 3/8	6.58
8	10.6	4 1/2	1 1/4-12	9 1/2	1 1/2	–	3 1/4	3 1/4	1 1/16	9 1/2	9 1/2	6 1/8	7.50
10	13.6	6	1 3/4-12	12 5/8	2	–	3 7/8	3 7/8	1 1/2	12 1/8	12 1/8	8	9.62
12	16.2	7	2-12	14 7/8	2 1/2	–	4 7/8	4 7/8	1 3/4	14 1/2	14 1/2	9 3/8	11.45
14	18.9	8	2 1/4-12	17 1/4	2 1/2	–	5 3/8	5 3/8	1 15/16	17	17	10 3/4	13.34

Double Rod End Cylinders

Double Rod End cylinders are specified for many reasons, some of which are as follows:

1. A simultaneous push and pull requirement.
2. Both rod ends are fixed and the cylinder moves – such as on a machine slide.
3. One rod does the work and the other serves to indicate position or to trip switches.
4. A double rod end cylinder has rod bearings at each end and therefore offers more resistance to deflection and side loading.

When the rod ends of a double rod end cylinder are not to be the same, such as a style 2 on one end and a style 4 on the other, be sure to so specify and to identify which end is which in relation to the mount. For example, on a Front Head Flange mount double rod end cylinder, specify style 2 rod end on flange end of cylinder and style 4 on opposite end.

Refer to **pages 36 and 37** for Rod End Information.

Storage

If it is necessary to store a cylinder for a period of time prior to installation, the following procedures should be adhered to:

1. Do not store out of doors or in a high humidity or corrosive atmosphere without a positive method of internal and external corrosion protection.
2. Where any adverse storage conditions exist, coat all unpainted external parts, including the piston rod, with corrosion inhibitive material. Fill both ends of the cylinder with a corrosion preventative fluid compatible with the system fluid.
3. If possible, store the cylinder in a vertical position, piston rod up.
4. Dirt protector plugs should be kept in the ports during storage.

Installation

Details on each specific mount are given in our HH Series Catalogue and reference should be made to the section on "Mountings". In addition, the following general procedures should be followed:

1. On all rigidly mounted cylinders, be sure that the part which attaches to the piston rod exactly "lines up" with the piston rod travel, or make provision for axial misalignment.
2. Flange mounted cylinders should be solidly mounted to a rigid section of the machine with high tensile bolts (socket head type recommended). When a pilot diameter cannot be used for alignment, the cylinder must be aligned to the work, tightened in place, and the flange drilled for a dowel and pinned to prevent shifting. For horizontal installations of flange mount cylinders with 48" of stroke and longer, we recommend supporting both ends of the cylinder.
3. Side mounted cylinders (Styles SL, CL, EL, FB and SF) used under shock conditions or at high pressure ranges (over 1500 psi) should be doweled or keyed to the machine. Styles SL, CL and EL have room for dowel pins in the mounting lugs. On Style FB mounts, two pins and one bolt can be used on one end to take the thrust. Cylinders should be pinned or keyed at one end only (especially important on long stroke cylinders) due to the deflection that takes place under load. On long stroke applications, the addition of an intermediate support (between the cylinder heads to support the tube and tie rods) is very important and is recommended. Care should be exercised in fastening the intermediate support so that no "humping" of the cylinder occurs. An intermediate support is utilised to afford additional cylinder support and is not designed to absorb thrust.
4. All clevis and trunnion mount cylinders need provisions on both ends for pivoting in one direction. Alignment in the other direction is essential to avoid excessive side loading. Where alignment in one direction is not possible, the cylinder must be equipped with two-direction pivoting such as can be obtained with a spherical bearing. See HH Series catalogue for a complete line of mounting accessories.
5. On trunnion mount cylinders, use pillow blocks of ample size, rigidly mounted as close to the cylinder heads as possible. Bearing should be provided for the full length of the trunnion pins. Lubrication should be provided to the pins.

Piping

BSP ports will be fitted as standard unless otherwise requested. Ports in the HH series can be supplied as requested with N.P.T. (American standard taper pipe thread). These threads are designed to be used with a sealing compound. Sealing compounds should be used sparingly. Teflon tape forms an excellent pipe thread sealer. No compound or tape should be used on the first 1½ threads. This will prevent sealing compound or tape from entering the system. Tapered pipe threads should be tightened only enough to prevent leakage. Over tightening can result in permanently distorted threads that will never give leak-proof seal.

Bleeding

If a cylinder is equipped with optional air bleeds, after the cylinder has been fully connected and the system has been filled with fluid, cycle the cylinder and bleed the air by loosening the air bleed plugs alternately. Loosen just enough to release the air bubbles. Tighten when no more air escapes. See note on Page 14.

Maintenance

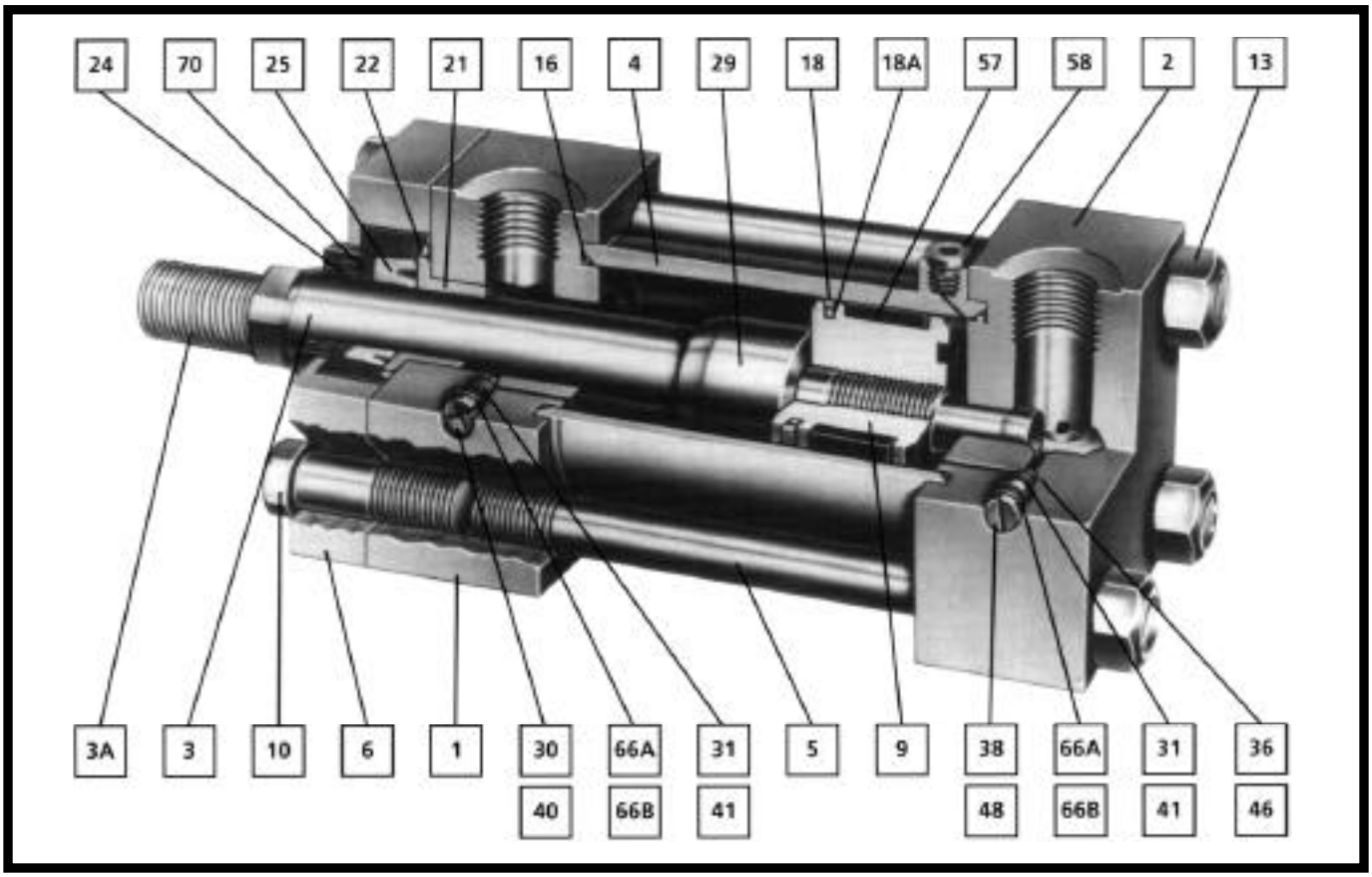
Please note when doing maintenance work on HH series cylinders:

1. The tie rod nuts need not be loosened or removed to service the rod bearing or gland except on mounting styles, BX, C, FF, FFX, RF, RFX, RHF and T on 1⅛" through 2½" bores, and 3¼" bore with 2" diameter rod.
2. One piece piston construction eliminates the need for removing the piston from the piston rod.
3. All parts removed from the cylinder that are to be re-used should be thoroughly cleaned. Be sure to carefully clean all cavities and grooves prior to replacing parts. All parts, new and old, should be lightly lubricated with a clean lubricant of the same type as, or compatible with, the fluid being used in the cylinder.
4. When a cylinder is disassembled, it is a good practice to replace all static and moving seals.

TO REPLACE ROD BEARING, ROD PACKING, ROD WIPER, OR ROD GLAND SEAL extend the piston rod (item 3) ¼ of the stroke. CAUTION! Support the rod end at all times to prevent nicking and to avoid cocking the piston in the tube. Inspect the piston rod wrench flats for burrs. Remove any burrs to prevent damage to the rod packing, rod wiper, or bearing when it is slipped off the rod. Remove rod packing gland retainer screws (item 10) and the rod gland retainer (item 6) or the rod gland (item 6A) on the single piece construction. On front flange and front flange extra mounts, 1⅛" through 2½" bores and 3¼" bore with 2" rod, the tie rod nuts (item 13) on the rear face of the cap must be removed as the tie rods are threaded into the flange. On rear flange, rear extra flange, clevis, and intermediate trunnion mounts, 1⅛" through 2½" bores and 3¼" bore with 2" rod, the tie rod nuts on the face of the gland retainer must be removed. After the gland or gland retainer has been removed, the rod packing may be removed from the gland. Place the rod gland on a clean, flat surface with the rod packing end up. Use a small screwdriver to remove the rod packing set (item 25) being careful not to nick or scratch the bore of the packing cavity. Remove the rod wiper in the same manner, being careful not to nick or scratch the wiper cavity. When replacing the rod wiper be sure it is fully seated in the groove. When replacing the rod packing, apply a light coating of clean lubricant to the new seal and insert it into the gland firmly with the fingers.

To remove the rod bearing (item 21), first remove the rod gland seal (item 22). This will expose the chamfer on the outside edge of the bearing against the head. Place two small pry bars or screwdrivers into the chamfer and pry the bearing gently out of the cylinder. Be sure to support the end of the rod. Inspect the bearing and rod for scoring, galling, etc. Replace any damaged parts. Replace the bearing by pushing or lightly tapping with a plastic hammer until its seated into the head. Lubricate the gland seal and place around the bearing. Slide the rod packing gland onto the rod taking care that the rod packing set is not damaged when being passed over the rod end threads and wrench flats. Be careful that the gland seal is not pinched or cut as the packing gland is brought up against the head. Replace the gland retainer screws. See chart on **page 34** for correct torque value for retainer screws. If the tie rod nuts have been removed, tighten them using the values shown on the tie rod torque chart. If the piston packings or tube seals are to be serviced, do not replace the rod gland or bearing until this service has been completed.

TO REPLACE TUBE SEALS, PISTON SEAL, AND PISTON BEARING STRIP. Remove the tie rod nuts (item 13) and remove the tie rods (item 5) CAUTION! Support the piston rod and piston assembly at all times. Remove the cap (item 2) and the tube (item 4). Examine the tube seals (item 16) for nicks, cuts, or grooves, and replace if necessary. The new seals should be lubricated before inserting into the grooves. (NOTE: When a cylinder has been disassembled to this degree, it is always wise to replace all seals and bearings.)



Maintenance Cont.

If the cylinder has a Teflon piston seal and bearing strip, cut the piston seal (item 18A) to remove from groove, being careful not to nick or scratch the sides of the groove. Remove the expander ring (item 18B) using a blunt screwdriver, again being careful not to damage bottom or sides of groove. For ease of installation and to minimise the time the piston seal is in the stretched condition, the expander and piston seal should be placed into the groove from the rod side of the piston. The leading edge of the piston at the top of the chamfer must be free of any deep nicks or burrs, before installing the piston seal. Lubricate this edge prior to putting the piston seal into the groove. Lightly lubricate the expander and stretch it over the end of the piston into the groove. Lift a segment of the piston seal over the lips of the piston and place as much of the seal into the groove as possible by pushing down on the outside of the ring to seat the I.D. on the expander. Place a small rod or screwdriver without sharp edges or points under the I.D. of the piston seal that is outside the groove. Pulling outward and inward toward the piston, stretch the seal up and over the lip to align it with the groove. Remove the screwdriver and the seal will snap into the groove. The stretching of the seal into the groove must be done rapidly due to Teflon's memory characteristics. The longer the seal remains in the stretched condition the longer it takes the seal to return to its original shape.

The piston bearing strip is a single piece that has scarfed cut ends that is simply wrapped around the piston. It is not intended that the cut ends meet to make a seal.

To replace the piston and rod assembly into the tube, the end of the piston containing the bearing strip should enter first. Lubricate the O.D. of the bearing and seal before inserting it into the tube. The piston and rod assembly should enter straight into the tube, but sometimes it is helpful to rock the component being moved up and down or sideways in order to move the piston into the tube. It may be necessary to apply a pressure on the bearing strip at the leading edge in order to get it started into the tube. To do this, use a small screwdriver with rounded edges and corners and push inward on the bearing strip (toward the centre of the piston) at the point where it is entering the tube, and at the same time pushing the piston into the tube. This procedure will be helpful when the piston seal starts to enter the tube, especially if the seal was stretched a little more than need be and has not returned completely to its proper size.

If it becomes necessary to disassemble the piston rod (item 3) and the piston (item 9), remove the piston dowel screw or screws apply heat (approximately 230°C) to break the chemical lock, and unscrew the piston. When doing so, be careful not to scratch or otherwise damage the polished surface of the piston rod or the piston.

When replacing the piston on the rod, apply a locking sealant, such as Loctite Grade AVV to the first 3-4 threads closest to the shoulder on the rod. Follow the manufacturer's recommendations for cleaning the threads prior to application of the sealant. Tighten the piston securely using the spanner wrench holes in the rear face of the piston. DO NOT ATTEMPT TO LINE UP ORIGINAL DOWEL SCREW HOLE. After tightening the piston in place, use a hand drill and relocate the dowel screw or screws in a new position.

When inserting the piston rod through the head, use care not to scrape the piston rod. Insert head and cap onto tube and replace the rods and tie rod nuts. Use the torque charts shown on **page 34**.

The cushion check plug (item 38 or item 48) and the cushion adjusting screw (item 30 or item 40) are interchangeable on the same head, but not necessarily between the head and cap. Both adjusting screw and plug use a back-up washer (item 66A or item 66B) and an "O" ring seal (item 31 or item 41). If leakage occurs around the seal, replace the back-up washer and seal. First, place the back-up washer against the shoulder, then the "O" ring. Lubricate the seal before replacing the plug into the cavity.

Rod Gland Retainer (or Rod Gland) Screw Torque Information

Screw Torque in Foot Pounds

Bore Size	Piston Road Diameter	Hex Head Set Screw	Socket Head Cap Screw
1 1/8"	5/8"		7.7
1 1/2"	ALL	13.6	
2"	ALL	33	
2 1/2"	ALL	33	
3 1/4"	ALL	66	3.6
4"	ALL		7.7
5"	ALL		7.7
6"	ALL		7.7
7"	ALL		33
8"	ALL		33
10"	4 1/2", 5" & 5 1/2"		33
10"	7"		39
12"	5 1/2" & 7"		39
12"	8"		95
14"	7"		39
14"	10"		95

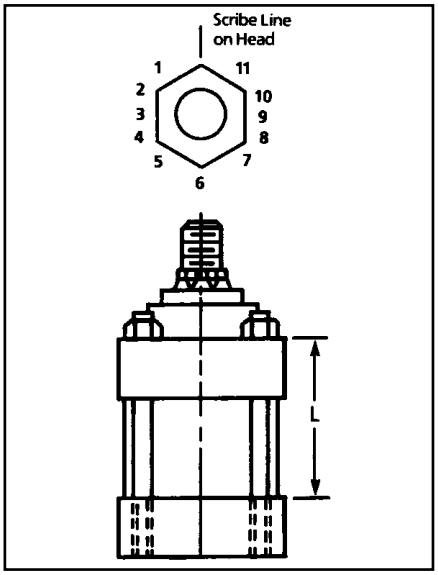
Tie Rod Torque Information

Tie Rod 1 1/8" Through 6" Bores

Bore	Torque in Foot Pounds	Bore	Torque in Foot Pounds
1 1/8"	8	3 1/4"	110
1 1/2"	30	4"	130
2"	50	5"	325
2 1/2"	50	6"	480

Tie Rod Torque for 7" Bore and Larger

Column 1 Turn (T) in 12ths	"L" Length	One Full Turn plus T "L" Length	Two Full Turns plus T "L" Length	Three Full Turns plus T "L" Length
1	2 3/4	36 1/2	70	103 5/8
2	5 5/8	39 1/4	72 3/4	106 1/2
3	8 1/2	42 1/2	75 5/8	109 1/4
4	11 1/4	44 3/4	78 1/2	112
5	14	47 5/8	81 1/4	114 3/4
6	16 3/4	50 1/2	84	117 5/8
7	19 5/8	53 1/4	86 3/4	120 1/2
8	22 1/2	56	89 5/8	123 1/4
9	25 1/4	58 3/4	92 1/2	126
10	28	61 5/8	95 1/4	128 3/4
11	30 3/4	64 1/2	98	131 5/8
12	33 5/8	67 1/4	100 3/4	134 1/2

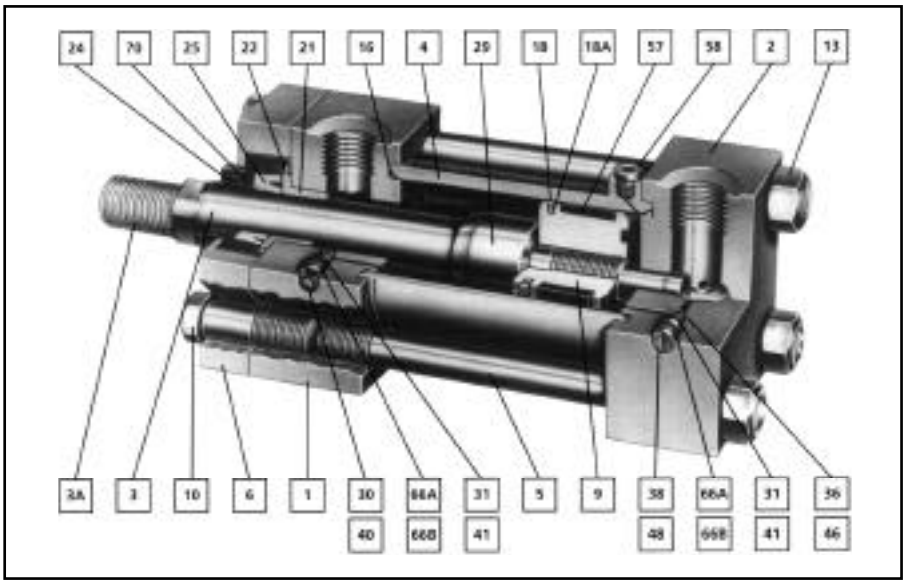


Large Bore Cylinders

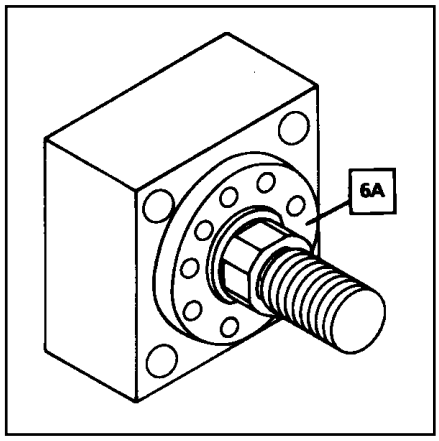
For 7" bore cylinders and larger, the tie rods are given an initial torque, and the tie rod nuts are turned a calculated amount. First torque all 4 tie rod nuts to 200-250 foot pounds. Measure the cylinder to obtain length "L" as shown in the illustration. Scribe a line on the cylinder head at one point of each hex nut and a matching mark on the hex nut point. Using the derived "L" consult the chart for the proper number of turns or fractions (in 12ths). The figures in Column 1 shown in 12ths corresponds to the points and flats of the hex nut (see illustration).

All 7" bore cylinders and larger are now fitted with hardened steel washers under the tie rod nuts in order that the secondary torque can be applied without heating, using an impact power wrench or a slogging type ring spanner.

PARTS LIST



Item No.	Description	Quantity Required
1	Head	1
2	Cap	1
3	Piston Rod	1
3A	Stud-Style II Thread Through 2" Rod Diameter	1
4	Tube	1
5	Tie Rod	4
6	Rod Gland Retainer	1
6A	Rod Gland and Retainer - Single Piece	1
9	Piston - Slipper Seal Type	1
10	Retainer Screw	◆
13	Tie Rod Nut	4
16†	Tube Seal	2
18†	Piston Seal - Slipper Seal	1
18A†	Expander - For Slipper Seal	1
21†	Rod Bearing	1
22†	Rod Gland Seal	1
24†	Rod Wiper/Seal	1
25†	Rod Seal	1
29	Cushion Piston - Front	**
30	Cushion Adj. Screw - Front (Cross Slot)	**
31	Seal - Cushion Adj. & Cush. Check - Front	**
36	Cushion Check Ball - Front	**
38	Cushion Check Plug - Front	**
40	Cushion Adj. Screw - Rear (Cross Slot)	**
41	Seal - Cush. Adj. & Cush. Check - Rear	**
46	Cushion Check Ball - Rear	**
48	Cushion Check Plus - Rear	**
57	Piston Bearing Strip	*
58	Air Bleed Plug	**
66A	Back-Up Wash. - Cush. Adj. & Check - Front	**
66B	Back-Up Wash. - Cush. Adj. & Check - Rear	**
70	Rod Gland	1



Round, Single Piece Rod Gland & Retainer used on all but some of the smaller bore sizes. Consult pages on specific mounts.

Ordering Information

When ordering parts, the following information must be specified. Model No., Serial No., Stroke, Pressure, Pressure Medium (air, oil or water) and any special features. Give item no., name and quantity of part desired. The Model No. and Serial No. will be found on a metal plate that has been drive-screwed to either the head or the cartridge retainer.

◆ Retainer screws required varies by bore and mount.

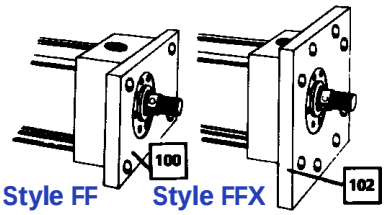
† Recommended spare parts.

* 1 required 25 through 100 bore, 2 required 125 through 200 bore.

** As required; specify if cushioned front, cushioned rear or cushioned both ends.

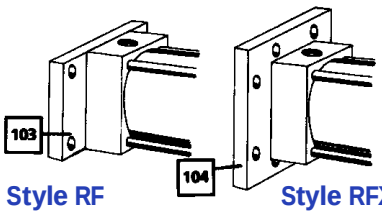
PARTS LIST

Front Flange Mounts



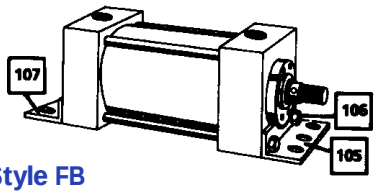
Style FF Style FFX

Rear Flange Mounts



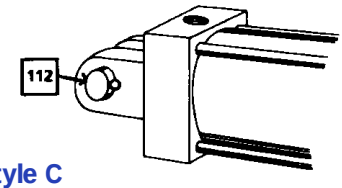
Style RF Style RFX

Foot Bracket Mount



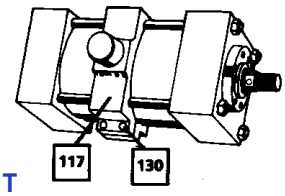
Style FB

Clevis Mount



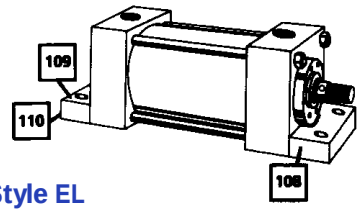
Style C

Intermediate Trunnion Mount



Style T

End Lug Mount



Style EL

Item No.	Description	Qty. Req'd.
117	Intermediate Trunnion	1
130	Intermediate Trunnion Screw	1
108 ■	End Lug – Front	1
109 ■	End Lug – Screw	2
110 ■	End Lug – Rear	1

■ Not available on 10", 12" and 14" bore cylinders.

Item No.	Description	Qty .Req'd
100	Front Flange	1
102	Front Flange Extra	1
103	Rear Flange	1
104	Rear Flange Extra	1
105 ■	Foot Bracket – Front	1
106 ■	Foot Bracket – Screw	2
107 ■	Foot Bracket – Rear	1
112	Clevis Pin	1

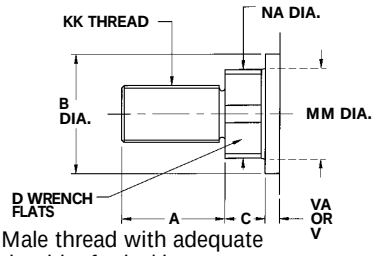
Complete replacement packing kits are available. For purposes of economy and less down-time, it is recommended that replacement packing kits be stocked. Contact factory for further details.

HH Series Cylinder Weight Chart													
Bore	1 1/8	1 1/2	2	2 1/2	3 1/4	4	5	6	7	8	10	12	14
Zero Stroke	3	8	14	19	37	50	90	140	210	290	650	975	1600
Add Per Inch of Stroke	.25	.5	.8	1.3	1.8	2.5	4	5.8	6.5	9	16	25	35

Note: The above weights are based on an average value for cushioning, rod size, and the various types of mountings for uncrated cylinders to establish approximate shipping weights. Add 10% of cylinder weight to determine estimate weight of crated cylinder. Weights given in lbs.

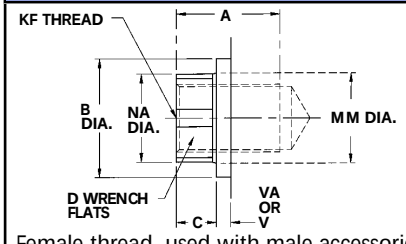
ROD END INFORMATION

Standard – Style 2

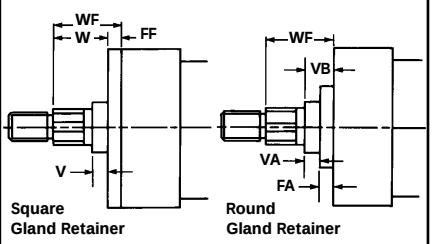


Male thread with adequate shoulder for locking accessory.

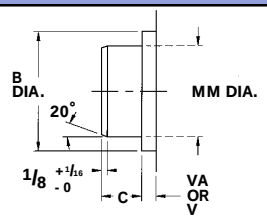
Alternate – Style 4



Female thread, used with male accessories for shorter overall cylinder length.

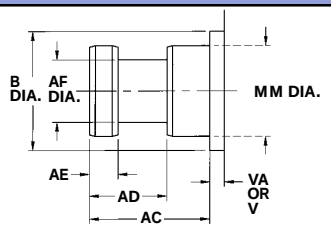


Alternate – Style 1



Plain male Rod End with no threads. Used for pushing, holding, knock-outs, etc.

Alternate – Style 6



Used with S.A.F.E. accessory (see accessory page 7) for fast, close radial alignment.

Important

Specify on order

1. Type of thread
2. Length of thread
3. Rod extension if non-standard
4. Any non standard thread please supply full details
5. **Style 6** For use only on fixed mountings. Under no circumstances to be used with pivot mountings

Note: See chart on page 37 to check wrench flats or spanner holes

ROD END INFORMATION

HH Rod End Dimensions

Bore	MM Rod Dia.	A	AC	AD	AE	AF Dia.	B Dia. −.001 −.003	C	D	KK	NA Dia. ±.002	V	VA *	Wrench Flats or Spanner Holes	
														Male Thread Rod Ends	Style 4 Rod End
1 1/8	5/8 std.	3/4	1 1/8	5/8	1/4	3/8	1 1/8	3/8	1/2	7/16-20	.594	1/4	–	W.F.	W.F.
1 1/2	5/8 std.	3/4	1 1/8	5/8	1/4	3/8	1 1/8	3/8	1/2	7/16-20	.594	1/4	–	W.F.	W.F.
	1 2:1	1 1/8	1 5/8	15/16	3/8	11/16	1 1/2	5/8	13/16	3/4-16	.968	3/8	–	W.F.	W.F.
2	1 std.	1 1/8	1 1/2	15/16	3/8	11/16	1 1/2	1/2	13/16	3/4-16	.968	1/4	–	W.F.	W.F.
	1 3/8 2:1	1 5/8	1 3/4	1 1/16	3/8	7/8	2	5/8	1 1/8	1-14 ✣	1.343	3/8	–	W.F.	W.F.
2 1/2	1 std.	1 1/8	1 1/2	15/16	3/8	11/16	1 1/2	1/2	13/16	3/4-16	.968	1/4	–	W.F.	W.F.
	1 3/8	1 5/8	1 3/4	1 1/16	3/8	7/8	2	5/8	1 1/8	1-14 ✣	1.343	3/8	–	W.F.	W.F.
	1 3/4 2:1	2	2	1 5/16	1/2	1 1/8	2 3/8	3/4	1 1/2	1 1/4-12	1.703	1/2	–	W.F.	W.F.
3 1/4	1 3/8 std.	1 5/8	1 3/4	1 1/16	3/8	7/8	2	5/8	1 1/8	1-14 ✣	1.343	1/4 ◆	5/16	W.F.	W.F.
	1 3/4	2	2	1 5/16	1/2	1 1/8	2 3/8	3/4	1 1/2	1 1/4-12	1.703	3/8 ◆	7/16	W.F.	W.F.
	2 2:1	2 1/4	2 5/8	1 11/16	5/8	1 3/8	2 5/8	7/8	1 5/8	1 1/2-12	1.953	3/8	–	W.F.	W.F.
4	1 3/4 std.	2	2	1 5/16	1/2	1 1/8	2 3/8	3/4	1 1/2	1 1/4-12	1.703	1/4 ◆	7/16	W.F.	W.F.
	2	2 1/4	2 5/8	1 11/16	5/8	1 3/8	2 5/8	7/8	1 5/8	1 1/2-12	1.953	1/4 ◆	5/16	W.F.	W.F.
	2 1/2 2:1	3	3 1/4	1 15/16	3/4	1 3/4	3 1/8	1	2 1/16	1 7/8-12	2.453	3/8 ◆	7/16	S.H.	W.F.
5	2 std.	2 1/4	2 5/8	1 11/16	5/8	1 3/8	2 5/8	7/8	1 5/8	1 1/2-12	1.953	1/4 ◆	5/16	W.F.	W.F.
	2 1/2	3	3 1/4	1 15/16	3/4	1 3/4	3 1/8	1	2 1/16	1 7/8-12	2.453	3/8 ◆	7/16	S.H.	W.F.
	3	3 1/2	3 5/8	2 7/16	7/8	2 1/4	3 3/4	1	2 9/16	2 1/4-12	2.937	3/8 ◆	7/16	S.H.	W.F.
	3 1/2 2:1	3 1/2	4 3/8	2 11/16	1	2 1/2	4 1/4	1	3	2 1/2-12	3.437	3/8 ◆	7/16	S.H.	W.F.
6	2 1/2 std.	3	3 1/4	1 15/16	3/4	1 3/4	3 1/8	1	2 1/16	1 7/8-12	2.453	1/4 ◆	7/16	S.H.	W.F.
	3	3 1/2	3 3/4	2 7/16	7/8	2 1/4	3 3/4	1	2 9/16	2 1/4-12	2.937	1/4 ◆	7/16	S.H.	W.F.
	3 1/2	3 1/2	4 3/8	2 11/16	1	2 1/2	4 1/4	1	3	2 1/2-12	3.437	1/4 ◆	7/16	S.H.	W.F.
	4 2:1	4	4 1/2	2 11/16	1	3	4 3/4	1	3 7/16	3-12	3.937	1/4 ◆	5/16	S.H.	W.F.
7	3 std.	3 1/2	3 3/4	2 7/16	7/8	2 1/4	3 3/4	1	2 9/16	2 1/4-12	2.937	1/4 ◆	7/16	S.H.	W.F.
	3 1/2	3 1/2	4 3/8	2 11/16	1	2 1/2	4 1/4	1	3	2 1/2-12	3.437	1/4 ◆	7/16	S.H.	W.F.
	4	4	4 1/2	2 11/16	1	3	4 3/4	1	3 7/16	3-12	3.937	1/4 ◆	5/16	S.H.	W.F.
	4 1/2	4 1/2	5 1/4	3 3/16	1 1/2	3 1/2	5 1/4	1	–	3 1/4-12	4.421	1/4 ◆	5/16	S.H.	S.H.
	5 2:1	5	5 3/8	3 3/16	1 1/2	3 7/8	5 3/4	1	–	3 1/2-12	4.921	1/4 ◆	5/16	S.H.	S.H.
8	3 1/2 std.	3 1/2	4 3/8	2 11/16	1	2 1/2	4 1/4	1	3	2 1/2-12	3.437	1/4 ◆	7/16	S.H.	W.F.
	4	4	4 1/2	2 11/16	1	3	4 3/4	1	3 7/16	3-12	3.937	1/4 ◆	5/16	S.H.	W.F.
	4 1/2	4 1/2	5 1/4	3 3/16	1 1/2	3 1/2	5 1/4	1	–	3 1/4-12	4.421	1/4 ◆	5/16	S.H.	S.H.
	5	5	5 3/8	3 3/16	1 1/2	3 7/8	5 3/4	1	–	3 1/2-12	4.921	1/4 ◆	5/16	S.H.	S.H.
	5 1/2 2:1	5 1/2	6 1/4	3 15/16	1 7/8	4 3/8	6 1/4	1	–	4-12	5.421	1/4 ◆	5/16	S.H.	S.H.
10	4 1/2 std.	4 1/2	5 1/4	3 3/16	1 1/2	3 1/2	5 1/4	1	–	3 1/4-12	4.421	1/4 ◆	5/16	S.H.	S.H.
	5	5	5 3/8	3 3/16	1 1/2	3 7/8	5 3/4	1	–	3 1/2-12	4.921	1/2 ◆	9/16	S.H.	S.H.
	5 1/2	5 1/2	6 1/4	3 15/16	1 7/8	4 3/8	6 1/4	1	–	4-12	5.421	1/2 ◆	9/16	S.H.	S.H.
	7 2:1	7	6 7/8	4 5/16	1 7/8	5 3/4	8	1 1/2	–	5 1/4-12	6.906	1/2 ◆	9/16	S.H.	S.H.
12	5 1/2 std.	5 1/2	6 1/4	3 15/16	1 7/8	4 3/8	6 1/4	1	–	4-12	5.421	1/4 ◆	9/16	S.H.	S.H.
	7	7	7	4 5/16	1 7/8	5 3/4	8	1 5/8	–	5 1/4-12	6.906	1/4 ◆	9/16	S.H.	S.H.
	8 2:1	8	5 3/4	3 3/16	1 1/2	6 3/8	9	1 15/16	–	5 3/4-12	7.875	1/2 ◆	9/16	S.H.	S.H.
14	7 std.	7	6 7/8	4 5/16	1 7/8	5 3/4	8	1 1/2	–	5 1/4-12	6.906	3/8 ◆	7/16	S.H.	S.H.
	10 2:1	10	4 3/8	2 1/16	1	8 1/2	11	2	–	7-12	9.875	1/2 ◆	9/16	S.H.	S.H.

◆ These dimensions for FF and FFX mounts only. For other mounts, use VA dimensions.

* On FF and FFX mounts, use "V" dimensions. ✣ NOTE: Extra fine thread.

MODEL NUMBER

Composition

2½	HH	FHF	25	CC	W
Bore	**Cylinder Series**	**Mounting**	**Stroke**	**Cushion**	**Modification**
As Required Use Fractions Where Required	**HH** – Heavy Duty Hydraulic **HA** – High Pressure Pneumatic to 750 psi **HG** – High Pressure Gas to 750 psi	Listed Below	Specify in inches as required Use Fractions where required Shown as Gross Stroke including Dual Piston or Stop Tube Length	**CF** – Cushion Front **CR** – Cushion Rear **CC** – Cushion both ends	**A** – Variation in Ports **D** – Double Rod Extension **K** – Any variation in Rod from Standard. Any variation from Standard Style 2 Rod End. **M** – Variation in Mounting **S** – Spring Return **W** – Water Fitted **Y** – Variation in Construction

Mounting Styles ISO

BX – Basic Cylinder – tie rods extended – both ends
C – Clevis
CL – Centre Line Lug
EL – End Lug
FB – Foot Bracket
FF – Front Flange
FFX – Front Flange – Extra Size
FHF – Front Head Flange
FX – Basic cylinder – tie rods extended – front end
NX – Basic cylinder – no tie rod extension
P – Pivot – Special Order
RF – Rear Flange
RFX – Rear Flange – Extra Size
RHF – Rear Head Flange
RX – Basic cylinder – tie rods extended – rear end
SF – Side Flush
SL – Side Lug
SP – Sub Plate
T – Trunnion – between heads
TF – Trunnion – front
TR – Trunnion – rear

Order Information

To insure prompt delivery, please BE SURE TO INCLUDE THIS INFORMATION WHEN ORDERING:

1. Quantity
2. Series
3. Bore
4. Stroke – Gross Stroke always shown in Model Number
5. Dual Piston or Stop Tube when necessary
6. Mounting Style
7. Cushion (front, rear, both or none)
8. Rod End Style (if other than Style 2 standard)
9. Rod Size (standard, oversize or 2:1)
10. Extra Rod Extension (where required)
11. Port Size (if other than standard)
12. Port Positions other than standard positions 1 and 5
13. Cushion check, adjusting screw, and bleed positions (when required) if other than standard positions
14. Medium (air, oil, water or other)
15. Type of fluid
16. Operating Pressure and Maximum Shock Pressure
17. Temperature
18. Double rod extension (when required)
19. XI dimension on all Trunnion (between head) cylinders
20. Operating environment
21. Paint finish required
22. Non standard materials ie. stainless steel rods
23. Delivery required, or scheduling

Complete and correct ordering information will eliminate untimely delays. When in doubt always contact our factory.

Policy and Warranty

POLICY The policy is one of continual improvement in design and manufacture to assure still finer products, hence, specifications are subject to change without notice.

WARRANTIES AND LIABILITIES Goods alleged by the Buyer to be defective or not to conform to the Contract and accepted by the Company as such during the period of 12 months after delivery will be replaced by the Company or if the Company shall so decide the total price in respect of the Goods shall be refunded to the Buyer. The total liability of the Company for any loss or damages or expenses of any description direct or indirect suffered by the Buyer and attributable to the Goods shall not exceed in total One million pounds Sterling. No claim in respect of allegedly defective Goods shall be valid unless the claim is made in writing immediately after the Buyer shall become aware of the alleged defect. Nor will such claim entitle the Buyer to cancel any outstanding part of the Order.

SERIES LIST

MA Series

1 1/2 (38 mm) through 8 inch (200 mm) bore. Medium duty Air Service. Popular dimensional interchangeable mounts at economy pricing. Rated for 10 bar Air. Lubed for life. Great OEM cylinder.

A Series

1 1/8 through 14 inch bore. 250 psi Air. Double Acting. Adjustable Cushions. Dimensionally NFPA/JIC interchangeable.

C20 Series

1 1/2 (38 mm) through 8 inch (200 mm) bore. 10 bar Air. Double Acting, cushioned and non-cushioned. Economy priced.

CL Series

3/4 (19 mm) and 1 1/8 (28 mm) bores. CLA for 10 bar Air Service. Heavy Duty CLH for 17 bar. Air Service or 103 bar Hydraulic Service. Double Acting and Spring Return. Universal mount with Accessories for all applications.

Limit Switch Cylinders

Mechanical

Mechanically operated switches available on square head cylinders - 10 bar air to 210 bar. hydraulic.

Magnetic

Magnetically operated reed switches available on A, MA and C20 Series air cylinders. Ideal for timing - automatic control.

Proximity

Permanent magnet ferrous material actuated proximity switches available on square head cylinders up to 550 bar. BASEEFA approved and sub-sea models available.

MH Series

1 1/8 (28 mm) through 8 inch (200 mm) bore. Medium Pressure Hydraulic. Compact and dimensionally interchangeable. Tapered Cushions.

HH Series

1 1/8 (28 mm) through 24 inch (600 mm) bore. 210-345 bar Hydraulic. Machine Tool Precision. Most easily serviced. Dimensionally interchangeable to NFPA/JIC.

UH Series

2 (50 mm) through 12 inch (300 mm) bore. 345-550 bar. Hydraulic.1-piece steel heads. Super-duty service. Tapered Cushions. Easily removed rod cartridge.

EH Series

Compact Metric to ISO 6020/2 and DIN 24554. 25mm through 200mm bore. 210 bar. Hydraulic.

ER Series

Roundline Mill Cylinder to ISO 6020/1 25mm through 200mm bore.160 bar. Hydraulic.

- Cylinders of all sizes, for all applications, pressures and fluid mediums... in almost every price range.
- Easily installed and serviced.
- Compact, rugged and reliable.
- Wide range of matched mounting accessories.
- Custom built variations of all standard cylinders at nominal cost.
- Cylinders to 42 inch bore in a variety of mountings and pressure ranges.
- Lubrication not required on standard air cylinders.

HELIPEBS CONTROLS LIMITED

EXCLUSIVE EUROPEAN LICENSEE: for THE SHEFFER CORPORATION, Cincinnati, Ohio, U.S.A.

NOTES