

# How to Order an N2 Cylinder

standard cylinders can be completely and accurately identified with a model number that encodes construction specifications. To develop the model number for ordering a cylinder, see the following example:

Feature	Description	Symbol
<b>Rod Diameter</b>	Specify in inches (2 position decimal)	-
<b>Cushions</b>	Noncushioned	N
	Cushioned both ends	B
	Cushioned head end	H
	Cushioned cap end	C
<b>Stroke</b>	Specify in inches (2 position decimal)	-
<b>Bore</b>	Specify in inches (2 position decimal)	-
<b>Double Rod</b>	Include ONLY for double-rod cylinder	D
<b>Mounting Style</b>	Side lugs, MS2	A
	Side tapped, MS4	B
	Cap fixed clevis, MP1	C
	Cap spherical bearing	CS
	Cap detachable clevis, MP2	DC
	Side end lugs, MS7	E
	Head rectangular flange, MF1	F
	Head rectangular, ME5	G
	Center-line lugs, MS3	H
	Head square flange, MF5	J
	No mount	K
	All tie rods extended, MX1	L
	Head end tie rods extended, MX3	M
	Cap end tie rods extended, MX2	N
	Cap rectangular, ME6	P
	Cap rectangular flange, MF2	R
	Cap square flange, MF6	S
	Intermediate fixed trunnion, MT4	TT
	Head trunnion, MT1	U
	Cap trunnion, MT2	W
<b>Model Series</b>	Hydraulic high pressure	N2
	Air heavy duty	AN2
	Air heavy duty prelubricated	LAN2
<b>Rod End Style</b>	Male, large	1
	Male, large, extended	1X
	Male, small (standard)	2
	Male, small, extended	2X
	Male modified	2M
	Female	4
	Female modified	4M
	Plain end	5
	Male, full rod diameter	6
	Male, for rod end coupling	10
	Modified	M
<b>Ports</b>	NPTF	N
	†SAE	S
	*SAE #12, standard for 3 1/4", 4" and 5" bore cylinders	T
	Manifold	M
	Flange	F
	BSP/G	G
	Special	X
<b>Rod Seals</b>	Urethane Ultra-Seal	H
	Carboxylated lip type	N
	PolyPak	P
	‡Viton PolyPak	F
	‡Viton lip type	V
	Ultra-Seal with scraper	J
	Nitrile lip type with scraper	S
	‡Viton PolyPak with scraper	G
	‡Viton lip type with scraper	U
	Special	X
<b>Piston Seals</b>	Carboxylated lip type	N
	Low friction PolyPak	D
	PolyPak	P
	Cast iron rings	R
	‡Viton lip type	V
	Low breakaway Teflon radial seal with wearband	B
	Special	X
<b>Port Locations</b>	Head end positions	1-4
	Special	X
	Cap end positions	1-5
	Special	X
<b>Special Modifications</b>	Include ONLY if special modifications are required.	X
	Air bleeders	Rod boots
	Drainbacks	Indicator switches
	Special seals	Four rod end flats
	Nonstd. mount	Port or cushion modifications
	Oversize ports	
	Bronze bushings	Double-end rod with different rod ends
	Key Plate	Special paint/plating
	Stainless steel rod	
	Stop tube	

## HOW TO ORDER

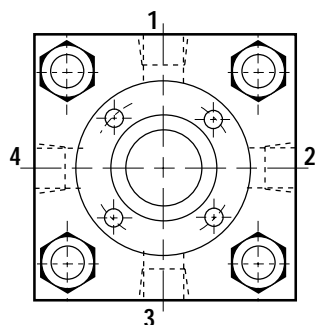
1. Quantity
2. Model number
3. Special modifications if required
4. Completed Application Data Sheet(s) (page 8) if required.
5. Required ship date

**N2KD - 3.25 X 8.00 - N - 1.38 -  
- 2 - T - H - R - 1 - 1 - X**

Customer Number (if desired)  
Serial Number



National  
**FLUID POWER**  
Association  
MEMBER



## Port Locations

Port location 5 is on the center of the back face of the end cap.

\* To order standard SAE #12 ports on 3 1/4", 4" and 5" bore, use **T**.  
† To order oversize SAE #16 ports on 3 1/4", 4" and 5" bore, use **S**.  
‡ Consider specifying pinning the piston to the piston rod for temperatures over 250° F.

# N2 Design Features

## A Heavy Duty Rod Cartridge

- Machined from gray iron for maximum bearing support and wear resistance
- Unitized, threadless assembly is pilot fitted into the head on a precision bored diameter to assure true concentricity (See Fig. 3-1)

## B Piston Seals

- Step cut iron piston rings standard on N5
- Nitrile lip-type seals standard on AN5 and LAN5
- Viton lip seals available for special fluid compatibility or temperatures to 400°F
- Special seals for high speed, low friction and other requirements are available

## C Long Life Urethane Rod Seals

- Urethane "Ultra-Seal" standard through 8" rod diameters on N5 cylinders providing the optimum in long life and sealing up to 200°F (see Fig. 3-3)
- Viton PolyPak seals available on N5 for special fluids or temperatures to 400°F
- Nitrile lip-type seals standard on AN5 and LAN5
- Special seals available

## D Double-Lipped Rod Wiper

- Carboxylated double-lipped rod wiper removes foreign materials from the exposed rod to extend rod seal life
- The standard rod wiper is carboxylated material through 5½"; Viton for 7" through 10" diameter rods
- Metallic rod scraper and low friction

## E Wipers available

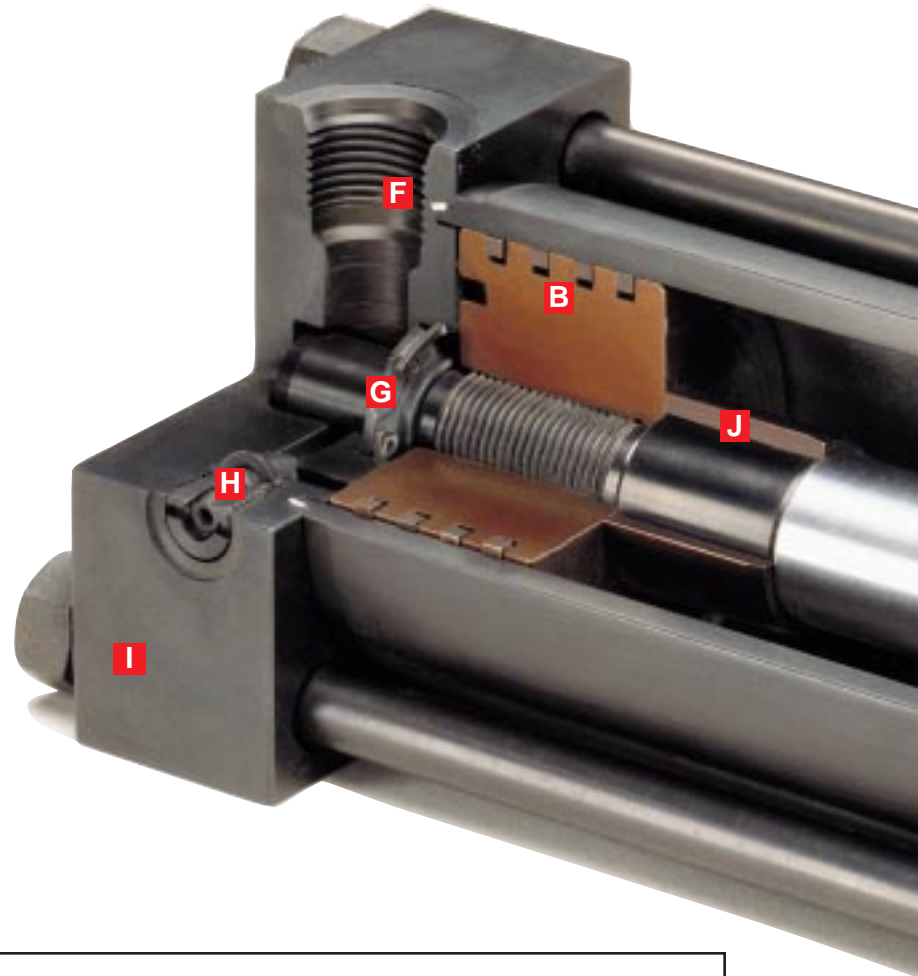
### SAE Ports

- SAE ports standard on N5; NPTF ports available at no extra charge
- NPTF ports standard on AN5 and LN5; SAE ports available at no extra charge
- Metric, BSP, Manifold,

## F Flange and other porting options available

### Teflon Tube Seals

- Superior design to prevent leakage
- Compatible with virtually all fluids



## Key Features

### Unitized Rod Cartridge Construction

- The unitized construction contains all cartridge seals in one assembly.
- Standard removable retainer allows cartridge removal with hex wrench without loosening the tie rods.
- See Page 5 for exceptions.

### Sculptured Floating Cushions

Self-centering cushions are sculptured to allow the cylinder driving force and load to be absorbed gradually and smoothly over the entire cushion length maintaining near constant pressure. Refer to pages 20 and 21 to determine your specific cushion requirements

Fig. 3-1

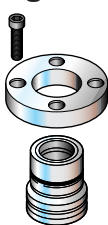
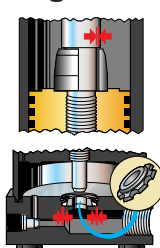


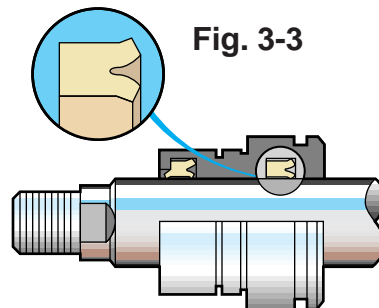
Fig. 3-2



### Urethane Ultra-Seal Rod Seal

Ultra-Seal Rod Seal provides much longer wear life than conventional rod seals. Special urethane formulation allows superior resistance to abrasion, tearing and extrusion. The balanced radial cross-sectional design with back-beveled sealing lips provides excellent low pressure sealability. Higher pressures energize the sealing lips increasing the contact stress profile and giving the added sealing needed at increased pressures.

Fig. 3-3



**G Floating Cap Cushion Insert**

- Floating design allows closer tolerance, yet minimum wear (see Fig. 3-2)
- Replaces ball check to provide greater flow area for fast breakaway

**H Captive Cushion Adjustment**

- Inner hex allows safe cushion adjustment under pressure
- Fine threads and special tip design allows for precise adjustment over a broad range of operating conditions

**I Precision Steel Heads and Caps**

- Provides truly flat and parallel mounting surfaces
- Insures correct alignment of tube and rod cartridge

**J Self Centering Head Cushion**

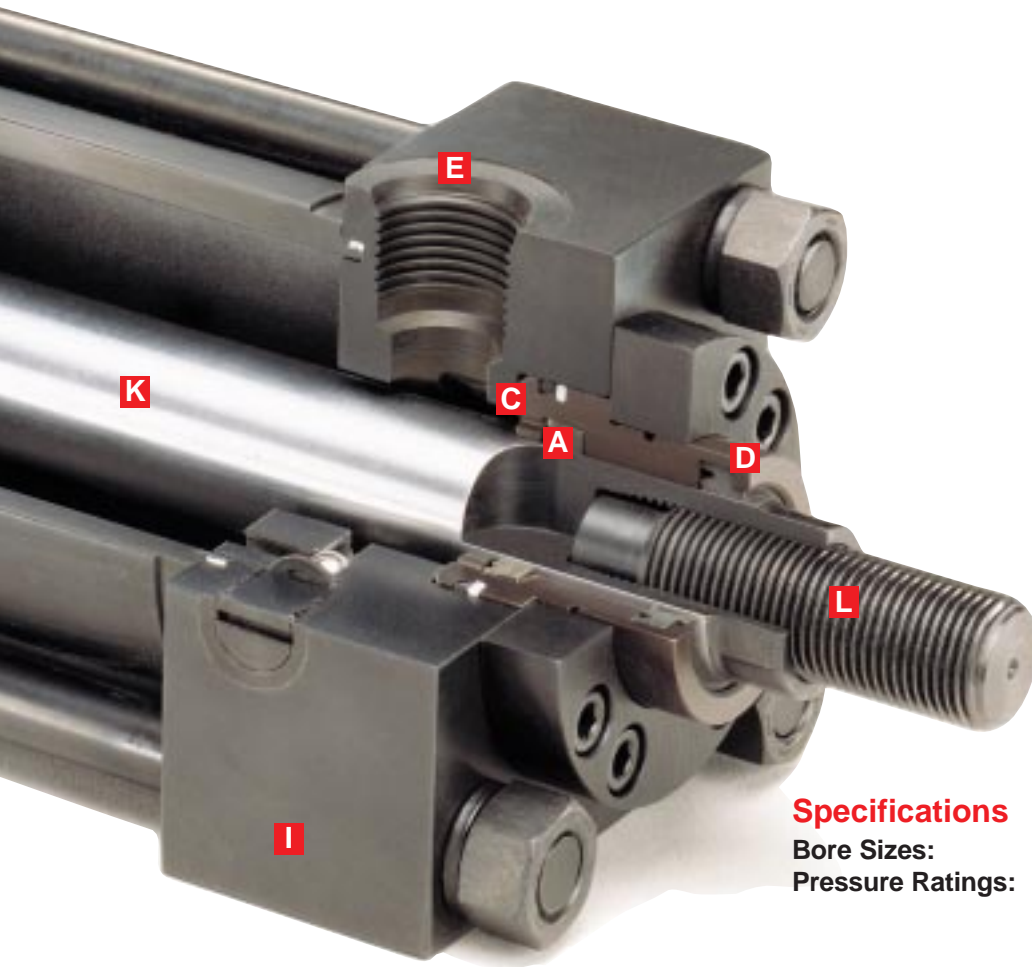
- Floating design allows closer tolerances, yet minimum wear (see Fig. 3-2)
- Sculptured shape provides constant deceleration curve
- Large size ball check provided at head end for fast breakaway

**K Damage Resistant Piston Rod**

- $\frac{5}{8}$ " through  $4\frac{1}{2}$ " diameters use 90,000 to 100,000 minimum psi yield steel, case hardened and hard chrome plated
- Over 5" diameter uses 41,000 to 80,000 psi yield steel, hard chrome plated
- All rods polished to 8-14 micro inch finish for long seal life
- 17-4 PH stainless steel and other materials also available

**L Studded Piston Rod End**

- Roll threaded 125,000 minimum psi yield steel
- Greater strength and fatigue resistance
- Standard on  $\frac{5}{8}$ ", 1" and  $1\frac{3}{8}$ " diameter rods in styles 1, 1X, 2 and 2X
- Available on  $1\frac{3}{4}$ ", 2" and  $2\frac{1}{2}$ " rods in styles 1, 1X, 2 and 2X upon request



**Specifications**

**Bore Sizes:**  $1\frac{1}{2}$ " through 30"

**Pressure Ratings:** N5 – 3000 psi hydraulic – nominal  
AN5, LAN5 – 250 psi air  
See page 23 for specific pressure ratings and safety factors

**Temperature:** -40°F to 200°F standard

**NFPA interchangeable mountings**

**N5:** Hydraulic cylinders incorporate urethane Ultra-Seal rod seals, carboxylated double-lipped rod wipers, cast iron piston rings, honed steel tubing I.D. and SAE ports.

**AN5:** Pneumatic cylinders incorporate carboxylated lip-type rod seals, carboxylated double-lipped rod wipers, carboxylated piston seals, .0003/.0005" thick chrome plated tube I.D. and NPTF ports.

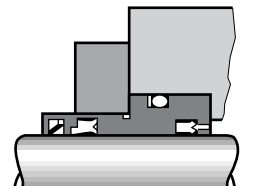
**LAN5:** Pneumatic cylinders incorporate all AN5 features, and are also permanently lubricated at assembly by filling the piston and rod seals "V" groove with molybdenum disulfide grease.

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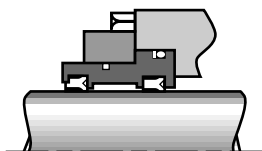
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## N5 Series Standard Design Options



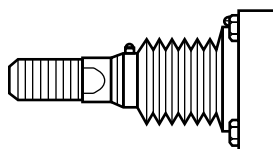
### Metallic Rod Scrapers

A Metallic Rod Scraper provides increased rod seal life by removing abrasive contamination from the rod in severe applications.



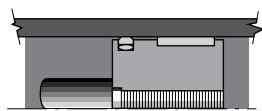
### Wearbands

Wearbands fitted to the piston and/or rod cartridge eliminate metal-to-metal contact on the piston/tube I.D. and the cartridge/rod O.D. Bronze-filled Teflon wearband material reduces friction and wear in applications where side-load is present.



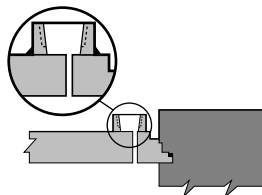
### Rod Boots

A rod boot surrounds the piston rod with an external, expandable cover to protect the rod surface from external contamination. Requires additional rod length which is determined by the cylinder stroke.



### Low Breakaway Piston

A low breakaway piston reduces running friction and metal-to-metal contact by utilizing a bronze-filled Teflon wearband and a bi-directional, O-ring energized, bronze-filled Teflon piston seal.



### Air Bleeders

1/8" NPTF bleeders are located in the tube or in the head and cap when specified. SAE #2 bleeders located in the head and cap are also available when specified. All bleeders may be located in positions 1, 2, 3 or 4.



### ABS Approved

accepted under the Equipment Type Approval Program of the American Bureau of Shipping, and is the preferred source of many customers with requirements for ABS Approval. Steering applications must be specified to obtain appropriate price and delivery.

### Special Rod Ends

Modifications of standard rod ends or completely special rod end styles are available to meet unique rod end connection requirements. (See page 29.)

### Special Ports

Metric, BSP, Manifold and other porting options are available to meet specific requirements. (See page 22.)

### Extra Heavy Chrome Tubes and Rods

Added wear and corrosion resistance are available by specifying Extra Heavy Chrome (.002" to .003" thick).

### Electronic Feedback

A complete line of precision cylinder position sensing and feedback devices are available. These packaged cylinder systems can handle virtually any application requiring feedback throughout the cylinder stroke — pneumatic or hydraulic, large or small bore, long or short strokes, with or without velocity monitoring — with resolutions of  $\pm 0.001$ " or better.

### Stainless Steel Piston Rods

Piston rods in 300 and 400 series, 17-4 PH, and others are available for those applications requiring increased corrosion resistance.

### Special Coating and Painting

Cylinders can be prepared with a primer coat, epoxy, lacquer, or enamel paint finish coatings to customer specifications. Synergistic, Nitrocarburizing and other material treatments are also available for special applications.

### Plating

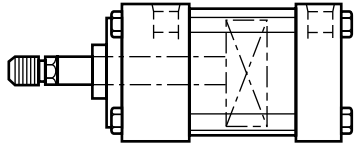
Electroless Nickel, Cadmium and other plating finishes are available for corrosive, washdown, pharmaceutical and other applications.

### Special Materials

Bronze rod cartridges, brass, aluminum and composite tubing, complete stainless steel cylinders or other special materials are available to meet most unique material requirements.

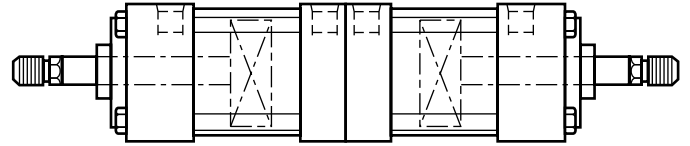


# N5 Series Cylinder Types



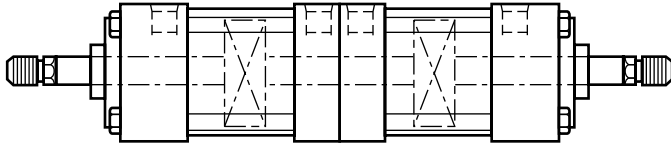
## Single/Double Acting Cylinders

Standard R5 & A5 Series cylinders are double acting, with fluid power driving the piston in both directions. Single acting cylinders have fluid power driving the piston in one direction, relying on either the load or an external force to return the piston after the pressure is released.



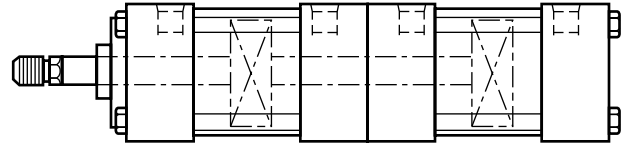
## Back-to-Back Cylinders

Back-to-back cylinders are two single rod cylinders mounted together at the caps. Combinations of positions are possible through various combinations of piston actuation. Consult for maximum operating pressure.



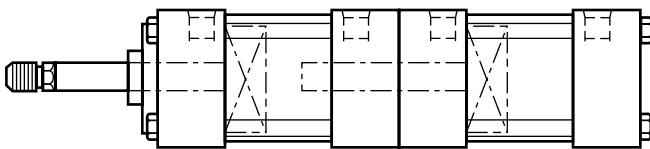
## Double End Cylinders Back-to-Back

Double end cylinders mounted back-to-back have common piston rod and tie rods and the same stroke length. Consult for maximum operating pressure.



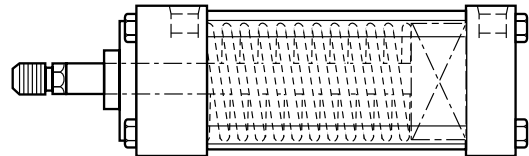
## Tandem Cylinders

Tandem cylinders consist of two cylinders interconnected (piston and rod assemblies are connected). Pressure can act on two effective piston areas allowing the cylinder to be used as a force multiplier. This type of cylinder can also be used in air/oil systems to provide smooth, metered flow because of equal volumes in one chamber of both cylinders. Consult for maximum operating pressure. **NOTE:** Front cylinder stroke is  $\frac{1}{8}$ " longer at front cylinder when strokes are the same.



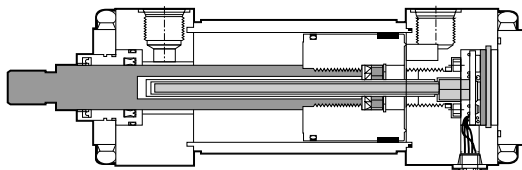
## Multiple Position Cylinders

Multiple position cylinders are similar to tandem cylinders (except that the piston and rod assemblies are not connected) in that the output force is increased. Additionally, they may act as a precision multiple positioning device by actuating each cylinder successively or independently. Consult for maximum operating pressure.



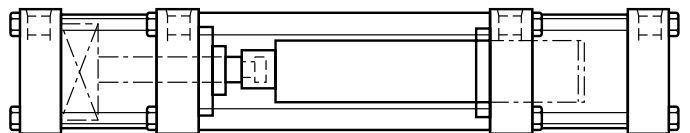
## Spring Return/Extend Cylinders

Spring return/extend cylinders provide thrust in one direction only (can be either direction). One port is used for pressure to act against the load while the inactive port is vented. An internal spring is used to return the cylinder to its normal position.



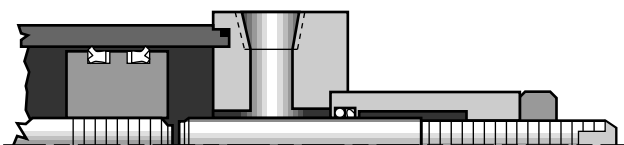
## Systems Cylinders

Systems cylinders integrate position sensing and control valves to produce a complete servoactuator package. Hydro-Line's unique HLT In-Cylinder magnetostrictive feedback sensor provides a compact, robust package. External magnetostrictive (with protective covers) or internally mounted linear potentiometer transducers provide additional options. Valve, manifold blocks and a variety of servocontrol valves may be added to yield a complete control solution. (See Hydro-Line's Systems Catalog for more information.)



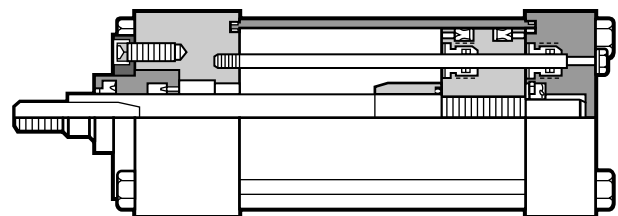
## Pumping Units

Pumping units consist of a standard hydraulic cylinder coupled with a volume displacing lance cylinder via tie-bars. Special seals and lance surface treatments are available to provide compatibility with resins and chemicals used in the pumping process. Single and double ended designs are available.



## Adjustable Stroke Cylinders

Adjustable stroke cylinders are furnished with a stroke adjusting screw in the cap end of the cylinder. Adjusting this screw in or out limits the retract stroke to the precise length desired.



## Non-Rotating Cylinders

Non-rotating cylinders are furnished with internal guide rods which prevent piston rod rotation throughout the stroke. Rotational torque and stroke length determine the amount and diameter of the guide rods.

# Commitment to Quality

It is the policy of to design, produce and deliver defect-free products and provide superior services, the first time and every time, that consistently meet the needs of our customers. Our philosophy calls upon every employee to strive for excellence in customer satisfaction through continuous improvement.

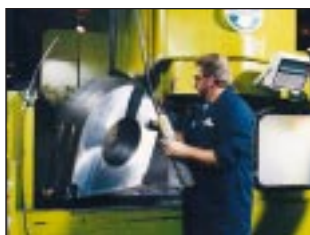


## Custom Cylinders

### For Special Applications

Hydro-Line's full line of cylinder products and options fit most customers' application requirements, however, a special cylinder is often required to meet custom specifications. These custom cylinders are often needed to solve difficult application problems, upgrade existing equipment or are designed into new machinery.

Hydro-Line's Sales, Engineering and Manufacturing groups are cylinder specialists and have many years of experience in the interpretation of requirements, design and manufacture of custom cylinder products.



Our capabilities include:

- Bore diameters to 30"
- Stroke lengths to 300"
- Operating pressures to 10,000 psi or higher
- Operating mediums ranging from shop air to nitrogen, or from standard hydraulic fluid to special synthetic fluids
- Tie rod, threaded and bolted cylinder construction
- Finite element analysis
- Application simulation in our testing laboratories



would appreciate an opportunity to submit a proposal to solve your application problem or fulfill your current cylinder requirements. Simply copy and complete the Application Data Sheet on page 8 and fax to your authorized distributor.

# Application Data Sheet

Company Name: _____	Distributor Name: _____
Contact: _____	Contact: _____
Phone Number: _____ Fax Number: _____	Phone Number: _____ Fax Number: _____

Model Numbering System

QUANTITY																				SEALS PORT LOC																													
MODEL/SERIES MOUNT										BORE										STROKE CUSHION ROD DIA ROD STY PORTS ROD PSTN H C MODEL																													
<div style="display: flex; justify-content: space-around;"><div><div></div><div></div><div></div><div></div></div></div>																																																	
DOUBLE END ROD STYLE										ADDITIONAL ROD LENGTH										NEEDLE LOCATION										4-FLAT										MODEL PREFIX									
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STOP TUBE LENGTH										TRUNNION XI DIMENSION										STAINLESS STEEL ROD TYPE																													
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Please fill in all available information above. Refer to the Model Numbering System on Pages 2.

WHAT IS THE OPERATING ENVIRONMENT?				WHAT IS THE WORK BEING PERFORMED?					
<b>Fluid Media Operating Pressure</b>		<b>Temperature at Cylinder</b>		<b>Load</b>		<b>Rod Speed</b>		<b>Cycles per Minute</b>	
Air _____	Minimum _____ psi	Minimum _____ °F		Push _____ lbs.	Extend _____ in./sec.				
Oil _____	Typical _____ psi	Typical _____ °F		Pull _____ lbs.	Retract _____ in./sec.	_____ (in and out)			
Other _____	Maximum _____ psi	Maximum _____ °F							
Fluid Type _____									

WHAT IS THE MOUNTING?

<b>Attitude</b>		<b>Rod End Connection</b>		<b>Known Side Load</b>	
Vertical _____	Angle _____ Horizontal _____	Firmly Guided _____			
	Degrees From Vertical _____	Supported _____	_____ lbs.		
Rod Up _____	Rod Up _____	Unsupported _____			
Rod Down _____	Rod Down _____				

WHAT ENVIRONMENTAL CONDITIONS IS THE CYLINDER SUBJECTED TO?

Standard Factory \_\_\_\_\_ Corrosive Washdown \_\_\_\_\_ Chemical \_\_\_\_\_ Outdoors \_\_\_\_\_ Other \_\_\_\_\_

WHAT IS THE PRESENT CYLINDER TYPE AND MODEL NUMBER?

\_\_\_\_\_

WHAT IS THE PRESENT PROBLEM?

\_\_\_\_\_

WHAT INDUSTRY IS THE CYLINDER USED IN?	WHAT TYPE OF MACHINE IS THE CYLINDER USED ON?	WHAT IS THE CYLINDER NAME THE APPLICATION?

APPLICATION SKETCH:	DESCRIPTION OF APPLICATION OR SPECIAL REQUIREMENT:

PREPARED BY:	DATE:	REVIEWED BY:	DATE:

CUSTOMER DRAWING NUMBER:	REVISION DATES:	QUOTE NUMBER:

# N5 Series Mounting Application Data

## Side and Center-Line Mountings

These mounts should be keyed or pinned to prevent shifting during operation. Keys or pins must be strong enough to resist the full thrust of the cylinder. The lugs on **A** and **H** mounts are large enough to accommodate dowel pins. Extended key plates for stock and custom cylinder models are available when specified. Pin or key the head whenever possible. Do not pin or key both ends. Cylinders become longer when pressure is applied and tube will tend to buckle.

The alignment and center-line height on the **E** mount are maintained by accurately machined surfaces on the head and cap which are held against the mounting surface by the end lugs.

DESCRIPTION	MOUNT	NFPA DESIGNATION	N5 BORES AVAILABLE
Side Lugs	A	MS2	1 1/2" - 8"
Side Tapped	B	MS4	1 1/2" - 8"
Center-Line Lugs	H	** MS3	1 1/2" - 20"
Side End Lugs	E	MS7	1 1/2" - 8"

## End and Intermediate Pivot Mountings

Trunnion and pivot pins are designed to carry shear loads only. Trunnion and pivot bearings must fit closely for the entire length of the pin. Hold the trunnion bearings rigidly and in accurate alignment.

DESCRIPTION	MOUNT	NFPA DESIGNATION	N5 BORES AVAILABLE
Cap Fixed Clevis	C	** MP1	1 1/2" - 30"
Cap Spherical Bearing	CS	N/A	1 1/2" - 6"
Detachable Clevis	DC	MP2	1 1/2" - 8"
Head Trunnion	U	** MT1	1" - 30"
Cap Trunnion	W	** MT2	1 1/2" - 30"
Intermediate Fixed Trunnion	TT	** MT4	1 1/2" - 30"

## End Mountings

The head and cap rectangular mounts **G** and **P** should be used for hydraulic applications to avoid excessive deflection which occurs on the **F** and **R** mountings.

Refer to the chart on page 10 for pressure ratings for **F** mounts in push and **R** mounts in pull.

The **G**, **P**, **J** and **S** mounts are usable in both push and pull at full rated hydraulic pressures as shown on page 23.

DESCRIPTION	MOUNT	NFPA DESIGNATION	N5 BORES AVAILABLE
Head Rectangular Flange	F	MF1	1 1/2" - 8"
Cap Rectangular Flange	R	MF2	1 1/2" - 8"
Head Square Flange	J	MF5	1 1/2" - 8"
Cap Square Flange	S	MF6	1 1/2" - 8"
Integral Square Head	J	**	10" - 30"
Integral Square Cap	S	**	10" - 30"
Tie Rods Extended	L, N, M	MX1, MX2, MX3	1 1/2" - 8"
Head Rectangular	G	** ME5	1 1/2" - 14"
Cap Rectangular	P	** ME6	1 1/2" - 14"
No Mount	K	N/A	1 1/2" - 30"

**\*\* NFPA MOUNTING DIMENSIONS ARE AVAILABLE ON ALL CYLINDERS 1 1/2" - 8" BORE. FOR LARGER CYLINDERS, SEE PAGES 16-17 FOR MOUNTING DIMENSIONS.**

## Piston Securing Methods

Piston to rod joints are threaded, anaerobically sealed and secured, and staked (single rod ends). Under normal operating conditions, additional securing is not necessary. However, in applications where: 1) temperatures exceed 250°F, 2) pressure spike or impact shock is present, or 3) a piston previously detached, the piston should be pinned; this must be specified when ordering. Consult factory for other securing methods.

## Double Rod Cylinders

Double rod cylinders are available in all mountings except **C**, **CS**, **DC**, **N**, **P**, **R**, **S** and **W**. Use the basic dimensional information on page 15 combined with dimensions in the drawings on pages 10-15.

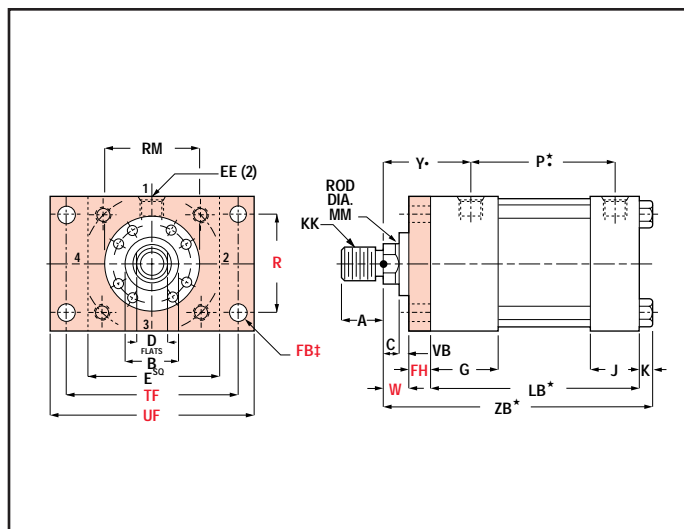
## Mounting Accessories

See pages 23-27 for mounting accessories.

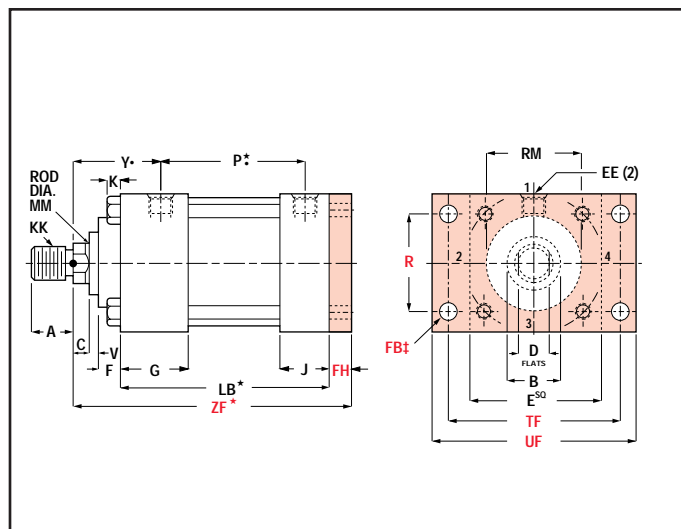


# N5 Series Mounting Dimensions

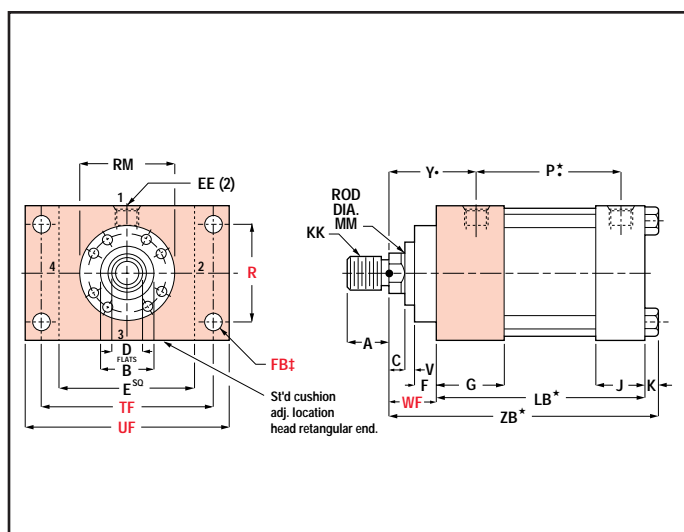
1 1/2" - 8" bore cylinders



N5F – Head Rectangular Flange Mount (NFPA Style MF1)



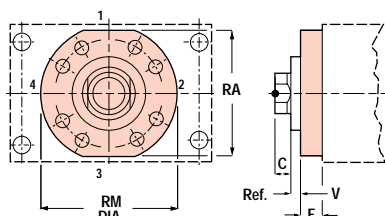
N5R – Cap Rectangular Flange Mount (NFPA Style MF2)



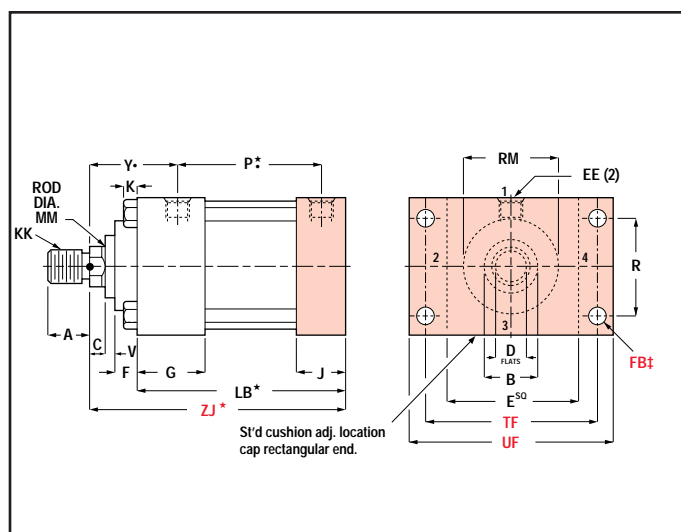
N5G – Head Rectangular Mount (NFPA Style ME5)

## MOUNTING G ONLY

**NOTE:** Use the chart below for the cartridge retainer plate dimensions for the bore and rod combinations listed. See page 11 for all other mounting dimensions.



Bore	Rod Dia.	F	RA	RM	V
1 1/2	5/8	11/32	-	23/8	9/32
	1	1/2	2.44	25/8	3/8
2	1	1/2	-	25/8	3/8
	1 3/8	19/32	2.94	3 1/4	13/32
2 1/2	1 3/8	19/32	-	3 1/4	13/32
	1 3/4	19/32	3.44	37/8	17/32
3 1/4	1 3/4	19/32	-	37/8	17/32
	2	19/32	-	4	17/32



N5P – Cap Rectangular Mount (NFPA Style ME6)

## MAXIMUM OPERATING PRESSURES IN PSI FOR F MOUNTING IN PUSH

CYLINDER BORE	STANDARD ROD		2:1 PISTON ROD	
	Heavy Duty	Nonshock	Heavy Duty	Nonshock
5 & 6	1440	2400	1120	1840
7	1040	1760	720	1200
8	800	1350	640	1120

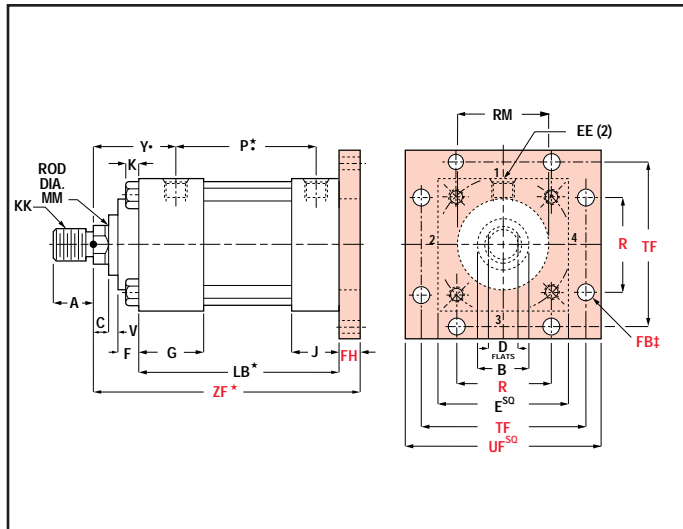
## MAXIMUM OPERATING PRESSURES IN PSI FOR R MOUNTING IN PULL

CYLINDER BORE	STANDARD ROD		2:1 PISTON ROD	
	Heavy Duty	Nonshock	Heavy Duty	Nonshock
5 & 6	1800	3000	1400	2300
7	1300	2200	900	1500
8	1000	1700	800	1400

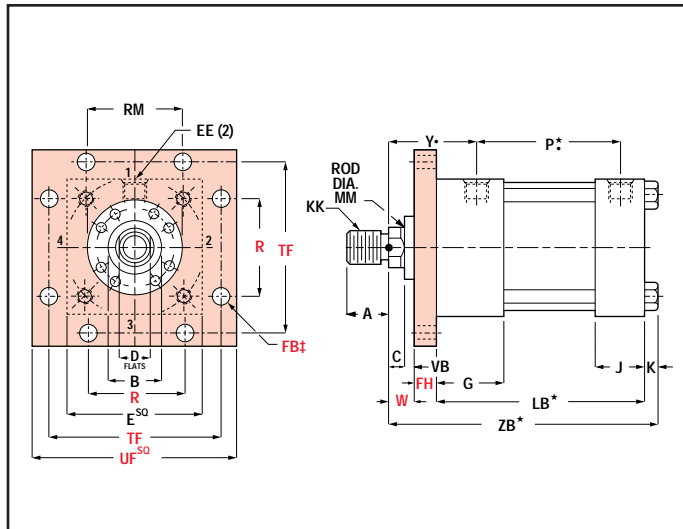
**NOTE:** When pressure must exceed the limitations above for mountings F and R, specify J or S mounting. (Up to a maximum of 3000 psi heavy duty, 5000 psi nonshock.)

## End Mountings

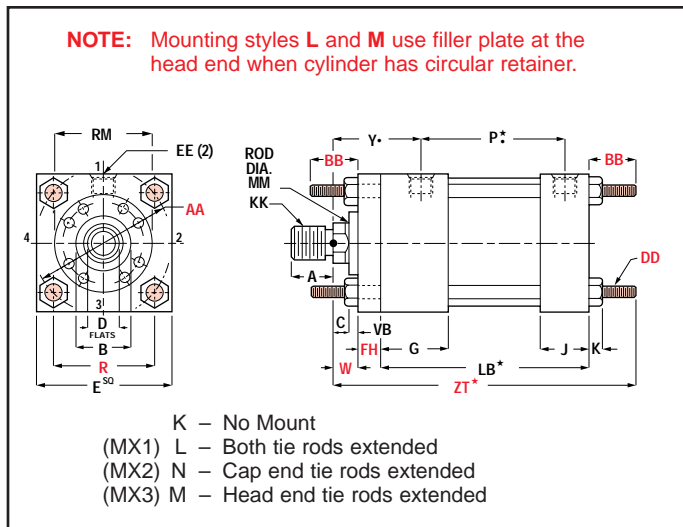
(See important application data on pages 18-19.)



N5S – Cap Square Flange Mount (NFPA Style MF6)



N5J – Head Square Flange Mount (NFPA Style MF5)



N5K (No Mount), N5L (NFPA Style MX1), N5N (NFPA Style MX2), N5M (NFPA Style MX3) – Tie Rods Extended Mounts

## Cylinder Dimensions

BORE	1½	2	2½	3¼	4	5	6	7	8
A	¾	1⅛	1⅛	1⅝	2	2¼	3	3½	3½
AA	2.3	2.9	3.6	4.6	5.4	7.0	8.1	9.3	10.6
AC	1⅛	1½	1½	1¾	2	2⅝	3¼	3¾	4⅜
AD	⅝	15/16	15/16	1⅞	1⅞	1⅞	1⅞	2⅞	2⅞
AE	¼	⅜	⅜	⅜	½	⅝	¾	⅞	1
AF	⅜	1⅞	1⅞	⅞	1⅞	1⅞	1⅞	2¼	2½
B -.001 -.003	1⅛	1½	1½	2	2⅜	2⅝	3⅞	3¾	4¼
BB	1⅜	1⅞	1⅞	2⅞	2⅞	3⅞	3⅞	4⅞	4½
C	⅜	½	½	⅝	¾	⅞	1	1	1
CC	1/2-20	7/8-14	7/8-14	1¼-12	1½-12	1¾-12	2¼-12	2¾-12	3¼-12
D	17/32	7/8	7/8	1⅞	1½	1¾	2⅞	2⅞	3
DD	3/8-24	1/2-20	1/2-20	5/8-18	5/8-18	7/8-14	1-14	1⅞-12	1¼-12
E	2½	3	3½	4½	5	6½	7½	8½	9½
EE (SAE)	10	10	10	12	12	12	16	20	24
EE (NPTF)	½	½	½	¾	¾	¾	1	1¼	1½
F	▲	▲	½	19/32	19/32	19/32	19/32	23/32	23/32
FB†	7/16	9/16	9/16	1⅞	1⅞	1⅞	1⅞	1⅞	1⅞
FH	⅜	⅝	⅝	¾	⅞	⅞	1	1	1
FT	5/8-18	1-14	1-14	1¾-12	1¾-12	2-12	2¼-12	3-12	3½-12
G	1¾	1¾	1¾	2	2	2	2¼	2¾	3
J	1½	1½	1½	1¾	1¾	1¾	2¼	2¾	3
K	⅜	7/16	7/16	9/16	9/16	13/16	15/16	1	1⅞
KK	7/16-20	3/4-16	3/4-16	1-14	1¼-12	1½-12	1⅞-12	2¼-12	2½-12
LB*	4⅝	4⅝	4¾	5½	5¾	6¼	7⅞	8½	9½
MM	⅝	1	1	1¾	1¾	2	2½	3	3½
P*	2⅞	2⅞	2⅞	3⅞	3⅞	4⅞	4⅞	5⅞	5⅞
R	1.63	2.05	2.55	3.25	3.82	4.95	5.73	6.58	7.50
RM	■	■	2⅞	3¼	3⅞	4	4⅞	5¼	5⅞
TF	3/16	4⅞	4⅞	5⅞	6⅞	8⅞	9⅞	10⅞	11⅞
UF	4¼	5⅞	5⅞	7⅞	7⅞	9¾	11¼	12⅞	14
V	▲	▲	¾	13/32	17/32	17/32	21/32	17/32	17/32
VB	¼	¼	¼	¼	¼	¼	¼	¼	¼
W	⅝	¾	¾	⅞	1	1⅞	1¼	1¼	1¼
WF	1	1¾	1¾	1⅞	1⅞	2	2¼	2¼	2¼
Y*	23/32	2⅞	2⅞	2⅞	2⅞	3⅞	3⅞	3⅞	4⅞
ZB*	6	6⅞	6⅞	7⅞	8⅞	9⅞	10⅞	11¾	12⅞
ZF*	6	6⅞	6¾	7⅞	8½	9⅞	10⅞	11¾	12¾
ZJ*	5⅞	6	6⅞	7⅞	7⅞	8¼	9⅞	10¾	11¾
ZT*	7	7⅞	7⅞	9⅞	9⅞	11⅞	13¼	14⅞	16¼
PISTON THICKNESS	1⅞	1⅞	1½	1¾	2	2½	2⅞	3	3½

Dimensions shown in red are mounting dimensions.

**NOTE:** Additional port information on page 22.

■ Oversize rods affect dimensions in gray-shaded areas.  
 See pages 28-29 for these dimensions.

★ Add stroke to all starred dimensions.

■ Refer to page 23.

**NOTE:** Overall length dimensions that require addition of stroke may vary from dimensions shown, due to manufacturing tolerances.

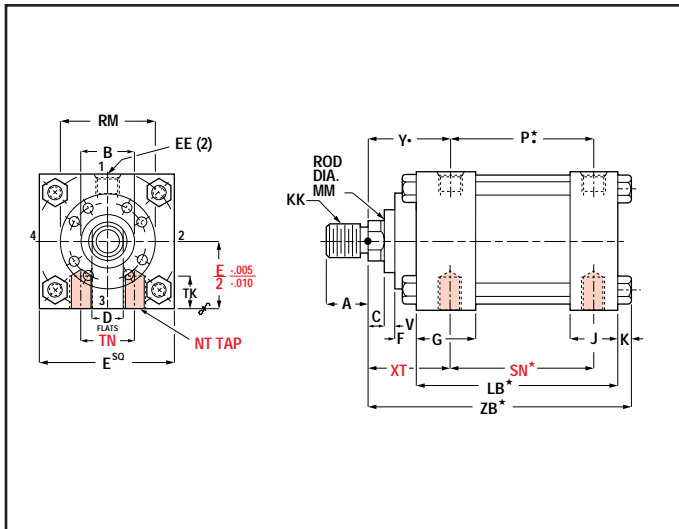
▲ Use FH dimension in place of F dimension and VB dimension in place of V dimension.

† Use screws 1/16" smaller than mounting holes.

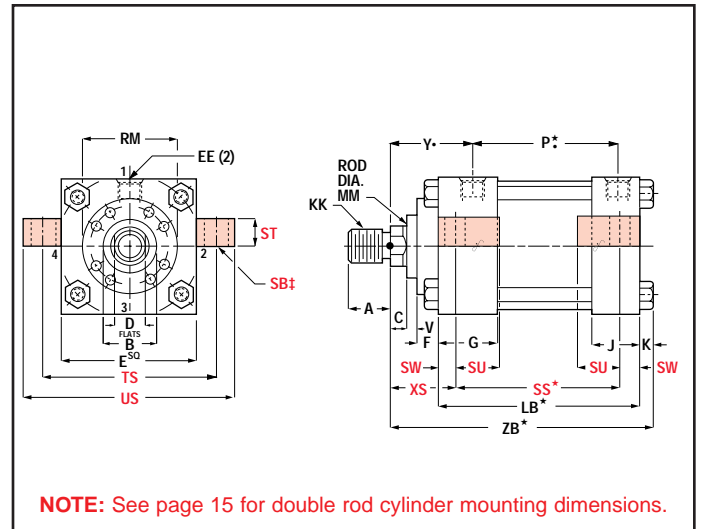
• Port dimensions for standard ports only. Consult for flange, manifold and special ports

# N5 Series Mounting Dimensions

1½" - 8" bore cylinders

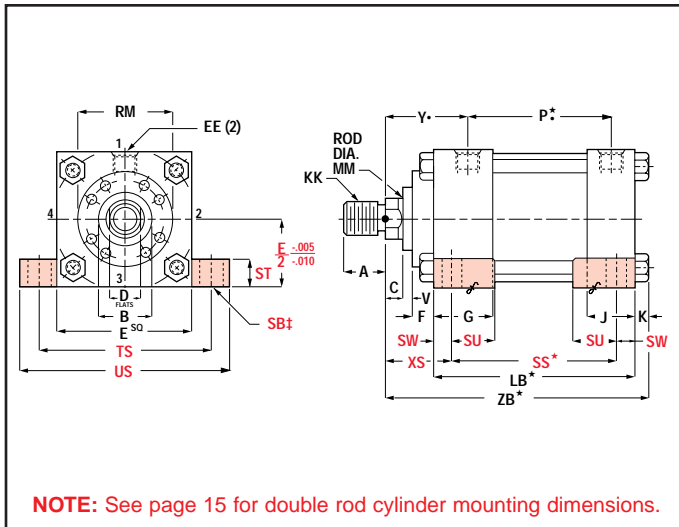


N5B – Side Tapped Mount (NFFA Style MS4)



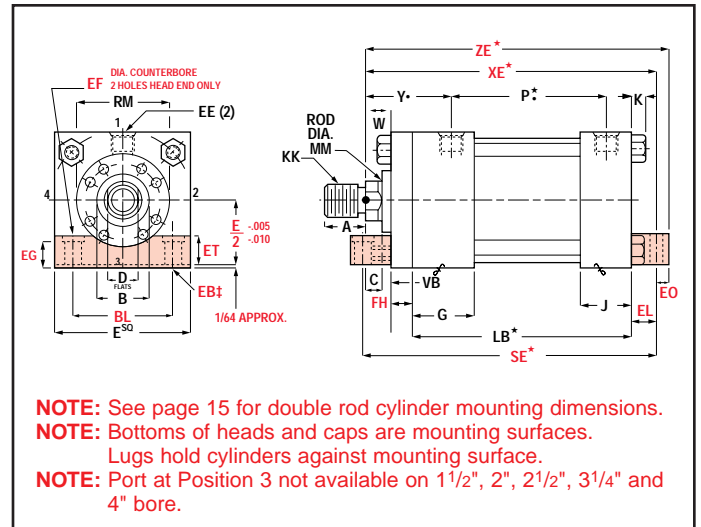
NOTE: See page 15 for double rod cylinder mounting dimensions.

N5H – Center-Line Lugs Mount (NFFA Style MS3)



NOTE: See page 15 for double rod cylinder mounting dimensions.

N5A – Side Lugs Mount (NFFA Style MS2)

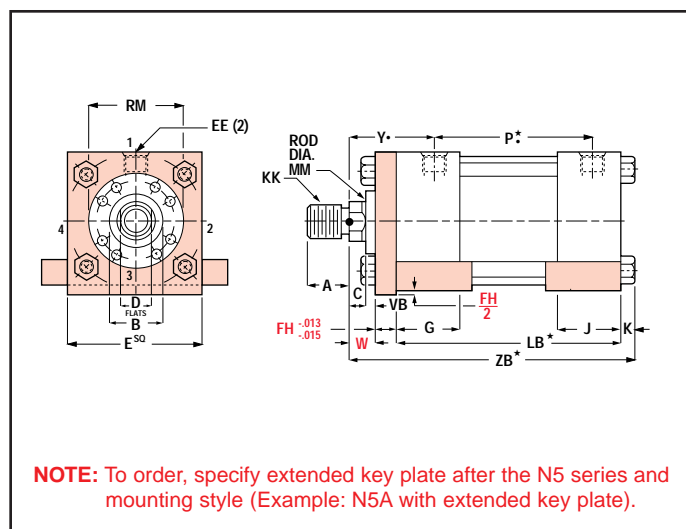


NOTE: See page 15 for double rod cylinder mounting dimensions.  
NOTE: Bottoms of heads and caps are mounting surfaces.  
Lugs hold cylinders against mounting surface.  
NOTE: Port at Position 3 not available on 1½", 2", 2½", 3¼" and 4" bore.

N5E – Side End Lugs (NFFA Style MS7)

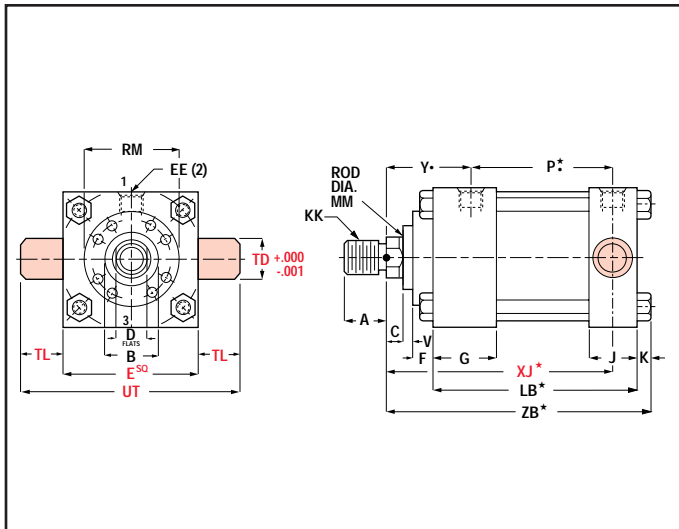
## Side and Center-Line Mountings

(See important application data on pages 18-19.)

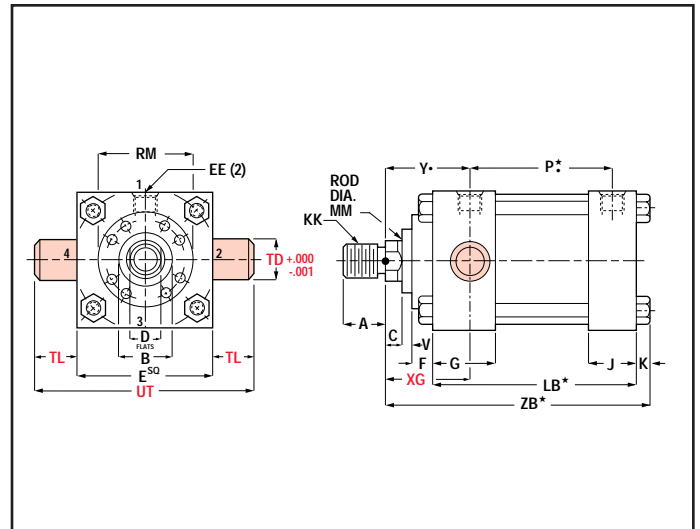


# N5 Series Mounting Dimensions

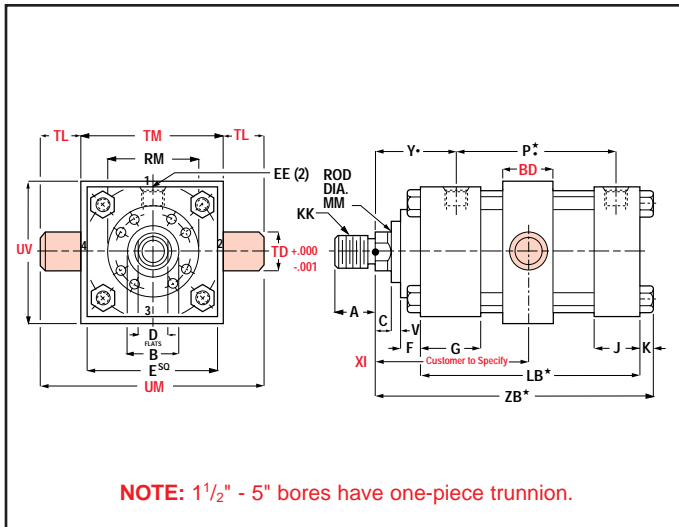
1½" - 8" bore cylinders



N5W – Cap Trunnion Mount (NFA Style MT2)

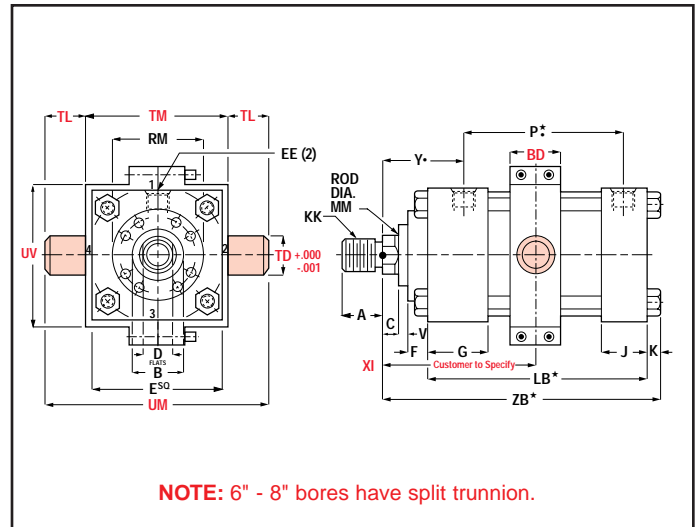


N5U – Head Trunnion Mount (NFA Style MT1)



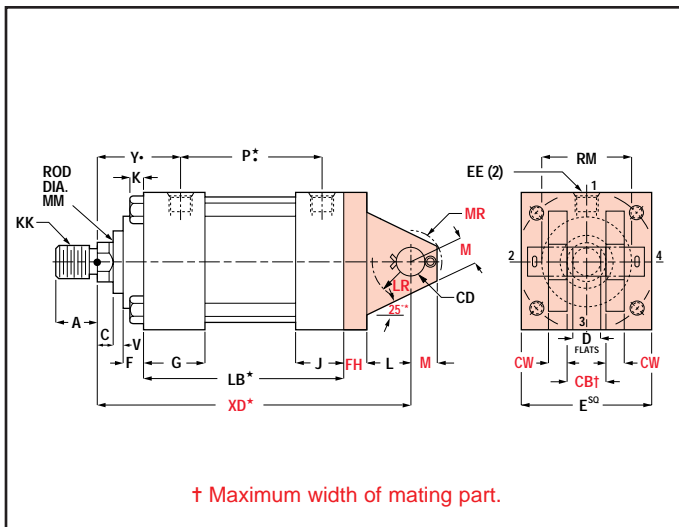
NOTE: 1½" - 5" bores have one-piece trunnion.

N5TT – Intermediate Fixed Trunnion Mount (NFA Style MT4)



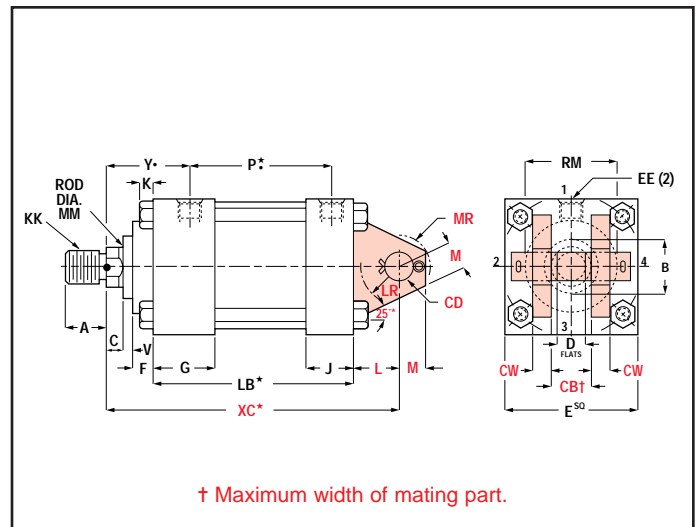
NOTE: 6" - 8" bores have split trunnion.

N5TT – Intermediate Fixed Trunnion Mount (NFA Style MT4)



† Maximum width of mating part.

N5DC – Cap Detachable Clevis Mount (NFA Style MP2)



† Maximum width of mating part.

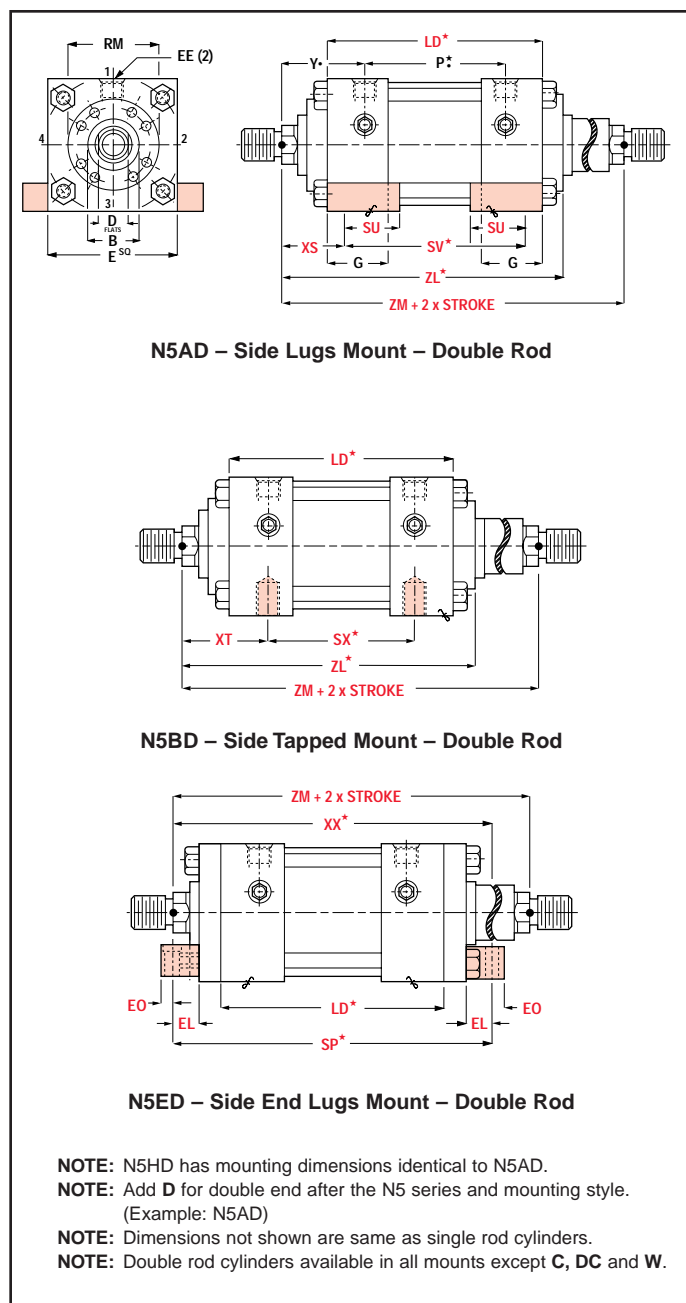
N5C – Cap Fixed Clevis Mount (NFA Style MP1)



# Pivot Mountings and Double Rod Cylinders

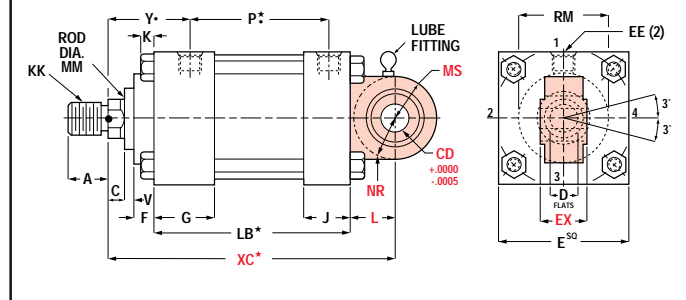
(See important application data on pages 18-19.)

# Cylinder Dimensions



## Maximum Operating Pressure

1 1/2	2	2 1/2	3 1/4	4	5	6
1650	2200	1400	1500	1750	1900	1700



BORE	1 1/2	2	2 1/2	3 1/4	4	5	6	7	8
<b>A</b>	3/4	1 1/8	1 1/8	1 5/8	2	2 1/4	3	3 1/2	3 1/2
<b>AC</b>	1 1/8	1 1/2	1 1/2	1 3/4	2	2 5/8	3 1/4	3 3/4	4 3/8
<b>AD</b>	5/8	15/16	15/16	1 1/16	15/16	1 11/16	1 15/16	2 7/16	2 11/16
<b>AE</b>	1/4	3/8	3/8	3/8	1/2	5/8	3/8	7/8	1
<b>AF</b>	3/8	1 1/16	1 1/16	7/8	1 1/8	1 3/8	1 3/4	2 1/4	2 1/2
<b>B-.001 -.003</b>	1 1/8	1 1/2	1 1/2	2	2 3/8	2 5/8	3 1/8	3 3/4	4 1/4
<b>BD</b>	1 1/2	1 1/2	1 1/2	2	2	2 1/2	3	3	3 1/2
<b>C</b>	3/8	1/2	1/2	5/8	3/4	7/8	1	1	1
<b>CB</b>	3/4	1 1/4	1 1/4	1 1/2	2	2 1/2	2 1/2	3	3
<b>CC</b>	1/2-20	7/8-14	7/8-14	1 1/4-12	1 1/2-12	1 3/4-12	2 1/4-12	2 3/4-12	3 1/4-12
<b>CD</b>	1/2	3/4	3/4	1	1 3/8	1 3/4	2	2 1/2	3
<b>CW</b>	1/2	5/8	5/8	3/4	1	1 1/4	1 1/4	1 1/2	1 1/2
<b>D</b>	17/32	7/8	7/8	1 1/8	1 1/2	1 3/4	2 1/8	2 5/8	3
<b>E</b>	2 1/2	3	3 1/2	4 1/2	5	6 1/2	7 1/2	8 1/2	9 1/2
<b>EE (NPTF)</b>	1/2	1/2	1/2	3/4	3/4	3/4	1	1 1/4	1 1/2
<b>EE (SAE)</b>	10	10	10	12	12	12	16	20	24
<b>EL</b>	7/8	15/16	15/16	1 1/8	1 1/8	1 1/2	1 11/16	1 13/16	2
<b>EO</b>	3/8	1/2	1/2	5/8	5/8	3/4	7/8	1	1 1/8
<b>EX</b>	7/16	2 1/32	2 1/32	7/8	13/16	1 17/32	1 3/4	—	—
<b>F</b>	▲	▲	1/2	19/32	19/32	19/32	19/32	23/32	23/32
<b>FH</b>	3/8	5/8	5/8	3/4	7/8	7/8	1	1	1
<b>FT</b>	5/8-18	1-14	1-14	1 3/8-12	1 3/4-12	2-12	2 1/2-12	3-12	3 1/2-12
<b>G</b>	1 3/4	1 3/4	1 3/4	2	2	2	2 1/4	2 3/4	3
<b>J</b>	1 1/2	1 1/2	1 1/2	1 3/4	1 3/4	1 3/4	2 1/4	2 3/4	3
<b>K</b>	3/8	7/16	7/16	9/16	9/16	13/16	15/16	1	1 1/8
<b>KK</b>	7/16-20	3/4-16	3/4-16	1-14	1 1/4-12	1 1/2-12	1 7/8-12	2 1/4-12	2 1/2-12
<b>L</b>	3/4	1 1/4	1 1/4	1 1/2	2 1/8	2 1/4	2 1/2	3	3 1/4
<b>LB*</b>	45/8	45/8	43/4	5 1/2	5 3/4	6 1/4	7 3/8	8 1/2	9 1/2
<b>LD*</b>	47/8	47/8	5	5 3/4	6	6 1/2	7 3/8	8 1/2	9 1/2
<b>LR</b>	9/16	1 1/16	1 1/16	1 1/4	1 7/8	1 15/16	2 1/16	2 9/16	2 11/16
<b>M</b>	1/2	3/4	3/4	1	1 3/8	1 3/4	2	2 1/2	2 3/4
<b>MM</b>	5/8	1	1	1 3/8	1 3/4	2	2 1/2	3	3 1/2
<b>MR</b>	9/16	1 1/16	1 1/16	1 1/8	1 3/4	1 7/8	2 1/8	2 1/2	2 3/4
<b>MS</b>	15/16	13/8	13/8	1 11/16	2 7/16	2 7/8	3 5/16	—	—
<b>NR</b>	5/8	1	1	1 1/4	1 5/8	2 1/16	2 3/8	—	—
<b>P*</b>	2 11/16	2 11/16	2 13/16	3 9/16	3 13/16	4 5/16	4 11/16	5 1/8	5 7/8
<b>RM</b>	■	■	2 5/8	3 1/4	3 7/8	4	4 7/16	5 1/4	5 3/8
<b>SP*</b>	7 3/8	8	8 1/8	9 1/2	10	11 1/4	12 3/4	14 1/8	15 1/2
<b>SU</b>	15/16	1 1/4	1 9/16	1 9/16	2	2	2 1/2	2 7/8	2 7/8
<b>SV*</b>	4 1/8	3 7/8	3 5/8	4 3/8	4 1/4	4 3/4	5 1/8	5 3/4	6 3/4
<b>SX*</b>	2 7/8	2 7/8	3	3 1/2	3 3/4	4 1/4	4 7/8	5 3/8	6 1/8
<b>TD</b>	1	1 3/8	1 3/8	1 3/4	1 3/4	1 3/4	2	2 1/2	3
<b>TL</b>	1	1 3/8	1 3/8	1 3/4	1 3/4	1 3/4	2	2 1/2	3
<b>TM</b>	3	3 1/2	4	5	5 1/2	7	8 1/2	9 3/4	11
<b>UM</b>	5	6 1/4	6 3/4	8 1/2	9	10 1/2	12 1/2	14 3/4	17
<b>UT</b>	4 1/2	5 3/4	6 1/4	8	8 1/2	10	11 1/2	13 1/2	15 1/2
<b>UV</b>	2 3/4	3 3/8	3 7/8	4 7/8	5 1/2	7 1/4	9 1/2	11 1/2	13 1/4
<b>V</b>	▲	▲	3/8	13/32	17/32	17/32	21/32	17/32	17/32
<b>VB</b>	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
<b>W</b>	5/8	3/4	3/4	7/8	1	1 1/8	1 1/4	1 1/4	1 1/4
<b>XC*</b>	6 3/8	7 1/4	7 3/8	8 5/8	9 3/4	10 1/2	12 1/8	13 3/4	15
<b>XD*</b>	6 3/4	7 7/8	8	9 3/8	10 5/8	11 3/8	13 1/8	14 3/4	16
<b>XG</b>	1 7/8	2 1/4	2 1/4	2 5/8	2 7/8	3	3 3/8	3 5/8	3 3/4
<b>XJ*</b>	4 7/8	5 1/4	5 3/8	6 1/4	6 3/4	7 3/8	8 3/8	9 3/8	10 1/4
<b>XS</b>	1 3/8	1 7/8	2 1/16	2 5/16	2 3/4	2 7/8	3 3/8	3 5/8	3 5/8
<b>XT</b>	2	2 3/8	2 3/8	2 3/4	3	3 1/8	3 1/2	3 3/16	3 15/16
<b>XX*</b>	7 1/8	7 13/16	7 15/16	9 1/4	9 7/8	10 7/8	12 5/16	13 9/16	14 3/4
<b>Y*</b>	2 3/32	2 15/32	2 15/32	2 23/32	2 31/32	3 3/32	3 19/32	3 15/32	4 1/16
<b>ZB*</b>	6	6 7/16	6 9/16	7 11/16	8 3/16	9 1/16	10 9/16	11 3/4	12 7/8
<b>ZL*</b>	6 1/4	6 7/8	6 7/8	7 31/32	8 15/32	9 3/32	10 7/32	11 15/32	12 15/32
<b>ZM**</b>	6 7/8	7 5/8	7 3/4	9	9 3/4	10 1/2	11 7/8	13	14
<b>PISTON THICKNESS</b>	1 3/8	1 3/8	1 1/2	1 3/4	2	2 1/4	2 7/8	3	3 1/2

Dimensions shown in red are mounting dimensions.

**NOTE:** Additional port information on page 22.

▲ Oversize rods affect dimensions in gray-shaded areas. See pages 28-29 for these dimensions.

\* Add stroke to all starred dimensions.

■ Refer to page 23.

**NOTE:** Overall length dimensions that require addition of stroke may vary from dimensions shown, due to manufacturing tolerances.

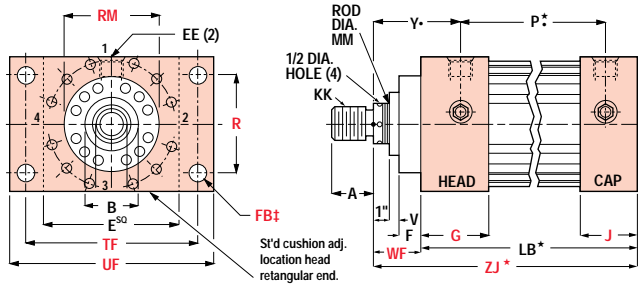
▲ Use FH dimension in place of F dimension and VB dimension in place of V dimension.

★★ Plus 2 x stroke

• Port dimensions for standard ports only. Consult for flange, manifold and special ports.

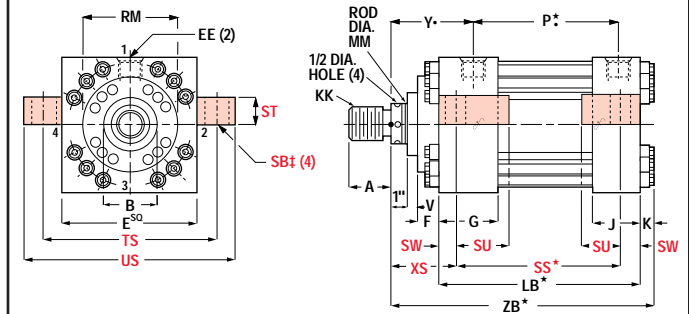
# N5 Series Mounting Dimensions 10"- 20", 24" and 30" bore cylinders

**NOTE:** Tie rod nuts will extend past the end cap **K** thickness on the end opposite flange mounting.

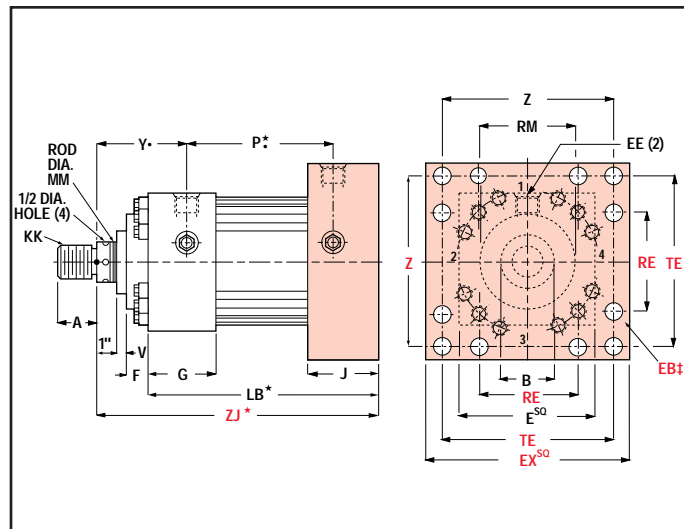


Available in 10", 12" and 14" bores only.  
Over 14" bore, use **J** or **S** mount.

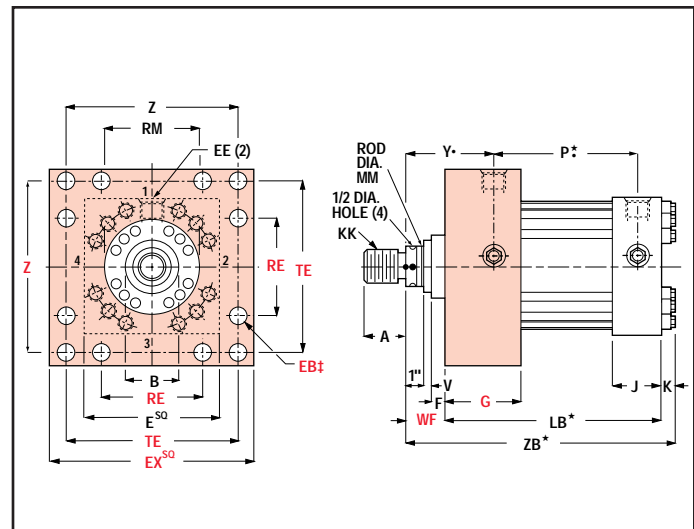
**N5G – Head Rectangular Mount**  
**N5P – Cap Rectangular Mount**



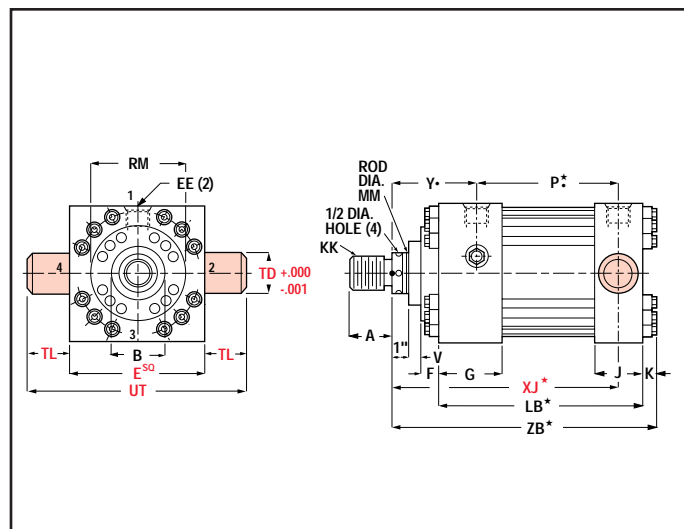
**N5H – Center-Line Lugs Mount**



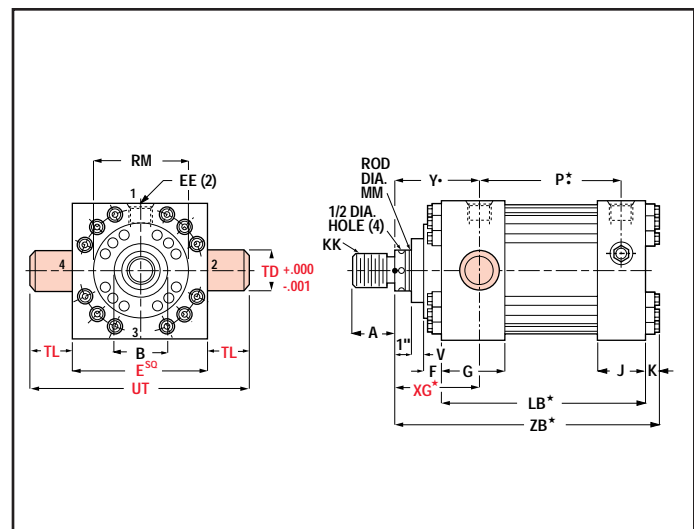
**N5S – Cap Square Mount**



**N5J – Head Square Mount**



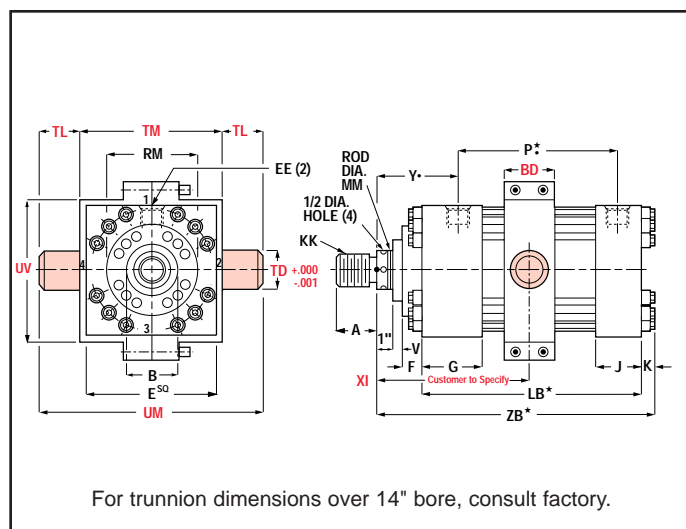
**N5W – Cap Trunnion Mount**



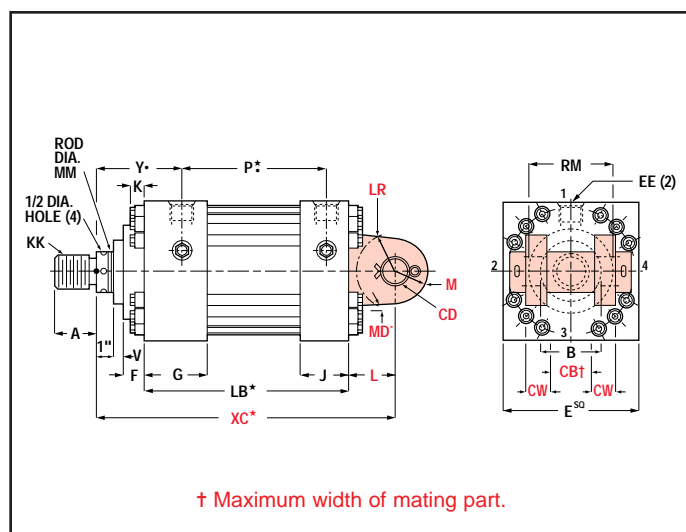
**N5U – Head Trunnion Mount**

## All Mountings

(See important application data on pages 18-19.)



N5TT – Intermediate Fixed Trunnion Mount

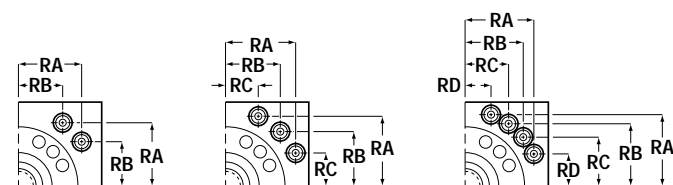


N5C – Cap Fixed Clevis Mount

## Tie Rod Information

10"- 20", 24" and 30" bore

DIM	10	12	14	16	18	20	24	30
RA	5.291	6.270	7.485	8.086	9.589	10.437	13.589	16.585
RB	3.775	4.555	6.143	6.093	7.910	8.750	11.722	14.380
RC	—	—	4.409	—	5.761	6.649	9.158	11.439
RD	—	—	—	—	—	—	6.050	7.911
TIE ROD THREAD	1 1/8-12	1 1/4-12	1 1/4-12	1 1/2-12	1 1/2-12	1 1/2-12	2-12	2 1/4-12



10", 12" and  
16" bores

14", 18" and  
20" bores

24" and 30" bores

**NOTE:** The interchangeability of the 10"- 20", 24" and 30" bores with other cylinder brands has not been established by the N.F.P.A. The above dimensions are standards.

## Cylinder Dimensions

BORE	10	12	14	16	18	20	24	30
A	4 1/2	5 1/2	7	8	9	10	11	14
AC	5 1/4	6 1/4	6 1/2	6 1/2	6 3/4	7 1/4	—	—
AD	3 3/16	3 15/16	4 1/16	4 1/16	4 1/8	4 5/8	—	—
AE	1 1/2	1 7/8	2	2	2	2 3/8	—	—
AF	3 1/2	4 3/8	5 3/4	6 1/2	7 1/4	8	—	—
B -.001 -.003	5 1/4	6 1/4	8	9	10	11	12	15
BD	4	5	5 1/2	—	—	—	—	—
CB†	4	4 1/2	6	7	8	9	10	12
CC	4 1/4-12	5 1/4-12	6 1/2-12	7 1/2-12	8 1/2-12	9 1/2-12	—	—
CD	3 1/2	4	5	6	6 1/2	7 1/2	9	11
CW	2	2 1/4	3	3 1/2	4	4 1/2	5	6
E	12 5/8	14 7/8	17 1/8	19 1/4	22	23 5/8	31	37 1/2
EB	1 5/16	1 9/16	1 13/16	1 13/16	2 1/16	2 1/16	2 9/16	3 1/16
EE	SEE PAGE 22							
EX	16 5/8	19 3/4	21 3/4	24 1/2	26 1/2	29	36	47
F	7/8	1 3/8	1 5/8	1 7/8	2 3/16	2 11/16	2 11/16	3 1/8
FB‡	1 13/16	2 1/16	2 5/16	—	—	—	—	—
FT	4 1/2-12	5 1/2-12	7-12	8-12	9-12	10-12	11-12	14-12
G	3 1/16	4 7/16	4 7/8	5 7/8	6 7/8	7 7/8	10	12 3/8
J	3 1/16	4 7/16	4 7/8	5 7/8	6 7/8	7 7/8	10	12 3/8
K	1 5/8	1 13/16	1 13/16	2	2	2	3	3 1/2
KK	3 1/4-12	4-12	5-12	5 3/4-12	6 1/2-12	7 1/4-12	8-8	11-8
L	4	4 1/2	5 3/4	7	7 5/8	8 3/4	17	21
LB*	12 1/8	14 1/2	15 5/8	18 1/8	21 1/8	23 5/8	29 1/2	36 1/4
LR	3 3/8	3 7/8	4 3/16	4 3/4	5 1/16	6 3/16	—	—
M	3 1/2	4	5	6	6 1/2	7 1/2	9	11
MD	10°	14°	0	0	0	0	0	0
MM	4 1/2	5 1/2	7	8	9	10	11	14
P*	8 1/8	9 1/2	9 7/8	11	12	12 1/2	18	21 5/16
R	9.62	11.45	13.26	—	—	—	—	—
RE	9.89	11.75	12.90	15.28	16.45	18.07	22.125	23.75
RM	7 1/8	8 3/8	10 13/16	12 3/8	13 1/8	14 5/8	16	19
SB‡	1 9/16	1 9/16	2 5/16	2 9/16	2 13/16	3 1/16	—	—
SS*	8 7/8	10 1/2	11 1/8	12 5/8	14 5/8	15 7/8	—	—
ST	2 1/4	3	4	4 1/2	5 1/4	6 1/2	—	—
SU	3 1/2	4 1/4	4 3/4	5 1/4	5 1/2	6 3/8	—	—
SW	1 5/8	2	2 1/4	2 3/4	3 1/4	3 7/8	—	—
TD	3 1/2	4	4 1/2	5	5 3/4	6 1/4	7 1/2	9 1/2
TE	14.13	16.79	18.43	21.03	22.65	24.87	31.25	40.75
TF	15 7/8	18 1/2	21	—	—	—	—	—
TL	3 1/2	4	4 1/2	5	5 3/4	6 1/4	7 1/2	9 1/2
TM	14	16 1/2	19 1/2	—	—	—	—	—
TS	15 7/8	18 7/8	21 5/8	24 1/4	27 1/2	30 1/8	—	—
UF	19	22	25	—	—	—	—	—
UM	21	24 1/2	28 1/2	—	—	—	—	—
US	19 1/8	22 7/8	26 1/8	29 1/4	33	36 5/8	—	—
UT	19 5/8	22 7/8	26 1/8	29 1/4	33 1/2	36 1/8	46	56 1/2
UV	17 1/2	20 3/4	24 3/4	—	—	—	—	—
V	1 1/16	1 3/16	7/8	1 1/8	1 1/16	1 3/16	1 3/16	3/8
WF	2 15/16	3 3/16	3 1/2	4	4 1/4	4 1/2	4 1/2	4 1/2
XC*	19 1/16	22 3/16	24 7/8	29 1/8	33	36 7/8	51	61 3/4
XG	4 3/4	5 3/8	5 5/16	6 15/16	7 11/16	8 7/16	9 1/2	10 3/4
XJ*	13 1/4	15 1/2	16 11/16	19 3/16	21 15/16	24 3/16	29	34 1/2
XS	4 9/16	5 3/16	5 3/4	6 3/4	7 1/2	8 3/8	—	—
Y*	4 15/16	5 11/16	6 3/8	7 9/16	8 13/16	10 1/16	10 1/4	11 7/16
Z	—	—	—	—	—	—	—	40 3/4
ZB*	16 11/16	19 1/2	20 15/16	24 1/8	27 3/8	30 1/8	37	44 1/4
ZJ*	15 1/16	17 11/16	19 1/8	22 1/8	25 3/8	28 1/8	34	40 3/4
PISTON THICKNESS	4 3/4	5 5/8	5 7/8	6 3/8	7 3/8	7 7/8	9 1/2	11 1/2

Dimensions shown in red are mounting dimensions.

○ Oversize rods affect dimensions in gray-shaded areas.  
See pages 28-29 for these dimensions.

★ Add stroke to all starred dimensions.

† Maximum width of mating part.

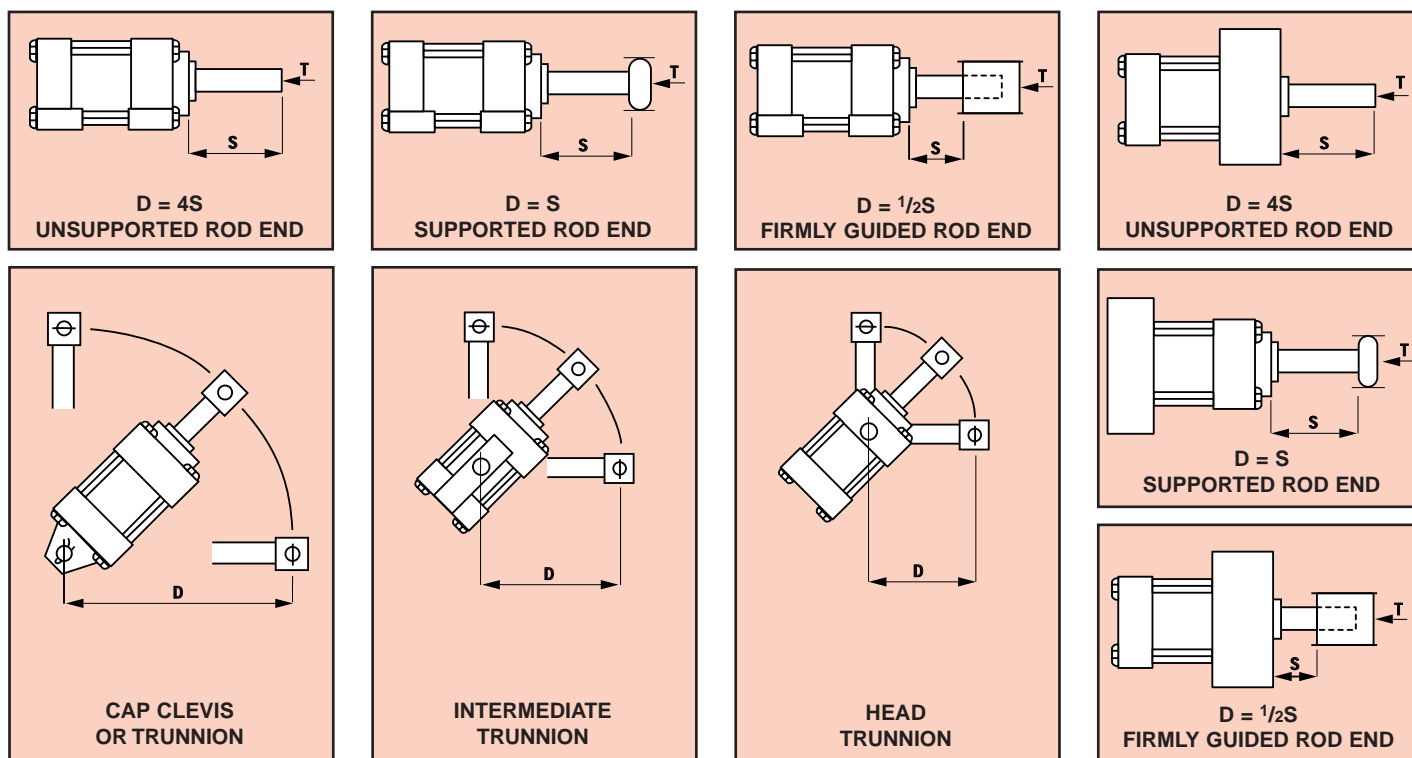
‡ Use screws 1/16" smaller than mounting holes.

**NOTE:** Overall length dimensions that require addition of stroke may vary from dimensions shown, due to manufacturing tolerances.

• Port dimensions for standard ports only. Consult for flange, manifold and special ports.

# Technical Data

## Rod Size And Stop Tube Selection

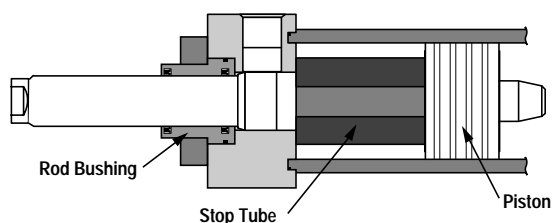


### Rod Size Selection

Standard rod sizes are normally suitable for all applications except for long stroke or high thrust applications. Proper selection of minimum rod size may be determined by the following steps:

1. With knowledge of bore size and operating pressure, thrust may be determined. Refer to the graph in the next column.
2. Select from illustrations above the type of mounting to be used and determine the length of  $D$  with the piston rod in the fully extended position.
3. Find the value of  $D$  at the bottom of the graph and follow its line vertically until it intercepts the horizontal line representing the maximum push thrust that will be applied to your cylinder. The intersection of these two lines will fall within a stripe representing the minimum recommended piston rod diameter for your application.

### Stop Tubes

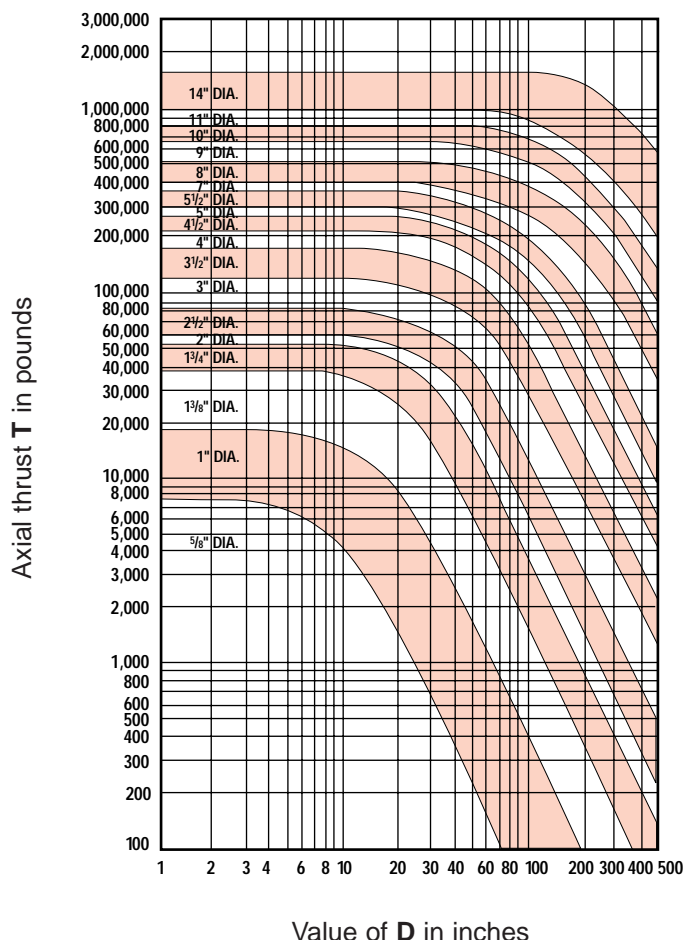


Stop tubes are located between the piston and the rod shoulder on the head end of the cylinder. Bearing loading is reduced by separating the piston and the rod bushing. Bearing wear and tendency to buckle is reduced.

To determine if a stop tube is required and the length of stop tube needed, use the following procedure:

Determine the value of  $D$  with the piston rod in the fully extended position. If the value of  $D$  is under 40", no stop tube is needed. If  $D$  is greater than 40", one inch of stop tube is recommended for each 10" or fraction thereof beyond 40".

**Special note:** When specifying stroke and stop tube lengths, please include net working stroke plus stop tube length.



# Technical Data

## Pressure-Thrust-Consumption-Flow Charts

Standard Operating Pressure Rating				Out-Stroke Thrust In Pounds Force												Consumption Per Inch Of Stroke in One Direction		
Cyl. Bore in inches	Air AN5 LAN5	Hyd. N5	Piston Area sq. in.	Pressures of Operating Medium – Air or Hydraulic												Oil Gallons Displaced	Air Pressure Cubic Ft. Displaced	Free Air Cubic Ft. at 80 psi Displaced
				50 psi	60 psi	80 psi	100 psi	200 psi	250 psi	500 psi	750 psi	1000 psi	1500 psi	2000 psi	3000 psi			
1 1/2	250	3000	1.84	92	110	147	184	368	460	920	1,380	1,840	2,760	3,680	5,520	.00797	.00106	.00683
2	250	3000	3.24	162	194	259	324	648	810	1,620	2,430	3,240	4,860	6,480	9,720	.01403	.00188	.01211
2 1/2	250	3000	5.03	252	302	402	503	1,006	1,258	2,520	3,773	5,030	7,545	10,060	15,090	.02177	.00291	.01875
3 1/4	250	3000	8.45	423	507	676	845	1,690	2,113	4,230	6,338	8,450	12,675	16,900	25,350	.03658	.00489	.03149
4	250	2700	12.76	638	766	1,021	1,276	2,552	3,190	6,380	9,570	12,760	19,140	25,520	38,280	.05524	.00738	.04755
5	250	3000	19.87	994	1,192	1,590	1,987	3,974	4,968	9,940	14,903	19,870	29,805	39,740	59,610	.08602	.01150	.07405
6	250	2700	28.56	1,428	1,714	2,285	2,856	5,712	7,140	14,280	21,420	28,560	42,840	57,120	85,680	.12364	.01653	.10644
7	250	3000	38.82	1,941	2,329	3,106	3,882	7,764	9,705	19,410	29,115	38,820	58,230	77,640	116,460	.16805	.02247	.14468
8	250	3000	50.64	2,532	3,038	4,051	5,064	10,128	12,660	25,320	37,980	50,640	75,960	101,280	151,920	.21922	.02931	.18873
10	250	3000	79.01	3,951	4,741	6,321	7,901	15,802	19,753	39,510	59,258	79,010	118,515	158,020	237,030	.34203	.04572	.29446
12	250	3000	113.66	5,683	6,820	9,093	11,366	22,732	28,415	56,830	85,245	113,660	170,490	227,320	340,980	.49203	.06578	.42359
14	250	2700	154.60	7,730	9,276	12,368	15,460	30,920	38,650	77,300	115,950	154,600	231,900	309,200	463,800	.66926	.08947	.57617
16	250	3000	201.82	10,091	12,109	16,146	20,182	40,364	50,455	100,910	151,365	201,820	302,730	403,640	605,460	.87368	.11679	.75215
18	250	3000	255.32	12,766	15,319	20,426	25,532	51,064	63,830	127,660	191,490	255,320	382,980	510,640	765,960	1.10528	.14775	.95154
20	250	3000	315.10	15,755	18,906	25,208	31,510	63,020	78,775	157,550	236,325	315,100	472,650	630,200	945,300	1.36407	.18235	1.17433
24	250	3000	453.12	22,676	27,211	36,282	45,352	90,704	113,380	226,760	340,140	453,520	680,280	907,040	1,360,560	1.96329	.26245	1.69020
30	250	3000	708.27	35,414	42,496	56,662	70,827	141,654	177,068	354,140	531,203	708,270	1,062,405	1,416,540	2,124,810	3.06610	.40988	2.63962

Below are cylinder sizes for which the rod diameters in the column to the left are standard. Consult bulletins for rods larger than standard. Thrusts for pressures not shown in table, add the thrust for two or more operating pressures which combined equal the desired pressure.

1 Gallon = 231 Cubic Inches

Oil consumption gal. per min = Gal. per in. times in. per min. piston speed

Air consumption cubic ft. per min = Cu. ft. per in. times in. per min. piston speed

Free air consumption per in. of stroke = Cu. ft. displaced x (press. + 14.7) ÷ 14.7

Piston Rod Dia. in inches	Bore Size N5 AN5 LAN5	Piston Rod Area sq. in.	In-Stroke Pull In Pounds Force Deduct The Following Force Or Consumptions Corresponding To Rod Size From Out-Stroke Thrust Or Consumptions To Determine In-Stroke Pull Or Consumptions												Consumption Per Inch Of Stroke in One Direction		
			Pressures of Operating Medium – Air or Hydraulic												Oil Gallons Displaced	Air Pressure Cubic Ft. Displaced	Free Air Cubic Ft. at 80 psi Displaced
			50 psi	60 psi	80 psi	100 psi	200 psi	250 psi	500 psi	750 psi	1000 psi	1500 psi	2000 psi	3000 psi			
5/8	1 1/2	.31	16	19	25	31	62	78	155	233	310	465	620	930	.00138	.00018	.00116
1	2 & 2 1/2	.79	40	47	63	79	158	198	395	593	790	1,185	1,580	2,370	.00342	.00046	.00294
1 1/8	3 1/4	1.49	75	89	119	149	298	373	745	1,118	1,490	2,235	2,980	4,470	.00645	.00086	.00555
1 3/4	4	2.41	121	145	193	241	482	603	1,205	1,808	2,410	3,615	4,820	7,230	.01043	.00139	.00898
2	5	3.14	157	188	251	314	628	785	1,570	2,355	3,140	4,710	6,280	9,420	.01359	.00182	.01170
2 1/2	6	4.91	246	295	393	491	982	1,228	2,455	3,683	4,910	7,365	9,820	14,730	.02126	.00284	.01830
3	7	7.07	354	424	566	707	1,414	1,768	3,535	5,303	7,070	10,605	14,140	21,210	.03061	.00409	.02635
3 1/2	8	9.62	481	577	770	962	1,924	2,405	4,810	7,215	9,620	14,430	19,240	28,860	.04165	.00557	.03585
4	—	12.57	629	754	1,006	1,257	2,514	3,143	6,285	9,428	12,570	18,855	25,140	37,710	.05442	.00727	.04685
4 1/2	10	15.90	795	954	1,272	1,590	3,180	3,975	7,950	11,925	15,900	23,850	31,800	47,700	.06883	.00920	.05926
5	—	19.63	982	1,178	1,570	1,963	3,926	4,908	9,815	14,723	19,630	29,445	39,260	58,890	.08498	.01136	.07316
5 1/2	12	23.76	1,188	1,426	1,901	2,376	4,752	5,940	11,880	17,820	23,760	35,640	47,520	71,280	.10286	.01375	.08855
7	14	38.48	1,924	2,309	3,078	3,848	7,696	9,620	19,240	28,860	38,480	57,720	76,960	115,440	.16658	.02227	.14341
8	16	50.27	2,514	3,016	4,022	5,027	10,054	12,568	25,135	37,703	50,270	75,405	100,540	150,810	.21762	.02909	.18735
9	18	63.62	3,181	3,817	5,090	6,362	12,724	15,905	31,810	47,715	63,620	95,340	127,240	190,860	.27541	.03682	.23710
10	20	78.54	3,927	4,712	6,283	7,854	15,708	19,638	39,270	58,905	78,540	117,810	157,080	235,620	.34000	.04545	.29271
11	24	95.03	4,752	5,702	7,602	9,503	19,006	23,758	47,515	71,272	95,030	142,545	190,060	285,090	.41138	.05499	.35413
14	30	153.94	7,697	9,236	12,315	15,394	30,788	38,485	76,970	115,455	153,940	230,910	307,880	461,820	.66641	.08908	.57367

**NOTE:** Bore Dimensions Are 0.030" Larger Than NOMINAL.

## Pipe Size Chart for Hydraulic Cylinders and Systems

Standard Weight Pipe			Oil Flow Gallons Per Minute And Friction Pressure Drop Pounds Per Square Inch Per Foot Length Of Pipe											
Pipe Size	Inside Diameter*	Area Sq. In.	Vel. = 5 Ft. Per Sec.		Vel. = 10 Ft. Per Sec.		Vel. = 15 Ft. Per Sec.		Vel. = 20 Ft. Per Sec.		Vel. = 25 Ft. Per Sec.		Vel. = 30 Ft. Per Sec.	
			Gallons Per Minute	Pressure Drop In psi	Gallons Per Minute	Pressure Drop In psi	Gallons Per Minute	Pressure Drop In psi	Gallons Per Minute	Pressure Drop In psi	Gallons Per Minute	Pressure Drop In psi	Gallons Per Minute	Pressure Drop In psi
1/2	.622	.304	4.7	.157	9.4	.585	14.1	1.215	18.6	2.065	23.5	3.130	28.2	4.34
3/4	.824	.533	8.3	.117	16.6	.370	24.9	.710	33.2	1.520	41.5	2.300	49.8	3.17
1	1.049	.864	13.5	.090	26.9	.323	40.4	.673	53.8	1.555	67.3	1.725	80.8	2.44
1 1/4	1.380	1.495	23.3	.064	46.5	.231	69.8	.488	93.0	.755	116.3	1.240	139.6	1.74
1 1/2	1.610	2.036	31.7	.054	63.4	.181	95.1	.404	126.8	.691	158.5	1.042	190.2	1.48
2	2.067	3.355	52.3	.047	104.5	.169	156.8	.360	209.0	.609	261.3	.927	313.6	1.11

Standard Weight Pipe			Equivalent Length of Straight Pipe In Feet For Various Fitting					
Pipe Size	Inside Diameter*	Area Sq. In.	Std. Elbow	Std. Tee	Gate Valve	Globe Valve	Cylinders & 2-3-Way Valves	4-Way Valves
1/2	.622	.304	1.5	3.3	.35	17	6 to 30	12 to 60
3/4	.824	.533	2.2	4.5	.47	22	10 to 50	20 to 100
1	1.049	.864	2.7	5.8	.60	28	13 to 65	25 to 125
1 1/4	1.380	1.495	3.7	7.7	.81	37	15 to 75	30 to 150
1 1/2	1.610	2.036	4.4	9.2	.92	44	20 to 100	40 to 200
2	2.067	3.355	5.5	12.0	1.20	57	25 to 125	50 to 250

\*Inside diameter and areas shown are standard pipe. For tubing or extra heavy and double extra heavy pipe, use I.D. in table closest to your pipe or tubing I.D.

The pressure drop shown in the above table is for ordinary wrought iron pipe. For smooth, new wrought iron pipes, multiply the values shown by .7; for very smooth, straight tubing, multiply the values shown by .54. Pressure drop is the same regardless of operating pressure. Avoid large pressure drops in low pressure systems. Note that oil flows through large pipes at high velocity (up to 30 ft. per sec.) with small pressure loss. The pressure drop shown is for hydraulic oil with approximately 225 SSU at 100°F under average operating conditions. The values also apply to water. In order to accommodate large pump volumes without severe pressure drops, all hydraulic cylinders are available with oversize ports with weld-ed half pipe couplings or flange fitting.



# Technical Data

## Cushion Formulas and Factors

Cushions are recommended when piston speed is in excess of 20-25 feet per minute. Cushions decelerate the piston and rod assembly at the end of the stroke, lessening the noise and shock and increasing cylinder life. Heavy

loads that are attached to the piston and rod assembly should be stopped by external means, such as shock absorbers, springs, decelerating valves, etc.

### Force Factor Chart

FORCE FACTORS ( $a = v^2 \times .001294$ )	
PISTON VELOCITY	
ips	a
1	.00129
2	.00518
3	.0117
4	.0208
5	.0324
6	.0466
7	.0635
8	.0829
9	.105
10	.129
11	.157
12	.186
13	.219
14	.254
15	.291
16	.332
17	.374
18	.420
19	.467
20	.518
21	.571
22	.627
23	.685
24	.746
25	.809
26	.875
27	.944
28	1.02
29	1.09
30	1.16
31	1.24
32	1.33
33	1.41
34	1.50
35	1.59
36	1.68
37	1.77
38	1.87
39	1.97
40	2.07
41	2.18
42	2.28
43	2.39
44	2.51
45	2.62
46	2.74
47	2.86
48	2.98
49	3.11
50	3.24

Use the information below along with the examples on page 21 to determine if standard cushioning is sufficient for your application.

### Force Factor Terminology

TERM USED	EXPLANATION	UNITS
<b>W</b>	Weight of the load	pounds
<b>A<sub>b</sub></b>	Bore area	square inches
<b>A<sub>h</sub></b>	A <sub>b</sub> less rod area	square inches
<b>A<sub>cc</sub></b>	A <sub>b</sub> less cap plunger cross-sectional area	square inches
<b>A<sub>hc</sub></b>	A <sub>b</sub> less head plunger cross-sectional area	square inches
<b>a</b>	Force factor	—
<b>s</b>	Acceleration or deceleration distance	inches
<b>u</b>	Coefficient of friction of load's motion	Horizontal = .15; Vertical = 0
<b>v</b>	Velocity	inches per second (ips)
<b>F<sub>acc</sub></b>	Force needed to accelerate a weight	pounds
<b>F<sub>dec</sub></b>	Force needed to decelerate a weight	pounds
<b>F<sub>f</sub></b>	Friction force due to load motion	pounds
<b>F<sub>p</sub></b>	Driving pressure force	pounds
<b>F<sub>t</sub></b>	Total cushioning force	pounds
<b>P<sub>p</sub></b>	Pump pressure	pounds per square inch (psi)
<b>P<sub>c</sub></b>	Contained cushioning pressure	pounds per square inch (psi)

### General Formulas

Horizontal motion .....	$F_{acc} \text{ or } F_{dec} = W \times a/s$
Vertical motion, decelerating downward or accelerating upward .....	$F_{acc} \text{ or } F_{dec} = (W \times a/s) + W$
Vertical motion, decelerating upward or accelerating downward .....	$F_{acc} \text{ or } F_{dec} = (W \times a/s) - W$
Frictional force .....	$F_f = u \times W$
Total cushioning force .....	$F_t = F_{acc} \text{ or } F_{dec} + F_p \pm F_f$ (+ $F_f$ if load accelerating, — $F_f$ if load decelerating)
Contained pressure .....	$P_c = F_t/A_{cc} \text{ or } F_t/A_{hc}$

### Acceleration and Deceleration Forces

The **a** force factors shown are used to determine the forces required to accelerate or decelerate a weight through a given distance, **s** (Refer to **Force Factor Chart**).

If the motion of the load is horizontal, use the general formula  $F_{acc} \text{ or } F_{dec} = W \times a/s$ .

If the motion of the load is vertical and is being decelerated downward or accelerated upward, use the general formula  $F_{acc} \text{ or } F_{dec} = (W \times a/s) + W$ .

If the motion of the load is vertical and is being decelerated upward or accelerated downward, use the general formula  $F_{acc} \text{ or } F_{dec} = (W \times a/s) - W$ .

Friction due to load motion affects  $F_t$ . Add  $F_f$  to  $F_t$  if the load is accelerating. Subtract  $F_f$  from  $F_t$  if the load is decelerating.

Cylinder friction is negligible.

The contained cushioning pressure must not exceed 5000 psi. If the standard cushion results in a too high pressure, then a longer cushion spud must be specified.

# Technical Data

## How to Calculate Your Cushion Requirements

### Hydraulic Examples

#### Example A

Horizontal deceleration

N5 series cylinder, 3¼" bore, 1⅜" rod (standard), cushioning at cap.

A weight of 3000 lbs., moving at 25 ips, and driven by a pump pressure of 1000 psi, is to be stopped in 1¼". Assume the coefficient of friction to be .15.

1.  $F_f = u \times W$   
 $= .15 \times 3000 \text{ lbs.}$   
 $F_f = 450 \text{ lbs.}$
2.  $F_p = A_h \times P_p$   
 $A_h = A_b - \text{rod area}$   
 $= 8.45 \text{ sq. in.} - 1.49 \text{ sq. in.}$   
 $A_h = 6.96 \text{ sq. in.}$   
 $F_p = 6.96 \text{ sq. in.} \times 1000 \text{ psi}$   
 $F_p = 6960 \text{ lbs.}$
3.  $F_{\text{dec}} = W \times a/s$   
 $= 3000 \text{ lbs.} \times .809/1.25 \text{ in.}$   
 $F_{\text{dec}} = 1942 \text{ lbs.}$
4.  $F_t = F_{\text{dec}} + F_p - F_f$   
 $= 1942 + 6960 - 450$   
 $F_t = 8452 \text{ lbs.}$
5.  $P_c = F_t/A_{cc}$   
 $= 8452 \text{ lbs.}/7.85 \text{ sq. in.}$   
 $P_c = 1077 \text{ psi}$

This figure does not exceed the pressure capability of the cylinder; therefore, the standard cushion is acceptable.

#### Example B

Vertical deceleration

N5 series cylinder, 6" bore, 2½" rod (standard), cushioning at head.

The cylinder is mounted vertical rod down, with a 2000 lb. load attached to the rod end. Pump pressure is 750 psi, the load is moving at 40 ips, and must be stopped in 1⅜". There is no load friction.

1.  $F_p = P_p \times A_b$   
 $= 750 \text{ psi} \times 28.56 \text{ sq. in.}$   
 $F_p = 21,420 \text{ lbs.}$
2.  $F_{\text{dec}} = (W \times a/s) + W$   
 $= (2000 \text{ lbs.} \times 2.07/1.375) + 2000 \text{ lbs.}$   
 $F_{\text{dec}} = 5011 \text{ lbs.}$
3.  $F_t = F_p + F_{\text{dec}}$   
 $= 21,420 \text{ lbs.} + 5011 \text{ lbs.}$   
 $F_t = 26,431 \text{ lbs.}$
4.  $P_c = F_t/A_{hc}$   
 $= 26,431 \text{ lbs.}/22.07 \text{ sq. in.}$   
 $P_c = 1198 \text{ psi}$

This does not exceed the pressure capability of the cylinder; therefore, the standard cushion is acceptable.

**NOTE:** If your calculations show you need a longer cushion than standard, longer cushions are available in ¼ inch increments.

### Standard Cushion Information N5 Series

Bore Size	Rod Dia.	Cushion Length (in.)		Effective Cushion Area (in. <sup>2</sup> )	
		Head	Cap	Head (A <sub>hc</sub> )	Cap (A <sub>cc</sub> )
1½	⅝	1⅛	1⅜	1.24	1.70
	1	1⅛	1⅜	.73	1.70
2	1	1⅛	1⅛	2.13	2.91
	1⅜	1⅛	1⅛	1.17	2.90
2½	1	1⅛	1⅛	3.92	4.77
	1⅜	1⅛	1⅛	2.96	4.77
	1¾	1⅛	1⅛	1.89	4.77
3¼	1⅜	1⅜	1¼	6.38	7.85
	1¾	1⅜	1¼	5.31	7.85
	2	1⅜	1¼	4.02	7.85
4	1¾	1⅜	1¼	9.62	12.16
	2	1⅜	1¼	8.33	12.16
	2½	1⅜	1¼	6.27	12.16
5	2	1⅜	1¼	15.44	18.64
	2½	1⅜	1¼	13.38	18.64
	3	1⅝	1¼	10.93	18.64
	3½	1⅝	1¼	8.08	18.64
6	2½	1⅜	1½	22.07	26.16
	3	1⅝	1½	19.62	26.16
	3½	1⅝	1½	16.77	26.16
	4	1½	1½	15.20	26.16
7	3	2	2	29.88	36.42
	3½	2	2	27.03	36.42
	4	2	2	25.46	36.42
	4½	2	2	19.29	36.42
	5	2	2	17.70	36.42
8	3½	2	2	38.85	48.24
	4	2	2	37.28	48.24
	4½	2	2	31.11	48.24
	5	2	2	29.52	48.24
	5½	2	2	29.52	48.24
10	4½	2	2	59.48	74.12
	5	2	2	57.89	74.12
	5½	2	2	57.89	74.12
	7	2	2	31.91	74.12
12	5½	2	2	92.54	108.77
	7	2	2	66.56	108.77
	8	2	2	53.61	108.77
14	7	2	2	107.50	143.36
	8	2	2	94.55	143.36
	9	2	2	80.04	143.36
	10	2	2	63.95	143.36
16	8	2	2	141.77	192.26
	9	2	2	127.26	192.26
	10	2	2	111.17	192.26
18	9	2	2	180.76	245.76
	10	2	2	164.67	245.76
20	10	2	2	224.45	304.12
24	11	2	2	325.99	439.82
30	14	2	2	512.03	687.22

# N2 Cylinder Port Size Data and Port, Cushion Adjustment and Ball Check Location Information

## Ports

Standard ports for N5 and WBN5 are SAE straight thread. AN5 and LAN5 standard ports are NPTF.

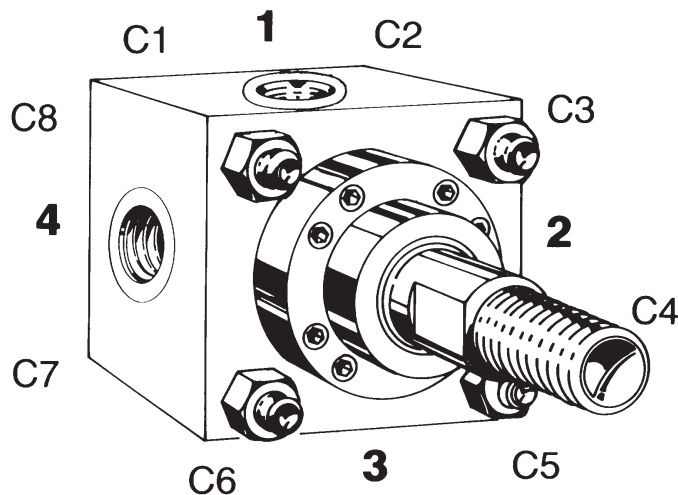
## Optional and Oversize Ports

The chart at right lists port sizes. Larger welded half-pipe coupling ports are available in some sizes; please contact . For oversize ports where short restrictions in dash pot areas cannot be allowed, specify "full flow porting."

## Port, Cushion Adjustment, Ball Check Locations

Standard port locations are at No. 1, with optional locations No. 2, 3, 4 or 5 furnished when specified, except where **H**, **U** or **W** mounts interfere at Nos. 2 and 4. Ports at No. 3 in **B** and the cap end of **E** mountings need special construction. Note possible piping interference with mounting screws in **A** cylinders ported at Pos. 2 and 4. Mounting holes are counter-bored to allow access to them with piping in place. Request Engineering File P-26 for reference to dimensions.

In the end view shown, standard position of cushion adjustment is above port location No. 2 in location C3; ball check above port location No. 4 at C8 when ports are at position No. 1. On **H**, the head on **G**, **U** and the cap on **P**, **W** cushion adjustments are on the right side of port location No. 3 at C5, and checks are on the left side at C6. For distance dimensions of ball checks and needles from the port locations, request Engineering File P-123C.



Locations 1 through 4 indicate possible port positions.

Number 1 is standard. Optional location No. 5 is available on cap end centerline.

Locations C1 through C8 indicate possible cushion adjustment positions. When ports are at position No. 1, C3 is standard needle location.

Cylinder Bore Dia. (inches)	Rod Diameter (inches)	SAE*			NPTF			4-Bolt SAE	Manifold ***
		Std.	Oversize		Std.	Oversize			
			Head	Cap		Head	Cap		
1 1/2"	5/8"	#10	N/A	N/A	1/2"	3/4"	3/4"	N/A	9/16"
	1"	#10	N/A	N/A	1/2"	N/A	3/4"	N/A	9/16"
2"	1"	#10	N/A	N/A	1/2"	3/4"	3/4"	N/A	9/16"
	1 3/8"	#10	N/A	N/A	1/2"	N/A	3/4"	N/A	9/16"
2 1/2"	1"	#10	N/A	N/A	1/2"	3/4"	3/4"	1/2"	9/16"
	1 3/8"	#10	N/A	N/A	1/2"	3/4"	3/4"	1/2"	9/16"
	1 3/4"	#10	N/A	N/A	1/2"	N/A	3/4"	N/A	9/16"
3 1/4"	1 3/8"	#12	#16	#16	3/4"	1"	1"	3/4"	3/4"
	1 3/4"	#12	#16	#16	3/4"	1"	1"	3/4"	3/4"
	2"	#12	#16	#16	3/4"	1"	1"	3/4"	3/4"
4"	1 3/4"	#12	#16	#16	3/4"	1"	1"	3/4"	3/4"
	2"	#12	#16	#16	3/4"	1"	1"	3/4"	3/4"
	2 1/2"	#12	#16	#16	3/4"	1"	1"	3/4"	3/4"
5"	2"	#12	#16	#16	3/4"	1"	1"	3/4"	3/4"
	2 1/2"	#12	#16	#16	3/4"	1"	1"	3/4"	3/4"
	3"	#12	#16	#16	3/4"	1"	1"	3/4"	3/4"
	3 1/2"	#12	#16	#16	3/4"	1"	1"	3/4"	3/4"
6"	2 1/2"	#16	N/A	#20	1"	1 1/4"	1 1/4"	1"	1"
	3"	#16	N/A	#20	1"	1 1/4"	1 1/4"	1"	1"
	3 1/2"	#16	N/A	#20	1"	1 1/4"	1 1/4"	1"	1"
	4"	#16	N/A	#20	1"	1 1/4"	1 1/4"	1"	1"
7"	3"	#20	#24	#24	1 1/4"	1 1/2"	1 1/2"	1 1/4"	1 3/8"
	3 1/2"	#20	#24	#24	1 1/4"	1 1/2"	1 1/2"	1 1/4"	1 3/8"
	4"	#20	#24	#24	1 1/4"	1 1/2"	1 1/2"	1 1/4"	1 3/8"
	4 1/2"	#20	#24	#24	1 1/4"	1 1/2"	1 1/2"	1 1/4"	1 3/8"
	5"	#20	#24	#24	1 1/4"	1 1/2"	1 1/2"	1 1/4"	1 3/8"
8"	3 1/2"	#24	N/A	N/A	1 1/2"	2"	2"	1 1/2"	1 5/8"
	4"	#24	N/A	N/A	1 1/2"	2"	2"	1 1/2"	1 5/8"
	4 1/2"	#24	N/A	N/A	1 1/2"	2"	2"	1 1/2"	1 5/8"
	5"	#24	N/A	N/A	1 1/2"	2"	2"	1 1/2"	1 5/8"
	5 1/2"	#24	N/A	N/A	1 1/2"	2"	2"	1 1/2"	1 5/8"
10"	4 1/2"	#32	N/A	N/A	2"	2 1/2"	2 1/2"	2"	N/A
	5"	#32	N/A	N/A	2"	2 1/2"	2 1/2"	2"	N/A
	5 1/2"	#32	N/A	N/A	2"	2 1/2"	2 1/2"	2"	N/A
	7"	#32	N/A	N/A	2"	2 1/2"	2 1/2"	2"	N/A
12"	5 1/2"	#32	N/A	N/A	2 1/2"	3"	3"	2 1/2"	N/A
	7"	#32	N/A	N/A	2 1/2"	3"	3"	2 1/2"	N/A
	8"	#32	N/A	N/A	2 1/2"	3"	3"	2 1/2"	N/A
14"	7"	#32	N/A	N/A	2 1/2"	3"	3"	2 1/2"	N/A
	8"	#32	N/A	N/A	2 1/2"	3"	3"	2 1/2"	N/A
	9"	#32	N/A	N/A	2 1/2"	3"	3"	2 1/2"	N/A
	10"	#32	N/A	N/A	2 1/2"	3"	3"	2 1/2"	N/A
16"	8"	#32	N/A	N/A	3"	3 1/2"	3 1/2"	2 1/2"	N/A
	9"	#32	N/A	N/A	3"	3 1/2"	3 1/2"	2 1/2"	N/A
	10"	#32	N/A	N/A	3"	3 1/2"	3 1/2"	2 1/2"	N/A
18"	9"	#32	N/A	N/A	3"	3 1/2"	3 1/2"	3"	N/A
	10"	#32	N/A	N/A	3"	3 1/2"	3 1/2"	3"	N/A
20"	10"	#32	N/A	N/A	3"	3 1/2"	3 1/2"	3"	N/A
24"	11"	#32	N/A	N/A	3"	3 1/2"	3 1/2"	4"	N/A
30"	14"	#32	N/A	N/A	3"	3 1/2"	3 1/2"	5"	N/A

\* Fitting hex may interfere with mountings **S**, **R** and **P**. Consult factory for additional information.

\*\* Flanges may overhang head and caps. Consult factory for additional information.

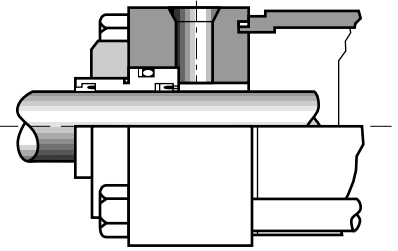
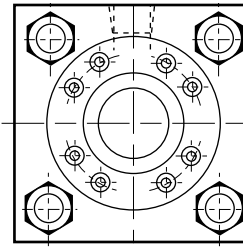
\*\*\* Manifold dimension is for flow passage diameter.

## N5 Series Hydraulic Pressure Ratings

Cylinder Bore (inches)	Piston Rod Diameters (inches)			Pressure Ratings (psi)	
	Standard	Oversize	2:1	4:1 Tensile	4:1 Yield
1 1/2	5/8	—	1	3750	3008
2	1	—	1 3/8	2900	2335
2 1/2	1	1 3/8	1 3/4	3150	2531
3 1/4	1 3/8	1 3/4	2	3050	2477
4	1 3/4	2	2 1/2	2400	2214
5	2	2 1/2, 3	3 1/2	3100	2836
6	2 1/2	3, 3 1/2	4	2800	2406
7	3	3 1/2, 4, 4 1/2	5	2850	2336
8	3 1/2	4, 4 1/2, 5	5 1/2	2375	1975
10	4 1/2	5, 5 1/2	7	2900	2499
12	5 1/2	7	8	2550	2069
14	7	8, 9	10	2600	1796
16	8	9, 10	—	2150	1864
18	9	10	—	2550	1919
20	10	—	—	2100	1822
24	11	—	—	2750	1921
30	14	—	—	2750	1835

N5 Series cylinders comply with NFPA specifications and ANSI B93.15-1981 mounting dimensions standard.

## Rod Cartridge Retainers Simplify Cartridge Removal



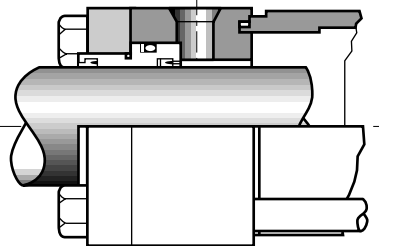
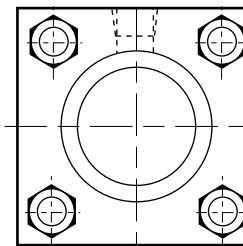
Cylinders with the following bore and rod combinations use circular retainers which permit removal of rod cartridge without disassembling the cylinder:

**2 1/2" bore with 1" rod**

**3 1/4" bore with 1 3/8" rod**

**4" bore and larger with all rod diameters**

Refer to Engineering File No. 188 for alternate removable cartridge constructions.



Cylinders use above retainer construction on the following bore and rod combinations:

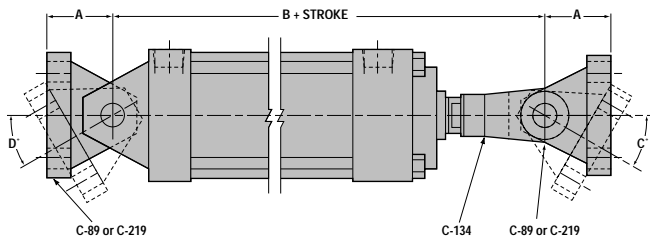
**1 1/2" bore with 5/8" and 1" rods**

**2 1/2" bore with 1 3/8" and 1 3/4" rods**

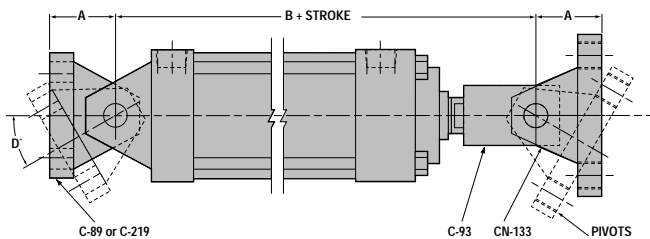
**2" bore with 1" and 1 3/8" rods**

**3 1/4" bore with 1 3/4" and 2" rods**

## Typical Mounting Accessories For Standard Rod Diameters Style #2



**N5, AN5 and LN5 Cylinder**



**N5, AN5 and LN5 Cylinder**

Bore	A	B	Eye Bracket		Female Clevis	Pivot Pin	C°	D°
			Standard	Swivel				
1 1/2	1 1/8	7 7/8	C-8903	C-219-3-1	C-134-05	C-9003-3	90°	60°
2	1 7/8	9 5/8	C-8904	C-219-3-2	C-134-08	C-9004-3	90°	65°
2 1/2	1 7/8	9 3/4	C-8904	C-219-3-2	C-134-08	C-9004-3	90°	65°
3 1/4	2 3/8	11 3/4	C-89065X	C-219-3-3X	C-134-11	C-9065-3	80°	65°
4	3	13 7/8	C-8908	C-219-3-4	C-134-14	C-9008-3	90°	70°
5	3 3/8	15	C-8910X	C-219-3-5X	C-134-16	C-9010-3	75°	65°
6	4	17 5/8	C-8912X	C-219-3-6X	C-134-20	C-9012-3	75°	65°
7	4	20 1/4	C-8914		C-134-24	C-9014-3	70°	65°
8	4 1/4	21 3/4	C-8916		C-134-28	C-9016-3	70°	65°
10	5 11/16	27 9/16	C-8920		C-134-36	C-9020-3	70°	60°
12	6 7/16	32 3/16	C-8924		C-134-44	C-9024-3	65°	60°

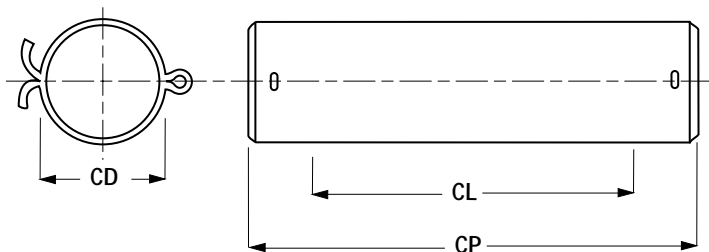
For mounting dimensions over 12" bore, consult

Bore	C	B	Eye Bracket		Clevis Bracket	Pivot Pin	Female Eye	D°
			Standard	Swivel				
1 1/2	1 1/8	7 7/8	C-8903	C-219-3-1	CN-133-03	C-9003-3	C-9303	60°
2	1 7/8	9 5/8	C-8904	C-219-3-2	CN-133-04	C-9004-3	C-9304	65°
2 1/2	1 7/8	9 3/4	C-8904	C-219-3-2	CN-133-05	C-9004-3	C-9304	65°
3 1/4	2 3/8	11 3/4	C-89065X	C-219-3-3X	CN-133-065	C-9065-3	C-93065	65°
4	3	13 7/8	C-8908	C-219-3-4	CN-133-08	C-9008-3	C-9308	70°
5	3 3/8	15	C-8910X	C-219-3-5X	CN-133-10	C-9010-3	C-9310	65°
6	4	17 5/8	C-8912X	C-219-3-6X	CN-133-12	C-9012-3	C-9312	65°
7	4	20 1/4	C-8914		CN-133-14	C-9014-3	C-9314	65°
8	4 1/4	21 3/4	C-8916		CN-133-16	C-9016-3	C-9316	65°
10	5 11/16	27 9/16	C-8920		CN-133-20	C-9020-3	C-9320	60°
12	6 7/16	31 5/16	C-8924		CN-133-24	C-9024-3	C-9324	60°

For mounting dimensions over 12" bore, consult .

# Cylinder Mounting Accessories

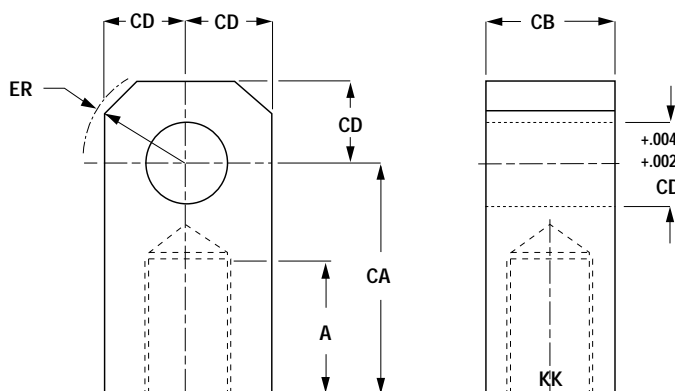
## Pivot Pin



1. Pivot pins are furnished with clevis mounted cylinders.
2. Pivot pins must be ordered as a separate item if to be used with female eye, female clevis, standard eye bracket and clevis bracket. They are included only with swivel eye bracket.
3.  $CL = (2 \times CW) + CB$

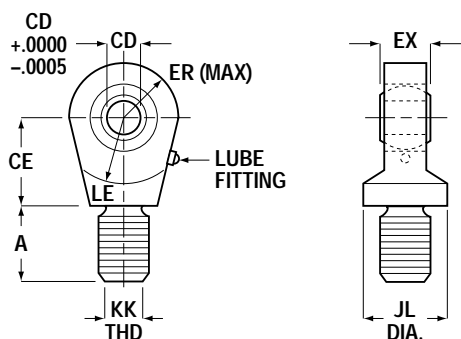
Part No.	CD	CL	CP
C-9003-3	1/2	1 3/4	2 3/8
C-9004-3	3/4	2 1/2	3 1/8
C-90065-3	1	3	3 3/4
C-9008-3	1 3/8	4	4 3/4
C-9010-3	1 3/4	5	6 1/32
C-9012-3	2	5	6 1/32
C-9014-3	2 1/2	6	7 1/32
C-9016-3	3	6	7 1/8
C-9020-3	3 1/2	8	9 5/8
C-9024-3	4	9	10 5/8

## Female Eye



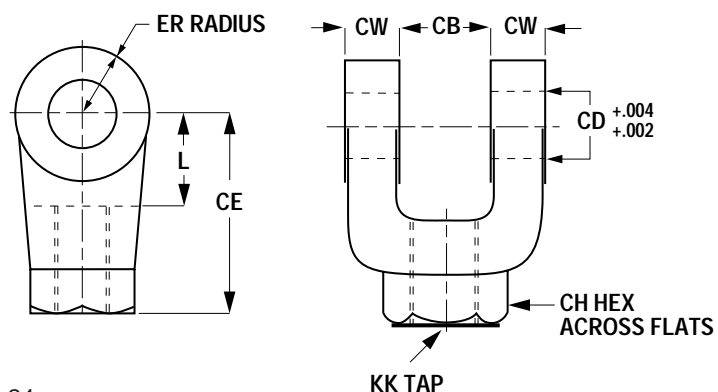
Part No.	A	CA	CB	CD	ER	KK
C-9302	3/4	1 1/2	7/16	7/16	19/32	5/16-24
C-9303	3/4	1 1/2	3/4	1/2	5/8	7/16-20
C-9304	1 1/8	2 1/16	1 1/4	3/4	7/8	3/4-16
C-93065	1 5/8	2 13/16	1 1/2	1	1 3/16	1-14
C-9308	2	3 7/16	2	1 3/8	1 9/16	1 1/4-12
C-9310	2 1/4	4	2 1/2	1 3/4	2	1 1/2-12
C-9312	3	5	2 1/2	2	2 1/4	1 7/8-12
C-9314	3 1/2	5 13/16	3	2 1/2	2 13/16	2 1/4-12
C-9316	3 1/2	6 1/8	3	3	3 1/4	2 1/2-12
C-9320	4 1/2	7 5/8	4	3 1/2	3 7/8	3 1/4-12
C-9324	5 1/2	9 1/8	4 1/2	4	4 7/16	4-12

## Spherical Rod Eye



Part No.	A	CD +0.0000 -0.0005	CE	EX	ER	JL	KK	LE	Load Capacity (lbs.)
CS-9303	1 1/16	1/2	7/8	7/16	7/8	7/8	7/16-20	3/4	2,600
CS-9304	1	3/4	1 1/4	2 1/32	1 1/4	1 5/16	3/4-16	1 1/16	9,400
CS-93065	1 1/2	1	1 7/8	7/8	1 3/8	1 1/2	1-14	1 7/16	16,800
CS-9308	2	1 3/8	2 1/8	1 3/16	1 13/16	2	1 1/4-12	1 7/8	28,600
CS-9310	2 1/8	1 3/4	2 1/2	1 17/32	2 3/16	2 1/4	1 1/2-12	2 1/8	43,000
CS-9312	2 7/8	2	2 3/4	1 3/4	2 5/8	2 3/4	1 7/8-12	2 1/2	70,000

## Female Clevis



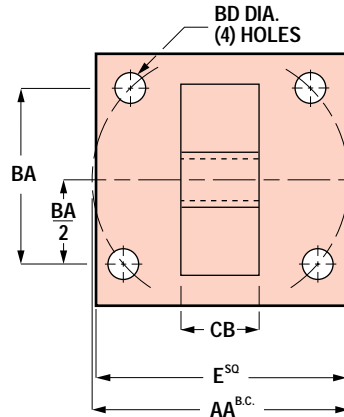
Part No.	CB	CD	CE	CH	CW	ER	KK	L
C-134-05	3/4	1/2	1 1/2	7/8	1/2	1/2	7/16-20	3/4
C-134-08	1 1/4	3/4	2 3/8	1 3/8	5/8	3/4	3/4-16	1 1/4
C-134-11	1 1/2	1	3 1/8	1 5/8	3/4	1	1-14	1 1/2
C-134-14	2	1 3/8	4 1/8	2	1	1 3/8	1 1/4-12	2 1/8
C-134-16	2 1/2	1 3/4	4 1/2	2 3/8	1 1/4	1 3/4	1 1/2-12	2 1/4
C-134-20	2 1/2	2	5 1/2	2 15/16	1 1/4	2	1 7/8-12	2 1/2
C-134-24	3	2 1/2	6 1/2	3 1/2	1 1/2	2 1/2	2 1/4-12	3
C-134-28	3	3	6 3/4	3 7/8	1 1/2	2 3/4	2 1/2-12	3 1/4
C-134-36	4	3 1/2	8 1/2	5	2	3 1/2	3 1/4-12	4
C-134-44	4 1/2	4	10	6 1/8	2 1/4	4	4-12	4 1/2



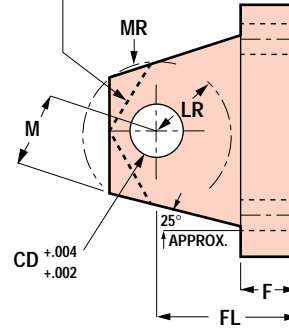
# Mounting Accessories

## Swivel Eye Bracket\* Standard Eye Bracket

(Includes spacers to allow swivel action up to 7° and to make dimensions interchangeable with standard eye bracket.)



RADIUS ON C-8910 & LARGER  
RADIUS ON ALL SWIVEL BRACKETS

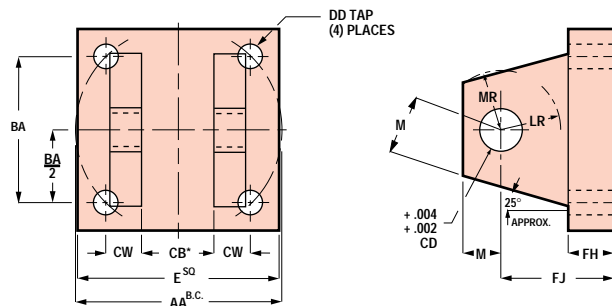


Part Number		Dimensions										Standard Bracket		Swivel Bracket		Swivel Bracket
Standard	Swivel*															Swivel Bracket Recommended
Part No.	Part No.	AA	BA	BD	CB	CD	E	F**	FL**	LR	M	MR	M	MR	Static Load Limit in lbs.	
C-8903	C-219-3-1	2.3	15/8	13/32	3/4	1/2	2 1/2	3/8	1 1/8	1/2	1/2	9/16	11/16	11/16	8,100	
C-8904	C-219-3-2	3.6	29/16	17/32	1 1/4	3/4	3 1/2	5/8	17/8	1	3/4	1 1/16	13/16	13/16	18,800	
C-89065X	C-219-3-3X	4.6	3 1/4	21/32	1 1/2	1	4 1/2	7/8	23/8	1	1	1 1/8	13/8	13/8	33,300	
C-8908	C-219-3-4	5.4	3 13/16	21/32	2	13/8	5	7/8	3	1 1/8	13/8	13/4	2	2	59,800	
C-8910X	C-219-3-5X	7.0	4 15/16	29/32	2 1/2	13/4	6 1/2	1 1/8	33/8	13/4	13/4	17/8	2 1/8	2 1/8	102,000	
C-8912X	C-219-3-6X	8.1	5 3/4	1 1/32	2 1/2	2	7 1/2	1 1/2	4	2	2	2 1/8	23/8	23/8	132,000	
C-8914X		9.3	6 19/32	15/32	3	2 1/2	8 1/2	13/4	43/4	2 1/2	2 1/2	2 1/2				
C-8916X		10.6	7 1/2	19/32	3	3	9 1/2	2	5 1/4	23/4	23/4	23/4				
C-8920		13.6	9 5/8	125/32	4	3 1/2	125/8	1 11/16	5 11/16	3 1/2	3 1/2	3 1/2				
C-8924		16.2	11 1/2	2 1/32	4 1/2	4	147/8	1 15/16	67/16	37/8	4	4				

\* **NOTE:** To assure precision fit-up, pivot pins machined to special tolerances are furnished with all swivel eye brackets, unless otherwise specified.

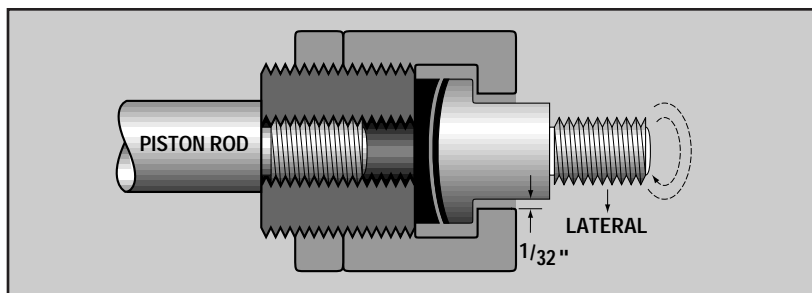
\*\* Dimensions F and FL reflect revised NFPA standards. Part numbers with suffix letter X are affected.

## Clevis Bracket



Part No.	AA	BA	CB	CD	CW	DD	E	FH	FJ	LR	M	MR
CN-133-03	2.3	15/8	25/32	1/2	1/2	3/8-24	2 1/2	3/8	1 1/8	1/2	1/2	9/16
CN-133-04	2.9	2 1/16	19/32	3/4	5/8	1/2-20	3	5/8	1 7/8	1	3/4	1 1/16
CN-133-05	3.6	29/16	19/32	3/4	5/8	1/2-20	3 1/2	5/8	1 7/8	1 1/16	3/4	1 1/16
CN-133-065	4.6	3 1/4	1 17/32	1	3/4	5/8-18	4 1/2	3/4	2 1/4	1 1/4	1	1 1/8
CN-133-08	5.4	3 13/16	2 1/32	1 3/8	1	5/8-18	5	7/8	3	1 7/8	1 3/8	1 3/4
CN-133-10	7.0	4 15/16	2 17/32	1 3/4	1 1/4	7/8-14	6 1/2	7/8	3 1/8	2	1 3/4	1 7/8
CN-133-12	8.1	5 3/4	2 17/32	2	1 1/4	1-14	7 1/2	1	3 1/2	2 1/8	2	2 1/8
CN-133-14	9.3	6 19/32	3 1/32	2 1/2	1 1/2	1 1/8-12	8 1/2	1	4	2 5/8	2 1/2	2 1/2
CN-133-16	10.6	7 1/2	3 1/32	3	1 1/2	1 1/4-12	9 1/2	1	4 1/4	2 7/8	2 3/4	2 3/4
CN-133-20	13.6	9 5/8	4 1/16	3 1/2	2	1 3/4-12	12 5/8	1 11/16	5 11/16	3 5/8	3 1/2	3 1/2
CN-133-24	16.2	11 1/2	4 9/16	4	2 1/4	2-12	14 7/8	1 15/16	6 7/16	4	4	4

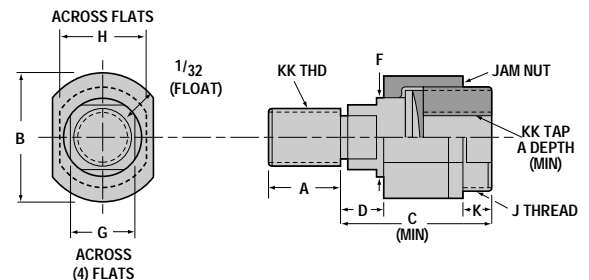
# Self-Aligning Coupler



Lateral movement (on push only) and radial movement provide precision alignment between cylinder and machine. Couplers preset with proper clearances and completely lubricated at factory before shipping.

## Self-Aligning Rod End Coupler

Part No.	Rod Dia.	A	B	C	D	F	G	H	J	K	KK	Max. Pull At Yield
AC-2-05	5/8	3/4	1 1/4	2	1/2	5/8	1/2	13/16	1-14	5/16	7/16-20	8,320
AC-2-08	1	1 1/8	1 11/16	2 5/16	1/2	3 1/32	13/16	1 1/8	1 3/8-12	1/2	3/4-16	35,000
AC-2-11	1 3/8	1 5/8	2 3/8	2 29/32	1/2	1 11/32	1 5/32	1 5/8	1 7/8-12	1 1/16	1-14	64,500
AC-2-14	1 3/4	2	2 5/8	3 19/32	3/4	1 23/32	1 7/16	2	2 1/4-12	27/32	1 1/4-12	82,550
AC-2-16	2	2 1/4	3	4 5/32	7/8	1 31/32	1 3/4	2 3/8	2 5/8-12	29/32	1 1/2-12	128,340
AC-2-20	2 1/2	3	3 3/4	5 7/16	1	2 15/32	2 1/8	3	3 1/4-12	1 5/16	1 7/8-12	231,000
AC-2-24	3	3 1/2	4 1/4	6 3/16	1	2 31/32	▲	3 3/8	3 3/4-12	1 3/16	2 1/4-12	289,200
AC-2-28	3 1/2	3 1/2	5	6 7/16	1	3 15/32	▲	4	4 1/2-12	1 1/2	2 1/2-12	342,400
AC-2-36	4 1/2	4 1/2	6	7 7/8	1	4 15/32	▲	4 3/4	5 1/4-12	1 5/8	3 1/4-12	475,500
AC-2-44	5 1/2	5 1/2	7 1/4	9 3/8	1	5 15/32	▲	5 3/4	6 1/2-12	1 7/8	4-12	750,010



▲ Four 1/2" diameter x 1/2" deep spanner holes instead of flats.

**NOTE:** When ordering oversize and 2:1 rod cylinders, specify modification to suit standard rod diameter's coupler.

## ONE YEAR LIMITED WARRANTY

### One Year Normal Use

Products are warranted for a period of one year from date of shipment from our plant to be free from defects in workmanship and material under correct use, normal operating conditions and proper applications. This warranty does not extend to goods damaged, or subjected to accident, abuse, or misuse after shipment from our factory, nor to goods altered or repaired by anyone other than authorized representatives.

### Disclaimers

This one year limited warranty is the only warranty extended by in connection with any sale by . THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, notwithstanding disclosure to of the product's intended use. An affirmation of fact or promise made on behalf of shall not be deemed to create an expressed warranty that the goods shall conform to the affirmation of promise; any description of the goods is for the sole purpose of identifying them and shall not be deemed to create an expressed warranty that the goods shall conform to the sample or model; and no affirmation or promise, or description, or sample or model, shall be deemed part of the basis of the bargain.

### Exclusive Remedy

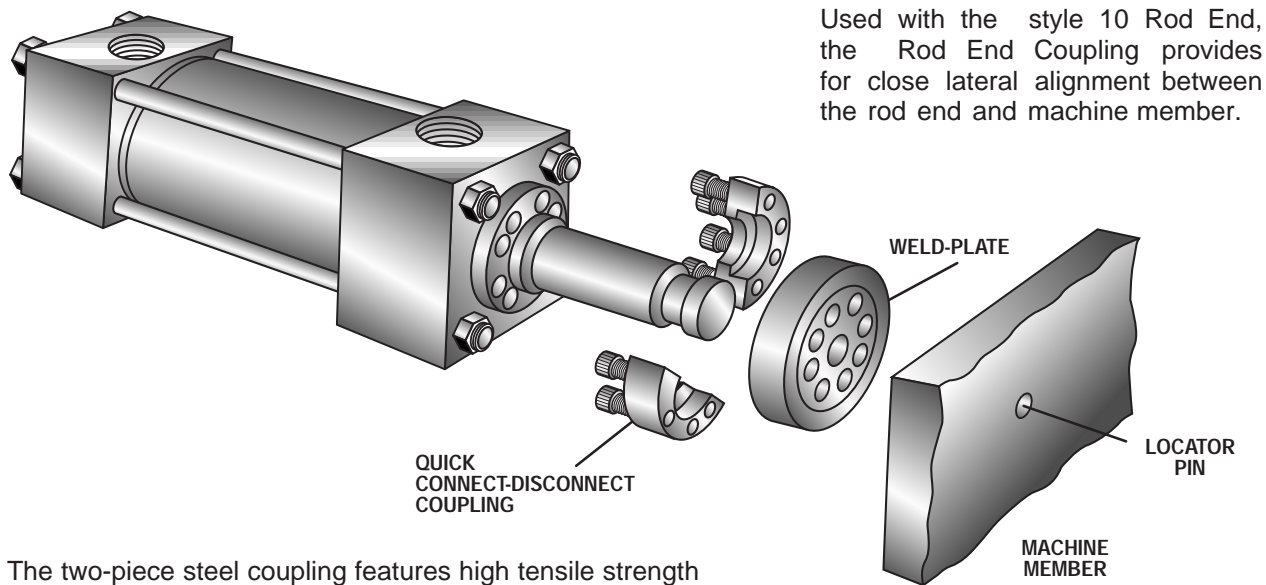
Hydro-Line's obligation upon breach of warranty shall be limited to replacing or repairing at our option, free of charge, but not including installation, dismantling, reassembling or any

other charge, the particular product or part which inspection discloses to have been defective at time of shipment. Inspection may be at the place of installation and use, or at our plant if requested (if returned to us at our expense including lowest transportation cost). Written notice of such defect shall be given by customer to within 30 days after such defect(s) appear. Written permission for any warranty claim return must be first obtained from authorized representatives. All returns must be accompanied with a complete written explanation of claimed defects and the circumstances of operational failure. Replacement of cylinders or parts thereof repaired under this warranty shall be warranted under the terms of this warranty for the remainder of the term of the original warranty or for a period of six months after such repair or replacement whichever is longer. Upon expiration of the warranty, all of Hydro-Line's obligations hereunder shall terminate.

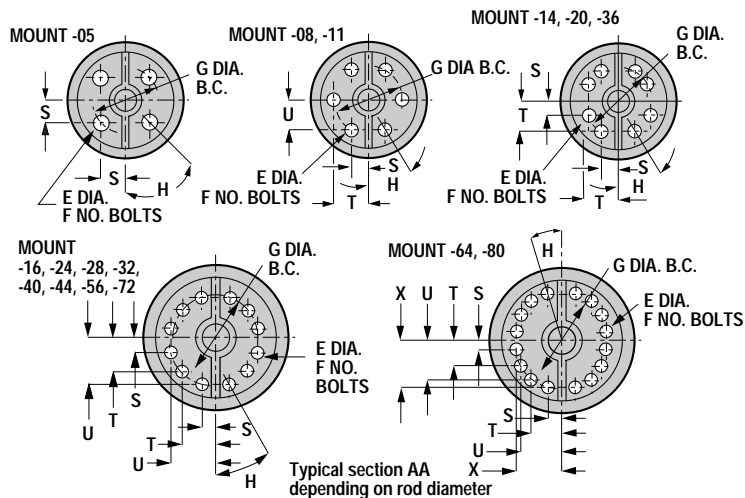
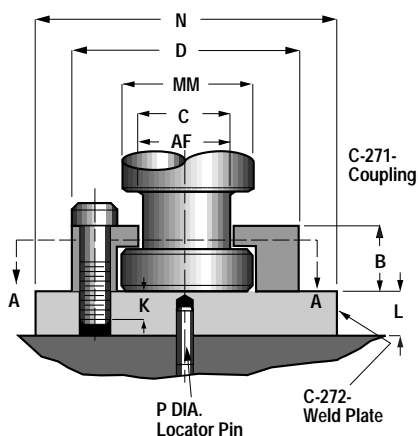
IN NO EVENT SHALL HAVE ANY LIABILITY FOR PAYMENT OF ANY CONSEQUENTIAL, INCIDENTAL, INDIRECT, SPECIAL OR TORT DAMAGES OF ANY KIND INCLUDING BUT NOT LIMITED TO, ANY LOSS OF PROFITS TO THE EXTENT EXCLUSION IS PERMITTED BY LAW.

This warranty states our entire and exclusive liability and buyer's exclusive remedy for any claim of damages in connection with the sale or furnishing of Hydro-Line's products or parts, their design, suitability for use, installations or operation or for any claimed defects therein. Goods not manufactured by are furnished subject only to the Manufacturer's warranties, if any, and without warranties, expressed or implied,

# Rod End Coupling



The two-piece steel coupling features high tensile strength socket head cap screws (with safety factor designed to take full load), permits quick assembly/disassembly for fast and easy installation and servicing.



Coupling C-271-	Rod Dia. MM	AF	B	C	D	E	F	G	H	K	Weld Plate C-272-	L	N	P	Soc. Hd. Cap Screws	Bolt Torq. Ft. lb.	S	T	U	X
C-271-05	.625	.38	.44	.41	1.50	.218	4	1.12	45°	.44	C-272-05	.50	2.00	.25	#10-24x.88	5	.398	—	—	—
C-271-08	1.000	.69	.62	.75	2.00	.281	6	1.50	30°	.38	C-272-08	.50	2.50	.25	1/4"-20x1.0	14	.375	.750	.650	—
C-271-11	1.375	.88	.69	.94	2.50	.343	6	2.00	30°	.56	C-272-11	.62	3.00	.25	5/16"-18x1.25	30	.500	1.000	.866	—
C-271-14	1.750	1.12	.88	1.18	3.00	.406	8	2.38	22° 30'	.62	C-272-14	.75	3.50	.25	3/8"-16x1.5	52	.454	1.097	—	—
C-271-16	2.000	1.38	1.25	1.44	3.50	.406	12	2.69	15°	.75	C-272-16	.88	4.00	.38	3/8"-16x2.0	52	.348	.950	1.298	—
C-271-20	2.500	1.75	1.38	1.88	4.25	.531	8	3.44	30° 30'	.88	C-272-20	1.00	5.00	.38	1/2"-13x2.25	128	.658	1.588	—	—
C-271-24	3.000	2.25	1.88	2.38	5.00	.531	12	4.00	15°	.88	C-272-24	1.00	5.50	.38	1/2"-13x2.75	128	.518	1.414	1.932	—
C-271-28	3.500	2.50	2.00	2.62	5.88	.656	12	4.69	15°	1.00	C-272-28	1.12	6.50	.38	5/8"-11x3.0	255	.607	1.657	2.264	—
C-271-32	4.000	3.00	2.00	3.12	6.38	.656	12	5.18	15°	1.00	C-272-32	1.12	7.00	.38	5/8"-11x3.0	255	.671	1.834	2.505	—
C-271-36	4.500	3.50	2.38	3.62	6.88	.781	8	5.69	22° 30'	1.12	C-272-36	1.25	7.50	.38	3/4"-10x3.5	450	1.088	2.627	—	—
C-271-40	5.000	3.88	2.50	4.00	7.38	.656	12	6.18	15°	1.25	C-272-40	1.38	8.00	.38	5/8"-11x3.75	255	.801	2.188	2.988	—
C-271-44	5.500	4.38	3.12	4.50	8.25	.781	12	6.88	15°	1.38	C-272-44	1.50	9.00	.38	3/4"-10x4.5	450	.890	2.431	3.320	—
C-271-56	7.000	5.75	4.00	5.94	10.38	1.031	12	8.75	15°	1.50	C-272-56	1.75	11.00	.50	1"-8x5.5	1090	1.132	3.094	4.226	—
C-271-64	8.000	6.50	4.00	6.69	11.38	1.031	16	9.75	11° 15'	1.50	C-272-64	2.00	12.00	.50	1"-8x5.5	1090	.951	2.708	4.053	4.781
C-271-72	9.000	7.25	4.00	7.50	13.12	1.281	12	11.12	15°	2.00	C-272-72	2.25	14.00	.50	1 1/4"-7x6	2180	1.440	3.933	5.373	—
C-271-80	10.000	8.00	4.50	8.25	14.12	1.281	16	12.12	11° 15'	2.00	C-272-80	2.50	15.00	.50	1 1/4"-7x6.5	2180	1.183	3.368	5.040	5.946

To order C-271-\_\_ and C-272-\_\_ as an assembly, use part no. C-275-\_\_

# Oversize Rod Information

The dimensions listed on these two pages are those that change when oversize

Bore	MM	KK	CC	FT	A	AC	AD	AE	AF	B <sup>~001</sup> <sub>~003</sub>	C	D	F‡	V‡	W	WF	Y <sup>*</sup> <sub>NPTF SAE</sub>	RM	TK	VB	XC*	XD*	XE*	XG	XI	XJ
1 1/2	▲1	3/4-16	7/8-14	1-14	1 1/8	1 1/2	15/16	3/8	11/16	1 1/2	1/2	7/8	—	—	1	13/8	215/32	■	1/2	1/2	63/4	71/8	67/8	21/4		
2	▲13/8	1-14	1 1/4-12	13/8-12	15/8	1 3/4	1 1/16	3/8	7/8	2	5/8	1 1/8	—	—	1	15/8	223/32	■	1/2	3/8	71/2	81/8	73/16	21/2		
2 1/2	▲13/8	1-14	1 1/4-12	13/8-12	15/8	1 3/4	1 1/16	3/8	7/8	2	5/8	1 1/8	—	—	1	15/8	223/32	■	9/16	3/8	75/8	81/4	75/16	21/2		
	▲13/4	1 1/4-12	1 1/2-12	13/4-12	2	2	15/16	1/2	1 1/8	23/8	3/4	1 1/2	—	—	1 1/4	17/8	231/32	■	5/16	1/2	77/8	81/2	79/16	23/4		
3 1/4	13/4	1 1/4-12	1 1/2-12	13/4-12	2	2	15/16	1/2	1 1/8	23/8	3/4	1 1/2	—	—	1 1/8	17/8	231/32	■	3/4	3/8	87/8	95/8	81/2	27/8		
	▲2	1 1/2-12	1 3/4-12	2-12	2 1/4	25/8	1 11/16	5/8	1 3/8	25/8	7/8	1 3/4	—	—	1 1/4	2	33/32	■	1/2	3/8	9	93/4	85/8	3		
4	▲2	1 1/2-12	1 3/4-12	2-12	2 1/4	25/8	1 11/16	5/8	1 3/8	25/8	7/8	1 3/4	19/32	17/32	1 1/8	2	33/32	4	3/4	1/4	97/8	103/4	87/8	3		
	▲2 1/2	17/8-12	2 1/4-12	2 1/2-12	3	3 1/4	1 15/16	3/4	1 3/4	3 1/8	1	2 1/8	19/32	21/32	13/8	2 1/4	3 11/32	47/16	1 1/16	3/8	101/8	11	91/8	3 1/4		
5	2 1/2	17/8-12	2 1/4-12	2 1/2-12	3	3 1/4	1 15/16	3/4	1 3/4	3 1/8	1	2 1/8	19/32	21/32	13/8	2 1/4	3 11/32	47/16	1 1/8	3/8	103/4	115/8	10	3 1/4		
	3	2 1/4-12	2 3/4-12	3-12	3 1/2	35/8	27/16	7/8	2 1/4	33/4	1	25/8	23/32	17/32	13/8	2 1/4	3 11/32	5 1/4	1 1/8	3/8	103/4	115/8	10	3 1/4		
	▲3 1/2	2 1/2-12	3 1/4-12	3 1/2-12	3 1/2	43/8	2 11/16	1	2 1/2	4 1/4	1	3	23/32	17/32	13/8	2 1/4	3 11/32	55/8	3/4	3/8	103/4	115/8	10	3 1/4		
6	3	2 1/4-12	2 3/4-12	3-12	3 1/2	33/4	27/16	7/8	2 1/4	33/4	1	25/8	23/32	17/32	1 1/4	2 1/4	3 19/32	5 1/4	15/16	1/4	121/8	131/8	115/16	33/8		
	3 1/2	2 1/2-12	3 1/4-12	3 1/2-12	3 1/2	43/8	2 11/16	1	2 1/2	4 1/4	1	3	23/32	17/32	1 1/4	2 1/4	3 19/32	55/8	15/16	1/4	121/8	131/8	115/16	33/8		
	▲4	3-12	3 3/4-12	4-12	4	4 1/2	2 11/16	1	3	43/4	1	□	7/8	3/8	1 1/4	2 1/4	3 19/32	67/16	7/8	1/4	121/8	131/8	115/16	33/8		
7	3 1/2	2 1/2-12	3 1/4-12	3 1/2-12	3 1/2	43/8	2 11/16	1	2 1/2	4 1/4	1	3	23/32	17/32	1 1/4	2 1/4	3 15/16	55/8	2 1/8	1/4	133/4	143/4	129/16	35/8		
	4	3-12	3 3/4-12	4-12	4	4 1/2	2 11/16	1	3	43/4	1	□	7/8	3/8	1 1/4	2 1/4	3 15/16	67/16	13/4	1/4	133/4	143/4	129/16	35/8		
	▲4 1/2	3 1/4-12	4 1/4-12	4 1/2-12	4 1/2	5 1/4	3 3/16	1 1/2	3 1/2	5 1/4	1	□	7/8	3/8	1 1/4	2 1/4	3 15/16	71/8	7/8	1/4	133/4	143/4	129/16	35/8		
	▲5	3 1/2-12	4 3/4-12	5-12	5	5 3/8	3 3/16	1 1/2	3 7/8	5 3/4	1	□	7/8	3/8	1 1/4	2 1/4	3 15/16	79/16	7/8	1/4	133/4	143/4	129/16	35/8		
8	4	3-12	3 3/4-12	4-12	4	4 1/2	2 11/16	1	3	43/4	1	□	7/8	3/8	1 1/4	2 1/4	4 1/16	67/16	19/16	1/4	15	16	133/4	33/4		
	4 1/2	3 1/4-12	4 1/4-12	4 1/2-12	4 1/2	5 1/4	3 3/16	1 1/2	3 1/2	5 1/4	1	□	7/8	3/8	1 1/4	2 1/4	4 1/16	71/8	19/16	1/4	15	16	133/4	33/4		
	5	3 1/2-12	4 3/4-12	5-12	5	5 3/8	3 3/16	1 1/2	3 7/8	5 3/4	1	□	7/8	3/8	1 1/4	2 1/4	4 1/16	79/16	19/16	1/4	15	16	133/4	33/4		
	▲5 1/2	4-12	5 1/4-12	5 1/2-12	5 1/2	6 1/4	3 15/16	1 7/8	4 3/8	6 1/4	1	□	7/8	3/8	1 1/4	2 1/4	4 1/16	83/8	13/8	1/4	15	16	133/4	33/4		
10	5	3 1/2-12	4 3/4-12	5-12	5	5 3/8	3 3/16	1 1/2	3 7/8	5 3/4	—	□	1 1/8	1 1/16	—	33/16	53/16	75/8	—	—	195/16	—	—	5		
	5 1/2	4-12	5 1/4-12	5 1/2-12	5 1/2	6 1/4	3 15/16	1 7/8	4 3/8	6 1/4	—	□	13/8	13/16	—	33/16	53/16	83/8	—	—	195/16	—	—	5		
	7	5-12	6 1/2-12	7-12	7	6 1/2	4 1/16	2	5 3/4	8	—	□	15/8	7/8	—	3 1/2	5 1/2	10 13/16	—	—	193/4	—	—	5 5/16		
12	7	5-12	6 1/2-12	7-12	7	6 1/2	4 1/16	2	5 3/4	8	—	□	15/8	7/8	—	3 1/2	6	10 13/16	—	—	22 1/2	—	—	5 11/16		
	8	5 3/4-12	7 1/2-12	8-12	8	6 1/2	4 1/16	2	6 1/2	9	—	□	17/8	1 1/8	—	4	6 1/2	12 3/8	—	—	23	—	—	6 3/16		
14	8	5 3/4-12	7 1/2-12	8-12	8	6 1/2	4 1/16	2	6 1/2	9	—	□	17/8	1 1/8	—	4	6 7/8	12 3/8	—	—	25 3/8	—	—	6 7/16		
	9	6 1/2-12	8 1/2-12	9-12	9	6 3/4	4 1/8	2	7 1/4	10	—	□	2 3/16	1 1/16	—	4 1/4	7 1/8	13 1/8	—	—	25 5/8	—	—	6 11/16		
	10	7 1/4-12	9 1/2-12	10-12	10	7 1/4	4 5/8	2 3/8	8	11	—	□	2 11/16	13/16	—	4 1/2	7 3/8	14 5/8	—	—	25 7/8	—	—	6 15/16		
16	9	6 1/2-12	8 1/2-12	9-12	9	6 3/4	4 1/8	2	7 1/4	10	—	□	2 3/16	1 1/16	—	4 1/4	7 13/16	13 1/8	—	—	29 3/8	—	—	7 3/16		
	10	7 1/4-12	9 1/2-12	10-12	10	7 1/4	4 5/8	2 3/8	8	11	—	□	2 11/16	13/16	—	4 1/2	8 1/16	14 5/8	—	—	29 5/8	—	—	7 7/16		
18	10	7 1/4-12	9 1/2-12	10-12	10	7 1/4	4 5/8	2 3/8	8	11	—	□	2 11/16	13/16	—	4 1/2	9 1/2	14 5/8	—	—	33 1/4	—	—	7 5/16		

Dimensions shown in red are mounting dimensions.

▲ Mount B not available with standard dimensions in these sizes. Contact for special dimensions.‡ If no dimension is given, use FH dimension in place of F dimension and VB dimension in place of V dimension.

□ Four 1/2" diameter spanner holes used instead of wrench flats on 4" diameter and larger.

NOTE: Consult for 20", 24" and 30" bore dimensions.

\* Add stroke to all starred dimensions.

■ Refer to lower half of page 21.

\*\* Plus 2 x stroke.

• Port dimensions for standard ports only. Consult for flange, manifold and special ports.

Customer to specify

J*	XS	XT	XX*	ZB*	ZE*	ZF*	ZJ*	ZL*	ZM**	ZT*
5/4	13/4	23/8	71/2	63/8	71/4	63/8	6	65/8	75/8	73/8
5/2	21/8	25/8	81/16	611/16	711/16	67/8	61/4	71/8	81/8	81/16
55/8	25/16	25/8	83/16	613/16	713/16	7	63/8	71/4	81/4	83/16
57/8	29/16	27/8	87/16	71/16	81/16	71/4	65/8	71/2	83/4	87/16
61/2	29/16	3	91/2	715/16	91/8	81/8	73/8	83/8	91/2	911/16
65/8	211/16	31/8	95/8	81/16	91/4	81/4	71/2	81/2	93/4	913/16
67/8	27/8	31/8	10	85/16	91/2	85/8	73/4	819/32	10	101/16
71/8	31/8	33/8	101/4	89/16	93/4	87/8	8	827/32	101/2	105/16
75/8	31/8	33/8	111/8	95/16	103/4	93/8	81/2	911/32	11	1111/16
75/8	31/8	33/8	111/8	95/16	103/4	93/8	81/2	915/32	11	1111/16
75/8	31/8	33/8	111/8	95/16	103/4	93/8	81/2	915/32	11	1111/16
83/8	33/8	31/2	125/16	109/16	123/16	105/8	95/8	1011/32	117/8	131/4
83/8	33/8	31/2	125/16	109/16	123/16	105/8	95/8	1011/32	117/8	131/4
83/8	33/8	31/2	125/16	109/16	123/16	105/8	95/8	101/2	117/8	131/4
93/8	35/8	313/16	139/16	113/4	139/16	113/4	103/4	1115/32	13	147/8
93/8	35/8	313/16	139/16	113/4	139/16	113/4	103/4	115/8	13	147/8
93/8	35/8	313/16	139/16	113/4	139/16	113/4	103/4	115/8	13	147/8
93/8	35/8	313/16	139/16	113/4	139/16	113/4	103/4	115/8	13	147/8
01/4	35/8	315/16	143/4	127/8	147/8	123/4	113/4	125/8	14	161/4
01/4	35/8	315/16	143/4	127/8	147/8	123/4	113/4	125/8	14	161/4
01/4	35/8	315/16	143/4	127/8	147/8	123/4	113/4	125/8	14	161/4
01/4	35/8	315/16	143/4	127/8	147/8	123/4	113/4	125/8	14	161/4
31/2	413/16	—	—	17	—	17	155/16	—	—	—
31/2	413/16	—	—	17	—	17	155/16	—	—	—
313/16	51/8	—	—	175/16	—	175/16	155/8	—	—	—
513/16	51/2	—	—	20	—	1915/16	18	—	—	—
65/16	6	—	—	201/2	—	207/16	181/2	—	—	—
73/16	61/4	—	—	217/16	—	217/8	195/8	—	—	—
77/16	61/2	—	—	217/8	—	221/8	197/8	—	—	—
711/16	63/4	—	—	2115/16	—	223/8	201/8	—	—	—
97/16	7	—	—	243/8	—	251/8	223/8	—	—	—
911/16	71/4	—	—	245/8	—	253/8	225/8	—	—	—
23/16	73/4	—	—	275/8	—	285/8	255/8	—	—	—

## Choose from eight

- \* Male Rod End Style No. 2 is standard and will be furnished unless otherwise specified.
- \*\* Rod End Style No. 4 will be furnished when female thread is required unless otherwise specified.
- \*\* Rod End Styles No. 1, 1X, 2 and 2X are furnished studded on 5/8", 1" and 1 3/8" diameter rods. Larger sizes are of one-piece construction.
- \*\* All mounting accessories are designed to fit No. 2 and 2X rod end styles only.
- E: A 1/8" long taper begins 1/16" from pilot face and leads to the turned down diameter, except on Rod Styles No. 5 and 6.
- E: Consult distributor for rod end configurations other than those shown.