



Electronic Feedback Cylinders

*Cylinder Position Sensing
SN5 Heavy Duty
SHR5 Medium Duty*



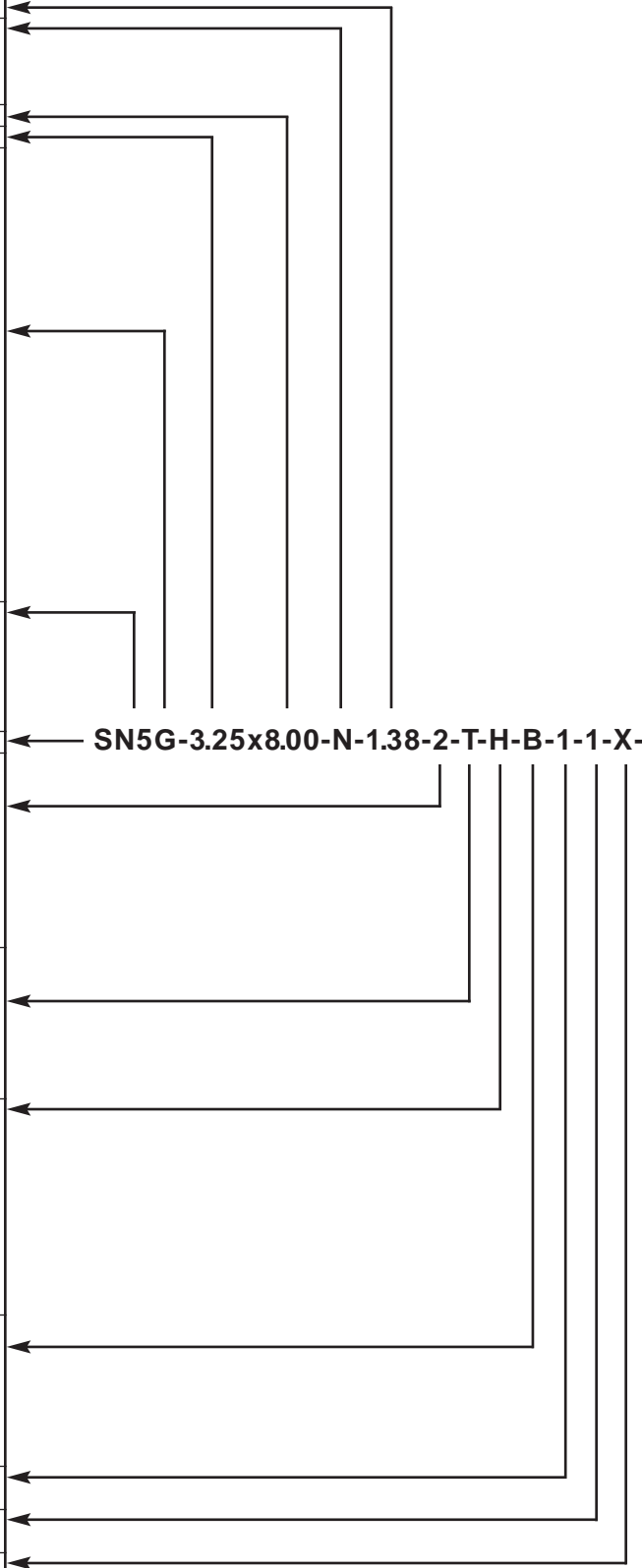
HYDRO-LINE, INC.

An IMC Company



How to Order an Electronic Feedback Cylinder

Feature	Description	Symbol
Rod Diameter	Specify in inches (2 Position Decimal)	-
Cushions ▲	Non-Cushioned	N
	Cushioned Both Ends	B
	Cushioned Head End	H
	Cushioned Cap End	C
Stroke	Specify in inches (2 Position Decimal)	-
Bore Size •	Specify in inches (2 Position Decimal)	-
Mounting Style	Side Lugs, MS2	A
	Side Tapped, MS4	B
	Cap Fixed Clevis, MP1	C
	Cap Mono Clevis	CM
	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
Model Series	Hydraulic High Pressure	N5
	Hydraulic Medium Pressure	HR5
	Air, Heavy Duty	AN5
	Air, Heavy Duty Pre-Lubricated	LAN5
	Air, Pre-Lubricated	R5 LR5
Systems Cylinder	Include ONLY for Electronic Feedback Cylinder	S
Rod End Style	Male, Large	1
	Male, Large, Extended	1X
	Male, Small (Standard)	2
	Male, Small, Extended	2X
	Male, Modified*	2M
	Female	4
	Female, Modified*	4M
	Male, Full Rod Diameter	6
	Modified	M
Ports	NPTF	N
	†SAE	S
	*SAE #12, Standard for 3 1/4", 4" and 5" Bore Sizes	T
	Manifold	M
	Flange	F
	BSP/G	G
Special	X	
Rod Seals	Urethane Ultra-Seal	H
	Nitrile 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
Piston Seals	Electronic Feedback Low Breakaway Teflon Radial Seal with Wearband	B
	Nitrile Lip Type	N
	Low Friction PolyPak	D
	PolyPak	P
	Viton Lip Type	V
Special	X	
Port Locations	Head End	1 Thru 4
	Special	X
	Cap End	1 Thru 4
	Special	X
Special Modifications	Air Bleeders	X
	Drain Backs	
	Special Seals	
	Non-Standard Mounts	
	Oversize Ports	
	Bronze Bushings	
	Stainless Steel Materials	
	Double End Rod	
	Double End Rod with Different Rod Ends	
	Rod Boots	
	Indicator Switches	
Four Rod End Flats		
Stop Tube		
Special Paint/Plating		
Key Plate		
Port		



SN5G-3.25x8.00-N-1.38-2-T-H-B-1-1-X-

* To order standard SAE #12 ports on 3 1/4", 4" and 5" bores, use T. (N5 only)
 † To order oversize SAE #16 ports on 3 1/4", 4" and 5" bores, use S. (N5 only)

• HLT II not available in 1 1/2" bore. Consult factory.
 ▲ Cushions not available in HLT II; not available in 1 1/2" bore with all other configurations.

Electronic Feedback Cylinder Design Features

A HLT II Transducer

- Corrosion-resistant stainless steel transducer is compatible with virtually all hydraulic fluids.

B HLT II Electronics

- Encapsulated electronics, housed within the solid steel end cap, provide maximum protection from shock, vibration damage and external elements.

C HLT II Noncontact Electronic Feedback Magnet

- Located in rod thread
- Nothing to wear out
- No speed limitation

D Long Life Urethane Rod Seals (N5 and HR5)

- The Urethane "Ultra-Seal" standard through 8" rod diameters on N5 and HR5 cylinders providing the optimum in long life and sealing.
- Nitrile lip-type seals are standard on AN5, LAN5 and R5.
- Special seals are available for lower friction and fluid compatibility.

E Piston Seal

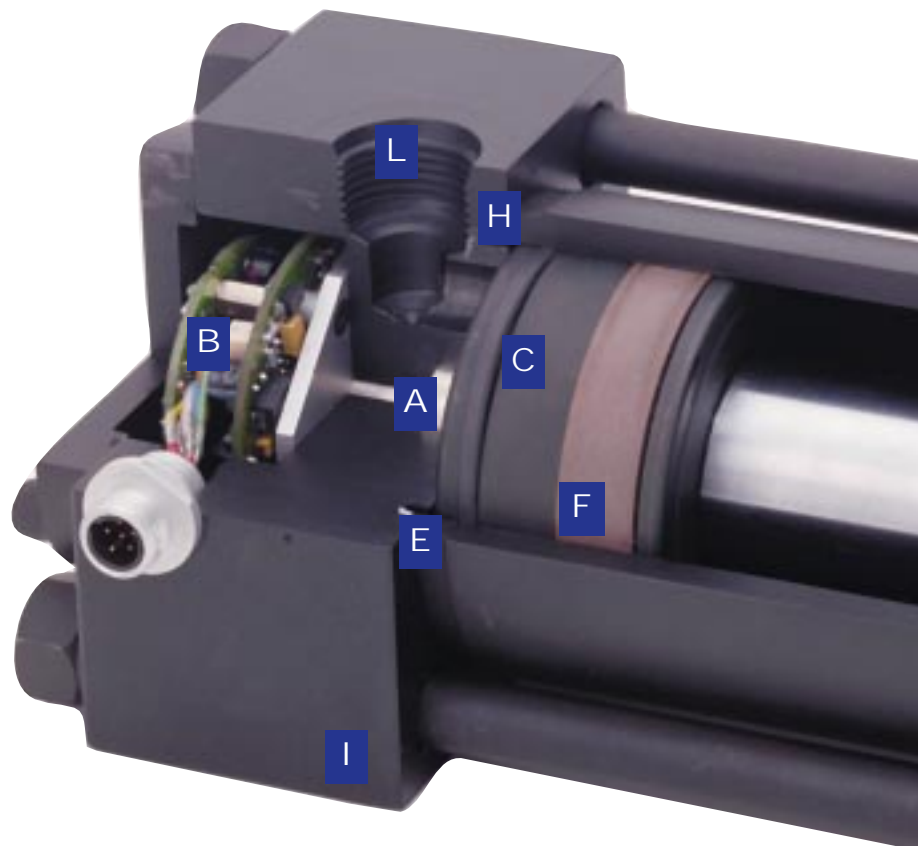
- O-ring loaded teflon radial seal
- Low-friction for positive sealing and smooth actuation
- Special seals available for lower friction and fluid compatibility

F Piston Wearband

- Provides low-friction piston bearing surface, reducing wear and maximizing life

G 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 concentricity



Specifications

Bore Sizes: 1½" through 30"

Media: Air, inert gases and hydraulic fluids.
Consult factory for other media.

Pressure Ratings: N5 – 3000 psi hydraulic – nominal
HR5 – 1500 psi hydraulic – nominal
AN5, LAN5 – 250 psi pneumatic

Temperature: -40°F to 158°F standard

- Notes:**
- 1) Mounting styles are NFPA interchangeable for all bore sizes.
 - 2) Envelope mounting dimensions are not to NFPA standard for certain bore and rod size combinations. Refer to the dimensional charts in this brochure and the respective N5 or R5/A5 catalog for dimensional interchangeability.
 - 3) HLT II not available in 1½" bore. Consult factory.



National
FLUID POWER
Association
MEMBER

H Teflon Tube Seals

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

I Precision Steel Heads and Caps

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

J Damage-Resistant Piston Rod

- For 1" through 4½" diameters 90,000 to 100,000 minimum psi yield, case hardened and hard-chrome plated steel is used.
- For 5" diameters and above 41,000 to 80,000 psi yield, hard-chrome plated steel is used.
- All rods are polished to 8-14 micro inch finish for long seal life.
- 17-4 PH stainless steel and other materials also available.

K Double-Lipped Rod Wiper

- Nitrile double-lipped rod wiper removes foreign materials from the exposed rod to extend rod-seal life.
- The standard rod wiper is nitrile material through 5½" rod diameter, Viton for 7" through 10" diameter rods.
- Metallic rod scraper and low-friction wipers are also available.

SAE Ports

- SAE ports standard on N5 and HR5; NPTF ports available at no extra charge
- NPTF ports standard on AN5, LAN5 and R5.
- Metric, BSP, Manifold, Flange and other porting options are available

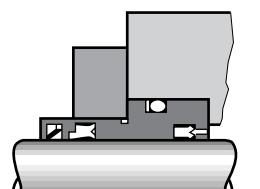


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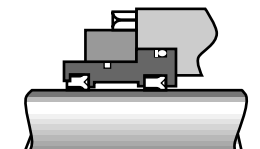
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Standard Design Options



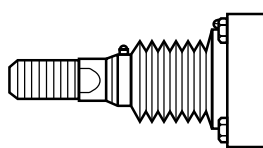
Metallic Rod Scrapers

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



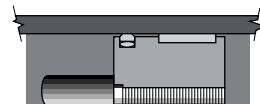
Wearbands

Bronze-filled Teflon wearband material reduces friction and wear in applications where side-load is present.



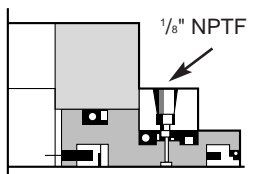
Rod Boots

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.



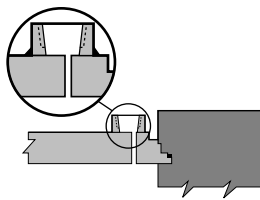
Low Breakaway Piston

A low breakaway piston reduces running friction and utilizes a bronze-filled Teflon wearband with a bi-directional, o-ring energized, bronze-filled Teflon piston seal.



Drainback Ports

Drainback ports are used to return fluid to the tank that accumulates between the rod seal and rod wiper. Port position No. 1 is standard with alternate locations at 2, 3 and 4. $\frac{1}{16}$ " NPTF is standard on $\frac{5}{8}$ " and 1" diameter rods. $\frac{1}{8}$ " NPTF is standard on larger rod diameters.



Air Bleeders

$\frac{1}{8}$ " 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.

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 33 for standard rod ends.)

Special Ports

Metric, BSP, Manifold, Flange and other porting options are available to meet specific requirements. (See page 24.)

Extra Heavy Chrome Tubes and Rods

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

Plating

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

Stainless Steel Piston Rods

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

Special Coating and Painting

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

Special Materials

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

Hydro-Line Application Data Sheet

Company Name: _____ Contact: _____ Phone Number: _____ Fax Number: _____	Distributor Name: _____ Contact: _____ Phone Number: _____ Fax Number: _____
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QUANTITY <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	Model Numbering System														
MODEL/SERIES MOUNT	BORE	STROKE	CUSHION	ROD DIA	ROD STY	SEALS	PORT LOC	ROD	PSTN	H	C	MODEL			
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
DOUBLE END ROD STYLE	ADDITIONAL ROD LENGTH	NEEDLE LOCATION		4-FLAT						MODEL PREFIX					
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>						<input type="text"/>					
STOP TUBE LENGTH		TRUNNION XI DIMENSION							STAINLESS STEEL ROD TYPE						
<input type="text"/>		<input type="text"/>							<input type="text"/>						

Please fill in all available information above. Refer to the Hydro-Line Model Numbering System on Pages 2.

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

WHAT IS THE MOUNTING?			
Attitude	Vertical _____	Angle _____	Horizontal _____
		Degrees From Vertical _____	
	Rod Up _____	Rod Up _____	
	Rod Down _____	Rod Down _____	
		Rod End Connection	Known Side Load
		Firmly Guided _____	_____ lbs.
		Supported _____	
		Unsupported _____	

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 USED IN THE APPLICATION?

APPLICATION SKETCH:	DESCRIPTION OF APPLICATION OR SPECIAL REQUIREMENT:

PREPARED BY:	DATE:	REVIEWED BY:	DATE:
CUSTOMER DRAWING NUMBER:	REVISION DATES:		HYDRO-LINE QUOTE NUMBER:

Hydro-Line Electronic Feedback Application Data Sheet

Sensor

Company Name _____ Contact _____ Telephone _____ Fax _____	Distributor Name _____ Contact _____ Telephone _____ Fax _____		
Non-cataloged Sensor Style – Special transducer definition			
Transducer Type/Model _____ Quantity _____ Part Number _____ _____ Special Conditions _____ _____			
Sensor Connector and Mating Cable Option “X” – Specify length or any special instructions			
Supplier “B” or “C”			
Installation: Hydro-Line _____ Customer _____ Supply the following information Transducer Type/Model _____ Quantity _____ Part Number _____ _____ Cable Part Number _____ Connector Part Number _____ Ship Date to Hydro-Line _____ Issue HLRG # _____ Special Considerations _____ _____			
Transducer, Cable and Connectors for Sensor Cover styles B, C, E and X must be installed by Hydro-Line			
Sensor Cover Style/ Connector Location “X” – Special engineered cover Include description, dimensions, drawings, wiring and diagrams	Position Output Options “V” or “X” – Electronics variation Describe variations		
Valve manifold style “X” – Special engineered manifold Reference Manifold Worksheet			
Prepared by: _____	Date: _____	Reviewed by: _____	Date: _____
Customer Drawing Number: _____	Revision Dates: _____		Hydro-Line Quote Number: _____

The Hydro-Line HLT II

Encapsulated Linear Displacement Transducer

Hydro-Line HLT II linear displacement transducers are precise, durable, cost-effective alternatives to linear potentiometers. In many applications, they can also replace LVDTs and linear encoders. Well protected within the core of the cylinder, the HLT II not only measures the position of the moving elements of an actuation system, but also remains untouched, and unaffected by even the harshest elements. The innovative encapsulated design and engineering along with the rugged construction of Hydro-Line HLT II transducers guarantee the best reliability, precision and durability in even the toughest industrial environments. In addition, problems associated with wear in linear potentiometers, and cable routing and control in linear encoders are eliminated. Furthermore, HLT II models require no external signal conditioning. Whether position sensing requirements are simple or complex, the Hydro-Line HLT II will help find solutions in a form factor and mounting configuration that fits any application.

Improved Design

As a leader in actuation products, Hydro-Line has enhanced the design of the HLT II to deliver superior accuracy in linear displacement technology. The cylinder's capabilities have been increased with a longer displacement range (up to 142") and smaller non-linearity ($\pm 0.02\%$). Absolute rather than incremental output eliminates the need for re-homing in power-down situations. A non-contact sensing element virtually eliminates the wear, noise and erroneous signal problems inherent in other linear displacement sensing devices.

The HLT II transducer is available in either analog or digital format. Tighter precision, along with a higher operating temperature (now 185° F) and faster response time, make the Hydro-Line HLT II an ideal solution for a wide range of industrial applications requiring strict motion control.

Specifications

Characteristic	Description/Specification
Supply Voltage	24 Vdc $\pm 20\%$ or ± 15 Vdc $\pm 2\%$ or ± 12 Vdc $\pm 2\%$
Current Draw	≤ 90 mA (≤ 1 A inrush)
Displacement Range	2" to 142" stroke
Output Update	≤ 1 ms
Non-Linearity	$\pm 0.02\%$
Repeatability	Resolution + Hysteresis
Hysteresis	< 0.00004 "
Resolution	<i>Analog:</i> Infinite <i>Pulse:</i> Defined by control
Shock Rating	100g /11ms (single hit)
Vibration Rating	12g (10 to 2,000Hz)
Operating Pressure*	3000 psi continuous, 8000 psi static
Operating Temperature	-40 to 185°F (-40 to 85°C)
Protection for Micro-Change Connector and Cable Assembly	NEMA 6P; IP68 (when cable is mated to connector)
Washdown Pressure	1000 psi (when cable is mated to connector)
Molded Cable Assembly	22 AWG, PVC insulated, metallic braid, fine stranded copper conductors, yellow PVC jacketed, 300 V, 3 amp, 105°C U.L. recognized, C.S.A. certified
Outputs	<i>Analog:</i> 0 to +10Vdc, -10 to +10 Vdc, -5 to +5 Vdc, 4 to 20 mA, 0 to 20 mA (All analog outputs can be forward and reverse acting) Analog Adjustability: 15% adjustment of full scale <i>Digital:</i> RS422 Start/Stop (leading or trailing edge active) Pulse-Width Modulated (Internal or External Interrogation with 2,4,6 or 8 recirculations)
Maximum Cable Length	<i>Analog:</i> Voltage output 50 feet, Current output 500 feet <i>Digital:</i> 1600 feet

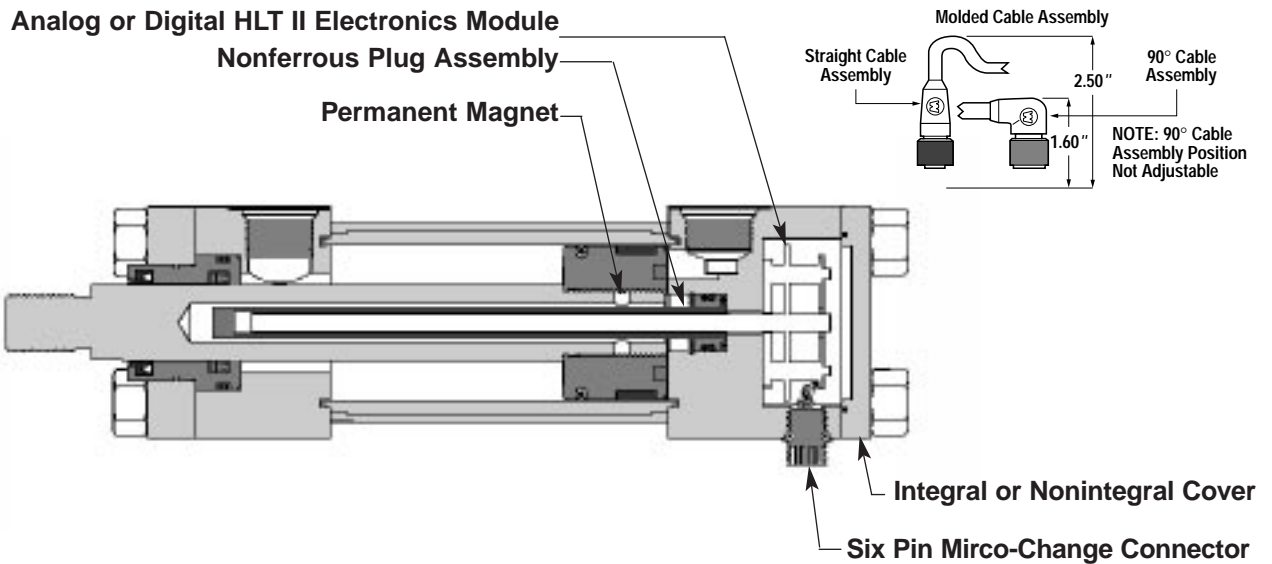
Specifications are subject to change without notice. Contact Hydro-Line for verification of specifications critical to your requirements.

* Compare these specifications to cylinder specifications. Use the proper limiting specifications.

How to Order an HLT II

Symbol	Feature	Description
1	Sensor Type	Hydro-Line In-Cylinder Sensor (HLT II)
A	Output Options Reference Page 18	<u>Analog Output</u>
B		0 to +10 Vdc
C		0 to +10 Vdc, Reverse Acting
D		4 to 20 mA
E		4 to 20 mA, Reverse Acting
F		0 to 20 mA
G		0 to 20 mA, Reverse Acting
H		-10 to +10 Vdc
J		-10 to +10 Vdc, Reverse Acting
K		-5 to +5 Vdc
		-5 to +5 Vdc Reverse Acting
P		<u>Digital Output</u>
R		PWM (Pulse Width Modulation) -specify internal or external interrogation and 2, 4, 6 or 8 recirculations
S	RS422 (Start/Stop leading edge active)	
	RS422 (Start/Stop trailing edge active)	
1	Power Requirement Reference Page 8	24 Vdc ($\pm 20\%$)
2		± 15 Vdc ($\pm 2\%$)
3		± 12 Vdc ($\pm 2\%$)
A	Mating Cable Options See below	Straight Micro Change Cable Assembly, 6 Foot
B		Straight Micro Change Cable Assembly, 12 Foot
C		Straight Micro Change Cable Assembly, 20 Foot
D		Right Angle Micro Change Cable Assembly, 6 Foot
E		Right Angle Micro Change Cable Assembly, 12 Foot
F		Right Angle Micro Change Cable Assembly, 20 Foot
J		Straight Micro Change Cable Assembly, Special Length Cable (Electronic Feedback Application Data Sheet Required)
K		Right Angle Micro Change Cable Assembly, Special Length Cable (Electronic Feedback Application Data Sheet Required)
N	No Cable Assembly	
X	Special Connector and Cable (Electronic Feedback Application Data Sheet Required)	
1	Connector Location Reference Page 20 or 40	Position 1
2		Position 2
3		Position 3
4		Position 4
X		Special Location (Electronic Feedback Application Data Sheet Required)
H	Supplier	Supplied by Hydro-Line
0	Valve Manifold Style Reference Page 42	No Manifold Block
1		Mounting Pattern 1
2		Mounting Pattern 2
3		DO5 Mounting Pattern
4		DO3 Mounting Pattern
X	Special Valve Patterns (Electronic Feedback Application Data Sheet Required)	
N	Sensor Cover	Not applicable

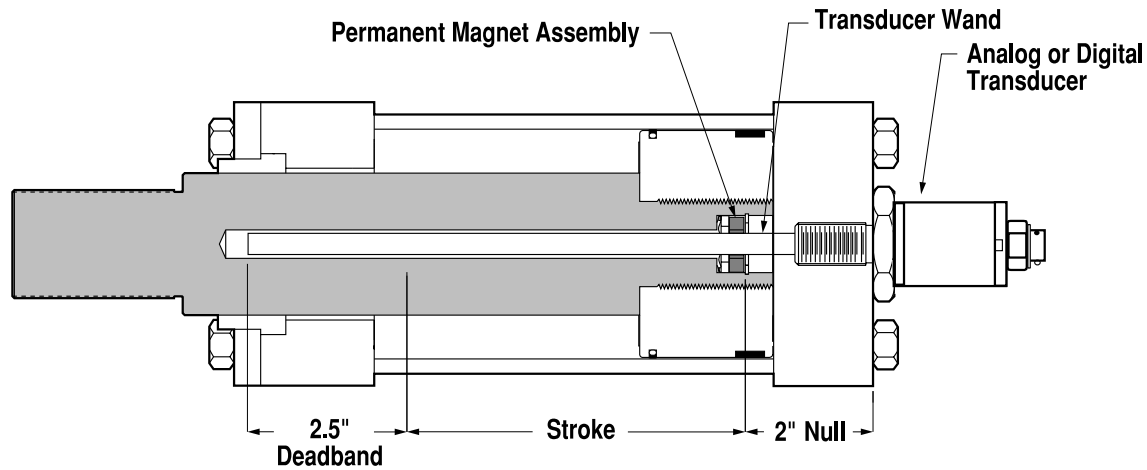
1-A-1-A-2-N-0-H



Transducer Specifications – Temposonics L Series

Noncontact Transducer

Hydro-Line utilizes MTS Temposonics® feedback technology, a magnetostriction device. Selection of feedback output should be matched to the control systems to ensure optimum performance of the positioning system.



Specifications

Characteristic	Description/Specification
Supply Voltage	Strokes $\leq 60"$; +13.5 to 26.4 Vdc ($\pm 0\%$); Strokes $>60"$; + 24Vdc ($\pm 10\%$)
Current Draw	Analog: 120 mA Digital: 100 mA Typical
Null Space	Null space is 2" unless otherwise noted
Dead Band	Dead band is 2.5" from tip of transducer
Displacement Range	Analog: 1" to 78" stroke Digital: 1" to 120" stroke
Head Enclosure	Aluminum die-cast head, IP 67 stainless rod and flange
Non-Linearity	$\pm 0.02\%$ or $\pm 0.0002"$, whichever is greater
Repeatability	$\pm 0.001\%$ of full stroke or $\pm 0.0001"$, whichever is greater
Hysteresis	0.0008" maximum
Resolution	Analog: Infinite Digital: $1 \div [\text{gradient} \times \text{Crystal Freq. (mHz)} \times \text{circulation}]$; Max resolution: 0.00025"
EMC Test*	DIN EN 50081-1 (Emissions) DIN EN 50082-2 (Immunity)
Operating Temperature	-40°F to 158°F
Operating Pressure **	3000 psi continuous, 5000 psi static, 10,000 psi spike
Shock Rating	100g (single hit) / IEC standard 68-2-27 (survivability)
Update Time	Analog: $\leq 1\text{ms}$ Digital: Resolution and Stroke dependent; Minimum = $[\text{Stroke (specified in inches)} + 3] \times 9.1 \mu\text{s}$
Output (absolute)	<i>Analog:</i> Voltage and current output available – see L Series ordering guide <i>Analog Adjustability:</i> Field adjustable zero and span to 5% of active stroke <i>Digital:</i> Pulse-width modulated (up to 15 recirculations); Start/Stop (RS422 compatible)
Vibration Rating	5g/10-150 Hz/IEC standard 68-2-6
Maximum Cable Length	<i>Analog:</i> 50 feet <i>Digital:</i> PWM output, 150 feet RS422 Start/Stop 500 feet

* EMC test specification does not include sensor with the RB connection style. Sensor with RB connection style meets the following standard: DIN EN 50081-2 (emissions) and DIN EN 50082-1 (immunity).

** Compare these specifications to cylinder specifications. Use the proper limiting specification.

Temposonics® is a registered trademark of MTS System Corporation

How to Order a Temposonics L Series

Symbol	Feature	Description
5	Sensor Type	Temposonics L Series
A	Output Options Reference Page 18	0 to +10 Vdc
B		0 to +10 Vdc, Reverse Acting
C		4 to 20 mA
D		4 to 20 mA, Reverse Acting
E		0 to 20 mA
F		0 to 20 mA, Reverse Acting
X		Special Analog Output (Electronic Feedback Application Data Sheet Required) <u>Digital Output</u>
P		DPM Module, Pulse Width Modulation (Electronic Feedback Application Data Sheet Required)
R		RPM Module, RS422 Start/Stop
V		Special Digital Output (Electronic Feedback Application Data Sheet Required)
1	Power Requirement Reference Page 10	+13.5 to 26.4 Vdc ($\pm 0\%$); Strokes $\leq 60"$ + 24Vdc $\pm 10\%$; Strokes $>60"$
A	Sensor Connector and Mating Cable Options Reference Page 19	Straight 7 Pin Molded Micro Connector 5 Foot
B		Straight 7 Pin Molded Micro Connector 15 Foot
C		Straight 7 Pin Molded Micro Connector 25 Foot
D		Right Angle 7 Pin Molded Micro Connector 5 Foot
E		Right Angle 7 Pin Molded Micro Connector 15 Foot
F		Right Angle 7 Pin Molded Micro Connector 25 Foot
G		10 Pin Molded Threaded Connector 5 Foot
H		10 Pin Molded Threaded Connector 15 Foot
J		10 Pin Molded Threaded Connector 25 Foot
K		Integral 5 foot
L		Integral 15 foot
M		Integral 25 foot
N		Straight 7 Pin Molded Micro Connector, Special Length
P		Right Angle 7 Pin Molded Micro Connector, Special Length
R		10 Pin Molded Threaded Connector Special Length
S		10 Pin Molded Threaded Connector Only, Transducer Side, No Cable Assembly
T		7 Pin Micro Connector Only, Transducer Side, No Cable Assembly
W		10 Pin Threaded Connector with mating Cable Connector Only. No Cable Attached
X	Special Connector And Cable	
0	Cover Connector Location Reference Page 20 or 40	No Cover
1		Position 1
2		Position 2
3		Position 3
4		Position 4
X	Special Location (Electronic Feedback Application Data Sheet Required)	
H	Supplier	Supplied By Hydro-Line
B		Customer to Supply, Hydro-Line to Install (Electronic Feedback Application Data Sheet Required)
C		Customer to Supply and Install (Electronic Feedback Application Data Sheet Required)
0	Valve Manifold Style Reference Page 42	No Manifold Block
1		Mounting Pattern 1
2		Mounting Pattern 2
3		DO5 Mounting Pattern
4		DO3 Mounting Pattern
X	Special Valve Patterns (Electronic Feedback Application Data Sheet Required)	
A	Sensor Cover Reference Page 19	No Cover
B		With Strain Relief
C		With MS Connector
D		Protective Cover with Strain Relief
E		Protective Cover with MS Connector
X		Special Configuration (Electronic Feedback Application Data Sheet Required)

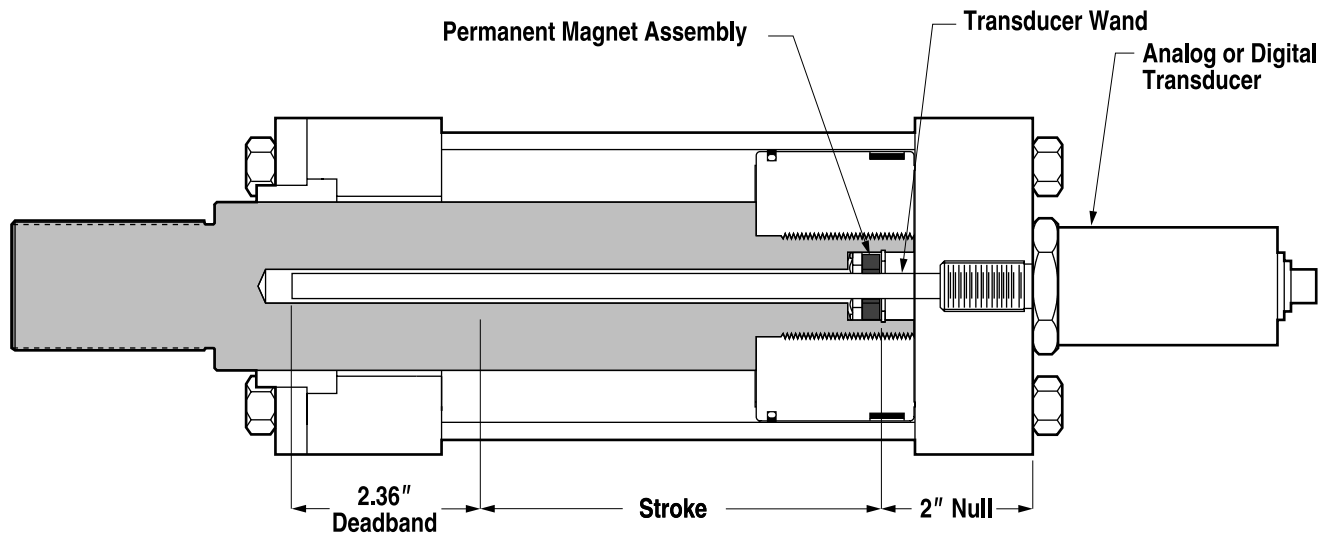
Temposonics II, III and intrinsically safe options are also available; consult Hydro-Line for details.

Transducer Specifications – Balluff BTL-2®

Noncontact Transducer

The BTL-2 utilizes magnetostriction technology. Balluff offers a transducer design for rugged industrial environments wherever linear motion must be controlled. Two standard types of feedback outputs are available: analog and digital.

Selection of feedback output should be matched to the control systems to ensure optimum performance of the positioning system.



Specifications

Characteristic	Description/Specification
Supply Voltage	+24 Vdc \pm 10% or \pm 15 Vdc \pm 2%
Current Draw	<i>Analog:</i> 130 mA @ +24 Vdc, 100/50 mA @ \pm 15 Vdc <i>Digital:</i> Differential Start/Stop version; 110 mA @ 24 Vdc All Others: 35 mA @ 24 Vdc
Displacement Range	2" to 140" stroke
Null Space	Null space is 2" unless otherwise noted
Dead Band	Dead band is 2.36" from tip of transducer
Non-Linearity	\pm 0.01 " @ \leq 20" stroke \pm 0.03% of full scale @ $>$ 20" stroke
Repeatability	Resolution + Hysteresis
Hysteresis	\leq 0.00008"
Resolution	<i>Analog:</i> 0.1 mVdc; voltage outputs < 1.0 μ Adc; current outputs <i>Digital:</i> Defined by control
Temperature Coefficient	20 ppm/ $^{\circ}$ C
Operating Temperature	-13 $^{\circ}$ F to 176 $^{\circ}$ F (-25 $^{\circ}$ C to 80 $^{\circ}$ C)
Operating Pressure*	3000 psi continuous; 8700 psi static
Protection Class	IP67, NEMA 6
Sampling Rate	<i>Analog:</i> 1.0 KHz (per update) <i>Digital:</i> 2,800 m/sec./length (maximum)
Shock Rating	50g (single hit)
Vibration Rating	6g (10 to 150 Hz)
Housing Material	Anodized aluminum
Rod Material	Stainless steel 304
Maximum Cable Length	50 feet Voltage output 500 feet Current output 1500 feet Pulse output
Outputs	<i>Analog:</i> Voltage and current output available – see BTL-2 Series ordering guide <i>Analog Adjustability:</i> Null – minimum \pm 3%; maximum up to 10% of total stroke or \pm 2", whichever is smaller Full Scale – \pm 2% of total stroke <i>Velocity (optional):</i> 0 to \pm 10 Vdc, polarity of output defines direction of travel (4 to 20 mA velocity is also available) <i>Digital:</i> TTL level, nominal 0 and 5 V, true high, parallel transmission

*Compare these specifications to cylinder specifications. Use the proper limiting specification.

BTL-2® is a registered trademark of Balluff Inc.

How to Order a Balluff BTL-2®

Symbol	Feature	Description
3	Sensor Type	Balluff Transducer (BTL-2)
A	Output Options Reference Page 18	0 to +10Vdc
B		0 to +10Vdc, Reverse Acting
C		-5 to +5Vdc
D		-5 to +5Vdc, Reverse Acting
E		-10 to +10Vdc
F		-10 to +10Vdc, Reverse Acting
G		0 to 20mA**
H		0 to 20mA, Reverse Acting**
J		4 to 20mA**
K		4 to 20mA, Reverse Acting**
X		Special Analog Output (Electronic Feedback Application Data Sheet Required)*
L		Digital Output
M		Start/Stop with Three State
N		Differential Stop – Leading Edge Active
P	Differential Pulse Width Modulated	
R	Differential Start/Stop – Leading Edge Active	
S	Single Ended Start/Stop – Leading Edge Active	
T	Differential Start/Stop – Trailing Edge Active	
V	Differential Pulse Width Recirculated (Electronic Feedback Application Data Sheet Required)	
1	Power Requirement Reference Page 12	+24Vdc ±10%
2		±15 Vdc ±2%
A	Sensor Connector and Mating Cable Options Reference Page 19	Cable Out Assembly, 3 meter
B		Cable Out Assembly, 5 meter
C		Cable Out Assembly, 10 meter
D		Straight Connector Cable Assembly, 3 meter
E		Straight Connector Cable Assembly, 5 meter
F		Straight Connector Cable Assembly, 10 meter
G		Right Angle Connector Cable Assembly, 3 meter
H		Right Angle Connector Cable Assembly, 5 meter
J		Right Angle Connector Cable Assembly, 10 meter
K		Straight Connector Only, No Cable
L		Right Angle Connector Only, No Cable
M		No Cable Assembly
N		Cable Out Assembly, Special Length Cable (Electronic Feedback Application Data Sheet Required)
P	Straight Connector Cable Assembly, Special Length (Electronic Feedback Application Data Sheet Required)	
R	Right Angle Connector Cable Assembly, Special Length (Electronic Feedback Application Data Sheet Required)	
X	Special Connector And Cable (Electronic Feedback Application Data Sheet Required)	
0	Cover Connector Location Reference Page 20 or 40	No Cover
1		Position 1
2		Position 2
3		Position 3
4		Position 4
X	Special Location (Electronic Feedback Application Data Sheet Required)	
H	Supplier	Supplied By Hydro-Line
B		Customer to Supply, Hydro-Line to Install (Electronic Feedback Application Data Sheet Required)
C		Customer to Supply and Install (Electronic Feedback Application Data Sheet Required)
0	Valve Manifold Style Reference Page 42	No Manifold Block
1		Mounting Pattern 1
2		Mounting Pattern 2
3		DO5 Mounting Pattern
4		DO3 Mounting Pattern
X	Special Valve Patterns (Electronic Feedback Application Data Sheet Required)	
A	Sensor Cover Reference Page 19	No Cover
B		With Strain Relief
C		With Threaded MS Connector
D		Protective Cover with Strain Relief
E		Protective Cover with Threaded MS Connector
X		Special Configuration (Electronic Feedback Application Data Sheet Required)

* Velocity output available upon customer request, specify on Electronic Feedback Application Data Sheet.

** Available in ungrounded conditioning, specify on Electronic Feedback Application Data Sheet.

Transducer Specifications – RT

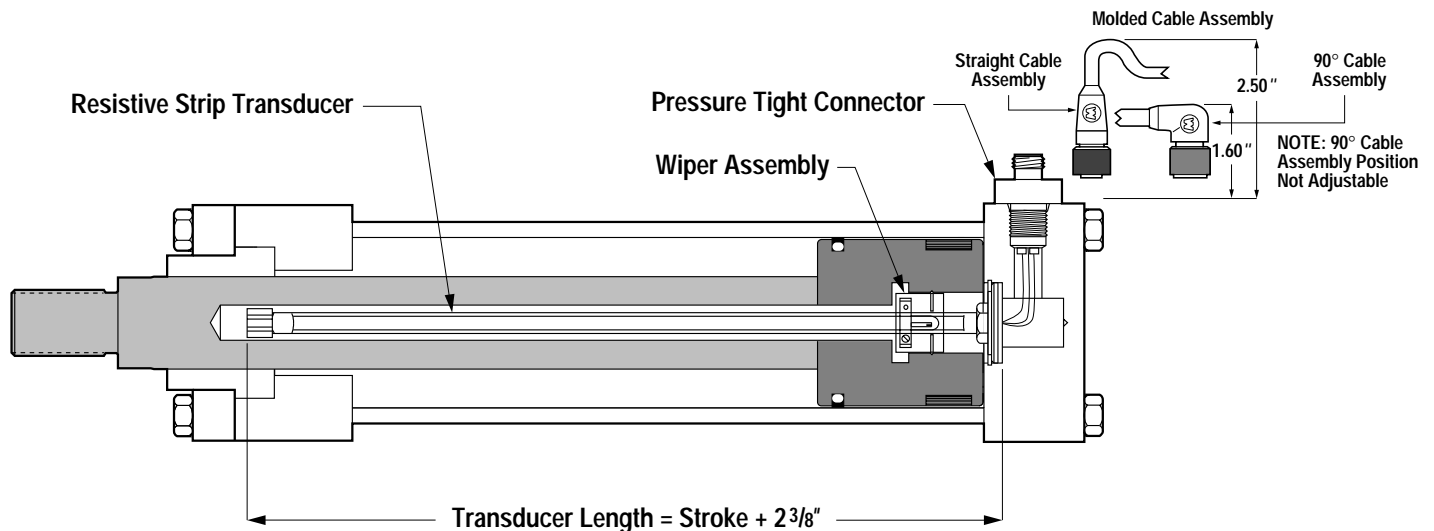
Contact Type Transducer

Linear Potentiometer – Method of Operations

The linear potentiometer device is rigidly attached to the cap end of the cylinder and runs the full stroke length inside a gun drilled piston rod. The transducer consists of a hardened aluminum extrusion in a shallow channel frame shape. A resistive plastic substrate material is bonded to one side of the channel and a conductive plastic substrate to the opposite side. A sliding wiper contact assembly is attached to the cylinder piston. As the piston rod moves through the stroke, the contacts conduct variable voltage changes from the resistive side to the conductive side.

Application Descriptions

This type of transducer provides accurate position feedback for low cycle, slow moving applications. When used in hydraulic applications, the transducer electric properties are dependent on nonconductive, noncontaminated operating fluids while the mechanical properties are dependent on nonvolatile, noncorrosive operating fluids. When used in pneumatic applications, the transducer depends on proper air filtration and drying to prevent contact wiper contamination. Avoid 'slick' type seal lubricants. The transducer mounting arrangement discourages infield repair. Duplicate cylinders with this transducer are recommended for spares if the application requires immediate turnaround.



Specifications

Characteristic	Description/Specification
Supply Voltage	+5 Vdc to +50 Vdc, bipolar or unipolar
Current Draw	1 microAmp maximum
Displacement Range	1" to 130", 1/8" increments
Non-Linearity	0.1% (1" to 46" stroke); 1.0% (47" to 130" stroke)
Repeatability	0.001"
Operating Temperature*	300°F
Operating Pressure*	5000 psi maximum
Transducer Life	500 million inches of travel
Cylinder Velocity	20 in/sec maximum hydraulic; 50 in/sec maximum pneumatic
Protection for Pressure Connector and Cable Assembly	NEMA 6P; IP68 (when cable is mated to pressure connector)
Washdown Pressure	1000 psi (when cable is mated to pressure connector)
Molded Cable Assembly	22 AWG: DVC insulated, metallic braid fine stranded copper conductors, yellow PVC jacketed, 300 V, 3 amp, 105°C U.L. recognized, C.S.A. certified
Maximum Cable Length from Cylinder to Signal Conditioning Electronics	20 feet
Maximum Cable Length from Signal Conditioning to User End	20 feet Voltage output 100 feet Current output
Output	Ratiometric

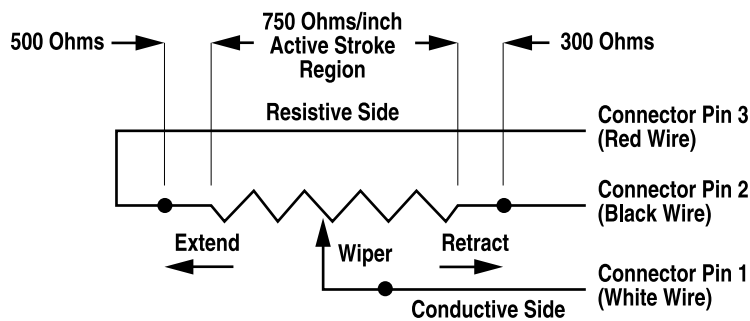
*Compare these specifications to cylinder specifications. Use the proper limiting specification.

How to Order an RT

Symbol	Feature	Description
4	Sensor Type	Resistive Transducer (RT)
A	Output Options Conditioning Module Reference Page 17	No Conditioning Module
B		Analog Output, Scalable Module
C		0 to +10 Vdc
D		-10 to +10 Vdc
E		4 to 20 mA
F		Analog Output, Nonscalable Module
G		Dual Set Point Relay, Standard Potentiometer Adjustment
H		Dual Set Point Triac, Standard Potentiometer Adjustment
J		Dual Set Point Relay, Precision Potentiometer Adjustment
K		Dual Set Point Triac, Precision Potentiometer Adjustment
X	Special Analog Output (Electronic Feedback Application Data Sheet Required)	
1	Power Requirement Conditioning Modules Reference Page 17	No Conditioning Module
2		+15 Vdc for Nonscalable Output Modules only
3		± 15 Vdc for Scalable Output Modules only
4		115 Vac for Either Type Module
X		Power requirement for special analog output
A	Mating Cable Options Reference Page 14	Straight Micro Change Cable Assembly, 6 Foot
B		Straight Micro Change Cable Assembly, 12 Foot
C		Straight Micro Change Cable Assembly, 20 Foot
D		Right Angle Micro Change Cable Assembly, 6 Foot
E		Right Angle Micro Change Cable Assembly, 12 Foot
F		Right Angle Micro Change Cable Assembly, 20 Foot
J		Straight Micro Change Cable Assembly, Special Length Cable (Electronic Feedback Application Data Sheet Required)
K	Right Angle Micro Change Cable Assembly, Special Length Cable (Electronic Feedback Application Data Sheet Required)	
N	No Cable Assembly	
X	Special Connector and Cable (Electronic Feedback Application Data Sheet Required)	
1	Connector Location Reference Page 20 or 40	Position 1
2		Position 2
3		Position 3
4		Position 4
X		Special Location (Electronic Feedback Application Data Sheet Required)
H	Supplier	Supplied By Hydro-Line
0	Valve Manifold Style Reference Page 42	No Manifold Block
1		Mounting Pattern 1
2		Mounting Pattern 2
3		DO5 Mounting Pattern
4		DO3 Mounting Pattern
X	Special Valve Patterns (Electronic Feedback Application Data Sheet Required)	
N	Sensor Cover	Not Applicable

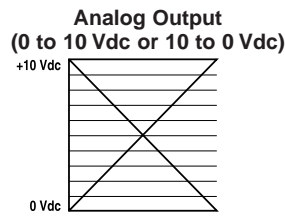
4-A-1-A-2-N-0-H

Linear Potentiometer Equivalent Circuit

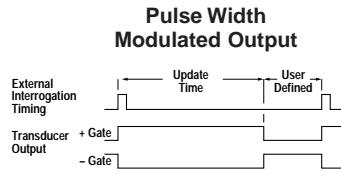


Definitions

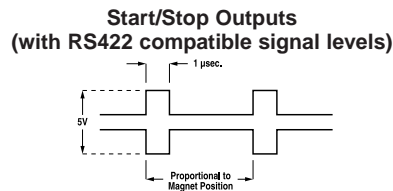
Analog Output – Voltage output measured on an absolute scale that is relative to the position of the external magnetic source. The analog output scale goes from 0 to 10 Vdc, or from 10 to 0 Vdc. This version is self-interrogating.



Pulse Width Output – The duration of the output pulse is proportional to position. A digital counter card can be used to convert this output signal into a Binary Coded Decimal (BCD) or Natural Binary output.



Start/Stop – The output of the Start/Stop signal is compatible with RS422 output levels. The interrogation signal is a differential pulse, 1 µsecond wide.



Resolution – The smallest increment stroke that can be detected and indicated in an output. In a digital system, the theoretical resolution of the transducer's sensing element is less than .001 inches. The actual resolution of a system is a direct function of oscillating frequency in the circuitry responsible for counting or timing. Units for resolution are normally given as inches or millimeters per count. For example, at any length, 28 MHz yields a .004 inches/count resolution, whereas 56 MHz yields a .002 inches/count resolution. The sensitivity and design of the receiver's electronics and external wiring limit the resolution of analog outputs.

Gradient – The rate at which magnetostrictive pulses travel through the waveguide. This figure is about 9.05 µsec. per inch (0.356 µsec. per millimeter), but will vary slightly from one transducer to the next.

Update Time – The minimum time interval between interrogation signals. To calculate the update time for Start/Stop units, use the following formula:

$$\text{Update Time (in milliseconds)} = (S) (G) (2)$$

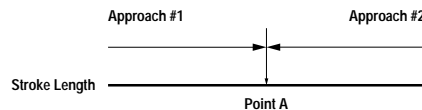
where

S = Maximum stroke length (e.g., active stroke in inches plus 2.62 inches, or active stroke in millimeters plus 66.5 millimeters).

G = Gradient (Gradient = approximately 0.00905 for English system of measurement, or 0.000356 for metric system)

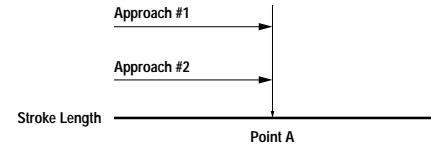
Non Linearity – Maximum deviation of a measured input/output curve which plots measured displacement versus actual displacement. Expressed in a + or – percent of deviation of full scale.

Hysteresis – The potential difference in indicated position for the same point along a stroke length when reached from **opposite directions**. Repeatability defines the potential difference in indicated position for the same point when repeatedly reached from the **same direction**.



It is important to note the hysteresis specification for position sensors is significantly less than resolution and can, in most applications, be ignored.

Repeatability – The deviation in output value when a point along a stroke length is repeatedly approached from the same direction. *Example:* Read the output value as you arrive at point A from a particular direction. If you leave position A and then return to it from the same direction as before, the potential change in output value from the two readings is described by the repeatability specification.



Temperature Coefficient (TC) – The degree to which the output signal (e.g., the indicated position) is affected by ambient temperature changes. Expressed as parts per million/°F or °C.

Example (analog output sensor):

- Output: 0 to 10 Vdc
- Stroke Length: 10 inches
- Temperature Change: 10°C

If the output at 10 inches is 10 Vdc, the potential change in output per degree Centigrade temperature change is ≤0.0008 V (0.00008 x 10) or a total of 8 mV for a 10°C rise.

Asynchronous Operation/Internal Interrogation – Defines a system which consists of a pulse width modulated transducer and a customer supplied digital counter card or high speed counter. The transducer generates an internal interrogation signal at a fixed frequency. The frequency is determined by the stroke length and the number of recirculations.

Synchronous Operation/External Interrogation – In digital systems, this defines a system which consists of a pulse width modulated transducer using a customer generated or external interrogation pulse. This is a complex method of interrogation that requires special user-designed hardware and detailed knowledge of the sensor technology.

Recirculations (circulations) – In digital systems, a process that improves resolution of an LDT system. The on time of the pulse duration signal is multiplied by a specified factor (2 to 127). This provides more counting time for the counter, improving resolution. The process involves retriggering an interrogation pulse a fixed number of times.

$$\text{Recirculations} = 1 \div (G \times F \times R)$$

where

G = Gradient (approximately 9.05 µs per inch or .356 µs per millimeter)

F = Crystal frequency of the counter

R = Resolution (in inches or millimeters)

4-20 mA Output – Grounded versus Ungrounded

Ungrounded Output: If this output is grounded, the output will fail. The negative (return) line of the output is isolated from the power supply common and cannot be connected to the power supply common or to the power supply positive. In many installations you will find that the receiver device input is grounded to the same earth ground that the power supply common is grounded to. This would effectively connect the return to power supply common and the units will not function.

Grounded Output: This output uses the supply common as the return and is, therefore, “grounded” since it is recommended that the user ground the power supply common to earth ground.

Output Specifications – RT and Signal Conditioning Modules

Ratiometric Output

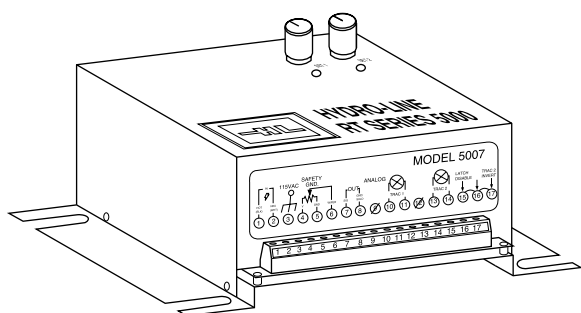
A ratiometric sensor output is directly proportional to the input source voltage. The user can take advantage of this by 'trimming' the sensor output to his specific needs by adjusting the input source voltage.

Scalable Analog Output Controller

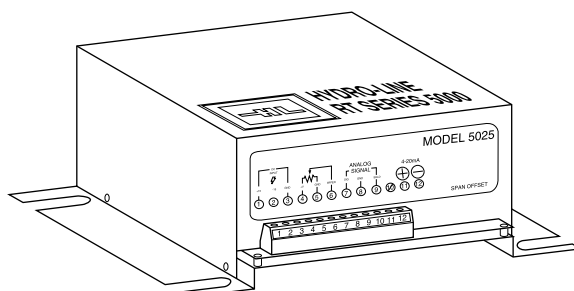
This controller offers the user a scalable output that can be measured by a meter, PLC or other device. Available outputs are 0 Vdc to 10 Vdc, -10 Vdc to 10 Vdc and 4 mA to 20 mA. Supply voltage to the controller can be DC or AC. The units output is scalable over the stroke of the cylinder providing full scale linear output between two points, whether end of stroke or points in between.

Nonscalable Dual Set Point Controller

This controller offers the user infinitely adjustable, dual trip points anywhere along the stroke of the cylinder. The controller is available with 2-Triac, 2-relay or 2-transistor type outputs. Controllers are equipped with either a single turn set-point potentiometer or an optional multi-turn potentiometer for applications that require more resolution.



Dual Set Point Controller
Infinitely adjustable within cylinder stroke



Scalable Analog Output Controller
For continuous position output

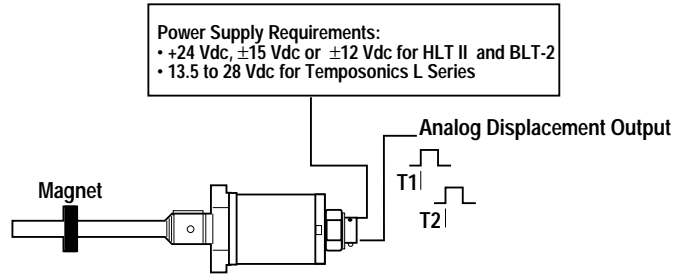
Specifications

Characteristic	Description/Specification
Enclosure Dimensions	3" High x 5 ⁵ / ₈ " Wide x 4 ⁵ / ₁₆ " Deep
Mounting Holes	3 ⁹ / ₁₆ " by 4 ⁷ / ₈ " center to center, 4 places
Shipping Weight	2 lbs.
Power Input Requirements	AC (All Units): 115 V, 60 Hz, .1 Amp DC (Set Point Systems): +15 Vdc, .1 Amp DC (Indicator Systems): +15 Vdc and -15 Vdc, 40 mA each supply 4 to 20 mA System: +15 Vdc and -15 Vdc, 50 mA each supply
Input Fuse	.250 Amp
Output Specification – Set Point	Relay (2): 3 Amp @ 28 Vdc, 5 Amp @ 115 Vdc Triac (2): 2 Amp (60-115 Vac) Transistor (2): 10 mA
Output Specifications – Analog Output	0 to 10 V, 1 mA maximum output current (10K ohm impedance minimum) -5 to +5, -10 to +10 V, 1 mA maximum output current (10K ohm impedance minimum) 4 to 20 mA, into 500 ohm maximum impedance Maximum Zero Offset: 50% of cylinder stroke Maximum Span Range: 50% of cylinder stroke
Electronics Operating Temperature	40°F to 130°F

Output Specifications – HLT II, BLT-2 and Temposonics L Series

Analog Output Options

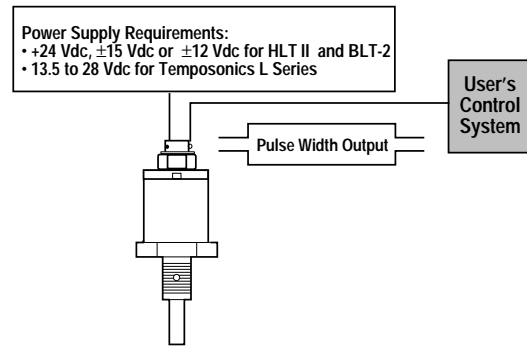
Analog Systems include a Linear Displacement Transducer, a magnet and the cable between the sensor and the customer electronics. The sensor generates the interrogation pulse, senses the return pulse and develops the analog output displacement signal (voltage or current). The HLT II has all of the electronics encased inside the cap of the cylinder.



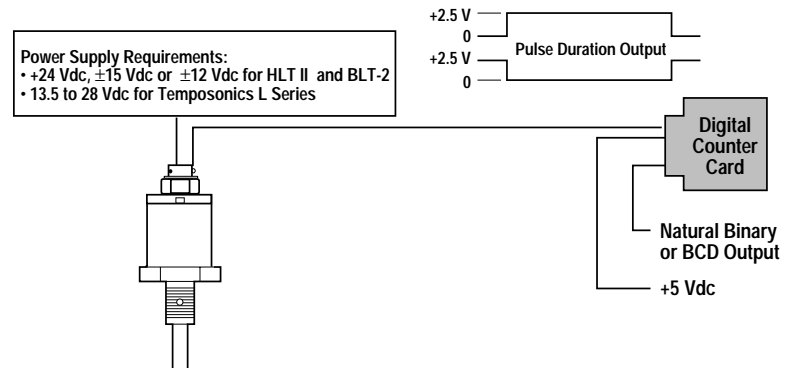
Digital Output Options

There are three digital output options available. Each provides a different type of digital output, either pulse width modulation, binary (natural binary or binary coded decimal) or an RS422 Start/Stop pulse output.

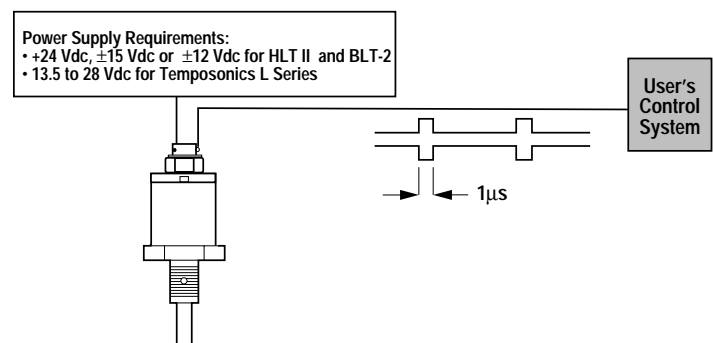
- 1) The digital PWM electronics are self contained in the transducer. The interrogation electronics provide a pulse width modulated TTL level output (no external signal conditioning required).



- 2) The PWM output, in conjunction with an externally mounted digital counter card, provides natural binary (18 bits) or BCD (4¹/₄ digits) output (using two counter cards would provide the capability to achieve 22 bit natural binary and 6 BCD outputs).

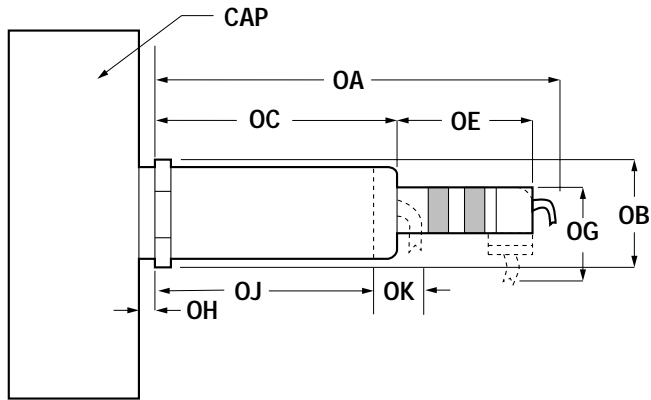


- 3) The RS422 output electronics are self contained in the transducer. A customer supplied 1 KHz square wave signal is required with this output option to produce an RS422 Start/Stop output.



Temposonics L and Balluff BTL-2 Clearance Requirements

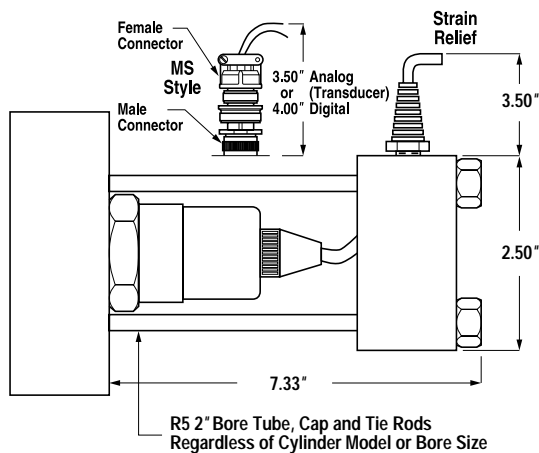
Transducer and Connector Without a Cover Option



Temposonics L and Balluff BTL-2 C-409-X Clearance Adder

Bore Dia.	Rod Dia.	C-409-X "OH"	
		R5	N5
1.50	1.00	N/A	1/4
2.00	1.00	3/4	1/4
	1.38	3/4	1/4
2.50	1.00	3/4	1/4
	1.38	3/4	1/4
	1.75	3/4	1/4
3.25	Standard Rod Diameter for Each Bore	1/2	N/A
4.00			
5.00			
6.00	Standard Rod Diameter for Each Bore	1/4	N/A
8.00			

Cover Option with MS or Strain Relief Connector



Protective Cover

Balluff BTL-2

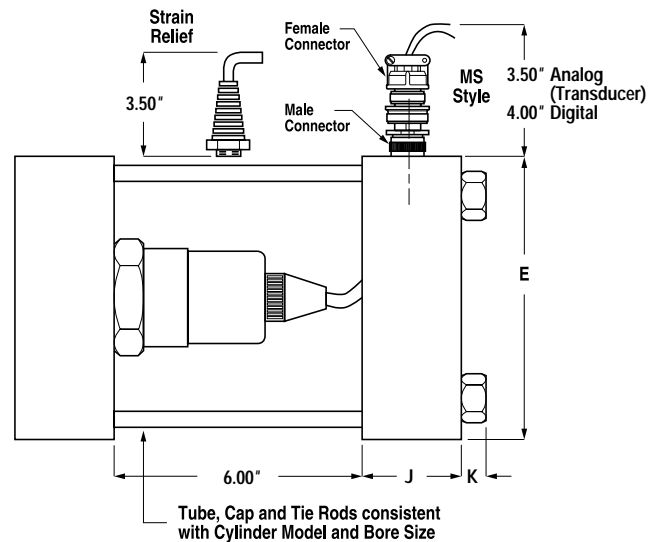
Sensor and Connector	OA	OB	OC	OE	OG
Analog BTL-2 w/ S32	7.30	2.09	4.33	2.44	-
Analog BTL-2 w/ S33	See OC and OE	2.09	4.33	1.46	2.66
Digital BTL-2 w/ S32	5.90	2.09	2.95	2.44	-
Digital BTL-2 w/ S33	See OC and OE	2.09	2.95	1.46	2.66
Analog BTL-2 w/Cable Out	-	2.09	4.33	1.10	-
Digital BTL-2 w/Cable Out	-	2.09	2.95	.50	-

Temposonics L Series

Sensor and Connector	OJ	OK
Analog/Digital Temposonics L Series	2.63	See Below

OK connector Dimensions (includes cable bend)

- Straight 7 pin molded Micro Connector with mating Connector. 3.38 in
- Right angle 7 pin molded Micro Connector with mating Connector. 2.15 in
- 10 pin molded threaded Connector with mating Connector. 4.30 in
- Integral cable out. 2.75 in



Hard Cover Continuous Tie Rod

N5 Cylinder Port Size Data and Location Information

Ports

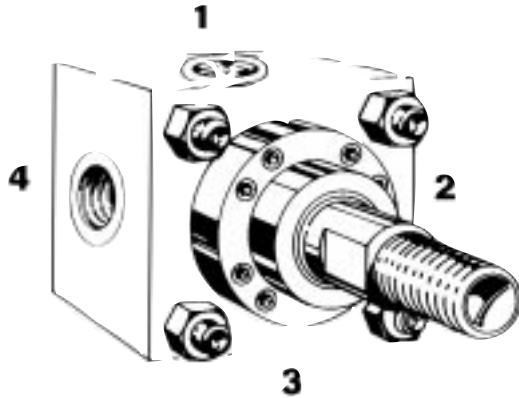
Standard ports for N5 and WBN5 are SAE straight thread. AN5 and LAN5 standard ports are NPTF.

Optional and Oversize Ports

The chart at right lists port sizes. Larger welded half-pipe coupling ports are available in some sizes; please contact Hydro-Line.

Port Locations

Standard port locations are at No. 1, with optional locations No. 2, 3 or 4 furnished when specified, except where **H**, **U** or **W** mounts interfere at No. 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 No. 2 and 4. Mounting holes are counterbored to allow access to them with piping in place. Request Engineering File P-26 for reference to dimensions.



Locations 1 through 4 indicate possible port positions. Number 1 is standard.

Cylinder Bore Dia.	Rod Diameter	SAE*			NPTF			4-Bolt SAE**	Manifold***
		Std.	Oversize		Std.	Oversize			
			Head	Cap		Head	Cap		
1 1/2	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 1/4	#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 1/4	#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

* 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 Systems Cylinder Pressure Ratings

Cylinder Bore Dia. (in.)	Piston Rod Dia. (in.)			Design Pressure Ratings			
	Std.	Oversize	Area 2:1	Non/Cap Cushion		Both/Head Cushion	
				4:1 Tensile	4:1 Yield	4:1 Tensile	4:1 Yield
1 1/2	1	N/A	1	3750*	3005*	N/A	N/A
2	1	N/A	1 3/8	2900	2335	1890	1575
2 1/2	1	1 3/8	1 3/4	2120	1765	1155	960
3 1/4	1 3/8	1 3/4	2	3050	2475	1890	1575
4	1 3/4	2	2 1/2	3050	2440	3050	2440
5	2	2 1/2, 3	3 1/2	3270	2615	3270	2615
6	2 1/2	3, 3 1/2	4	2770	2220	2770	2220
7	3	3 1/2, 4, 4 1/2	5	2690	2155	2690	2155
8	3 1/2	4, 4 1/2, 5	5 1/2	2810	2245	2810	2245

* Only available in noncushion design

Hydro-Line 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	Air LR5 R5	Hyd. HR5	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				
1½	250	3000	200	1500	1.84	92	110	147	184	368	460	920	1,380	1,840	2,760	3,680	5,520	.00797	.00106	.00683	
2	250	2900	200	1500	3.24	162	194	259	324	648	810	1,620	2,430	3,240	4,860	6,480	9,720	.01403	.00188	.01211	
2½	250	2120	200	1500	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	
3¼	250	3000	200	1185	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	3000	200	770	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	200	485	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	2770	200	960	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	2690	200	N/A	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	2810	200	530	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	

Piston Rod Dia. in inches	Bore Size N5 AN5 LAN5	Bore Size LR5 R5 HR5	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									
1	1½	1, 1½, 2, 2½	.79	40	47	63	79	158	198	395	593	790	1,185	1,580	2,370	3,165	4,740	6,315	9,470	12,645	18,960	.00138	.00018	.00116
1	2 & 2½	3¼, 4, 5	.79	40	47	63	79	158	198	395	593	790	1,185	1,580	2,370	3,165	4,740	6,315	9,470	12,645	18,960	.00342	.00046	.00294
1½	3¼	6, 8	1.49	75	89	119	149	298	373	745	1,118	1,490	2,235	2,980	4,470	6,705	10,050	14,925	22,380	33,570	50,355	.00645	.00086	.00555
1¼	4		2.41	121	145	193	241	482	603	1,205	1,808	2,410	3,615	4,820	7,230	10,040	15,060	20,080	30,120	40,160	60,240	.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	13,590	18,120	27,180	36,240	54,360	72,480	.01359	.00182	.01170
2½	6		4.91	246	295	393	491	982	1,228	2,455	3,683	4,910	7,365	9,820	14,730	22,095	29,460	44,190	58,920	88,380	117,840	.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	31,815	42,420	63,630	84,840	127,260	169,680	.03061	.00409	.02635
3½	8		9.62	481	577	770	962	1,924	2,405	4,810	7,215	9,620	14,430	19,240	28,860	43,290	57,720	86,580	115,440	173,160	231,840	.04165	.00557	.03585

NOTE: Bore dimensions are 0.030" larger than NOMINAL.

Above are cylinder sizes for which the rod diameters in the column to the left are standard. Consult factory 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.

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
½	.622	.304	4.7	.157	9.4	.585	14.1	1.215	18.6	2.065	23.5	3.130	28.2	4.34
¾	.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
1¼	1.380	1.495	23.3	.064	46.5	.231	69.8	.488	93.0	.755	116.3	1.240	139.6	1.74
1½	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	
½	.622	.304	1.5	3.3	.35	17	6 to 30	12 to 60	
¾	.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	
1¼	1.380	1.495	3.7	7.7	.81	37	15 to 75	30 to 150	
1½	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	

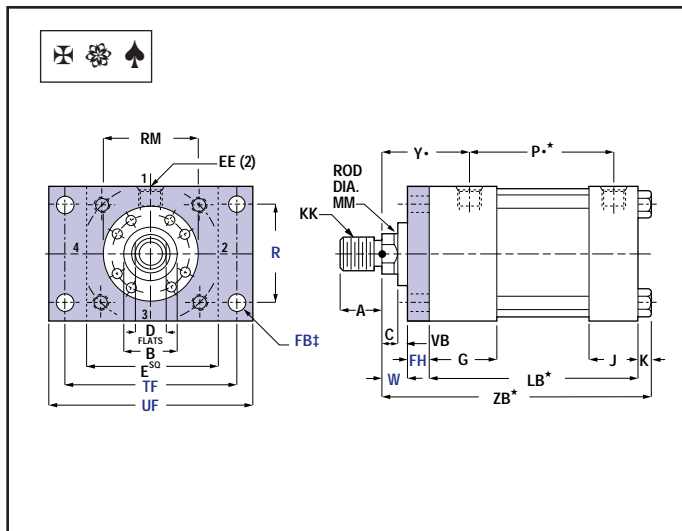
* Inside diameter and areas shown are standard pipe. For tubing or extra heavy and double extra heavy pipe, use I.D. in table closest to your pipe or tubing I.D.

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 Hydro-Line hydraulic cylinders are available with oversize ports with welded half pipe couplings or flange fitting.

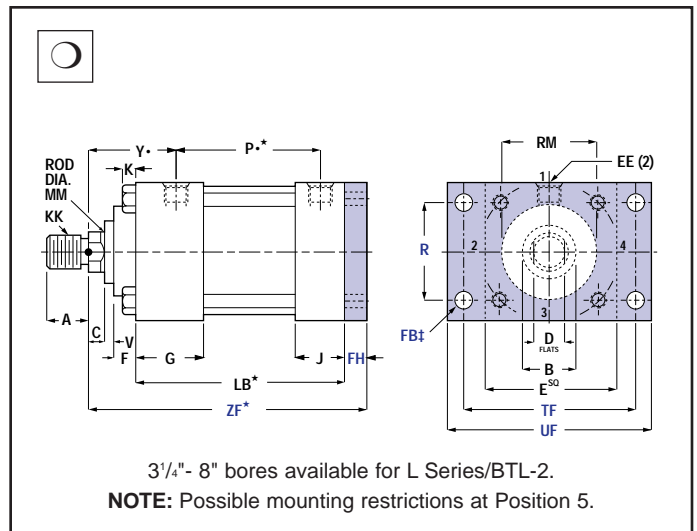
1 Gallon = 231 Cubic Inches
 Oil consumption gal. per min = Gal. per in X in. per min. piston speed
 Air consumption cubic ft. per min = Cu. ft. per in X in. piston speed
 Free air consumption per in. of stroke = Cu. ft. displaced X (press. + 14.7) ÷ 14.7

N5 Series Mounting Dimensions

1 1/2" - 8" bore cylinders



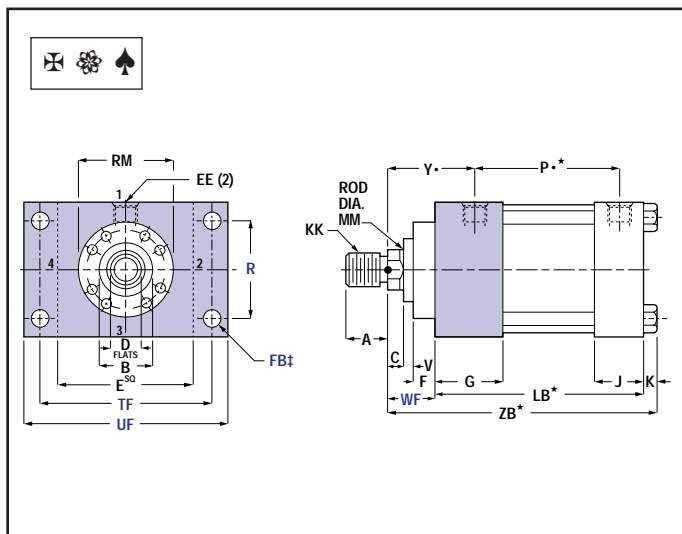
N5F – Head Rectangular Flange Mount (NFA Style MF1)



N5R – Cap Rectangular Flange Mount (NFA Style MF2)

3 1/4" - 8" bores available for L Series/BTL-2.

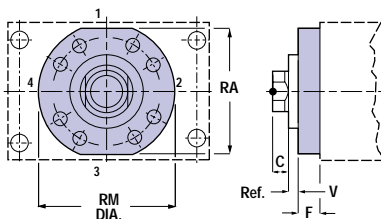
NOTE: Possible mounting restrictions at Position 5.



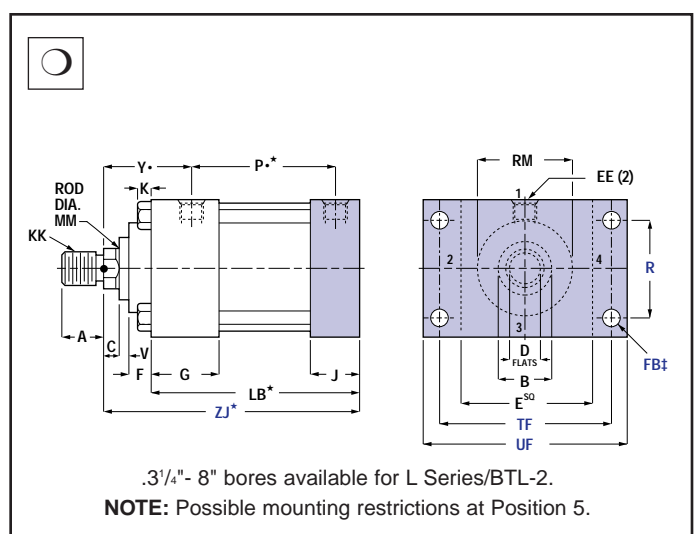
N5G – Head Rectangular Mount (NFA Style ME5)

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	—	2 3/8	9/32
	1	1/2	2.44	2 5/8	3/8
2	1	1/2	—	2 5/8	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	3 7/8	17/32
3 1/4	1 3/4	19/32	—	3 7/8	17/32
	2	19/32	—	4	17/32



N5P – Cap Rectangular Mount (NFA Style ME6)

.3 1/4" - 8" bores available for L Series/BTL-2.

NOTE: Possible mounting restrictions at Position 5.

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.)

Cylinder Dimensions

BORE	1½	2	2½	3¼	4	5	6	7	8
A	1⅛	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
B ⁻⁰⁰¹ -003	1½	1½	1½	2	2⅝	2⅝	3⅝	3¾	4¼
C	½	½	½	⅝	¾	⅞	1	1	1
CC	½-20	⅞-14	⅞-14	1¼-12	1½-12	1¾-12	2¼-12	2¾-12	3¼-12
D	⅞	⅞	⅞	1⅛	1½	1¾	2⅛	2⅝	3
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	11/16	11/16	15/16	11/16	13/16	15/16
FH	¾	⅝	⅝	¾	⅞	⅞	1	1	1
FT	⅝-18	1-14	1-14	1¾-12	1¾-12	2-12	2½-12	3-12	3½-12
G	1¾	1¾	1¾	2	2	2	2¼	2¾	3
K	¾	7/16	7/16	9/16	9/16	13/16	15/16	1	1⅛
KK	¾-16	¾-16	¾-16	1-14	1¼-12	1½-12	1⅞-12	2¼-12	2½-12
MM	1	1	1	1¾	1¾	2	2½	3	3½
R	1.63	2.05	2.55	3.25	3.82	4.95	5.73	6.58	7.50
RM	■	■	2⅝	3¼	3⅞	4	4⅞	5¼	5⅝
TF	37/16	4⅛	4⅝	5⅞	6⅜	8⅜	9⅞	10⅝	11⅜
UF	4¼	5⅛	5⅝	7⅛	7⅝	9¾	11¼	12⅝	14
V	▲	▲	¾	13/32	17/32	17/32	21/32	17/32	17/32
VB	½	¼	¼	¼	¼	¼	¼	¼	¼
W	1	¾	¾	⅞	1	1⅛	1¼	1¼	1¼
WF	1¾	1¾	1¾	1⅝	1⅞	2	2¼	2¼	2¼
Y•	2⅝/32	2⅝/32	2⅝/32	2⅝/32	2⅝/32	3⅜/32	3⅜/32	3⅝/16	4⅜/16

Electronic Feedback Cylinder Dimensional Changes

BORE		1½	2	2½	3¼	4	5	6	8
C	HLT II	–	7/8	7/8	¾	9/16	¾	–	–
	L Series/BTL-2	–	–	–	–	–	–	–	–
	RT	–	–	–	–	–	–	–	–

**Style 4 rod ends may require additional rod length. The following dimensions will increase by the C dimension in the above chart: C, SE, W, WF, XC, XD, XE, XG, XJ, XS, XT, Y, ZB, ZE, ZF, ZJ and ZT.

J	HLT II	–	2¼	2⅞	2	2	2	2¼	2¾	3
	L Series/BTL-2	1½	1½	1½	1¾	1¾	1¾	2¼	2¾	3
	RT	1½	1½	1½	1¾	1¾	1¾	2¼	2¾	3
JJ♦	HLT II	–	¾	¾	¾	¾	¾	¾	¾	¾
	L Series/BTL-2	5½	5½	5⅝	5½	5¾	6¼	7⅞	8½	9½
	RT	5⅝	5⅝	5¾	5½	5¾	6¼	7⅞	8½	9½
LB★	HLT II	–	5⅜	5⅜	5¾	6	6½	7⅞	8½	9½
	L Series/BTL-2	5½	5½	5⅝	5½	5¾	6¼	7⅞	8½	9½
	RT	5⅝	5⅝	5¾	5½	5¾	6¼	7⅞	8½	9½
P★	HLT II	–	2⅞	2⅞	3⅞	3⅞	4⅞	4⅞	5⅞	5⅞
	L Series/BTL-2	3⅞	3⅞	3⅞	3⅞	3⅞	4⅞	4⅞	5⅞	5⅞
	RT	3⅞	3⅞	3⅞	3⅞	3⅞	4⅞	4⅞	5⅞	5⅞
ZB★	HLT II	–	7⅞	7⅞	7⅞	8⅞	9⅞	10⅞	11¾	12⅞
	L Series/BTL-2	7¼	7⅞	7⅞	7⅞	8⅞	9⅞	10⅞	11¾	12⅞
	RT	7⅞	7⅞	7⅞	7⅞	8⅞	9⅞	10⅞	11¾	12⅞
ZF★	HLT II	–	7⅞	7⅞	8⅞	8⅞	9⅞	10⅞	11¾	12¾
	L Series/BTL-2	7¼	7½	7⅞	7⅞	8⅞	9⅞	10⅞	11¾	12¾
	RT	7⅞	7⅞	7¾	7⅞	8⅞	9⅞	10⅞	11¾	12¾
ZJ★	HLT II	–	6¾	6¾	7⅞	7⅞	8⅞	9⅞	10¾	11¾
	L Series/BTL-2	6⅞	6⅞	7	7⅞	7⅞	8⅞	9⅞	10¾	11¾
	RT	7	7	7⅞	7⅞	7⅞	8⅞	9⅞	10¾	11¾

Dimensions shown in purple are mounting dimensions.

NOTE: To determine piston thickness, subtract G and J dimensions from LB dimension.

NOTE: Additional port information on page 20.

○ Oversize rods affect dimensions in gray-shaded areas.

See pages 30-31 for these dimensions.

★ Add stroke to all starred dimensions.

■ Requires full front square retainer.

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.

♦ The JJ dimension is the cover plate thickness for the HLT II electronics. A square cover plate is required on the 2" bore size while all others receive a circular type.

‡ Use screws ⅛" smaller than mounting holes.

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

– No additional C required for a Style 4 rod end.

Refer to ordering code on pages 9, 11, 13 and 15:

✱ Sensor cover not available for 1½" bore.

✱ A, B & C sensor cover options available for 2" bore.

✧ A, B & C sensor cover options available for 2" and 2½" bore.

■ A, B & C sensor cover options available for 2"-3¼" bore.

∞ A, B & C sensor cover options available for 2"-8" bore.

◇ B & C sensor cover options available for 2"-8" bore.

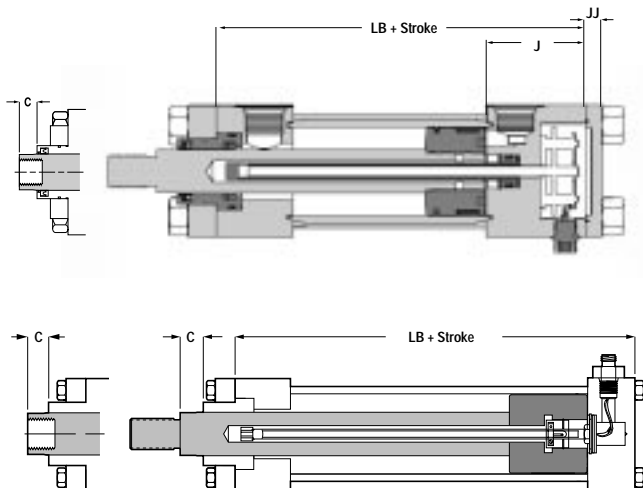
♣ All sensor cover options available for 2½"-8" bores.

○ All sensor cover options available for 3¼"-8" bores.

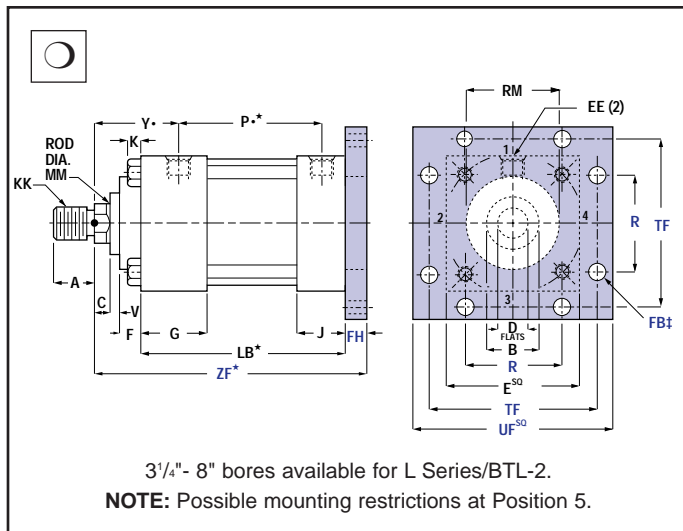
Ω All sensor cover options available for 4"-8" bores.

NOTE: Consult factory on applications requiring cushions or bores over 8".

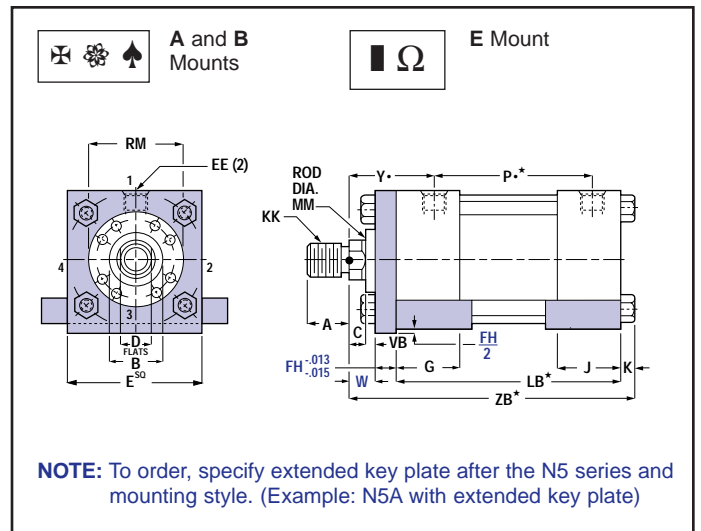
NOTE: Consult factory on applications requiring 1½" bore HLT II.



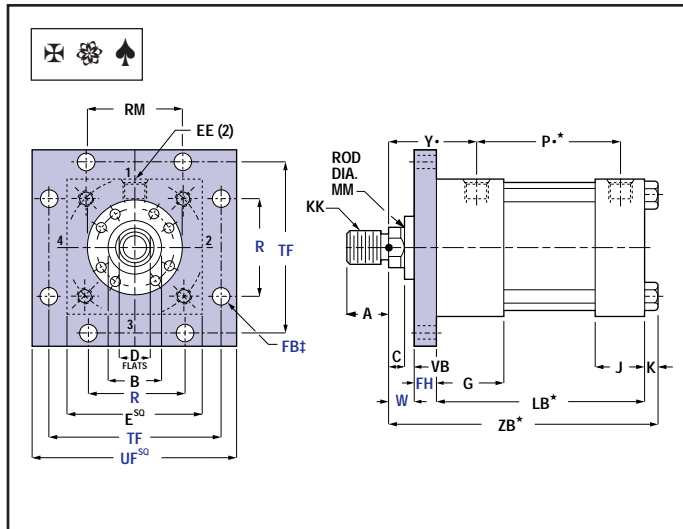
N5 Series Mounting Dimensions



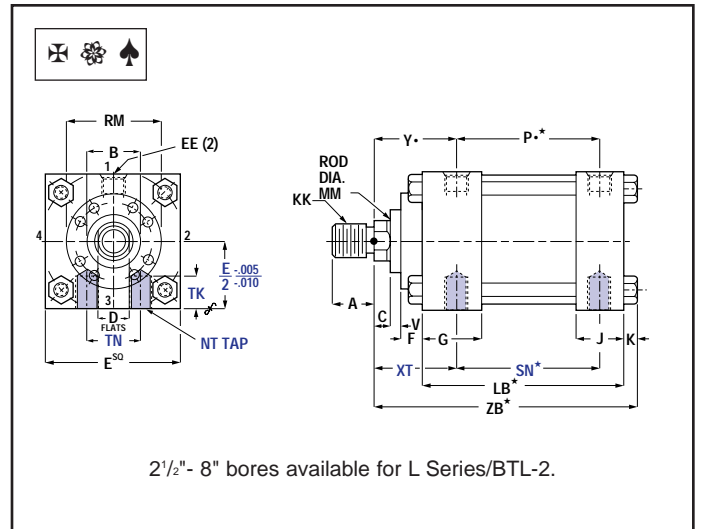
N5S – Cap Square Flange Mount (NFPA Style MF6)



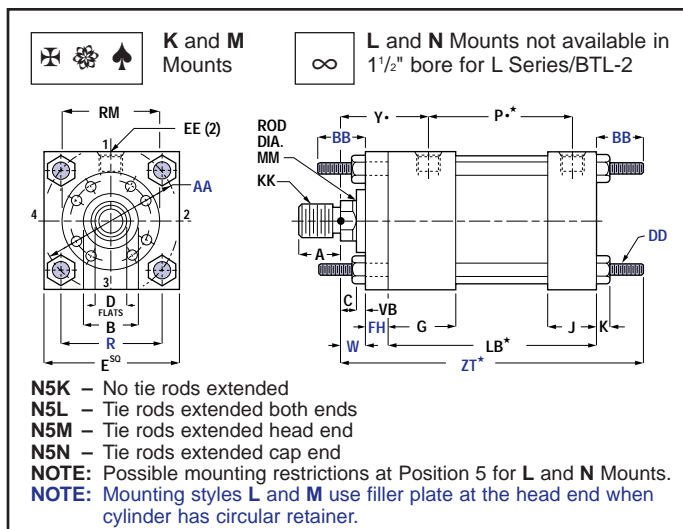
N5 – Extended Key Plate – Available when specified



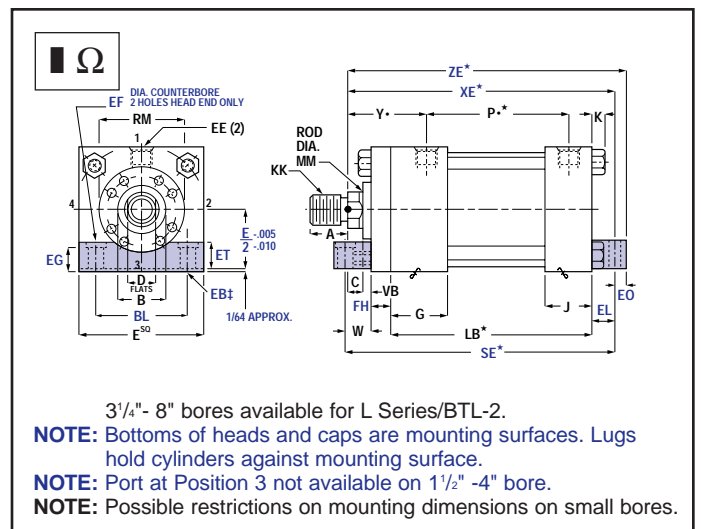
N5J – Head Square Flange Mount (NFPA Style MF5)



N5B – Side Tapped Mount (NFPA Style MS4)



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



N5E – Side End Lugs Mount (NFPA Style MS7)

Cylinder Dimensions

BORE	1½	2	2½	3¼	4	5	6	7	8
A	1½	1½	1½	15/8	2	2¼	3	3½	3½
AA	2.3	2.9	3.6	4.6	5.4	7.0	8.1	9.3	10.6
B -.001 -.003	1½	1½	1½	2	2⅝	2⅝	3⅞	3¾	4¼
BB	1⅜	1⅜	1⅜	2⅝	2⅝	3⅜	3⅝	4⅞	4½
C	½	½	½	5/8	¾	7/8	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	7/8	7/8	7/8	1⅞	1½	1¾	2⅞	2⅝	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
EF	5/8	13/16	13/16	1	1	1⅜	1⅝	1⅝	2⅜
EG	11/16	¾	¾	1⅞	7/8	1¼	1½	1½	1¾
EL	7/8	15/16	15/16	1⅞	1⅞	1½	1⅞	1⅞	2
EO	¾	½	½	5/8	5/8	¾	7/8	1	1⅞
ET	7/8	1	1	1¼	1¼	1½	1¾	2	2
F	▲	▲	½	19/32	19/32	19/32	19/32	23/32	23/32
FB‡	7/16	9/16	9/16	1⅞	1⅞	15/16	1⅞	13/16	15/16
FH	¾	5/8	5/8	¾	7/8	7/8	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
K	¾	7/16	7/16	9/16	9/16	13/16	15/16	1	1⅞
KK	¾-16	¾-16	¾-16	1-14	1¼-12	1½-12	1¾-12	2¼-12	2½-12
MM	1	1	1	1¾	1¾	2	2½	3	3½
NT	¾-16	1/2-13	5/8-11	¾-10	1-8	1-8	1¼-7	1½-6	1½-6
R	1.63	2.05	2.55	3.25	3.82	4.95	5.73	6.58	7.50
RM	■	■	2⅝	3¼	3⅞	4	4⅞	5¼	5⅝
TF	3/16	4/8	4⅝	5⅞	6⅜	8⅜	9⅞	10⅝	11⅜
TK	9/16	½	13/16	¾	1	1⅞	15/16	2⅞	19/16
TN	¾	15/16	15/16	1½	2⅞	2⅝	3⅝	3¾	4¼
UF	4¼	5⅞	5⅝	7⅞	7⅝	9¾	11¼	12⅝	14
V	▲	▲	¾	13/32	17/32	17/32	21/32	17/32	17/32
VB	½	¼	¼	¼	¼	¼	¼	¼	¼
W	1	¾	¾	7/8	1	1⅞	1¼	1¼	1¼
XT	2	2⅝	2⅝	2¾	3	3⅞	3½	3⅞	3⅞
Y•	2⅝	2⅝	2⅝	2⅝	2⅝	3⅜	3⅞	3⅞	4⅞

Electronic Feedback Cylinder Dimensional Changes

BORE		1½	2	2½	3¼	4	5	6	8
C	HLT II	—	7/8	7/8	¾	9/16	¾	—	—
	L Series/BTL-2	—	—	—	—	—	—	—	—
	RT	—	—	—	—	—	—	—	—

**Style 4 rod ends may require additional rod length. The following dimensions will increase by the C dimension in the above chart: C, SE, W, WF, XC, XD, XE, XG, XJ, XS, XT, Y, ZB, ZE, ZF, ZJ and ZT.

J	HLT II	—	2¼	2⅞	2	2	2	2¼	2¾	3
L Series/BTL-2	RT	1½	1½	1½	1¾	1¾	1¾	2¼	2¾	3
	RT	1½	1½	1½	1¾	1¾	1¾	2¼	2¾	3
JJ♦	HLT II	—	¾	¾	¾	¾	¾	¾	¾	¾
LB★	HLT II	—	5⅜	5⅜	5¾	6	6½	7⅜	8½	9½
	L Series/BTL-2	5½	5½	5⅝	5½	5¾	6¼	7⅜	8½	9½
P★	RT	5⅝	5⅝	5¾	5½	5¾	6¼	7⅜	8½	9½
	RT	3⅞	3⅞	3⅞	3⅞	3⅞	4⅞	4⅞	5⅞	5⅞
SE★	HLT II	—	8¼	7⅞	8¾	9⅞	10⅞	11¾	13⅞	14½
	L Series/BTL-2	7⅝	8	8	8½	8⅞	10⅞	11¾	13⅞	14½
SN★	RT	7¾	8⅞	8¼	8½	8⅞	10⅞	11¾	13⅞	14½
	RT	7¾	8⅞	8¼	8½	8⅞	10⅞	11¾	13⅞	14½
SE★	HLT II	—	2⅞	3	3½	3¾	4¼	5⅞	5⅞	6⅞
	L Series/BTL-2	3¾	3¾	3⅞	3½	3¾	4¼	5⅞	5⅞	6⅞
ZE★	RT	3⅞	3⅞	4	3½	3¾	4¼	5⅞	5⅞	6⅞
	RT	3⅞	3⅞	4	3½	3¾	4¼	5⅞	5⅞	6⅞
XE★	HLT II	—	8⅞	7⅞	8½	9	10	11⅞	12⅞	13¾
	L Series/BTL-2	N/A	7⅞	7⅞	8¼	8¾	9¾	11⅞	12⅞	13¾
RT	7⅞	7⅞	8¼	8¾	9¾	11⅞	12⅞	13¾	13¾	
	7⅞	7⅞	8¼	8¾	9¾	11⅞	12⅞	13¾	13¾	
ZB★	HLT II	—	7⅞	7⅞	7⅞	8⅞	9⅞	10⅞	11¾	12⅞
	L Series/BTL-2	7¼	7⅞	7⅞	7⅞	8⅞	9⅞	10⅞	11¾	12⅞
RT	7⅞	7⅞	7⅞	7⅞	8⅞	9⅞	10⅞	11¾	12⅞	
	7⅞	7⅞	7⅞	7⅞	8⅞	9⅞	10⅞	11¾	12⅞	
ZE★	HLT II	—	8⅞	8⅞	9⅞	9⅞	10¾	12⅞	13⅞	14⅞
	L Series/BTL-2	N/A	8⅞	8⅞	8⅞	9⅞	10½	12⅞	13⅞	14⅞
RT	8¼	8⅞	8⅞	8⅞	9⅞	10½	12⅞	13⅞	14⅞	
	8¼	8⅞	8⅞	8⅞	9⅞	10½	12⅞	13⅞	14⅞	
ZF★	HLT II	—	7⅞	7⅞	8⅞	8¾	9⅞	10⅞	11¾	12¾
	L Series/BTL-2	7¼	7½	7⅞	7⅞	8½	9⅞	10⅞	11¾	12¾
RT	7⅞	7⅞	7¾	7⅞	8½	9⅞	9⅞	10⅞	11¾	12¾
	7⅞	7⅞	7¾	7⅞	8½	9⅞	9⅞	10⅞	11¾	12¾
ZT★	HLT II	—	8⅞	8⅞	9⅞	9⅞	10¾	11⅞	13¼	14⅞
	L Series/BTL-2	8¼	8⅞	8⅞	9⅞	9⅞	10¾	11⅞	13¼	14⅞
RT	8¾	8⅞	8⅞	9⅞	9⅞	10¾	11⅞	13¼	14⅞	
	8¾	8⅞	8⅞	9⅞	9⅞	10¾	11⅞	13¼	14⅞	

Dimensions shown in purple are mounting dimensions.

NOTE: To determine piston thickness, subtract G and J dimensions from LB dimension.

NOTE: Additional port information on page 20.

○ Oversize rods affect dimensions in gray-shaded areas.

■ See pages 30-31 for these dimensions.

★ Add stroke to all starred dimensions.

■ Requires full front square retainer.

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.

♦ The JJ dimension is the cover plate thickness for the HLT II electronics. A square cover plate is required on the 2" bore size while all others receive a circular type.

‡ Use screws ⅛" smaller than mounting holes.

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

– No additional C required for a Style 4 rod end.

Refer to ordering code on pages 9, 11, 13 and 15:

○ Sensor cover not available for 1½" bore.

✱ A, B & C sensor cover options available for 2" bore.

✱ A, B & C sensor cover options available for 2" and 2½" bore.

■ A, B & C sensor cover options available for 2"-3¼" bore.

∞ A, B & C sensor cover options available for 2"-8" bore.

◇ B & C sensor cover options available for 2"-8" bore.

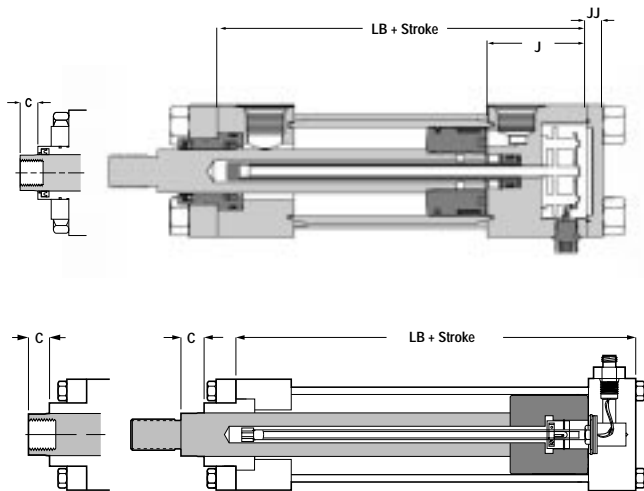
♣ All sensor cover options available for 2½"-8" bores.

○ All sensor cover options available for 3¼"-8" bores.

Ω All sensor cover options available for 4"-8" bores.

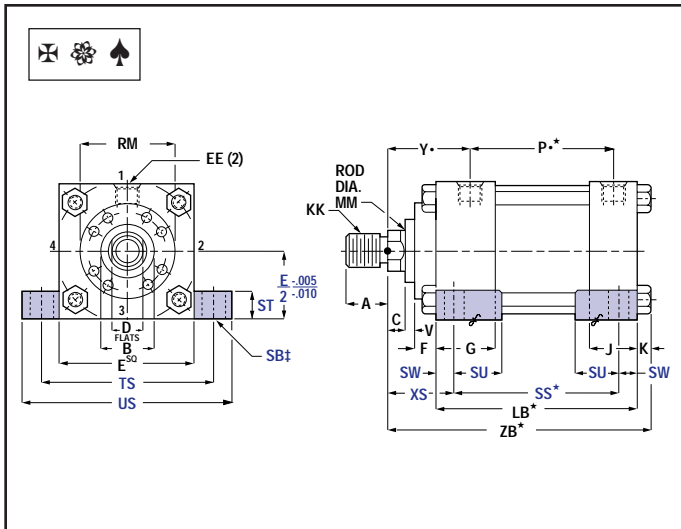
NOTE: Consult factory on applications requiring cushions or bores over 8".

NOTE: Consult factory on applications requiring 1½" bore HLT II.

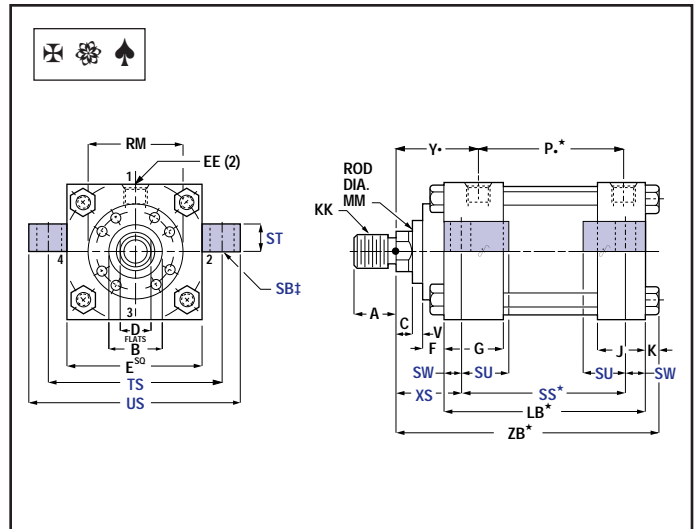


N5 Series Mounting Dimensions

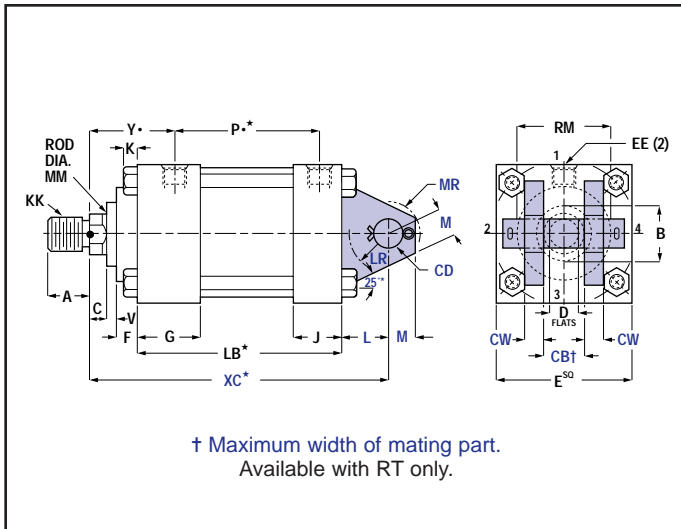
1½" - 8" bore cylinders



N5A – Side Lugs Mount (NFFA Style MS2)

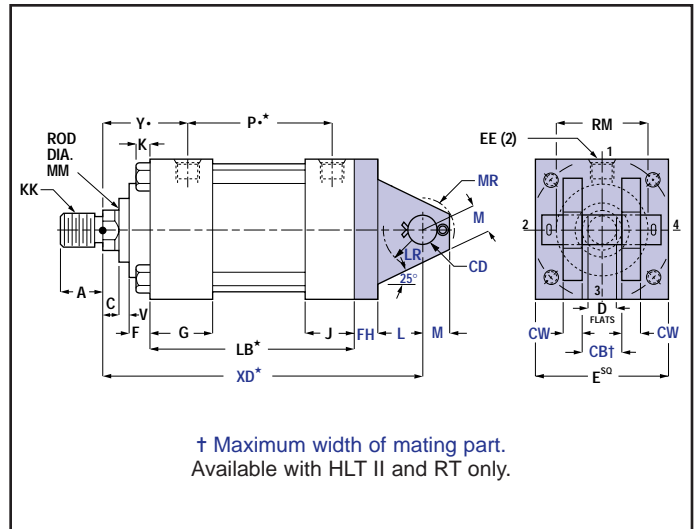


N5H – Center-Line Lugs Mount (NFFA Style MS3)



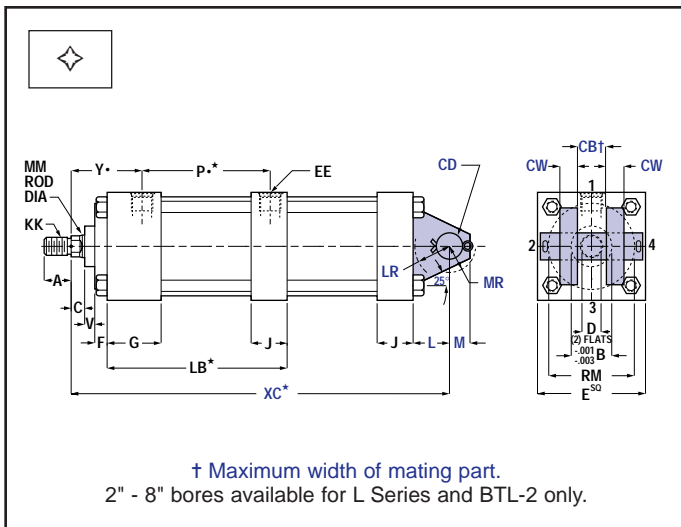
† Maximum width of mating part.
Available with RT only.

N5C – Cap Fixed Clevis Mount



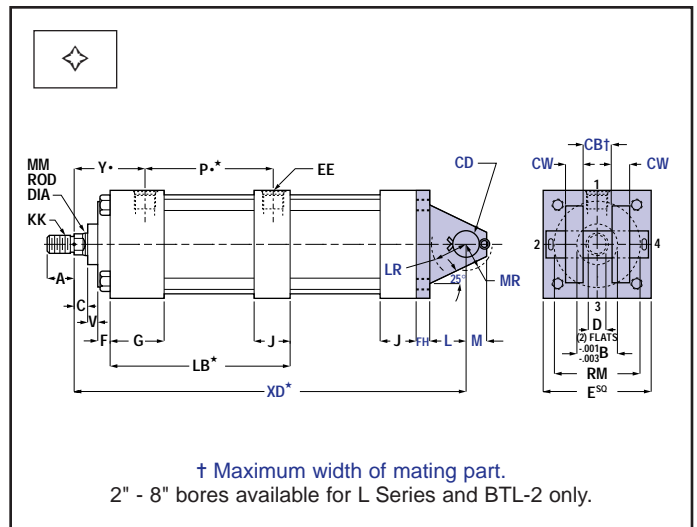
† Maximum width of mating part.
Available with HLT II and RT only.

N5DC – Cap Detachable Clevis Mount (NFFA Style MP2)



† Maximum width of mating part.
2" - 8" bores available for L Series and BTL-2 only.

N5C – Cap Fixed Clevis Mount



† Maximum width of mating part.
2" - 8" bores available for L Series and BTL-2 only.

N5DC – Cap Detachable Clevis Mount (NFFA Style MP2)

Cylinder Dimensions

BORE	1½	2	2½	3¼	4	5	6	7	8
A	1½	1½	1½	15/8	2	2¼	3	3½	3½
B ⁻⁰⁰¹ ⁻⁰⁰³	1½	1½	1½	2	2¾	2¾	3½	3¾	4¼
BL	1.63	2.07	2.56	3.27	3.84	4.95	5.74	6.58	7.51
C	½	½	½	5/8	¾	7/8	1	1	1
CB	¾	1¼	1¼	1½	2	2½	2½	3	3
CC	½-20	7/8-14	7/8-14	1¼-12	1½-12	1¾-12	2¼-12	2¾-12	3¼-12
CD	½	¾	¾	1	1¾	1¾	2	2½	3
CW	½	5/8	5/8	¾	1	1¼	1¼	1½	1½
D	7/8	7/8	7/8	1½	1½	1¾	2½	2½	3
E	2½	3	3½	4½	5	6½	7½	8½	9½
EB‡	7/16	9/16	9/16	11/16	11/16	15/16	1½	1¾	1¾
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
FH	¾	5/8	5/8	¾	7/8	7/8	1	1	1
FT	5/8-18	1-14	1-14	1¾-12	1¾-12	2-12	2½-12	3-12	3½-12
G	1¾	1¾	1¾	2	2	2	2¼	2¾	3
K	¾	7/16	7/16	9/16	9/16	13/16	15/16	1	1½
KK	¾-16	¾-16	¾-16	1-14	1¼-12	1½-12	1¾-12	2¼-12	2½-12
L	¾	1¼	1¼	1½	2½	2¼	2½	3	3¼
LR	9/16	1½	1½	1¼	1¾	1½	2½	2¾	2½
M	½	¾	¾	1	1¾	1¾	2	2½	2¾
MM	1	1	1	1¾	1¾	2	2½	3	3½
MR	9/16	1½	1½	1½	1¾	1¾	2½	2½	2¾
RM	■	■	2½	3¼	3¾	4	4¾	5¼	5½
SB‡	7/16	9/16	13/16	13/16	1½	1½	1½	1¾	1¾
ST	½	¾	1	1	1¼	1¼	1½	1¾	1¾
SU	15/16	1¼	1¾	1¾	2	2	2½	2½	2½
SW	¾	1½	1½	1½	1¾	1¾	1¾	1¾	1¾
TS	3¼	4	4¾	5¾	6¾	8¼	9¾	11¼	12¼
US	4	5	6¼	7¼	8½	10	12	14	15
V	▲	▲	¾	13/32	17/32	17/32	21/32	17/32	17/32
VB	½	¼	¼	¼	¼	¼	¼	¼	¼
W	1	¾	¾	7/8	1	1½	1¼	1¼	1¼
XS	1¾	1¾	2½	2½	2¾	2¾	3¾	3¾	3¾
Y•	2½	2½	2½	2¾	2¾	3¾	3¾	3¾	4¼

Electronic Feedback Cylinder Dimensional Changes

BORE		1½	2	2½	3¼	4	5	6	8
C	HLT II	—	19/16	19/16	1¼	1¼	1	1	1
	L Series/BTL-2	1/8	1/8	—	—	—	—	¾	¼
	RT	—	—	—	—	—	—	—	—

**Style 4 rod ends may require additional rod length. The following dimensions will increase by the C dimension in the above chart: C, SE, W, WF, XC, XD, XE, XG, XJ, XS, XT, Y, ZB, ZE, ZF, ZJ and ZT.

J	HLT II		—	2¼	2½	2	2	2¼	2¾	3	
	L Series/BTL-2	1½	1½	1½	1¾	1¾	1¾	2¼	2¾	3	
		RT	1½	1½	1¾	1¾	1¾	2¼	2¾	3	
JJ♦	HLT II	—	¾	¾	¾	¾	¾	¾	¾	¾	
LB★	HLT II		—	5¾	5¾	5¾	6	6½	7¾	8½	9½
	L Series/BTL-2	5½	5½	5½	5½	5¾	6¼	7¾	8½	9½	
		RT	5½	5½	5¾	5½	5¾	6¼	7¾	8½	9½
P★	HLT II		—	2½	2¾	3¾	3¾	4½	4½	5½	5½
	L Series/BTL-2	3¾	3¾	3¾	3¾	3¾	4½	4½	5½	5½	
		RT	3¾	3¾	3¾	3¾	3¾	4½	4½	5½	5½
SS★	HLT II		—	3¾	3¾	4½	4	4½	5½	6¾	6¾
	L Series/BTL-2	4¾	4½	4¼	4½	4	4½	5½	5¾	6¾	
		RT	4¾	4¾	4¾	4½	4	4½	5½	5¾	6¾
XC★	L Series/BTL-2		15½	15½	15¾	16¾	17½	18¼	20¾	22½	24
	RT		7¾	8¼	8¾	8¾	9¾	10½	12½	13¾	15
XD★	HLT II		—	8¾	8¾	9½	10¾	11½	13½	14¾	16
	L Series/BTL-2	15½	16¼	16¾	17½	18¾	19½	21¾	23½	25	
		RT	8½	8¾	9	9¾	10½	11¾	13½	14¾	16
ZB★	HLT II		—	7¾	7¾	7½	8¾	9½	10¾	11¾	12¾
	L Series/BTL-2	7¼	7½	7½	7½	8¾	9½	10¾	11¾	12¾	
		RT	7¾	7¾	7¾	7½	8¾	9½	10¾	11¾	12¾

Dimensions shown in purple are mounting dimensions.

NOTE: To determine piston thickness, subtract G and J dimensions from LB dimension.

NOTE: Additional port information on page 20.

○ Oversize rods affect dimensions in gray-shaded areas. See pages 30-31 for these dimensions.

★ Add stroke to all starred dimensions.

■ Requires full front square retainer.

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.

♦ The JJ dimension is the cover plate thickness for the HLT II electronics. A square cover plate is required on the 2" bore size while all others receive a circular type.

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

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

— No additional C required for a Style 4 rod end.

Refer to ordering code on pages 9, 11, 13 and 15:

✱ Sensor cover not available for 1½" bore.

✳ A, B & C sensor cover options available for 2" bore.

✧ A, B & C sensor cover options available for 2" and 2½" bore.

■ A, B & C sensor cover options available for 2"-3¼" bore.

∞ A, B & C sensor cover options available for 2"-8" bore.

✧ B & C sensor cover options available for 2"-8" bore.

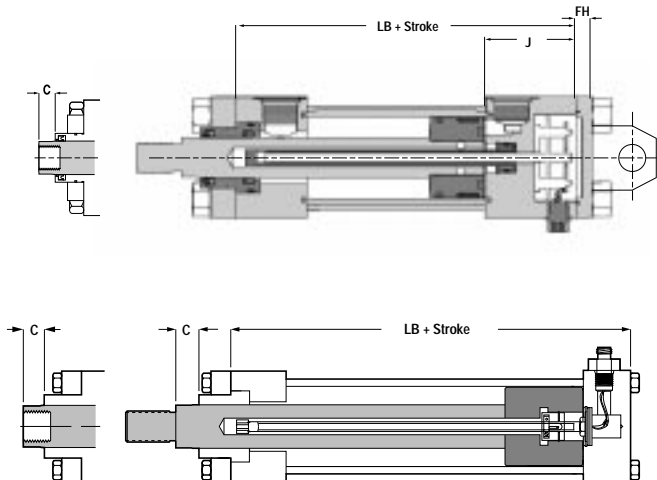
♣ All sensor cover options available for 2½"-8" bores.

○ All sensor cover options available for 3¼"-8" bores.

Ω All sensor cover options available for 4"-8" bores.

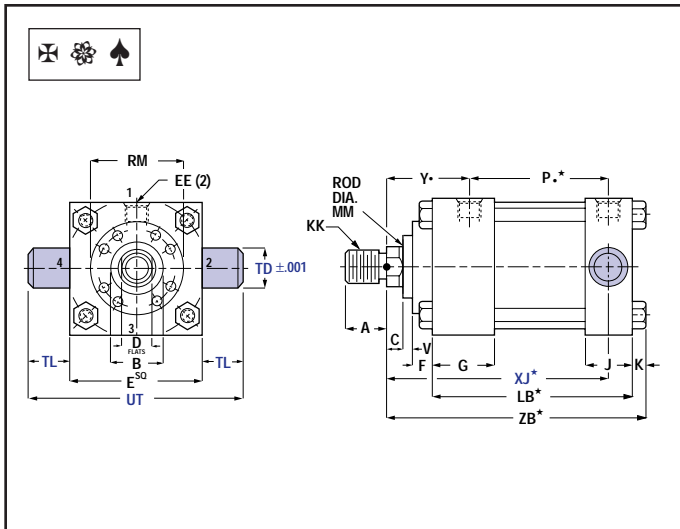
NOTE: Consult factory on applications requiring cushions or bores over 8".

NOTE: Consult factory on applications requiring 1½" bore HLT II.

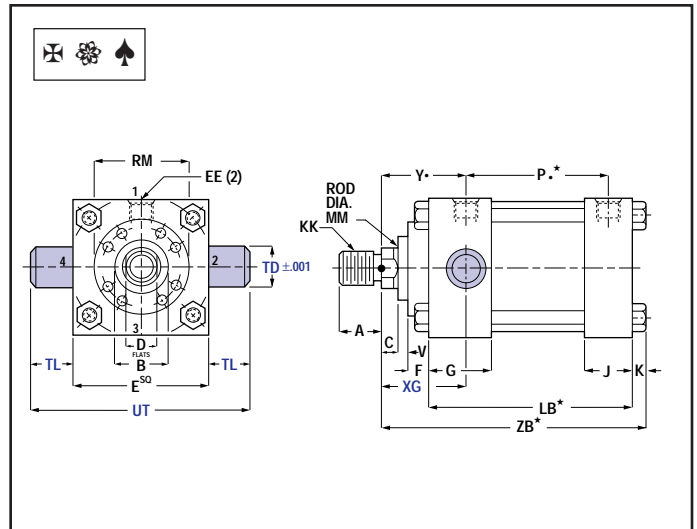


N5 Series Mounting Dimensions

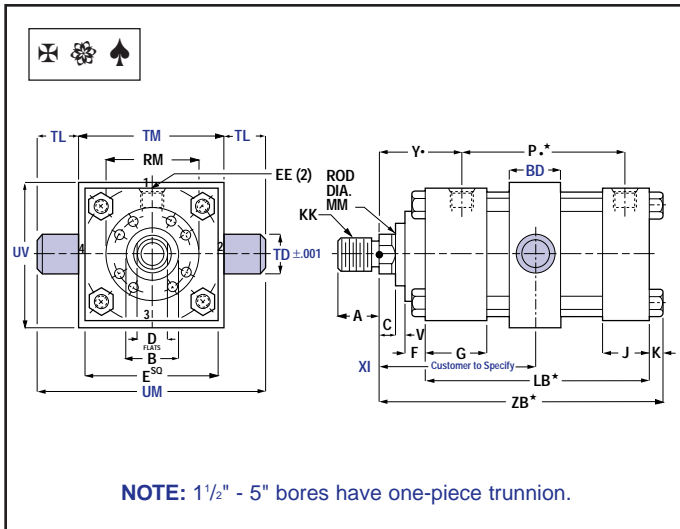
1½" - 8" bore cylinders



N5W – Cap Trunnion Mount (NFPA Style MT2)

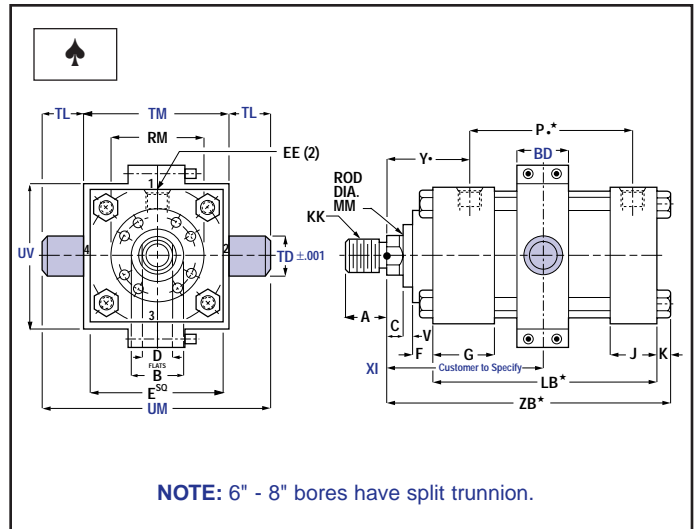


N5U – Head Trunnion Mount (NFPA Style MT1)



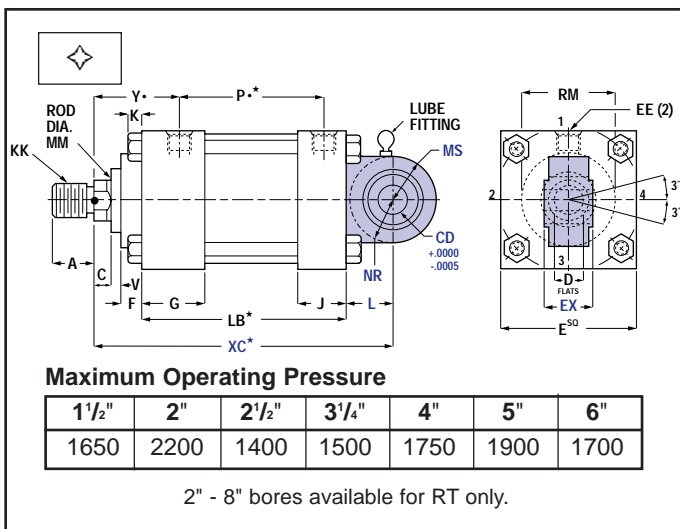
NOTE: 1½" - 5" bores have one-piece trunnion.

N5TT – Intermediate Fixed Trunnion Mount (NFPA Style MT4)

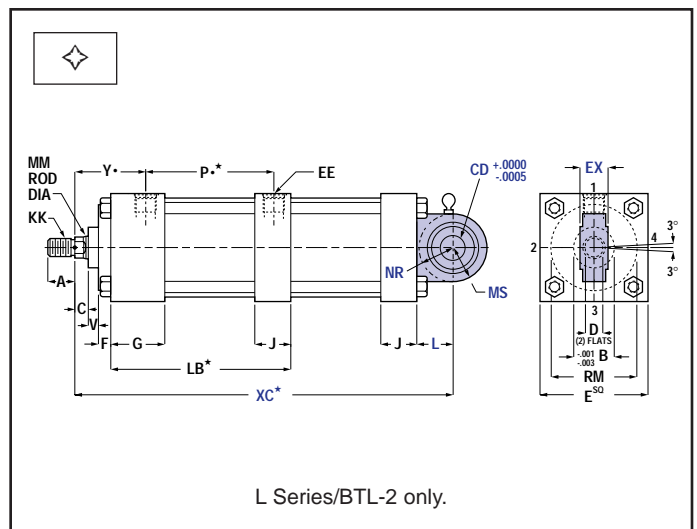


NOTE: 6" - 8" bores have split trunnion.

N5TT – Intermediate Fixed Trunnion Mount (NFPA Style MT4)



N5CS – Cap Spherical Bearing Mount



N5CS – Cap Spherical Bearing Mount

Cylinder Dimensions

BORE	1 1/2	2	2 1/2	3 1/4	4	5	6	7	8
A	1 1/8	1 1/8	1 1/8	1 5/8	2	2 1/4	3	3 1/2	3 1/2
B ⁻⁰⁰¹ -003	1 1/2	1 1/2	1 1/2	2	2 3/8	2 5/8	3 1/8	3 3/4	4 1/4
BD	1 1/2	1 1/2	1 1/2	2	2	2 1/2	3	3	3 1/2
C	1/2	1/2	1/2	5/8	3/4	7/8	1	1	1
CC	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
CD	1/2	3/4	3/4	1	1 3/8	1 3/4	2	2 1/2	3
D	7/8	7/8	7/8	1 1/8	1 1/2	1 3/4	2 1/8	2 5/8	3
E	2 1/2	3	3 1/2	4 1/2	5	6 1/2	7 1/2	8 1/2	9 1/2
EE (NPTF)	1/2	1/2	1/2	3/4	3/4	3/4	1	1 1/4	1 1/2
EE (SAE)	10	10	10	12	12	12	16	20	24
EX	7/16	2 1/32	2 1/32	7/8	13/16	1 17/32	1 3/4	-	-
F	▲	▲	1/2	19/32	19/32	19/32	23/32	23/32	23/32
FH	3/8	5/8	5/8	3/4	7/8	7/8	1	1	1
FT	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
G	1 3/4	1 3/4	1 3/4	2	2	2	2 1/4	2 3/4	3
K	3/8	7/16	7/16	9/16	9/16	13/16	15/16	1	1 1/8
KK	3/4-16	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
L	3/4	1 1/4	1 1/4	1 1/2	2 1/8	2 1/4	2 1/2	3	3 1/4
MM	1	1	1	1 3/8	1 3/4	2	2 1/2	3	3 1/2
MS	15/16	13/8	13/8	1 11/16	27/16	2 7/8	3 5/16	-	-
NR	5/8	1	1	1 1/4	1 5/8	2 1/16	2 3/8	-	-
RM	■	■	2 5/8	3 1/4	3 7/8	4	4 7/16	5 1/4	5 5/8
TD	1	1 3/8	1 3/8	1 3/4	1 3/4	1 3/4	2	2 1/2	3
TL	1	1 3/8	1 3/8	1 3/4	1 3/4	1 3/4	2	2 1/2	3
TM	3	3 1/2	4	5	5 1/2	7	8 1/2	9 3/4	11
UM	5	6 1/4	6 3/4	8 1/2	9	10 1/2	12 1/2	14 3/4	17
UT	4 1/2	5 3/4	6 1/4	8	8 1/2	10	11 1/2	13 1/2	15 1/2
UV	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
V	▲	▲	3/8	13/32	17/32	17/32	2 1/32	17/32	17/32
VB	1/2	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4
W	1	3/4	3/4	7/8	1	1 1/8	1 1/4	1 1/4	1 1/4
XG	2 1/4	2 1/4	2 1/4	2 5/8	2 7/8	3	3 3/8	3 5/8	3 3/4
Y*	2 15/32	2 15/32	2 15/32	2 23/32	2 31/32	3 3/32	3 19/32	3 15/32	4 1/16

System Cylinder Dimensional Changes

BORE	1 1/2	2	2 1/2	3 1/4	4	5	6	7	8	
C	HLT II	-	7/8	7/8	3/4	9/16	3/16	-	-	-
**	L Series/BTL-2	-	-	-	-	-	-	-	-	-
	RT	-	-	-	-	-	-	-	-	-

**Style 4 rod ends may require additional rod length. The following dimensions will increase by the C dimension in the above chart: C, SE, W, WF, XC, XD, XE, XG, XJ, XS, XT, Y, ZB, ZE, ZF, ZJ and ZT.

J	HLT II	-	2 1/4	2 1/8	2	2	2	2 1/4	2 3/4	3
	L Series/BTL-2	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
	RT	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
JJ♦	HLT II	-	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8
LB★	HLT II	-	5 3/8	5 3/8	5 3/4	6	6 1/2	7 3/8	8 1/2	9 1/2
	L Series/BTL-2	5 1/2	5 1/2*	5 5/8*	5 1/2	5 3/4	6 1/4	7 3/8	8 1/2	9 1/2
	RT	5 5/8	5 5/8	5 3/4	5 1/2	5 3/4	6 1/4	7 3/8	8 1/2	9 1/2
P★	HLT II	-	2 11/16	2 13/16	3 9/16	3 13/16	4 5/16	4 11/16	5 1/8	5 7/8
	L Series/BTL-2	3 9/16	3 9/16	3 11/16	3 9/16	3 13/16	4 5/16	4 11/16	5 1/8	5 7/8
	RT	3 11/16	3 11/16	3 13/16	3 9/16	3 13/16	4 5/16	4 11/16	5 1/8	5 7/8
XC★	L Series/BTL-2	15 1/8	15 5/8	15 3/4	16 3/8	17 1/2	18 1/4	20 3/8	22 1/2	24
	RT	7 3/4	8 1/4	8 3/8	8 5/8	9 3/4	10 1/2	12 1/8	13 3/4	15
XJ★	HLT II	-	5 1/4	5 3/8	6 1/4	6 3/4	7 3/8	8 3/8	9 3/8	10 1/4
	L Series/BTL-2	6 1/8	6 1/8	6 1/4	6 1/4	6 3/4	7 3/8	8 3/8	9 3/8	10 1/4
	RT	6 1/4	6 1/4	6 3/8	6 1/4	6 3/4	7 3/8	8 3/8	9 3/8	10 1/4
ZB★	HLT II	-	7 9/16	7 3/16	7 15/16	8 7/16	9 5/16	10 9/16	11 3/4	12 7/8
	L Series/BTL-2	7 1/4	7 5/16	7 7/16	7 11/16	8 3/16	9 1/16	10 9/16	11 3/4	12 7/8
	RT	7 3/8	7 7/16	7 9/16	7 11/16	8 3/16	9 1/16	10 9/16	11 3/4	12 7/8

Dimensions shown in purple are mounting dimensions.

NOTE: To determine piston thickness, subtract G and J dimensions from LB dimension.

NOTE: Additional port information on page 20.

Over-size rods affect dimensions in gray-shaded areas. See pages 30-31 for these dimensions.

★ Add stroke to all starred dimensions.

■ Requires full front square retainer.

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.

♦ The JJ dimension is the cover plate thickness for the HLT II electronics. A square cover plate is required on the 2" bore size while all others receive a circular type.

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

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

- No additional C required for a Style 4 rod end.

Refer to ordering code on pages 9, 11, 13 and 15:

⊛ Sensor cover not available for 1 1/2" bore.

⊛ A, B & C sensor cover options available for 2" bore.

⊛ A, B & C sensor cover options available for 2" and 2 1/2" bore.

■ A, B & C sensor cover options available for 2"-3 1/4" bore.

∞ A, B & C sensor cover options available for 2"-8" bore.

◇ B & C sensor cover options available for 2"-8" bore.

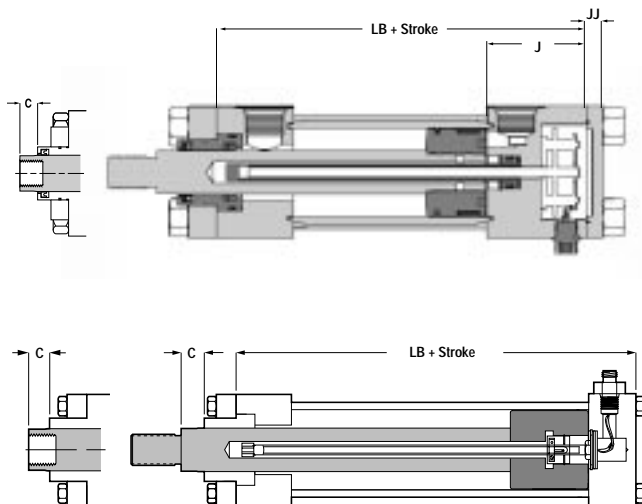
♣ All sensor cover options available for 2 1/2"-8" bores.

○ All sensor cover options available for 3 1/4"-8" bores.

Ω All sensor cover options available for 4"-8" bores.

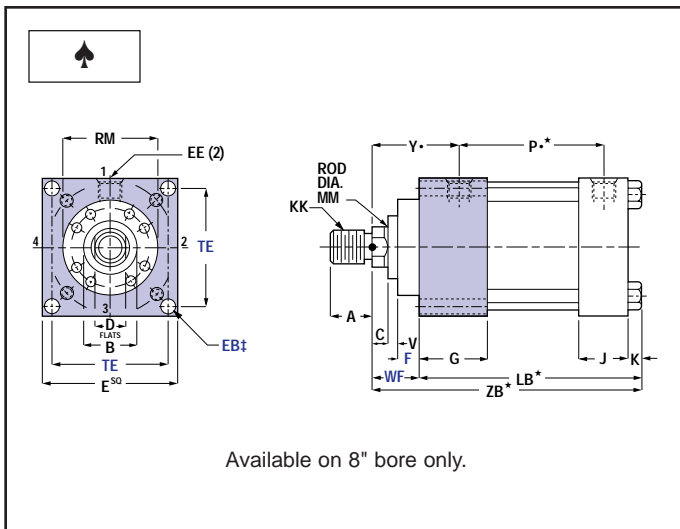
NOTE: Consult factory on applications requiring cushions or bores over 8".

NOTE: Consult factory on applications requiring 1 1/2" bore HLT II.

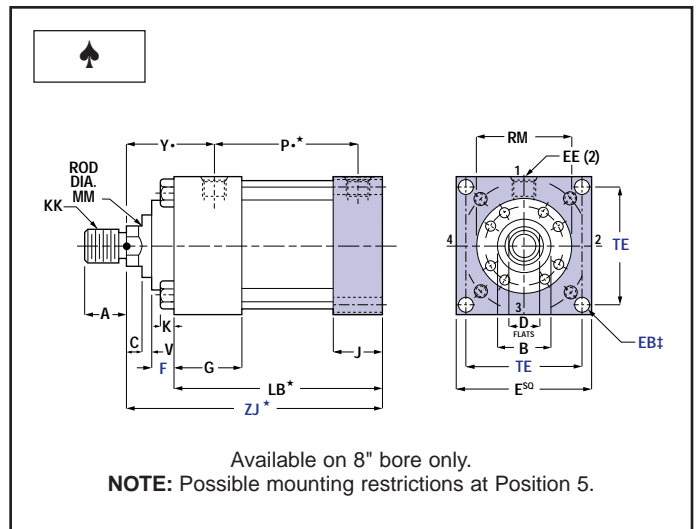


HR5 Series Mounting Dimensions

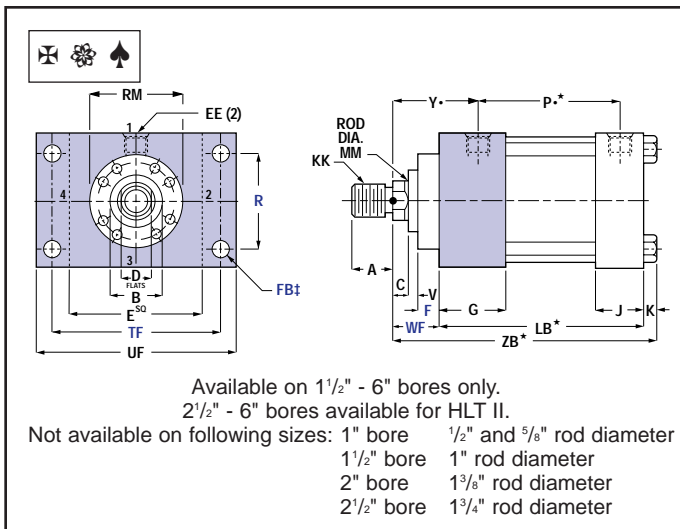
1½" - 8" bore cylinders



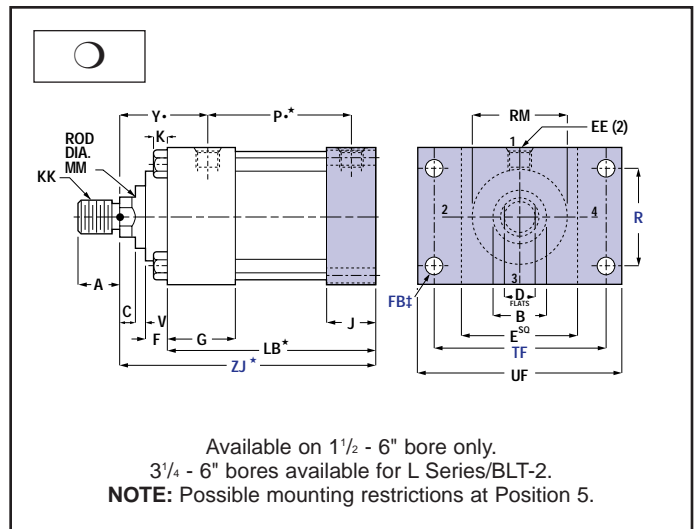
HR5G – Head Square Mount (NFFA Style ME3)



HR5P – Cap Square Mount (NFFA Style ME4)



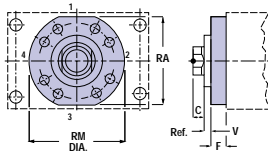
HR5G – Head Rectangular Mount (NFFA Style ME5)



HR5P – Cap Rectangular Mount (NFFA Style ME6)

G-Mounting Retainer Dimensions

NOTE: Use the chart below for the cartridge retainer plate dimensions for the bore and rod combinations listed.



Bore	Rod Dia.	F	RA	RM	V
1½"	5/8"	11/32"	1.94	2 3/8"	9/32"
2"	5/8"	11/32"	—	2 3/8"	9/32"
	1"	1/2"	2.44	2 5/8"	3/8"
2½"	1 3/8"	19/32"	2.94	3 1/4"	13/32"
3¾"	1 3/4"	19/32"	3.44	3 7/8"	17/32"
	2"	19/32"	3.69	4"	17/32"
4"	2 1/2"	19/32"	—	4 7/16"	21/32"
	3"	23/32"	—	5 1/4"	17/32"
5"	3 1/2"	23/32"	5.25	5 5/8"	17/32"

Standard Cylinder Dimensions

BORE	1 1/2	2	2 1/2	3 1/4	4	5	6	8
A	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 1/8	1 5/8	1 5/8
AA	2.02	2.6	3.1	3.9	4.7	5.8	6.9	9.1
B-.001 -.003	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	1 1/2	2	2
C	1/2	1/2	1/2	1/2	1/2	1/2	5/8	5/8
CC	7/8-14	7/8-14	7/8-14	7/8-14	7/8-14	7/8-14	1 1/4-12	1 1/4-12
D	7/8	7/8	7/8	7/8	7/8	7/8	1 1/8	1 1/8
E	2	2 1/2	3	3 3/4	4 1/2	5 1/2	6 1/2	8 1/2
EB ‡	N/A	N/A	N/A	N/A	N/A	N/A	N/A	1 1/16
EE (NPTF)	3/8	3/8	3/8	1/2	1/2	1/2	3/4	3/4
EE (SAE)	#6	#6	#6	#10	#10	#10	#12	#12
F	▲	▲	11/32	1/2	1/2	1/2	19/32	19/32
FB ‡	5/16	3/8	3/8	7/16	7/16	9/16	9/16	N/A
FH	3/8	3/8	3/8	5/8	5/8	5/8	3/4	3/4
FT	1-14	1-14	1-14	1-14	1-14	1-14	1 3/8-12	1 3/8-12
G	1 1/2	1 1/2	1 1/2	1 3/4	1 3/4	1 3/4	2	2
K	1/4	5/16	5/16	3/8	3/8	7/16	7/16	9/16
KK	3/4-16	3/4-16	3/4-16	3/4-16	3/4-16	3/4-16	1-14	1-14
MM	1	1	1	1	1	1	1 3/8	1 3/8
R	1.43	1.84	2.19	2.76	3.32	4.10	4.88	6.44
RM	■	■	2 31/64	2 5/8	2 5/8	2 5/8	3 1/4	3 1/4
TE	N/A	N/A	N/A	N/A	N/A	N/A	N/A	7.57
TF	2 3/4	3 3/8	3 7/8	4 11/16	5 7/16	6 5/8	7 5/8	N/A
UF	3 3/8	4 1/8	4 5/8	5 1/2	6 1/4	7 5/8	8 5/8	N/A
V	▲	▲	17/32	3/8	3/8	3/8	13/32	13/32
VB	1/2	1/2	1/2	1/4	1/4	1/4	1/4	N/A
WF	N/A	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 5/8	1 5/8
Y•	1 31/32	1 31/32	1 31/32	2 7/16	2 7/16	2 7/16	2 13/16	2 13/16

Electronic Feedback Cylinder Dimensional Changes

BORE		1 1/2	2	2 1/2	3 1/4	4	5	6	8
C	HLT II	—	1 9/16	1 9/16	1 1/4	1 1/4	1	1	1
	L Series/BTL-2	1/8	1/8	—	—	—	—	3/8	1/4
	RT	—	—	—	—	—	—	—	—

**Style 4 rod ends may require additional rod length. The following dimensions will increase by the C dimension in the above chart: C, SE, W, WF, XC, XD, XE, XG, XJ, XS, XT, Y, ZB, ZE, ZF, ZJ and ZT.

J	HLT II	—	2	2	2	2	2	2	2
	L Series/BTL2	1 3/4	1	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2
RT	1	1	1	1 1/4	1 1/4	1 1/4	1 1/2	1 1/2	
JJ♦	HLT II	—	3/8	3/8	3/8	3/8	3/8	3/8	3/8
LB★	HLT II	—	4 5/8	4 3/4	5	5	5 1/4	5 1/2	5 5/8
	L Series/BTL2	5 1/4	4 1/2	4 5/8	5 1/8	5 1/8	5 3/8	5	5 1/8
	RT	4 5/8	4 5/8	4 3/4	5 1/4	5 1/4	5 1/4	5	5 1/8
P★	HLT II	—	2 3/16	2 5/16	2 5/8	2 5/8	2 7/8	3 1/8	3 1/4
	L Series/BTL2	3 1/16	3 1/16	3 3/16	3 1/2	3 1/2	3 3/4	3 1/8	3 1/4
RT	3 3/16	3 3/16	3 5/16	3 5/8	3 5/8	3 5/8	3 1/8	3 1/4	
ZB★	HLT II	—	6 11/16	6 13/16	6 3/4	6 3/4	7 1/16	7 9/16	7 13/16
	L Series/BTL2	6 7/8	6 3/16	6 5/16	6 7/8	6 7/8	7 3/16	7 1/16	7 5/16
RT	6 1/4	6 5/16	6 7/16	7	7	7 1/16	7 1/16	7 5/16	
ZJ★	HLT II	—	6	6 1/8	6 3/8	6 3/8	6 5/8	7 1/8	7 1/4
	L Series/BTL2	—	5 7/8	6	6 1/2	6 1/2	6 3/4	6 5/8	6 3/4
RT	—	6	6 1/8	6 5/8	6 5/8	6 7/8	6 5/8	6 3/4	

Dimensions shown in purple are mounting dimensions.

NOTE: To determine piston thickness, subtract G and J dimensions from LB dimension.

NOTE: Additional port information on page 40.

○ Oversize rods affect dimensions in gray-shaded areas.

See page 46-47 for these dimensions.

★ Add stroke to all starred dimensions.

■ Requires full front square retainer.

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.

♦ The JJ dimension is the cover plate thickness for the HLT II electronics. A square cover plate is required on the 2" and 2 1/2" bore sizes while all others receive a circular type.

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

— No additional C required for a Style 4 rod end.

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

Refer to ordering code on pages 9, 11, 13 and 15:

✱ Sensor cover not available for 1 1/2" bore.

✳ A, B & C sensor cover options available for 2" bore.

✳ A, B & C sensor cover options available for 2" and 2 1/2" bore.

■ A, B & C sensor cover options available for 2"-3 1/4" bore.

∞ A, B & C sensor cover options available for 2"-8" bore.

◇ B & C sensor cover options available for 2"-8" bore.

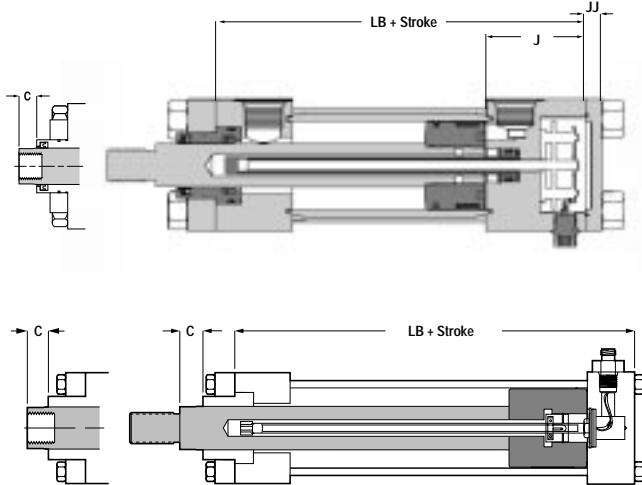
♣ All sensor cover options available for 2 1/2"-8" bores.

○ All sensor cover options available for 3 1/4"-8" bores.

Ω All sensor cover options available for 4"-8" bores.

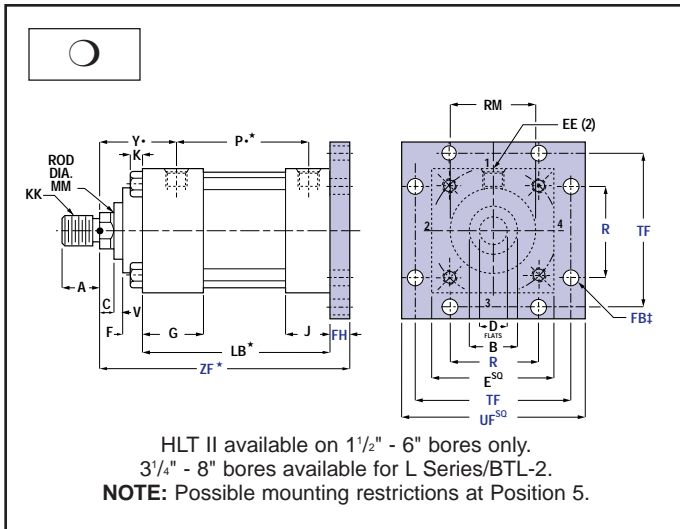
NOTE: Consult factory on applications requiring cushions or bores over 8".

NOTE: Consult factory on applications requiring 1 1/2" bore HLT II.

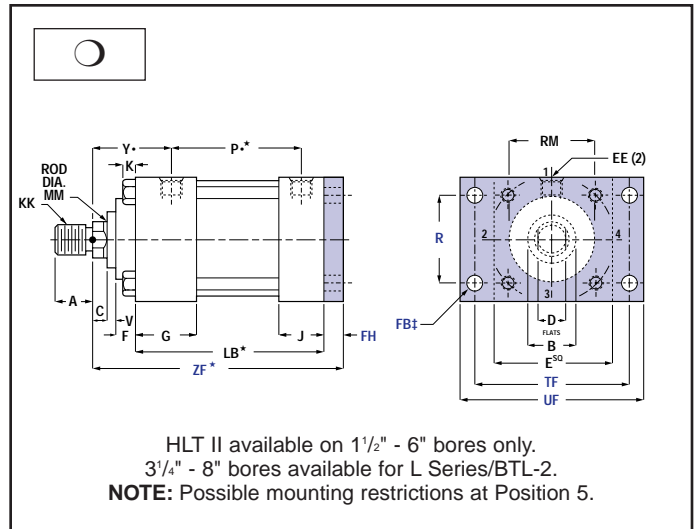


HR5 Series Mounting Dimensions

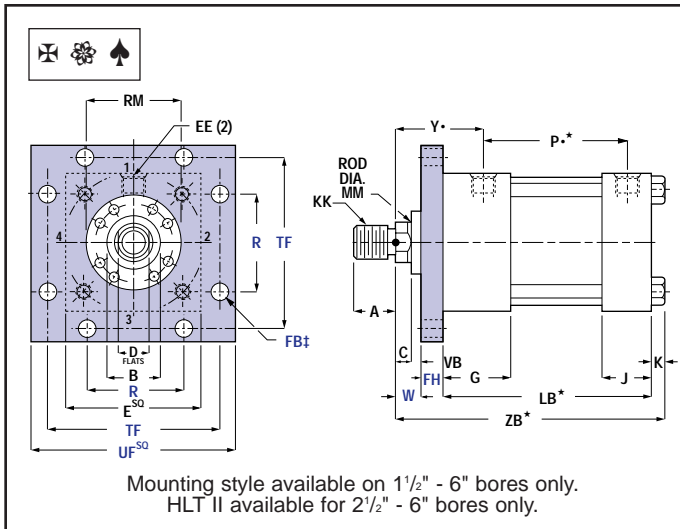
1½" - 8" bore cylinders



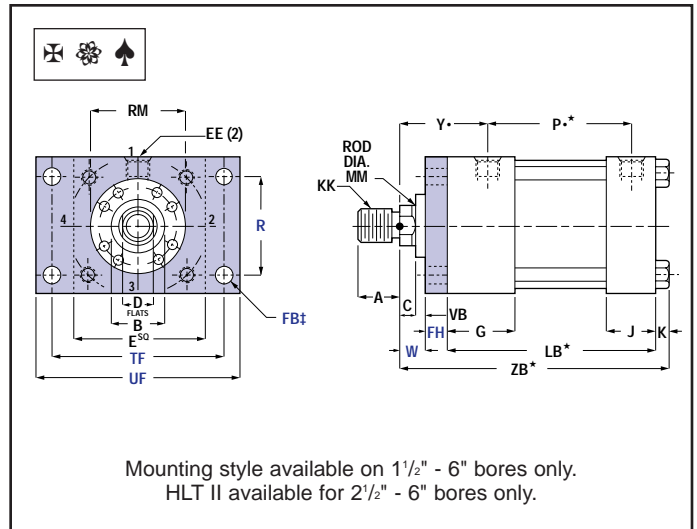
HR5S – Cap Square Flange Mount (NFFA Style MF6)



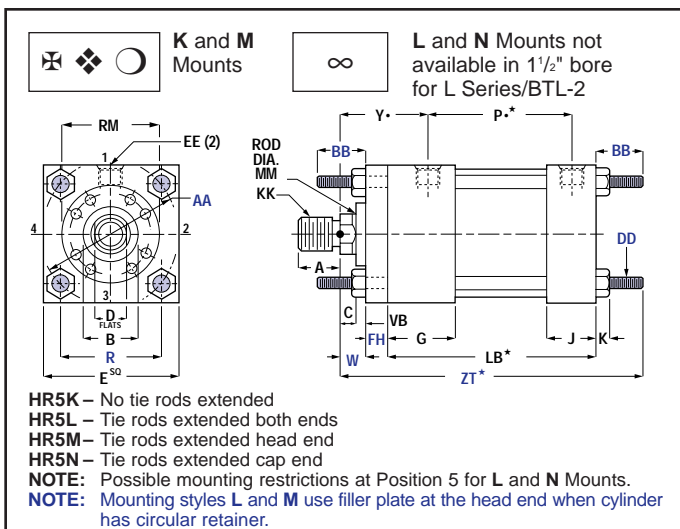
HR5R – Cap Rectangular Flange Mount (NFFA Style MF2)



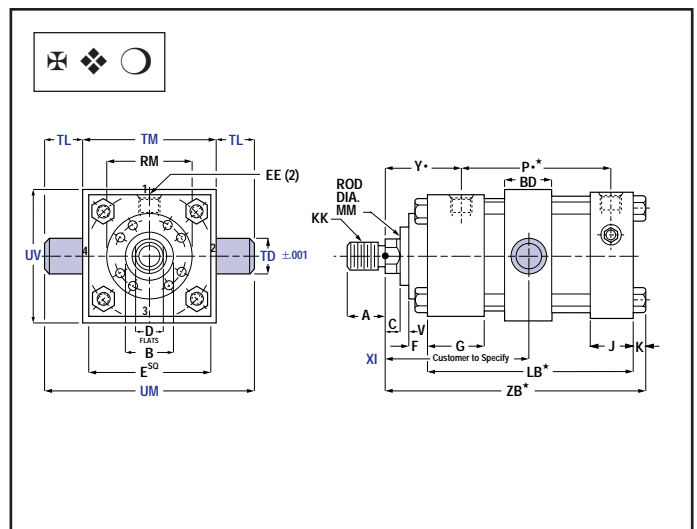
HR5J – Head Square Flange Mount (NFFA Style MF5)



HR5F – Head Rectangular Flange Mount (NFFA Style MF1)



HR5K – No Mount, HR5L (NFFA Style MX1), HR5N (NFFA Mount Style MX2), HR5M (NFFA Style MX3) – Tie Rods Extended Mounts



HR5TT – Intermediate Fixed Trunnion Mount (NFFA Style MT4)

Standard Cylinder Dimensions

BORE	1½	2	2½	3¼	4	5	6	8
A	1½	1½	1½	1½	1½	1½	15/8	15/8
AA	2.02	2.6	3.1	3.9	4.7	5.8	6.9	9.1
B ⁻⁰⁰¹ -003	1½	1½	1½	1½	1½	1½	2	2
BB	1	1½	1½	1¾	1¾	1¾	1¾	2½
BD	1½	1½	1½	2	2	2	2	2½
C	1/2	1/2	1/2	1/2	1/2	1/2	5/8	5/8
CC	7/8-14	7/8-14	7/8-14	7/8-14	7/8-14	7/8-14	1¼-12	1¼-12
D	7/8	7/8	7/8	7/8	7/8	7/8	1½	1½
DD	1/4-28	5/16-24	5/16-24	3/8-24	3/8-24	1/2-20	1/2-20	5/8-18
E	2	2½	3	3¾	4½	5½	6½	8½
EE (NPTF)	3/8	3/8	3/8	1/2	1/2	1/2	3/4	3/4
EE (SAE)	#6	#6	#6	#10	#10	#10	#12	#12
F	▲	▲	11/32	1/2	1/2	1/2	19/32	19/32
FB‡	5/16	3/8	3/8	7/16	7/16	9/16	9/16	N/A
FH	3/8	3/8	3/8	5/8	5/8	5/8	3/4	3/4
FT	1-14	1-14	1-14	1-14	1-14	1-14	13/8-12	13/8-12
G	1½	1½	1½	1¾	1¾	1¾	2	2
K	1/4	5/16	5/16	3/8	3/8	7/16	7/16	9/16
KK	3/4-16	3/4-16	3/4-16	3/4-16	3/4-16	3/4-16	1-14	1-14
MM	1	1	1	1	1	1	13/8	13/8
R	1.43	1.84	2.19	2.76	3.32	4.10	4.88	6.44
RM	■	■	231/64	25/8	25/8	25/8	3¼	3¼
TD	1	1	1	1	1	1	13/8	13/8
TF	2¾	3¾	3¾	4½	5½	6½	7½	N/A
TL	1	1	1	1	1	1	13/8	13/8
TM	2½	3	3½	4½	5¼	6¼	7½	9¾
UF	3¾	4½	4½	5½	6¼	7½	8½	N/A
UM	4½	5	5½	6½	7¼	8¼	10¾	12½
UV	2½	3	3½	4¼	5	6	7	9½
V	▲	▲	17/32	3/8	3/8	3/8	13/32	13/32
VB	1/2	1/2	1/2	1/4	1/4	1/4	1/4	N/A
W	1	1	1	¾	¾	¾	7/8	N/A
Y•	131/32	131/32	131/32	27/16	27/16	27/16	213/16	213/16

Electronic Feedback Cylinder Dimensional Changes

BORE		1½	2	2½	3¼	4	5	6	8
C	HLT II	—	19/16	19/16	1¼	1¼	1	1	1
	L Series/BTL-2	1/8	1/8	—	—	—	—	3/8	1/4
	RT	—	—	—	—	—	—	—	—

**Style 4 rod ends may require additional rod length. The following dimensions will increase by the C dimension in the above chart: C, SE, W, WF, XC, XD, XE, XG, XJ, XS, XT, Y, ZB, ZE, ZF, ZJ and ZT.

J	HLT II	—	2	2	2	2	2	2	2
	L Series/BTL-2	1¾	1	1	1¼	1¼	1¼	1½	1½
	RT	1	1	1	1¼	1¼	1¼	1½	1½
JJ♦	HLT II	—	3/8	3/8	3/8	3/8	3/8	3/8	3/8
LB★	HLT II	—	45/8	4¾	5	5	5¼	5½	55/8
	L Series/BTL-2	5¼	4½	45/8	5½	5½	5¾	5	5½
	RT	45/8	45/8	4¾	5¼	5¼	5¼	5	5½
P•★	HLT II	—	23/16	25/16	25/8	25/8	27/8	3½	3¼
	L Series/BTL-2	31/16	31/16	33/16	3½	3½	3¾	3½	3¼
	RT	33/16	33/16	35/16	35/8	35/8	35/8	3½	3¼
ZB★	HLT II	—	611/16	613/16	6¾	6¾	71/16	79/16	713/16
	L Series/BTL-2	67/8	63/16	65/16	67/8	67/8	73/16	71/16	75/16
	RT	6¼	65/16	67/16	7	7	71/16	71/16	75/16
ZF★	HLT II	—	63/8	6½	7	7	7¼	7½	N/A
	L Series/BTL-2	7	6¼	63/8	7½	7½	7¾	7¾	N/A
	RT	63/8	63/8	6½	7¼	7¼	7¼	7¾	N/A
ZT★	HLT II	—	7½	75/8	7¾	7¾	87/16	85/16	99/16
	L Series/BTL-2	75/8	7	7½	7½	7½	89/16	87/16	91/16
	RT	7	7½	7¼	8	8	87/16	87/16	91/16

Dimensions shown in purple are mounting dimensions.

NOTE: To determine piston thickness, subtract G and J dimensions from LB dimension.

NOTE: Additional port information on page 40.

○ Oversize rods affect dimensions in gray-shaded areas.

See page 46-47 for these dimensions.

★ Add stroke to all starred dimensions.

■ Requires full front square retainer.

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.

♦ The JJ dimension is the cover plate thickness for the HLT II electronics. A square cover plate is required on the 2" and 2½" bore sizes while all others receive a circular type.

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

— No additional C required for a Style 4 rod end.

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

Refer to ordering code on pages 9, 11, 13 and 15:

⊛ Sensor cover not available for 1½" bore.

⊛ A, B & C sensor cover options available for 2" bore.

⊛ A, B & C sensor cover options available for 2" and 2½" bore.

■ A, B & C sensor cover options available for 2"-3¼" bore.

∞ A, B & C sensor cover options available for 2"-8" bore.

◇ B & C sensor cover options available for 2"-8" bore.

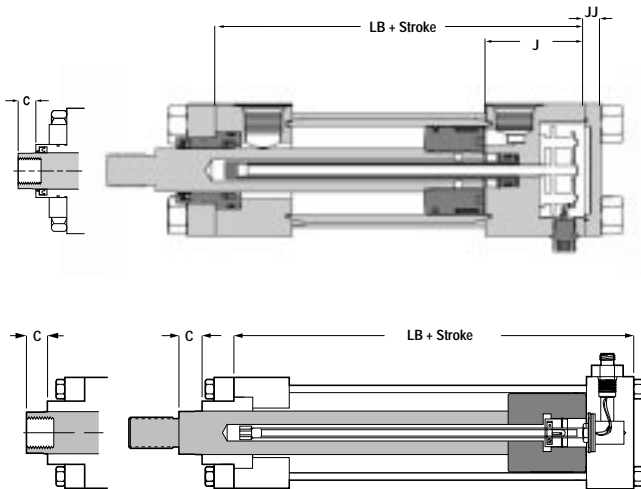
♣ All sensor cover options available for 2½"-8" bores.

○ All sensor cover options available for 3¼"-8" bores.

Ω All sensor cover options available for 4"-8" bores.

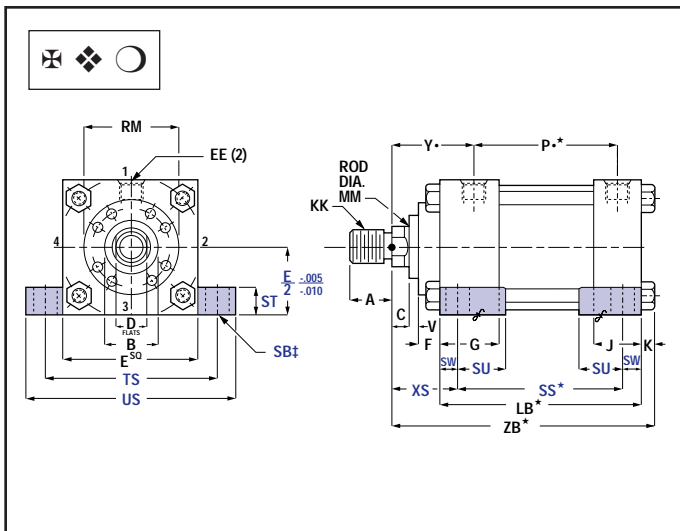
NOTE: Consult factory on applications requiring cushions or bores over 8".

NOTE: Consult factory on applications requiring 1½" bore HLT II.

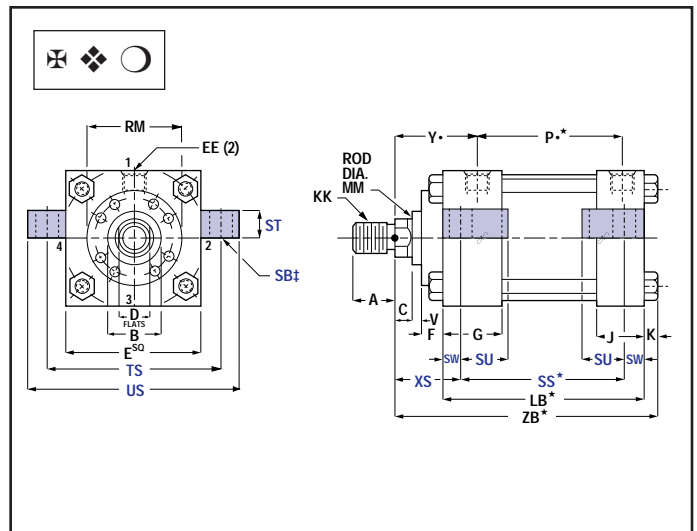


HR5 Series Mounting Dimensions

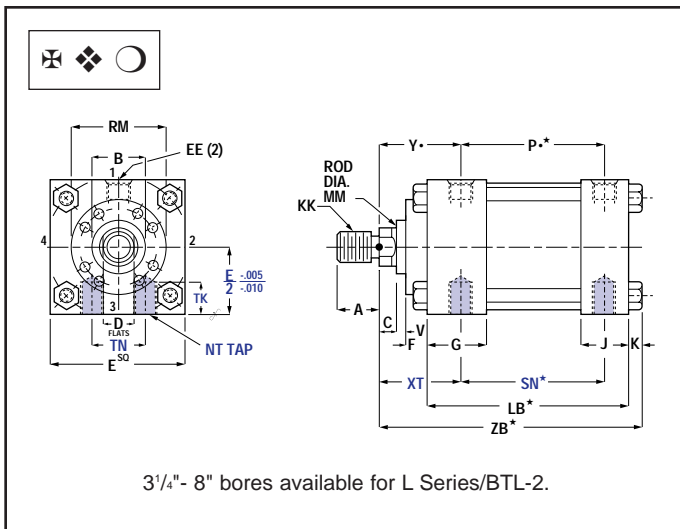
1½" - 8" bore cylinders



HR5A – Side Lugs Mount (NFFA Style MS2)

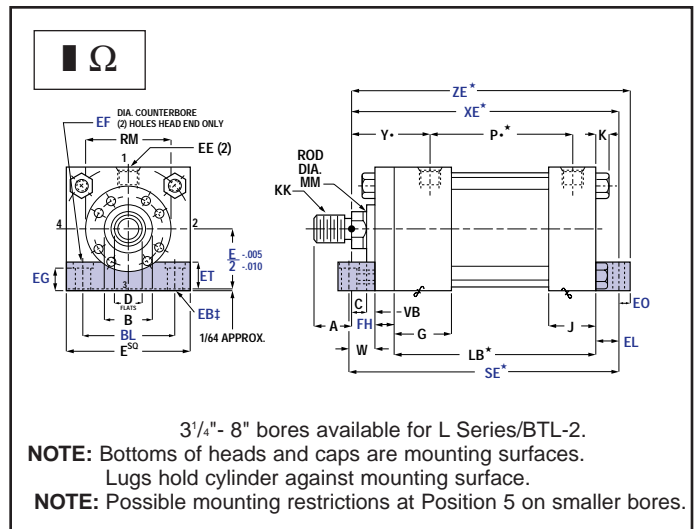


HR5H – Center-Line Lugs Mount (NFFA Style MS3)



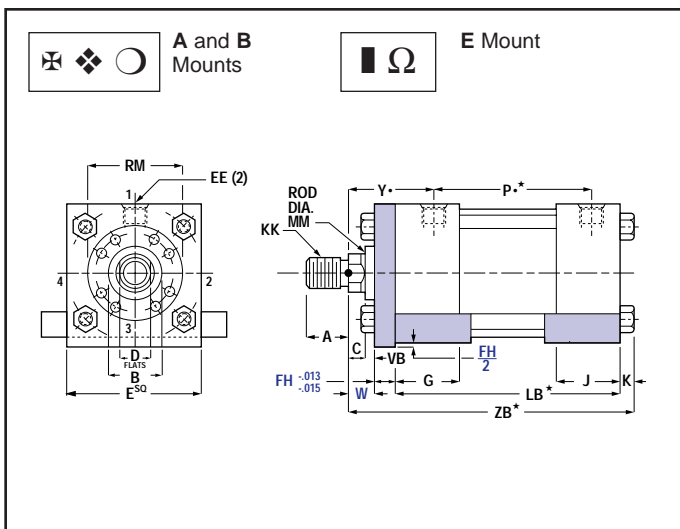
3¼" - 8" bores available for L Series/BTL-2.

HR5B – Side Tapped Mount (NFFA Style MS4)



3¼" - 8" bores available for L Series/BTL-2.
NOTE: Bottoms of heads and caps are mounting surfaces.
 Lugs hold cylinder against mounting surface.
NOTE: Possible mounting restrictions at Position 5 on smaller bores.

HR5E – Side End Lugs Mount (NFFA Style MS7)



HR5 – Extended Key Plate (available when specified)

Standard Cylinder Dimensions

BORE	1½	2	2½	3¼	4	5	6	8
A	1½	1½	1½	1½	1½	1½	15/8	15/8
B⁻⁰⁰¹ -003	1½	1½	1½	1½	1½	1½	2	2
BL	1.43	1.84	2.19	2.76	3.32	4.10	4.88	6.44
C	½	½	½	½	½	½	5/8	5/8
CC	7/8-14	7/8-14	7/8-14	7/8-14	7/8-14	7/8-14	1¼-12	1¼-12
D	7/8	7/8	7/8	3¾	7/8	7/8	1½	1½
E	2	2½	3	3¾	4½	5½	6½	8½
EB‡	5/16	3/8	3/8	7/16	7/16	9/16	9/16	11/16
EE (NPTF)	3/8	3/8	3/8	½	½	½	¾	¾
EE (SAE)	#6	#6	#6	#10	#10	#10	#12	#12
EF	½	½	½	N/A	N/A	7/8	7/8	N/A
EG	7/16	15/32	5/8	N/A	N/A	1¼	1¼	N/A
EL	¾	15/16	11/16	7/8	1	1½	1	1½
EO	¼	5/16	5/16	3/8	3/8	½	½	5/8
ET	9/16	¾	7/8	1	1¼	1½	15/8	2
F	▲	▲	11/32	½	½	½	19/32	19/32
FH	3/8	3/8	3/8	5/8	5/8	5/8	¾	N/A
FT	1-14	1-14	1-14	1-14	1-14	1-14	13/8-12	13/8-12
G	1½	1½	1½	1¾	1¾	1¾	2	2
K	¼	5/16	5/16	3/8	3/8	7/16	7/16	9/16
KK	¾-16	¾-16	¾-16	¾-16	¾-16	¾-16	1-14	1-14
MM	1	1	1	1	1	1	1¾	1¾
NT	1¼-20	5/16-18	3/8-16	1/2-13	1/2-13	5/8-11	¾-10	¾-10
RM	■	■	231/64	25/8	25/8	25/8	3¼	3¼
SB‡	7/16	7/16	7/16	9/16	9/16	13/16	13/16	13/16
ST	½	½	½	¾	¾	1	1	1
SU	15/16	15/16	15/16	1¼	1¼	19/16	19/16	19/16
SW	3/8	3/8	3/8	½	½	11/16	11/16	11/16
TK	3/8	½	5/8	¾	¾	1	1½	1½
TN	5/8	7/8	1¼	1½	21/16	21/16	3¼	4½
TS	2¾	3¼	3¾	4¾	5½	67/8	77/8	97/8
US	3½	4	4½	5¾	6½	8¼	9¼	11¼
V	▲	▲	17/32	3/8	3/8	3/8	13/32	13/32
VB	½	½	½	¾	¾	¾	1	N/A
W	1	1	1	¾	¾	¾	7/8	N/A
XS	1¾	1¾	1¾	17/8	17/8	21/16	25/16	25/16
XT	215/16	215/16	215/16	27/16	27/16	27/16	213/16	213/16
Y•	131/32	131/32	131/32	27/16	27/16	27/16	213/16	213/16

Electronic Feedback Cylinder Dimensional Changes

BORE	1½	2	2½	3¼	4	5	6	8
C	HLT II	—	19/16	19/16	1¼	1¼	1	1
**	L Series/BTL-2	1/8	1/8	—	—	—	3/8	1/4
	RT	—	—	—	—	—	—	—

Style 4 rod ends may require additional rod length. The following dimensions will increase by the **C dimension in the above chart: **C, SE, W, WF, XC, XD, XE, XG, XJ, XS, XT, Y, ZB, ZE, ZF, ZJ** and **ZT**.

J	HLT II	—	2	2	2	2	2	2
	L Series/BTL-2	1¾	1	1	1¼	1¼	1¼	1½
	RT	1	1	1	1¼	1¼	1¼	1½
JJ♦	HLT II	—	3/8	3/8	3/8	3/8	3/8	3/8
LB★	HLT II	—	45/8	4¾	5	5	5¼	5½
	L Series/BTL-2	5¼	4½	45/8	5½	5½	5¾	5
	RT	45/8	45/8	4¾	5¼	5¼	5¼	5
P•★	HLT II	—	23/16	25/16	25/8	25/8	27/8	31/8
	L Series/BTL-2	31/16	31/16	33/16	3½	3½	3¾	3¼
	RT	33/16	33/16	35/16	35/8	35/8	35/8	3¼
SE★	HLT II	—	7¼	75/8	73/8	75/8	8	8¼
	L Series/BTL-2	7½	6¾	7½	7½	7¾	8½	7¾
	RT	6½	67/8	7¼	75/8	77/8	8	7¾
SN★	HLT II	—	2¼	23/8	25/8	25/8	27/8	31/8
	L Series/BTL-2	31/8	31/8	3¼	3½	3½	3¾	3¼
	RT	3¼	3¼	33/8	35/8	35/8	35/8	3¼
SS★	HLT II	—	27/8	3	3¼	3¼	31/8	35/8
	L Series/BTL-2	3¾	3¾	37/8	4½	4½	4	35/8
	RT	37/8	37/8	4	4¼	4¼	37/8	3¾
XE★	HLT II	—	79/16	79/16	7¼	73/8	711/16	81/8
	L Series/BTL-2	73/8	613/16	71/16	73/8	7½	713/16	75/8
	RT	6¾	615/16	73/16	71/2	75/8	711/16	75/8
ZB★	HLT II	—	611/16	613/16	6¾	6¾	71/16	79/16
	L Series/BTL-2	67/8	63/16	65/16	67/8	67/8	73/16	71/16
	RT	6¼	65/16	67/16	7	7	71/16	75/16
ZE★	HLT II	—	73/8	77/8	73/8	7¾	83/16	85/8
	L Series/BTL-2	75/8	71/8	73/8	7¾	77/8	715/16	81/8
	RT	7	7¼	7½	77/8	8	81/16	81/2

Dimensions shown in purple are mounting dimensions.

NOTE: To determine piston thickness, subtract **G** and **J** dimensions from **LB** dimension.

NOTE: Additional port information on page 40.

○ Oversize rods affect dimensions in gray-shaded areas.
See page 46-47 for these dimensions.

★ Add stroke to all starred dimensions.

■ Requires full front square retainer.

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.

♦ The **JJ** dimension is the cover plate thickness for the HLT II electronics. A square cover plate is required on the 2" and 2½" bore sizes while all others receive a circular type.

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

— No additional **C** required for a Style 4 rod end.

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

Refer to ordering code on pages 9, 11, 13 and 15:

⊛ Sensor cover not available for 1½" bore.

⊛ A, B & C sensor cover options available for 2" bore.

⊛ A, B & C sensor cover options available for 2" and 2½" bore.

■ A, B & C sensor cover options available for 2"-3¼" bore.

∞ A, B & C sensor cover options available for 2"-8" bore.

⊛ B & C sensor cover options available for 2"-8" bore.

♣ All sensor cover options available for 2½"-8" bores.

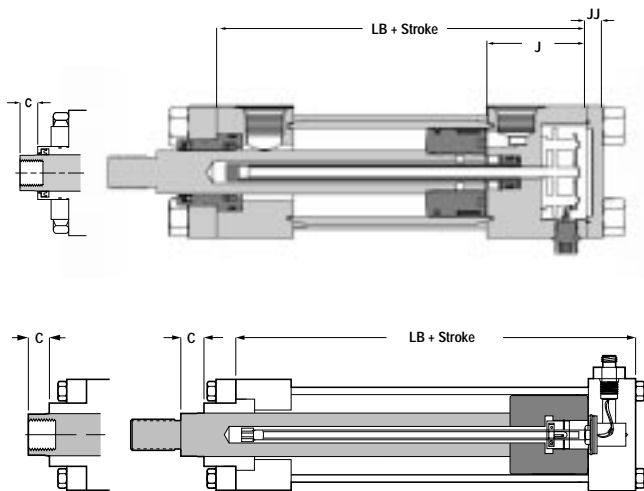
○ All sensor cover options available for 3¼"-8" bores.

Ω All sensor cover options available for 4"-8" bores.

NOTE: Consult factory on applications requiring cushions or bores over 8".

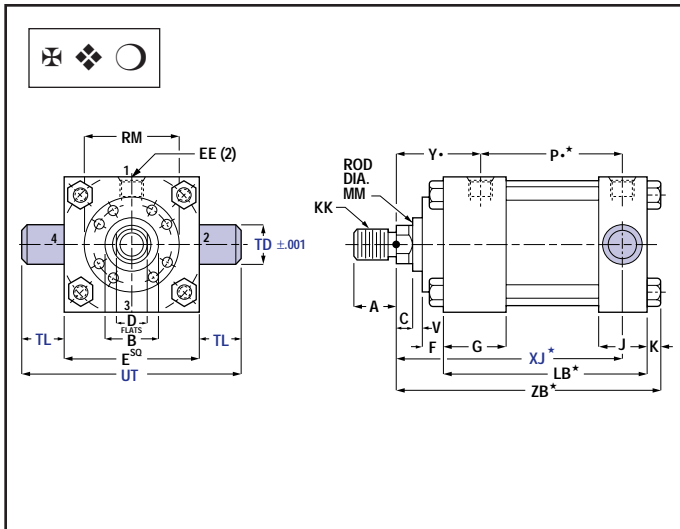
NOTE: Consult factory on applications requiring 1½" bore HLT II.

NOTE: Consult factory on applications requiring 1½"-2½" bore B mounts.

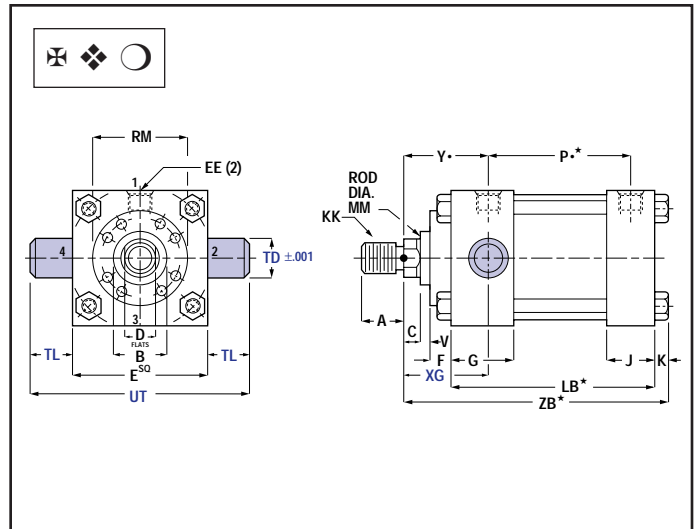


HR5 Series Mounting Dimensions

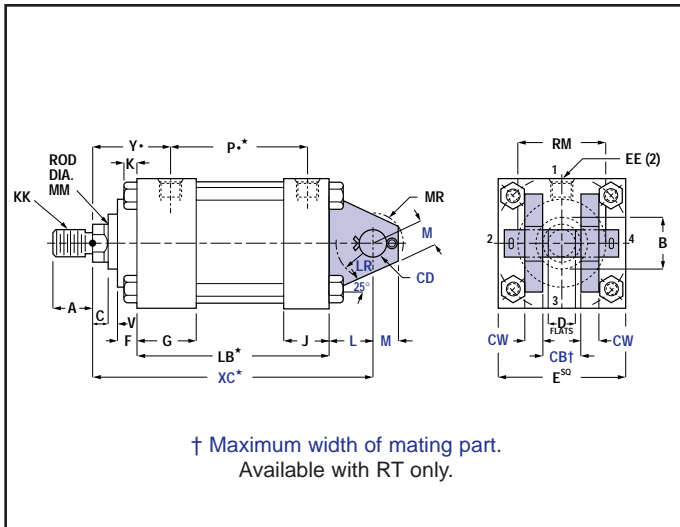
1 1/2" - 8" bore cylinders



HR5W – Cap Trunnion Mount (NFFA Style MT2)

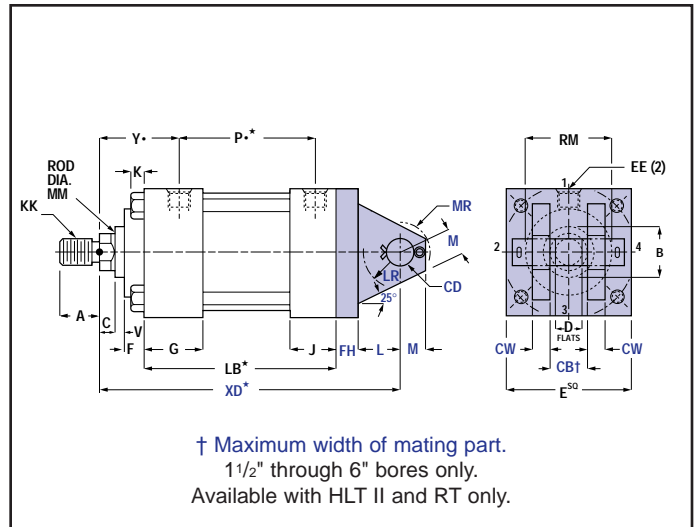


HR5U – Cap Trunnion Mount (NFFA Style MT1)



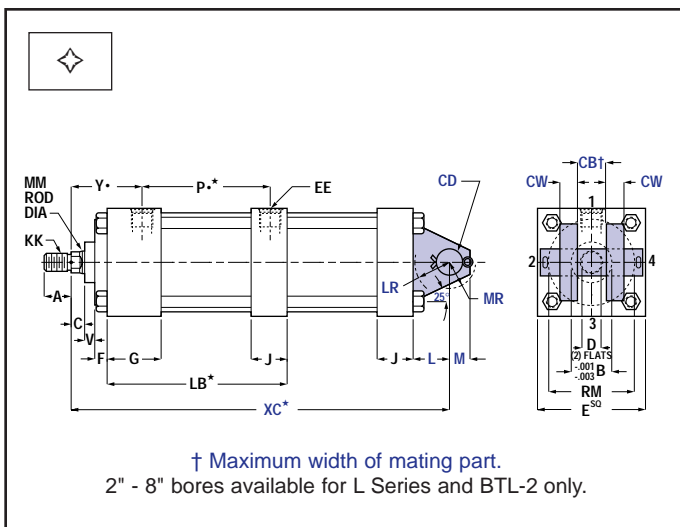
† Maximum width of mating part.
Available with RT only.

HR5C – Cap Fixed Clevis Mount (NFFA Style MP1)



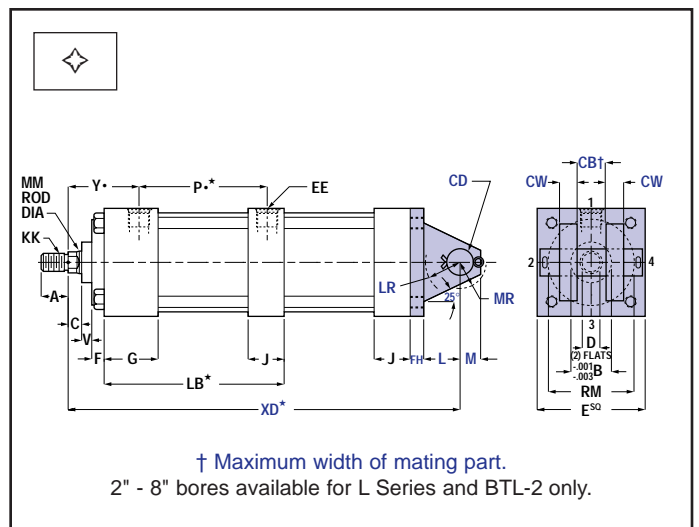
† Maximum width of mating part.
1 1/2" through 6" bores only.
Available with HLT II and RT only.

HR5DC – Cap Detachable Clevis Mount (NFFA Style MP2)



† Maximum width of mating part.
2" - 8" bores available for L Series and BTL-2 only.

HR5C – Cap Fixed Clevis Mount (NFFA Style MP1)



† Maximum width of mating part.
2" - 8" bores available for L Series and BTL-2 only.

HR5DC – Cap Detachable Clevis Mount (NFFA Style MP2)

Standard Cylinder Dimensions

BORE	1½	2	2½	3¼	4	5	6	8
A	1⅛	1⅛	1⅛	1⅛	1⅛	1⅛	15⁄8	15⁄8
B-001 -003	1½	1½	1½	1½	1½	1½	2	2
BD	1¼	1½	1½	2	2	2	2	2½
C	½	½	½	½	½	½	5⁄8	5⁄8
CB†	¾	¾	¾	1¼	1¼	1¼	1½	1½
CC	7⁄8-14	7⁄8-14	7⁄8-14	7⁄8-14	7⁄8-14	7⁄8-14	1¼-12	1¼-12
CD	½	½	½	¾	¾	¾	1	1
CW	½	½	½	5⁄8	5⁄8	5⁄8	¾	¾
D	7⁄8	7⁄8	7⁄8	7⁄8	7⁄8	7⁄8	1⅛	1⅛
E	2	2½	3	3¾	4½	5½	6½	8½
EE (NPTF)	¾	¾	¾	½	½	½	¾	¾
EE (SAE)	#6	#6	#6	#10	#10	#10	#12	#12
F	▲	▲	11⁄32	½	½	½	19⁄32	19⁄32
FH	¾	¾	¾	5⁄8	5⁄8	5⁄8	¾	¾
FT	1-14	1-14	1-14	1-14	1-14	1-14	13⁄8-12	13⁄8-12
G	1½	1½	1½	1¾	1¾	1¾	2	2
K	¼	5⁄16	5⁄16	¾	¾	7⁄16	7⁄16	9⁄16
KK	¾-16	¾-16	¾-16	¾-16	¾-16	¾-16	1-14	1-14
L	¾	¾	¾	1¼	1¼	1¼	1½	1½
LR	9⁄16	9⁄16	9⁄16	11⁄16	11⁄16	11⁄16	15⁄16	13⁄16
M	½	½	½	¾	¾	¾	1	1
MM	1	1	1	1	1	1	13⁄8	13⁄8
MR	9⁄16	9⁄16	9⁄16	11⁄16	11⁄16	11⁄16	1⅛	1⅛
RM	-	-	231⁄64	25⁄8	25⁄8	25⁄8	3¼	3¼
TD	1	1	1	1	1	1	13⁄8	13⁄8
TL	1	1	1	1	1	1	13⁄8	13⁄8
UT	4	4½	5	5¾	6½	7½	9¼	11¼
V	▲	▲	17⁄32	¾	¾	¾	13⁄32	13⁄32
VB	½	½	½	¼	¼	¼	¼	N/A
W	1	1	1	¾	¾	¾	7⁄8	N/A
XG	2⅛	2⅛	2⅛	2¼	2¼	2¼	25⁄8	25⁄8
Y•	211⁄32	211⁄32	211⁄32	27⁄16	27⁄16	27⁄16	213⁄16	213⁄16

Electronic Feedback Cylinder Dimensional Changes

	BORE	1½	2	2½	3¼	4	5	6	8
C	HLT II	-	19⁄16	19⁄16	1¼	1¼	1	1	1
**	L Series/BTL-2	1⁄8	1⁄8	1⁄8	1⁄8	1⁄8	1⁄8	3⁄8	1⁄4
	RT	1⁄8	1⁄8	1⁄8	1⁄8	1⁄8	1⁄8	1⁄8	1⁄8

**Style 4 rod ends may require additional rod length. The following dimensions will increase by the C dimension in the above chart: C, SE, W, WF, XC, XD, XE, XG, XJ, XS, XT, Y, ZB, ZE, ZF, ZJ and ZT.

J	HLT II	-	2	2	2	2	2	2	2
	L Series/BTL-2	13⁄4	1	1	1¼	1¼	1¼	1½	1½
	RT	1	1	1	1¼	1¼	1¼	1½	1½
JJ♦	HLT II	-	3⁄8	3⁄8	3⁄8	3⁄8	3⁄8	3⁄8	3⁄8
LB★	HLT II	-	45⁄8	43⁄4	5	5	5¼	5½	55⁄8
	L Series/BTL-2	5¼	4½	45⁄8	5	5	53⁄8	5	5½
	RT	45⁄8	45⁄8	4¾	5¼	5¼	5¼	5	5½
P★	HLT II	-	23⁄16	25⁄16	25⁄8	25⁄8	27⁄8	31⁄8	3¼
	L Series/BTL-2	31⁄16	31⁄16	33⁄16	3½	3½	33⁄4	31⁄8	3¼
	RT	33⁄16	33⁄16	35⁄16	35⁄8	35⁄8	35⁄8	31⁄8	3¼
XC★	L Series/BTL-2	143⁄8	135⁄8	133⁄4	15	15	15¼	155⁄8	153⁄4
	RT	63⁄4	63⁄4	67⁄8	77⁄8	77⁄8	81⁄8	81⁄8	8¼
XD★	HLT II	-	7⅛	7¼	8¼	8¼	8½	93⁄8	N/A
	L Series/BTL-2	143⁄4	14	141⁄8	155⁄8	155⁄8	157⁄8	163⁄8	N/A
	RT	71⁄8	71⁄8	7¼	8½	8½	83⁄4	87⁄8	N/A
XJ★	HLT II	-	4½	45⁄8	5	5	5¼	57⁄8	6
	L Series/BTL-2	53⁄8	53⁄8	5½	57⁄8	57⁄8	61⁄8	57⁄8	6
	RT	5½	5½	55⁄8	6	6	6	57⁄8	6
ZB★	HLT II	-	611⁄16	613⁄16	6¾	6¾	71⁄16	79⁄16	713⁄16
	L Series/BTL-2	67⁄8	63⁄16	65⁄16	67⁄8	67⁄8	73⁄16	71⁄16	75⁄16
	RT	6¼	65⁄16	67⁄16	7	7	71⁄16	71⁄16	75⁄16

Dimensions shown in purple are mounting dimensions.

NOTE: To determine piston thickness, subtract G and J dimensions from LB dimension.

NOTE: Additional port information on page 40.

○ Oversize rods affect dimensions in gray-shaded areas. See page 46-47 for these dimensions.

★ Add stroke to all starred dimensions.

■ Requires full front square retainer.

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

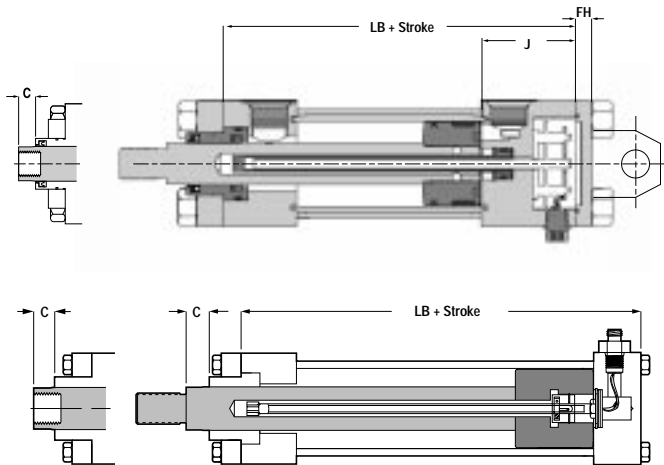
▲ Use FH dimension in place of F dimension and VB dimension in place of V dimension.

♦ The JJ dimension is the cover plate thickness for the HLT II electronics. A square cover plate is required on the 2" and 2½" bore sizes while all others receive a circular type.

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

1⁄8 No additional C required for a Style 4 rod end.

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



Refer to ordering code on pages 9, 11, 13 and 15:

⊛ Sensor cover not available for 1½" bore.

⊛ A, B & C sensor cover options available for 2" bore.

⊛ A, B & C sensor cover options available for 2" and 2½" bore.

■ A, B & C sensor cover options available for 2"-3¼" bore.

∞ A, B & C sensor cover options available for 2"-8" bore.

⊛ B & C sensor cover options available for 2"-8" bore.

♣ All sensor cover options available for 2½"-8" bores.

○ All sensor cover options available for 3¼"-8" bores.

Ω All sensor cover options available for 4"-8" bores.

NOTE: Consult factory on applications requiring cushions or bores over 8".

NOTE: Consult factory on applications requiring 1½" bore HLT II.

HR5 Port Size Data and Location Information

Ports

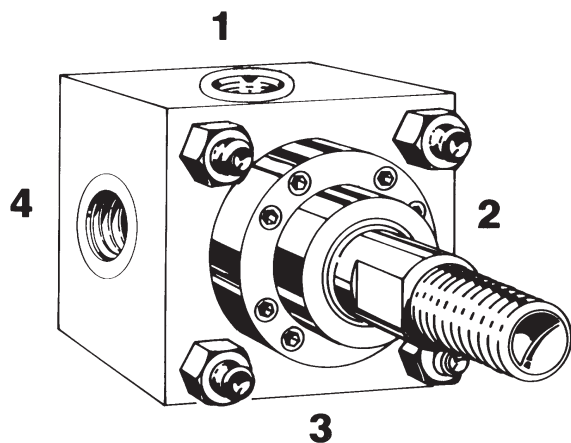
Standard ports for HR5 are SAE straight thread. R5 and LR5 standard ports are NPT.

Optional and Oversize Ports

The chart at right lists port sizes. Larger welded half-pipe coupling ports are available in some sizes, please contact Hydro-Line.

Port Locations

Standard port locations are at No. 1, with optional locations No. 2, 3 or 4 furnished when specified, except where **H**, **U** or **W** mounts interfere at No. 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 No. 2 and 4. Mounting holes are counterbored to allow access to them with piping in place. Request Engineering File P-26 for reference to dimensions.



Locations 1 through 4 indicate possible port positions. Number 1 is standard.

Cylinder Bore Dia. (inches)	Cylinder Rod Dia. (inches)	SAE			NPT			Manifold	
		Std.	Oversize		Std.	Oversize		"A" Mount	"B" Mount
			Head	Cap		Head	Cap		
1 1/2*	1	#6	N/A	N/A	3/8	N/A	N/A	1/2	3/16
2	5/8	#6	#8	N/A	3/8	1/2	N/A	1/2	1/4
	1	#6	N/A	N/A	3/8	N/A	N/A	1/2	1/4
	1 3/8	#6	N/A	N/A	3/8"	N/A	N/A	1/2	1/4
2 1/2	5/8	#6	#8	N/A	3/8	N/A	N/A	1/2	1/2
	1	#6	#8	N/A	3/8	N/A	N/A	1/2	1/2
	1 3/8	#6	N/A	N/A	3/8	N/A	N/A	1/2	1/2
3 1/4	1 3/4	#6	N/A	N/A	3/8	N/A	N/A	1/2	1/2
	1	#10	#12	N/A	1/2	3/4	N/A	5/8	5/8
	1 3/4	#10	#12	N/A	1/2	3/4	N/A	5/8	5/8
4	1	#10	#12	N/A	1/2	N/A	N/A	5/8	5/8
	1 3/8	#10	#12	N/A	1/2	N/A	N/A	5/8	5/8
	1 3/4	#10	#12	N/A	1/2	N/A	N/A	5/8	5/8
5	2	#10	#12	N/A	1/2	N/A	N/A	5/8	5/8
	2 1/2	#10	#12	N/A	1/2	N/A	N/A	5/8	5/8
	3	#10	N/A	N/A	1/2	N/A	N/A	5/8	5/8
	3 1/2	#10	N/A	N/A	1/2	N/A	N/A	5/8	5/8
	1	#10	#12	N/A	1/2	N/A	N/A	5/8	5/8
	1 3/8	#10	#12	N/A	1/2	N/A	N/A	5/8	5/8
6	1 3/4	#10	#12	N/A	1/2	N/A	N/A	5/8	5/8
	2	#10	#12	N/A	1/2	N/A	N/A	5/8	5/8
	2 1/2	#10	#12	N/A	1/2	N/A	N/A	5/8	5/8
	3	#10	#12	N/A	1/2	N/A	N/A	5/8	5/8
	3 1/2	#10	#12	N/A	1/2	N/A	N/A	5/8	5/8
	4	#10	N/A	N/A	1/2	N/A	N/A	5/8	5/8
8	1 3/8	#12	#14	N/A	3/4	N/A	N/A	13/16	13/16
	1 3/4	#12	#14	N/A	3/4	N/A	N/A	13/16	13/16
	2	#12	#14	N/A	3/4	N/A	N/A	13/16	13/16
	2 1/2	#12	#14	N/A	3/4	N/A	N/A	13/16	13/16
	3	#12	#14	N/A	3/4	N/A	N/A	13/16	13/16
	3 1/2	#12	#14	N/A	3/4	N/A	N/A	13/16	13/16
8	4	#12	#14	N/A	3/4	1	N/A	13/16	13/16
	4 1/2	#12	#14	N/A	3/4	1	N/A	13/16	13/16
	5	#12	#14	N/A	3/4	1	N/A	13/16	13/16
	5 1/2	#12	#14	N/A	3/4	1	N/A	13/16	13/16
	1 3/8	#12	#14	N/A	3/4	1	N/A	13/16	13/16
	1 3/4	#12	#14	N/A	3/4	1	N/A	13/16	13/16
	2	#12	#14	N/A	3/4	1	N/A	13/16	13/16
	2 1/2	#12	#14	N/A	3/4	1	N/A	13/16	13/16

* Port adapter 1" in diameter and 3/4" high furnished on head end only on 1 1/2" bore cylinders with 1" diameter rod.

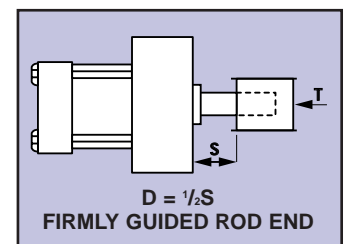
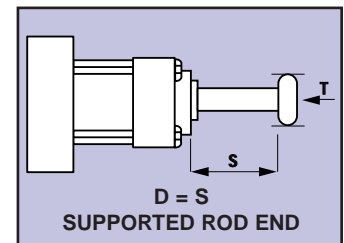
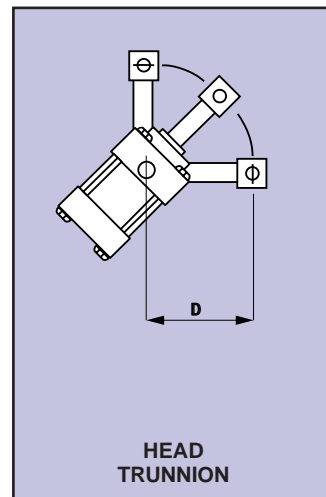
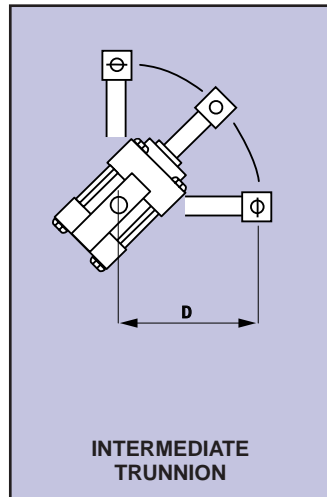
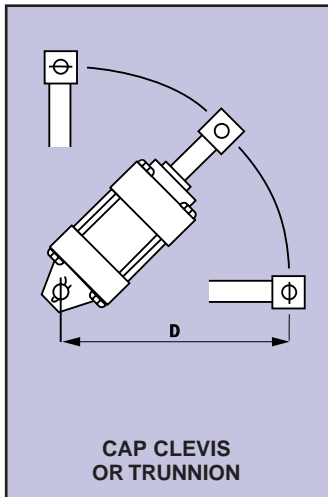
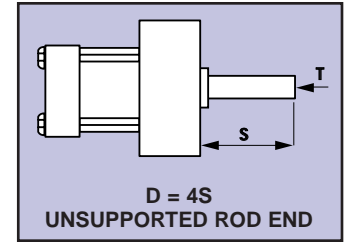
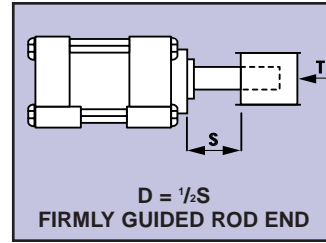
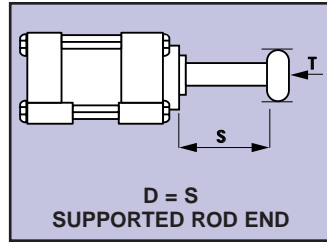
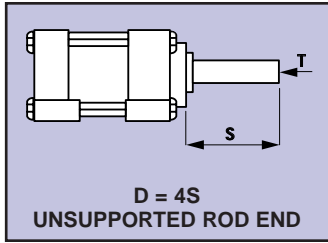
SHR5 Systems Cylinder Pressure Ratings

Cylinder Bore Dia. (in.)	Piston Rod Dia. (in.)			Design Pressure (psi)			
				Non/Cap Cushion		Both/Head Cushion	
	Std.	Oversize	Area 2:1	4:1 Tensile	4:1 Yield	4:1 Tensile	4:1 Yield
1 1/2	1	N/A	1	2500*	2000*	N/A	N/A
2	1	N/A	1 3/8	1920	1530	1895	1530
2 1/2	1	1 3/8	1 3/4	1555	1240	1155	960
3 1/4	1	1 3/8, 1 3/4	2	1185	970	660	550
4	1	1 3/8, 1 3/4, 2	2 1/2	770	640	430	355
5	1	1 3/8, 1 3/4, 2, 2 1/2, 3	3 1/2	485	405	270	225
6	1 3/8	1 3/4, 2, 2 1/2, 3, 3 1/2	4	960	800	520	435
8	1 3/8	1 3/4, 2, 2 1/2, 3, 3 1/2, 4, 4 1/2, 5	5 1/2	530	440	290	240

* Only available in noncushioned design.

Hydro-Line Technical Data

Rod Size and Stop Tube Selection

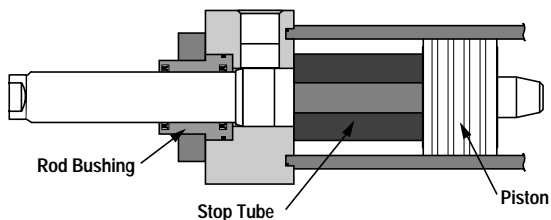


Rod Size Selection

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 graph in 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

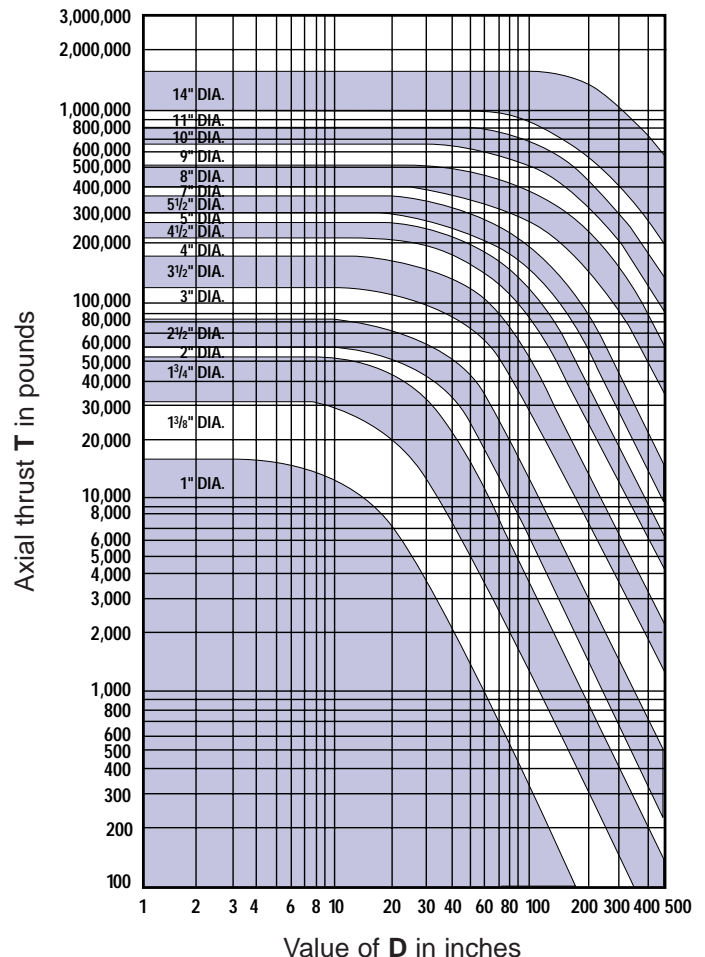


Stop tubes are located between the piston and the rod shoulder on the head end of the cylinder. Bearing loading is reduced by separating the piston and the rod bushing. Bearing wear and tendency to buckle is reduced.

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".

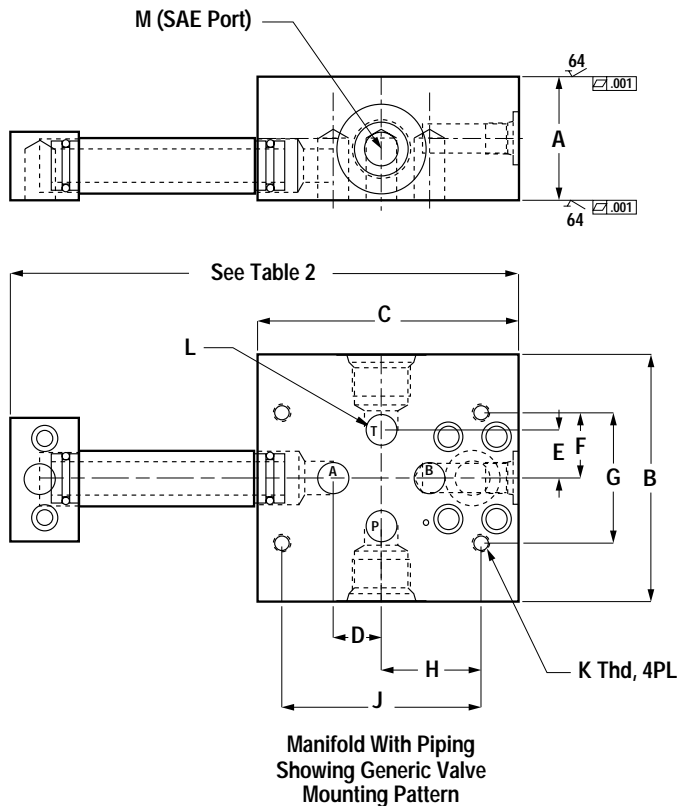
Special note: When specifying stroke and stop tube lengths, please include net working stroke plus stop tube length.



Valve and Manifold Accessories

Hydro-Line offers two methods of hydraulic manifolds, piping and integral. The standard method is piping with integral manifolds used for short stroke cylinders as shown below. Special options are available, including regeneration

mode, reverse mounting and operation, drainback and straddle block design, oversize or special porting or special patterns².



(Applies to Mounting Patterns 1, 2 & D03)

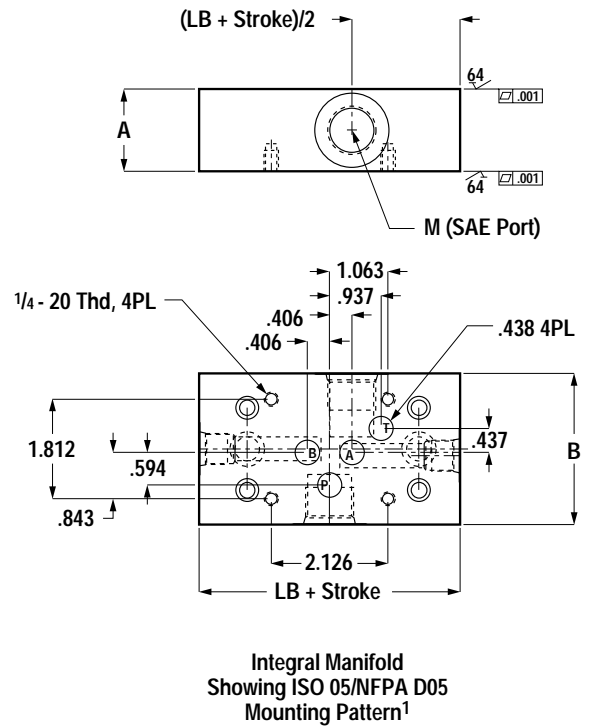


Table 1 – Standard Valves and Manifold Patterns Available²

Control Valve Series	A	B	C	D	E	F	G	H	J	K	L	M
Mounting Pattern 1	1.50	3.25	3.75	.469	.469	.672	1.344	.844	1.688	1/4-20	.312	#8
Mounting Pattern 2	2.00	3.00	3.50	.437	.437	.875	1.750	1.281	2.562	5/16-18	.312	#8
D05 Mounting Pattern	2.00	5.00	5.00	See Integral Manifold drawing sample above								#10
D03 Mounting Pattern	1.50	3.25	3.75	.344	.422	.610	1.280	.750	1.590	10-24	.250	#6

Table 2

Bore Diameter	Minimum Stroke Requirements for Manifold Block Applications	
	SN5	SHR5
1 1/2	3	4
2	3	4
2 1/2	3	3 1/2
3 1/4	2 1/2	3 1/2
4	2	3 1/2
5	2	3
6	1 1/2	3
7	1	N/A
8	1/2	2 1/2

¹ Integral manifold used for cylinders with strokes less than the minimum requirement shown in Table 2 at left.

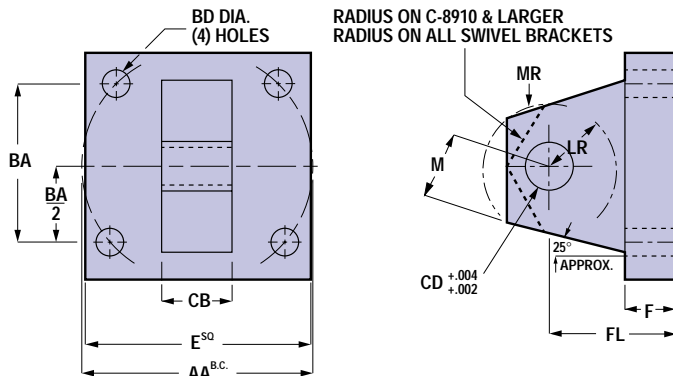
² Specify "X" valve order code for values or options not shown in Table 1 or 2, or for special manifold requirements. Specify manufacturer, model, flow and pressure requirements on Electronic Feedback Application Data Sheet. Include any special instructions for manifold pattern, porting, mounting styles or applicable drawings.

Mounting Accessories

Standard Eye Bracket

Swivel Eye Bracket*

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



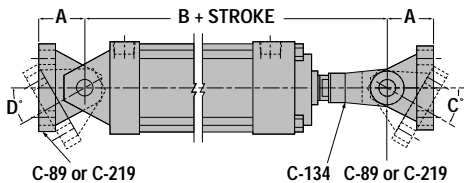
Part Number		Dimensions										Std. Bracket		Swivel Bracket		Swivel Bracket Recommended Static Load Limit in Pounds
Std.	Swivel*															
Part No.	Part No.	AA	BA	BD	CB	CD	E	F**	FL**	LR	M	MR	M	MR		
C-8903	C-219-3-1	2.3	1 ⁵ / ₈	1 ³ / ₃₂	3 ³ / ₄	1 ¹ / ₂	2 ¹ / ₂	3 ³ / ₈	1 ¹ / ₈	1 ¹ / ₂	1 ¹ / ₂	9/16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

* NOTE: To assure a precision fit, 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.

Typical Mounting Accessories

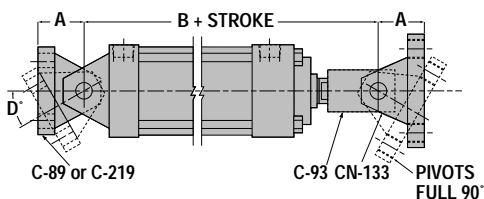
For Standard Rod Diameters Style #2



R5, LR5 and HR5 Cylinders

Bore	A	B	Eye Bracket		Female Clevis	Pivot Pin	C°	D°
			Standard	Swivel				
1 ¹ / ₂	1 ¹ / ₈	6 ⁵ / ₈	C-8903	C-219-3-1	C-134-05	C-9003-3	90°	60°
2	1 ¹ / ₈	6 ⁵ / ₈	C-8903	C-219-3-1	C-134-05	C-9003-3	90°	60°
2 ¹ / ₂	1 ¹ / ₈	7	C-8903	C-219-3-1	C-134-05	C-9003-3	90°	60°
3 ¹ / ₄	1 ⁷ / ₈	9 ¹ / ₄	C-8904	C-219-3-2	C-134-08	C-9004-3	90°	65°
4	1 ⁷ / ₈	9 ¹ / ₄	C-8904	C-219-3-2	C-134-08	C-9004-3	90°	65°
5	1 ⁷ / ₈	9 ¹ / ₂	C-8904	C-219-3-2	C-134-08	C-9004-3	90°	65°
6	2 ¹ / ₈	11 ¹ / ₄	C-89065X	C-219-3-3X	C-134-11	C-9065-3	80°	65°
8	2 ¹ / ₈	11 ³ / ₈	C-89065X	C-219-3-3X	C-134-11	C-9065-3	80°	65°

For mounting dimensions over 14" bore, consult Hydro-Line.



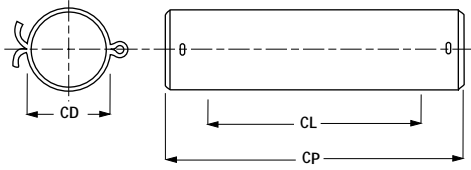
R5, LR5 and HR5 Cylinders

Bore	C	B	Eye Bracket		Clevis Bracket	Pivot Pin	Female Eye	D°
			Standard	Swivel				
1 ¹ / ₂	1 ¹ / ₈	6 ⁵ / ₈	C-8903	C-219-3-1	CN-133-03	C-9003-3	C-9303	60°
2	1 ¹ / ₈	6 ⁵ / ₈	C-8903	C-219-3-1	CN-133-03	C-9003-3	C-9303	60°
2 ¹ / ₂	1 ¹ / ₈	7	C-8903	C-219-3-1	CN-133-03	C-9003-3	C-9303	60°
3 ¹ / ₄	1 ⁷ / ₈	8 ¹⁵ / ₁₆	C-8904	C-219-3-2	CN-133-04	C-9004-3	C-9304	65°
4	1 ⁷ / ₈	8 ¹⁵ / ₁₆	C-8904	C-219-3-2	CN-133-04	C-9004-3	C-9304	65°
5	1 ⁷ / ₈	9 ⁷ / ₁₆	C-8904	C-219-3-2	CN-133-04	C-9004-3	C-9304	65°
6	2 ¹ / ₈	10 ¹⁵ / ₁₆	C-89065X	C-219-3-3X	CN-133-065	C-9065-3	C-93065	65°
8	2 ¹ / ₄	11 ¹ / ₁₆	C-89065	C-219-3-3	CN-133-065	C-9065-3	C-93065	65°

For mounting dimensions over 14" bore, consult Hydro-Line.

Mounting Accessories

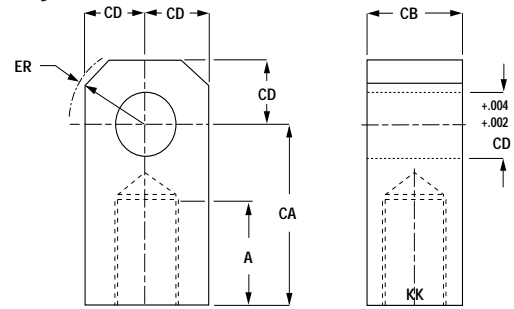
Pivot Pin



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

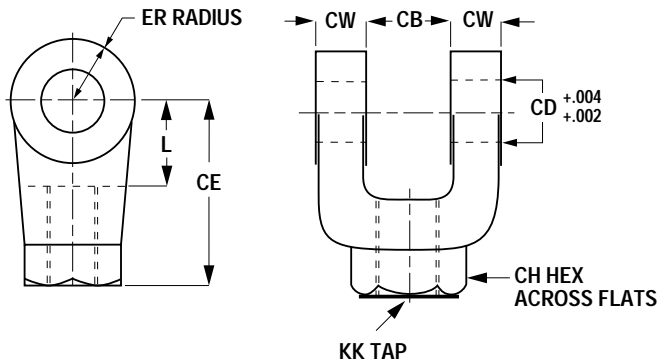
- Pivot pins are furnished with clevis mounted cylinders.
- Pivot pins must be ordered as a separate item if to be used with female eye, female clevis, standard eye bracket and clevis bracket. They are included only with swivel eye bracket.
- CL = 2(CW) + CB

Female Eye



Part No.	A	CA	CB	CD	ER	KK
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

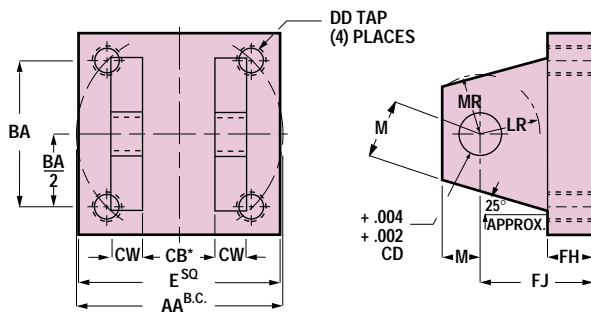
Female Clevis



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 5/8	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

* Maximum width of mating part

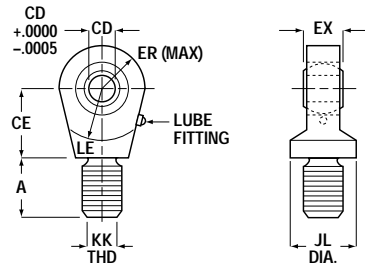
Clevis Bracket



Part No.	AA	BA	CB	CD	CW	DD	E	FH	FJ	LR	M	MR
CN-133-03	2.3	1 5/8	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	1 9/32	3/4	5/8	1/2-20	3	5/8	1 7/8	1	3/4	1 1/16
CN-133-05	3.6	2 9/16	1 9/32	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

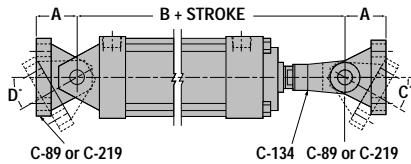
* Maximum width of mating part

Spherical Rod Eye (N5 Series only)



Part No.	A	CD +.0000 -.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 ¹ / ₂	1 ¹ / ₂	1-14	1 ¹ / 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

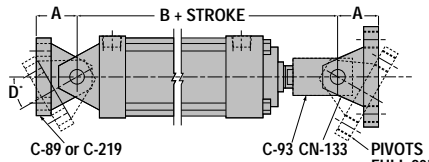
For Standard Rod Diameters Style #2



N5, AN5 and LAN5 Cylinder

Bore	A	B	Eye Bracket		Female Clevis	Pivot Pin	C°	D°
			Standard	Swivel				
1 ¹ / ₂	1 ¹ / ₂	7 ⁷ / ₈	C-8903	C-219-3-1	C-134-05	C-9003-3	90°	60°
2	1 ⁷ / ₂	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 Hydro-Line.



N5, AN5 and LAN5 Cylinder

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	C-133-03	C-9003-3	C-9303	60°
2	1 ⁷ / ₂	9 ⁵ / ₁₆	C-8904	C-219-3-2	C-133-04	C-9004-3	C-9304	65°
2 ¹ / ₂	1 ⁷ / ₈	9 ⁷ / ₁₆	C-8904	C-219-3-2	C-133-05	C-9004-3	C-9304	65°
3 ¹ / ₄	2 ³ / ₈	11 ⁷ / ₁₆	C-89065X	C-219-3-3X	C-133-065	C-9065-3	C-93065	65°
4	3	13 ⁷ / ₁₆	C-8908	C-219-3-4	C-133-08	C-9008-3	C-9308	70°
5	3 ³ / ₈	14 ¹ / ₂	C-8910X	C-219-3-5X	C-133-10	C-9010-3	C-9310	65°
6	4	17 ¹ / ₈	C-8912X	C-219-3-6X	C-133-12	C-9012-3	C-9312	65°
7	4	19 ⁹ / ₁₆	C-8914		C-133-14	C-9014-3	C-9314	65°
8	4 ¹ / ₄	21 ³ / ₈	C-8916		C-133-16	C-9016-3	C-9316	65°
10	5 ¹¹ / ₁₆	26 ¹¹ / ₁₆	C-8920		C-133-20	C-9020-3	C-9320	60°
12	6 ⁷ / ₁₆	31 ⁵ / ₁₆	C-8924		C-133-24	C-9024-3	C-9324	60°

For mounting dimensions over 12" bore, consult Hydro-Line.

ONE YEAR LIMITED WARRANTY

One Year Normal Use

Hydro-Line 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 Hydro-Line representatives.

Disclaimers

This one year limited warranty is the only warranty extended by Hydro-Line in connection with any sale by Hydro-Line. THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, notwithstanding disclosure to Hydro-Line of the product's intended use. An affirmation of fact or promise made on behalf of Hydro-Line 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 such description; any sample or model is for illustrative purposes only 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 returned to us at our expense including lowest transportation cost, is requested. Written notice of such defect shall be given by customer to Hydro-Line within 30 days after such defect(s) appear. Written permission for any warranty claim return must be first obtained from authorized Hydro-Line 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 HYDRO-LINE 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 Hydro-Line are furnished subject only to the Manufacturer's warranties, if any, and without warranties, expressed or implied, by Hydro-Line.

HYDRO-LINE Actuation Products



N5 SERIES CYLINDERS

- NFPA interchangeable
- **N5** – 3000 psi nominal hydraulic
- **AN5** – to 250 psi very heavy-duty pneumatic
- **LAN5** – to 250 psi very heavy-duty pneumatic – permanently lubricated
- All steel construction



R5 SERIES CYLINDERS

- NFPA interchangeable
- **A5/R5** – to 250 psi pneumatic
- **LA5/LR5** – to 250 psi pneumatic – permanently lubricated
- **HA5** – to 400 psi hydraulic
- **HR5** – 1500 psi nominal hydraulic



Q5 SERIES CYLINDERS

- NFPA interchangeable
- **Q5** – to 250 psi pneumatic
- **LQ5** – to 250 psi pneumatic – permanently lubricated
- **HQ5** – to 400 psi hydraulic
- Aluminum construction



HM SERIES CYLINDERS

- Conform to international metric specifications ISO 6020/2 and DIN 24 554
- 25 mm to 200 mm bore sizes
- 210 BAR nominal hydraulic
- All steel construction



ROCKFORD SERIES CYLINDERS

- ASAE interchangeable agricultural cylinders
- **Rockford 2500**–2500 psi hydraulic
- **Rockford 3000**–3000 psi hydraulic



ELECTRONIC FEEDBACK CYLINDERS

Hydraulic or pneumatic cylinders which incorporate cylinder position sensing and feedback throughout the stroke. Available in N5, R5, A5, Q5, HM, HW, SM or special cylinders.



SERIES 20/30 BOOSTERS

- Standard series to 5000 psi output
- Custom designs to 20,000 psi

T SERIES AIR/OIL TANKS

- All steel construction

QT SERIES AIR/OIL TANKS

- Aluminum end caps and translucent tubing



V5 SERIES CYLINDERS

- NFPA Interchangeable
- To 200 psi pneumatic
- Aluminum construction
- Now available in 5", 6" and 8" bore



HW SERIES CYLINDERS

- Welded construction
- 3000 psi nominal hydraulic



TSAYER CYLINDERS

- Threaded body construction
- To 200 psi pneumatic
- To 1000 psi nominal hydraulic



SM SERIES CYLINDERS

- Steel mill type construction
- **MSM**–2000 psi nominal hydraulic
- **HSM**–3000 psi nominal hydraulic
- **ASM**–Pneumatic



CUSTOM CYLINDERS

- Custom cylinders to meet special requirements
- Bores to 48"
 - Strokes to 300"
 - Pressures to 10,000 psi or higher



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CHARLOTTE, NORTH CAROLINA 28208 U.S.A.
704-394-0043 • FAX 704-394-0073

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HYDRO-LINE, INC.

Delivering Engineered Solutions
in Actuation Worldwide

An IMC Company