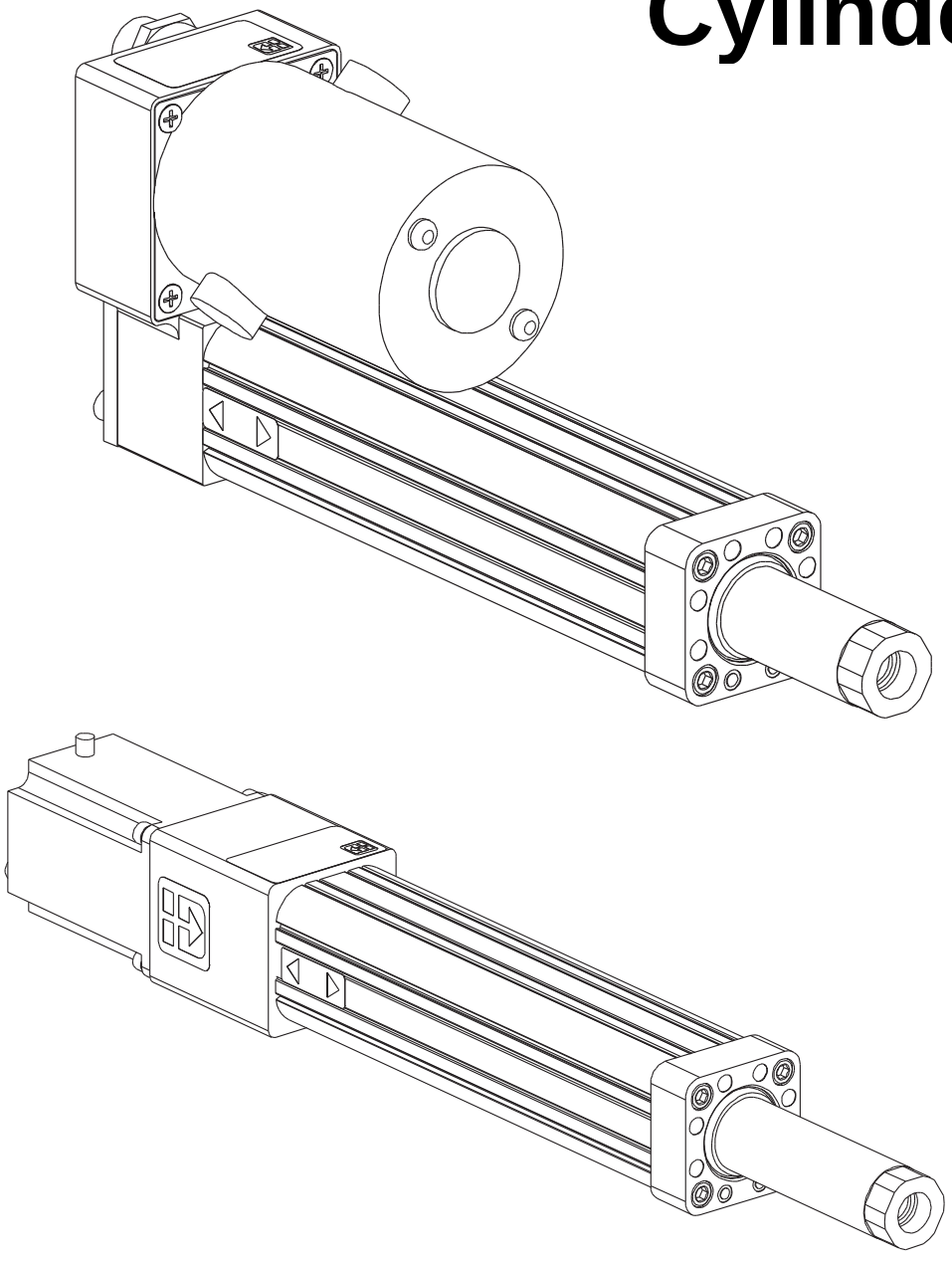
INDUSTRIAL
DEVICES
CORPORATION

N2 Series Electric Cylinders



User's Manual

P/N CUS10048 Rev. 1.01

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1. Product Overview

Industrial Devices Corporation's N2 Series Electric Cylinders are designed for use in a wide variety of industrial, scientific, and commercial applications requiring precise control of linear thrust, speed, or position. This manual will help you install, operate, and maintain your N2 Series Cylinder.

N2 Series Features

The N2 is the next generation of IDC's N Series, the most prolific electric cylinder design in the world. The N2 provides the performance range of the N Series in a more rugged and higher quality package. Following are just a few of the N2's more desirable features:

- **Highest Customization**
  The N2 is both flexible and robust to accommodate almost every industrial motion control application. In fact, the N2 offers the most available custom options of all IDC products.

- **Improved Anti-Rotation System**
  A significant N2 improvement lies in the newly designed anti-rotation guide flange, which is six times as strong as the previous N Series version.

- **No Extra Charge for Nonstandard Stroke Length**
  Our manufacturing process can quickly respond to custom stroke length requests, which ensures that you can always specify the length of cylinder that best fits your application.

- **Smaller, More Economical Limit Switches**
  Our limit switches have also been updated for the N2. The new limit switches are smaller, better sealed (IP67), and less expensive.

- **Same Mounting Footprint as N Series**
  N2s retain the compact size (very low overall length per usable stroke), and are footprint-compatible with the N Series.

- **N2 Compatibility with IDC Controls**
  IDC controls are designed to optimize the performance of N2 cylinders. See the "Compatible Controls" section of the table below to ensure that you are using the correct IDC control with your N2 cylinder. If you are not currently using an IDC control, please consult the table below and consider upgrading your application.

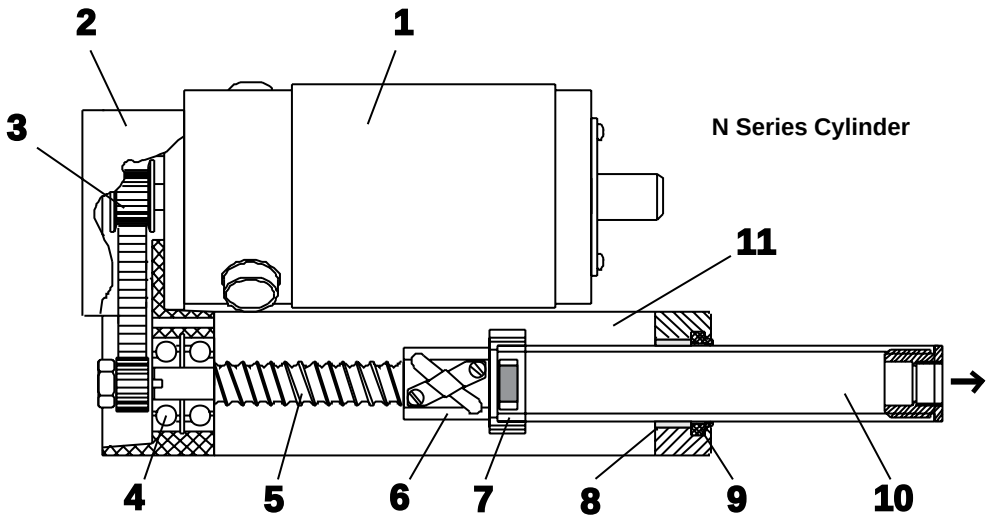
N2 Specifications

The following are maximum values for the N2 Series. See the IDC Catalog for full specifications.

Parameter	N2 Configurations			
	N2-D	N2-H	N2-S/P	N2-B
Motor Type	24 VDC Permanent Magnet	160 VDC Permanent Magnet Servo	1.8° Hybrid Stepper	Rare Earth Magnet Brushless Servo
Performance Curves	See Latest IDC Catalog			
Load Capacity lbs [N]	600 [2,670]	600 [2,670]	600 [2,670]	600 [2,670]
Max No Load Speed in/s [mm/s]	24 [610]	25 [635]	25 [635]	30 [760]
Repeatability in [mm]	±0.005 [.127]	±0.005 [.127]	±0.0005 [.0127]	±0.001 [.025]
Compatible IDC Controls	D2200 D2300 D2400 D2500*	H3301B H3321B H3501*	NextStep S6002 SmartStep S6961 S6001 S6962	B8001 B8501* B8961 B8962
*This application (control + cylinder) requires the Linear Pot. (-L) option.				

Electric Cylinder Construction (Typical)

This cylinder cross-section, with motor attached, is provided to illustrate the typical components of an IDC electric cylinder. Refer to Section 7, *Parts List and Exploded Parts Diagrams*, for more detailed information on the N2 cylinder.

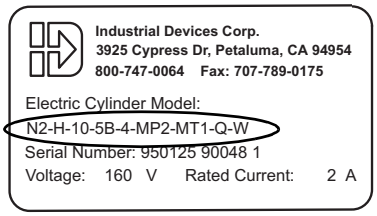


1. Motor (may be customer supplied)
2. Bearing Housing
3. Drive Train (belt drive shown)
4. Thrust Bearings
5. Leadscrew
6. Drive Nut
7. Internal Guide Flange (including magnets)
8. Rod End Sleeve Bearing
9. Thrust Tube Wiper
10. Thrust Tube
11. Guide Cylinder

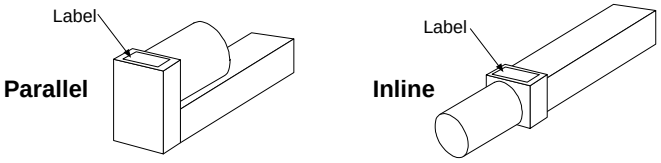
Cylinder Part Numbers - Identifying a Cylinder

Your new N2 cylinder will arrive with an IDC factory label attached as shown below. The factory label provides a detailed breakdown of the cylinder model with all of its mechanical characteristics. This section can be used to: 1) identify a cylinder's mechanical characteristics based on the factory label, or 2) order a new N2 cylinder with different mechanical characteristics.

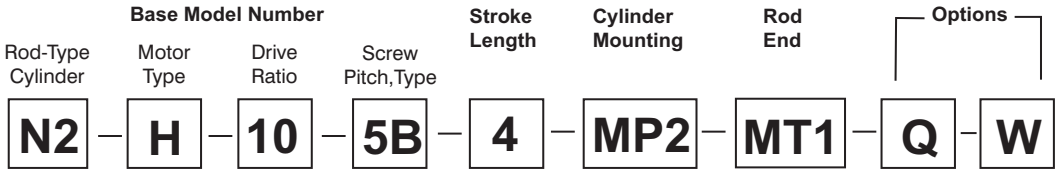
Label Location



Locations of Labels on Different Motor-Mounting Configurations



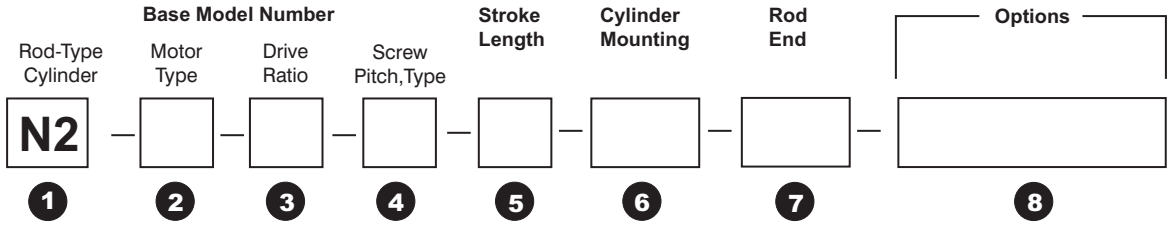
Model Number Example



N2 = Product Series
H = H Motor, 160 VDC, 2 Amp, Permanent Magnet
10 = 1.0 to 1 Drive Ratio - Belt/Pulley
5B = 5 Pitch (0.2" lead) Ballscrew
4 = 4-inch stroke
MP2 = Rear Double Clevis Mount
MT1 = Male Threaded Rod End
Q = Quick Disconnect Option
W = Water Resistant Seal Option

Identify Your N2 Cylinder Using the Cylinder Configuration Guide

This fill-in-the-box section is provided for users who want to identify an existing N2 cylinder or perhaps order a new N2 cylinder. To identify the mechanical characteristics of an existing N2 cylinder, photocopy this page and transcribe the model number from the factory label to boxes 2 through 8. To reconfigure or order a new N2, fill in boxes 2 - 8 with codes for the new cylinder. Refer to the **Cylinder Configuration Guide** on the following pages for boxes 2 - 8. Please see IDC's latest catalog for additional information.



Cylinder Configuration Guide

2 Motor Type

D	24VDC, 4.5 Amp, Permanent Magnet Motor
H	160VDC, 2 Amp, Permanent Magnet Motor
P22[**x*]	NEMA 23 Frame, Step Motor, 3 Stack
S32[**x*]	NEMA 34 Frame, Step Motor, 2 Stack
B23	23 Frame Brushless Servo Motor
X	Customer Supplied Motor (motor described in "Options" element of part number)

***Insert one of the following for *x*:**

N = 8 leads (windings can be wired in Series or Parallel)
T = Windings pre-wired in Series
V = Windings pre-wired in Parallel

3 Drive Ratio

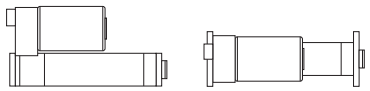
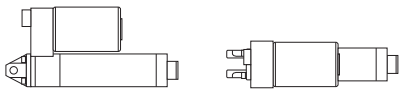
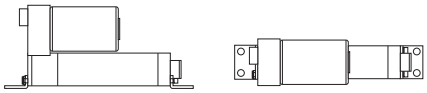
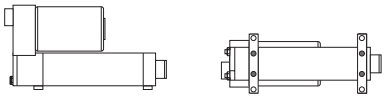
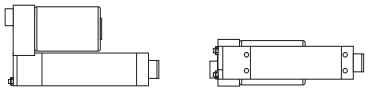
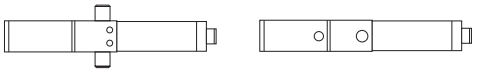
10	1.0:1 Drive Belt/Pulley *(1.0:1 exact ratio)*
15	1.5:1 Drive Belt/Pulley *(1.5:1 exact ratio)*
20	2.0:1 Drive Belt/Pulley *(2.0:1 exact ratio)*
25	2.5:1 Helical Gear *(2.5:1 exact ratio)*
31	3.1:1 Helical Gear *(3.125 exact, or 50:16 ratio)*
120	12.0:1 Helical Gear *(12:1 exact ratio)*
10L	1.0:1 Inline Coupling [Note: Direct 1:1 coupling is the only ratio available for Inline Models

4 Screw Type

5A	5 Pitch (.2" lead) acme leadscrew
8A	8 Pitch (.125" lead) acme leadscrew
2B	2 Pitch (.5" lead) ballscrew
5B	5 Pitch (.2" lead) ballscrew

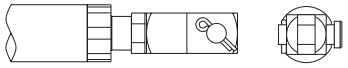
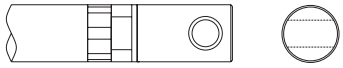
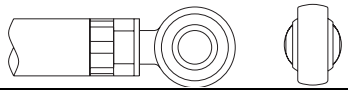
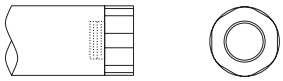
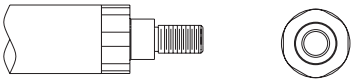
5 Stroke Length - *Specified in inches*

6 Mounting Styles

MF1* **MF2*** **MF3***	Front Rectangular Flange Rear Rectangular Flange Front & Rear Rectangular Flange	
MP2 **MP3**	Rear Double Clevis Mount (shown) Rear Double Clevis Mount with Pivot Base	
MS1	Side End Angles	
MS2	**Side Lugs**	
MS6*	Side Tapped Mounting Holes	
MT4	Trunnion Mount (Inline versions only)	
*Add M suffix for Metric version (e.g. MF1M, MS6M, etc.)		

Cylinder Configuration Guide

7 Rod Ends

FC2	Clevis (includes MT1)	
FE2	Female Eye (includes FT1)	
FS2	Spherical Joint (includes FT1)	
FT1*	Female Thread	
MT1*	Male Thread	
*Add M suffix for metric version (e.g. FT1M, MT1M, etc.)		
Note: Rod-End dimensions can be found in the latest IDC Catalog		

8 Cylinder Options

BM	Brake on Motor
BS	Brake on Leadscrew
DB	Double Bearing
EM	Encoder on Motor (500 line)
EMK	Encoder on Motor (1000 line)
F	Subfreezing
H	High Temperature
L	Linear Potentiometer
PB	Protective Boot
PN	Pre-loaded Nut
Q	Quick Disconnect
W	Water Resistant Seal
Motor Mod Codes for X Motors (Customer Supplied) also found in Option part of Part Number	

2. Mounting Your N2 Cylinder

Warning! Ensure that **power to the electric cylinder is OFF** before attempting any installation, adjustment, or modification to the cylinder mounting, rod end attachment, or the load.

Mounting Requirements

1. The structure on which the cylinder is mounted must be capable of holding three times (3X) the cylinder load and be rigid enough to prevent undue deflection or distortion of the cylinder or its supporting members.
2. The cylinder must be mounted parallel to the travel of the load to ensure proper alignment (this is especially important with externally guided loads using rails, bearings, etc.).
3. All mounting surfaces must be flat and clean to provide secure and stable fittings.
4. Units with flat surface mounts (MF1, MF2, MF3, MS1, MS6) must be rigidly mounted.

Cylinder Mounting Styles

Each cylinder mounting style presents different application considerations. Find your mounting style(s) in the table below and pay special attention to the corresponding "Application Requirements" column.

Cylinder Mounting Style	Application Requirements
MF1 - Front Flange	Not recommended for use in horizontal applications with stroke lengths greater than 12 inches unless there is additional support in the rear of the cylinder.
MF2 - Rear Flange	Not recommended for use in horizontal applications with stroke lengths greater than 12 inches unless there is additional support in the front of the cylinder.
MF3 - Front & Rear Flange	Do not allow the body of the cylinder to twist while aligning the front and rear mounting flanges to their mating surfaces.
MP2 - Rear Clevis	Use a flexible rod end or load attachment to compensate for system misalignment. Example: FC2, FE2, or FS2 rod ends
MS1 - Side End Angle Brackets	Bolts used to secure brackets must be able to withstand a shearing force of up to 1000 lbs.
MS2 - Side Lugs	Bolts used to secure brackets must be able to withstand a shearing force of up to 1000 lbs.
MS6 - Side Tapped Holes	Mounting-screws (used with Side Tapped Holes) must resist a peak shear force of up to 1000 lbs. This mounting alone is not recommended for loads in excess of 500 lbs.
MT4 - Trunnion Mount	Use a flexible rod end or load attachment to compensate for system misalignment.

Mounting Rod Ends

As with mounting styles, different rod ends also require certain application considerations. Find your rod end(s) in the table below and pay special attention to the corresponding "Application Requirements" column.

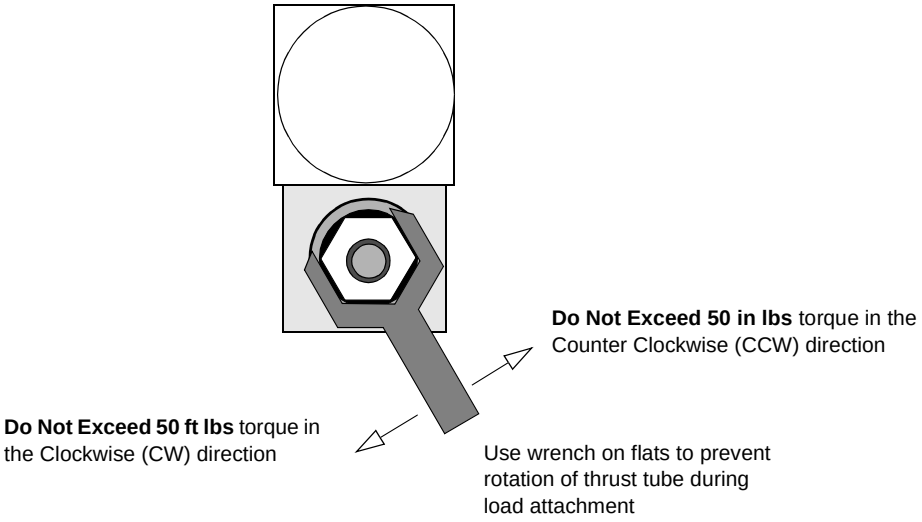
Rod End Style	Application Requirements
FC2 - Clevis w/MT1 Thread	Clevis must be secured by its locknut when in desired position. The mounting pin must be secured with a cotter pin after it is inserted into the double clevis holes.
FE2 - Female Eye	Adjust for maximum thread engagement.
FS2 - Spherical Joint	Not recommended if stiff or rigid load attachment is required.
FT1 - Female Thread	**Maximum thread depth is 3/8 inch.** Exceeding maximum thread depth may cause contact with leadscrew or cause damage when the thrust tube is fully retracted.
MT1 - Male Thread	Any attachment to an MT1 rod end must be secured in place by a locknut

Attaching the Load to the Rod End

Warning!

Do Not Exceed the Maximum Torque Limits on the Thrust Tube when attaching the load to the rod end. Failure to heed this warning could cause irreparable damage to the internal guide flange. Maximum torque limits are shown on the drawing below.

Hexagonal flats are provided at the end of the thrust tube to prevent rotation while the rod end attachment is being secured.

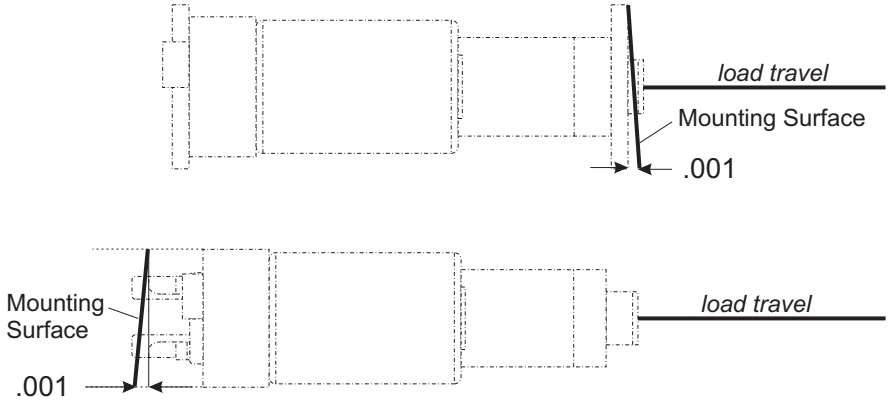


Aligning the Actuator to the Load

Load-travel alignment is critical for the prevention of binding and premature wear of internal components. The following alignment procedures and specifications have been developed for users who demand the highest level of precision and longest life from their IDC electric cylinders.

Alignment Using MF1, MF2, MF3, MP2, MP3, or MT4 Cylinder Mounting Styles

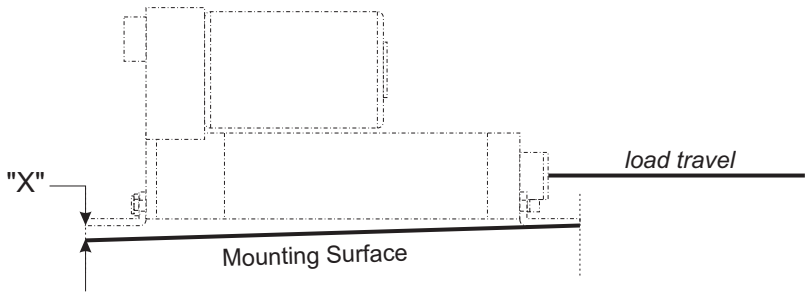
1. Ensure that the mounting surface is within .001 inches from perpendicular to the travel of the guided load. See illustrations below.
2. Mount the actuator loosely to the mounting surface, i.e. all mounting bolts are installed but they are loose enough to allow the actuator to move in the mounting.
3. Attach the guided load system to the cylinder rod end.
4. Reduce as much weight as possible from the guided load system.
5. Run the actuator for 5 to 10 cycles, allowing the actuator to align itself to the guided load system.
6. Tighten the actuator mounting bolts according to the torque specifications for your specific hardware.



Alignment Using MS1, MS2, or MS6 Cylinder Mounting Styles

1. Ensure that the mounting surface is within "X" inches from parallel to the travel of the guided load. See table and illustration below.
2. Mount the actuator loosely to the mounting surface, i.e. all mounting bolts are installed but they are loose enough to allow the actuator to move from side to side.
3. Attach the guided load system to the cylinder rod end.
4. Reduce as much weight as possible from the guided load system.
5. Run the actuator for 5 to 10 cycles, allowing the actuator to align itself to the guided load system.
6. Tighten the actuator mounting bolts according to the torque specifications for your specific hardware.

Cylinder Length	"X" inches
2	.002
4	.002
6	.003
8	.004
10	.004
12	.005
18	.007



Installing Position Sensors for Overtravel Protection

Although an "elastomeric spring" inside the actuator is designed to prevent actuator jams, position sensors (aka limit switches) are required to prevent such potentially damaging jam conditions. If the motor is accidentally commanded to move toward a hard-stop, position sensors can signal a stop before a collision occurs. To work properly, position sensors must be positioned inward from the hard-stop, and wired correctly to the motor controller.

Note: Using the physical limits of the cylinder (hard stops) will reduce cylinder life and can cause premature component failure.

Position Sensor Specifications for Sensors Used on N2 Electric Cylinders							
Sensor Series		**PSR-1**	**PSR-2**	**PSN-1**	**PSN-2**	***PSP-1**	***PSP-2**
Sensor Type		Mechanical Reed		Hall-Effect			
Output Type		Contact Closure		Sinking, Open Collector (NPN)		Sourcing (PNP)	
Connection		Norm. Open	Norm. Closed	Norm. Open	Norm. Closed	Norm. Open	Norm. Closed
LED Color		Green	Red	Green	Red	Yellow	Red
Leads (wiring)		2 + shield, 26 AWG, 3 meters		3 + shield, 26 AWG, 3 meters			
Supply	**Voltage**	4 - 120V (AC or DC)		10 - 24 VDC			
	Current			5 mA @ 12 VDC; 10 mA @ 24 VDC			
	Power			0.24 W			
Leakage Current (max.)				0.01 mA			
Output	**DC Maximum**	120 VDC		24 VDC			
	AC Maximum	120 VAC					
	Current Max.	50 mA		100mA			
	Power Max.	6 W		3 W			
Operating Temp.		-4° to 158°F [-20° to 70°C]					
Storage Temp.		-4° to 176°F [-20° to 80°C]					
Environmental Rating		IEC Standard IP67					
***Not compatible with IDC motion controllers**							

Mounting Location - Deceleration Distance

The position sensor's location along the cylinder is associated with the beginning of a deceleration, not the final stopping point. Therefore, position sensors must be mounted inward of the cylinder hard-stops to provide a slowdown area to prevent jamming. The faster the approach speed, the longer it takes to stop the cylinder, so deceleration distance varies with actuator speed, load, and cylinder/control type. A small amount of adjustment may be necessary during initial setup.

Important Installation Notes

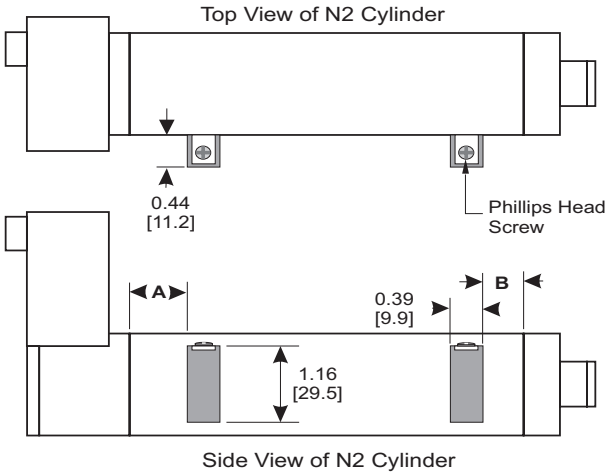
1. Position sensors may be mounted along either side of an N2 cylinder. Note: Position sensors can be mounted on only one side of a cylinder equipped with the Linear Potentiometer (-L) option.
2. Distance between sensors should be 1.50 inches or more. If sensors are located closer than 1.50 inches apart, they may trigger at the same time.
3. Using position sensors for end-of-travel protection reduces effective travel distance. Consult the factory.
4. **IDC's D2200, D2300 and D2400 series controls use only PSR-1 and PSN-1 position sensors.**

CAUTION

When installing a position sensor, tighten the clamp screw to a maximum 7.0 oz-in of torque. Failure to heed this caution could cause irreparable damage to the sensor. Tighten the clamp screw gently and only to the point where the sensor assembly feels secure and does not slide along the cylinder wall.

Position Sensor Dimensions and Mounting Locations

The illustrations below show sensor mounting locations when cylinder magnet and sensor are physically aligned. These locations are recommended as a starting point when setting up a cylinder for the first time. Depending on the speed and payload of the application, sensors may be moved inward to prevent hard-stop crash when the load travels at full speed past a limit switch.



See "Caution" on previous page before attempting to tighten the installation screws on a position sensor

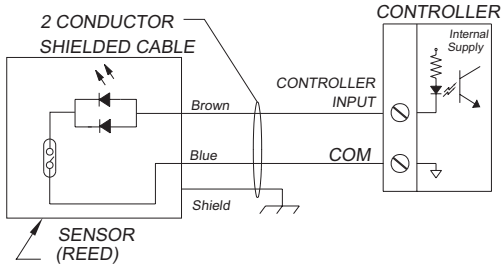
Dimensions "A" and "B" are approximate end-of-stroke locations for the position sensors.

N2 Screw Type	Dim "A"	Dim "B"
Acme	1.00 [25.4]	0.70 [17.8]
Ball	1.40 [35.6]	0.30 [7.6]

Sensor-to-Controller Connections

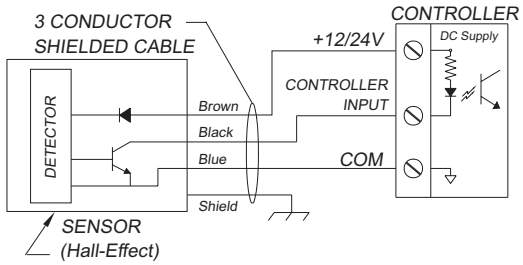
The sensor connection diagrams below show wiring color codes and controller inputs for connecting each type of position sensor.

PSR Reed Sensor

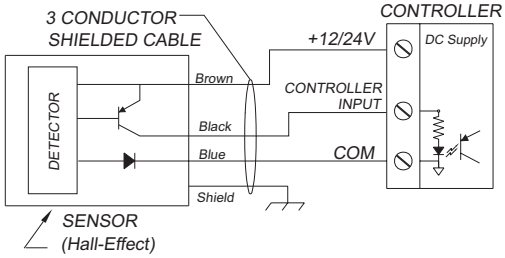


Note: The black wire in *Quick Disconnect* cables is not used with any version of the PSR (Reed) sensor. In the above drawing, only the blue wire, brown wire, and shield are connected.

PSN Hall-Effect Sensor



PSP* Hall-Effect Sensor



*****PSP sensor is not compatible with IDC controls.

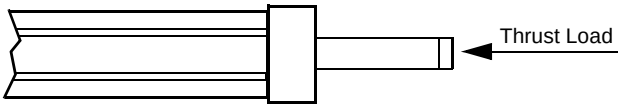
3. Application Considerations

Certain conditions can limit cylinder performance and should be addressed prior to installation and operation. Adherence to the following application guidelines will ensure a successful application.

Maximum Thrust Load

Exceeding the maximum thrust load will cause the leadscrew to buckle and become permanently damaged.

Maximum Thrust Load for all configurations of N2 cylinders is 600 lbs [2670 N]

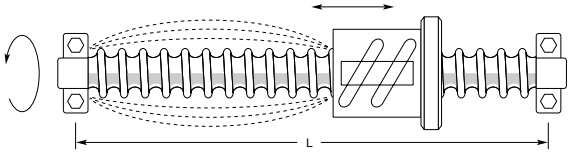


Critical Speed

All leadscrew systems have a rotational speed limit at which harmonic vibrations begin to occur. Sustained operation beyond this critical speed may cause the leadscrew to vibrate or whip violently, eventually bending or warping the screw. The critical speed limit is typically caused by unsupported leadscrew length.

Speed Limitations Due to Stroke Length

Screw Type	Max. Speed per Cylinder Stroke Speed = in/sec [mm/sec]	
	< 12"	< 18"
2B	36.7 [932]	
5B	15 [381]	
5A	15 [381]	13.8 [351]
8A	9.4 [239]	



Application Note:
IDC programmable controls have a maximum velocity parameter that can be configured not to exceed the "critical speed."

Duty Cycle Limits

Duty cycle is the percentage of **ON Time** divided by **Total Cycle Time** for the worst-case 10-minute period. During operation, duty cycle represents the maximum acceptable power dissipation of the motor and the frictional heat losses of the internal cylinder components, primarily the leadscrew/drivenut assembly. In general, ballscrew actuators are rated for 100% duty cycle and acme screws are rated for a maximum of 60%. Your motor may also have duty cycle limitations. Consult your IDC Catalog for more information on duty cycles. Exceeding the recommended duty cycle will damage the motor or internal cylinder components.

Environmental Specifications

The following environmental specifications must be observed for optimal cylinder performance.

Temperature Ratings

Standard N2 Cylinder	32° to 140°F [0° to 60°C]
High Temp Option (-H)	32° to 160°F [0° to 71°C]
Sub-Freezing Option (-F)	-20° to 105°F [-29° to 41°C]

Preventing Exposure to Contaminants

Liquids: Standard N2 Series Cylinders are not water (nor any liquid) resistant. If liquid or moisture contaminates internal components, damage may occur. A Water Resistant option (-W) is available for environments with a slight mist on the cylinder body but not on the thrust tube.

The Protective Boot option (-PB), which includes the -W option, is available to protect the thrust tube/wiper interface. The -W and -PB options provide a seal between the motor and cylinder body, but do not protect the motor itself.

For applications where exposure is unavoidable with a corrosive liquid or a pressurized liquid, an external protective enclosure is recommended. Consult the factory for assistance.

Solid Particles: Rod-type cylinders are generally well protected against particle contaminants. For environments with exposure to fine or abrasive particles, the Water Resistant (-W) option provides added resistance to entry by sealing mating surfaces with RTV sealant during assembly. The Protective Boot (-PB) option is recommended when the thrust tube/sleeve bearing interface is exposed to abrasive particles or water spray.

4. Optional Equipment - Specifications, Dimensions, and Wiring

Brake on Leadscrew Option (-BS24, -BS115, -BS230)

This brake option provides a spring-set, electrically-released friction brake mounted to an extension of the leadscrew. It prevents backdriving when the unit is at rest, or in case of power failure. Without power, the brake is engaged. Applying power releases the brake, allowing motion to occur.

Application Note: This option is used only for *in-position* holding, it should not be used for stopping a moving load.

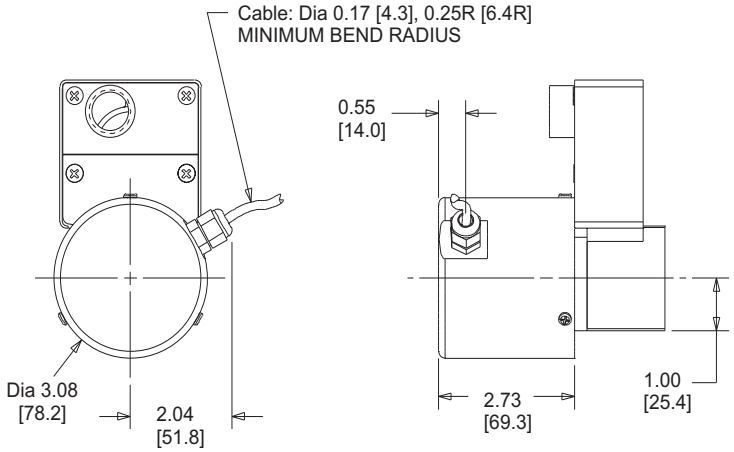
Specifications

Specification Parameters		Leadscrew-Mounted Brake Configurations		
		-BS24	**-BS115**	**-BS230**
Voltage		24 VDC	115 VAC	230 VAC
Current	(Amps)	0.667	0.14	0.07
Power	(Watts)	16		
Holding Torque	(in lbs)	30		
Cable Length	(ft)	12		

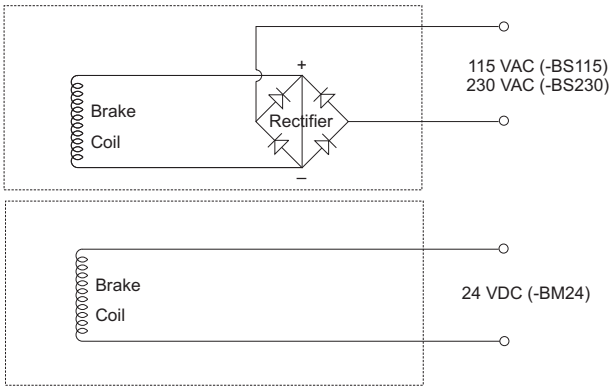
Holding Force

Screw Type and Pitch	Holding Force
2B (2 Pitch Ballscrew)	240 [1100]
5B (5 Pitch Ballscrew)	600 [2670]
5A (5 Pitch Acme Screw)	600 [2670]
8A (8 Pitch Acme Screw)	600 [2670]

Dimensions



Electrical Connections



Brake on Motor Option (-BM24, -BM115, -BM230)

The motor shaft-mounted brake can be an advantage because brake torque is multiplied by the belt or gear reduction and does not interfere with certain rear cylinder-mounting options. A broken drive belt will render the motor-mounted brake inoperable.

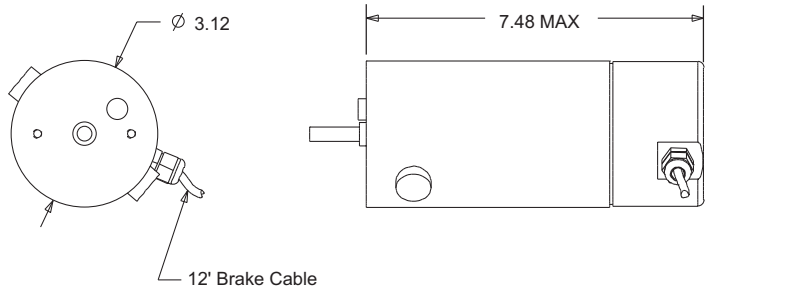
Note: This brake option is used only for *in-position* holding, it should not be used for stopping a moving load.

Specifications

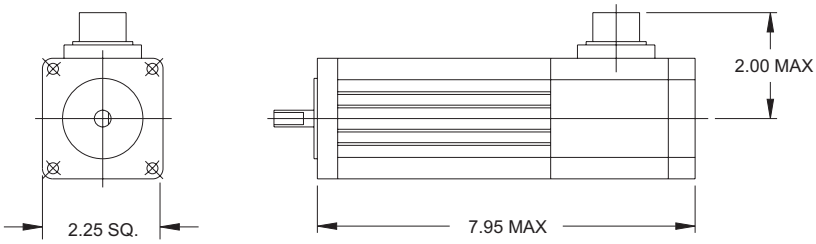
Specificaiton Parameters		Brake Option Availability by N2 Configuration			
		N2-H (H Motor)			N2-B (B23)
		-BM24	-BM115	-BM230	-BM24
Voltage		24 VDC	115 VAC	230 VAC	24 VDC
Current	(Amps)	0.25	0.05	0.03	0.21
Power	(Watts)	6			5
Holding Torque	(in lbs)	10			10
Cable Length	(ft)	12			See Note
Holding Force		Consult the Factory			
Note: Brake wiring included in B23 motor cable. Motor cable available in 12', 25', and 50' lengths.					

Dimensions

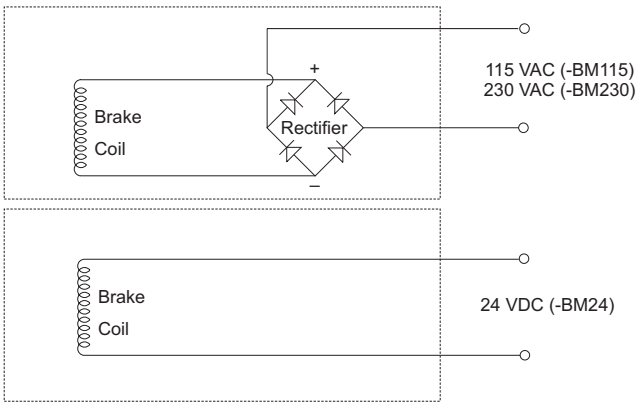
H Motor with Brake



B23 Motor with Brake



Electrical Connections



Note:
Observe polarity when using a -BM24 Brake with a B23 Motor only.

Encoder Option (-EMK/-EM)

The encoder option for the N2 cylinder provides an incremental rotary encoder, factory-mounted directly to the rear of the D, H, P22, and S32 IDC motors. The -EMK encoder is an industry-standard, 1000-line version, while the -EM encoder is a reverse-compatible 500-line version. The digital pulse output is used to provide position feedback to external devices such as motor controllers, counters, or PLC's. The only other IDC motor available with the N2 cylinder is the B23, which comes already equipped with a 2000-line encoder (specs shown below for reference).

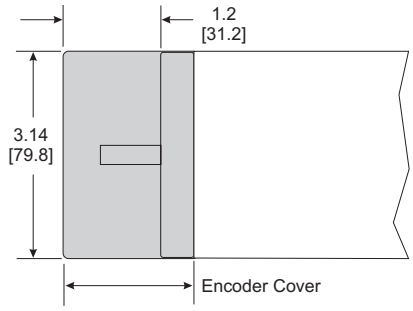
Specifications per N2-Applicable IDC Motor

Parameter	D, H, P22, S32 Motors	*B23 Motor
Pulses per Revolution	**-EMK** 1000 line (4000 post-quad) **-EM** 500 line (2000 post-quad)	Standard 2000 line (8000 post-quad)
Output Pulse Format	Incremental, Dual Square Wave Quadrature, with Index Pulse	
Cable Length/Type m [ft]	3.7 [12]/Leads	3.7 [12]/MS Connector
Voltage	5 VDC ±5%	
Current	120 mA	200 mA
Max. Speed	6000 rpm	
Weight kg [oz]	0.17 [6.0]	0.25 [8.8]
Inertia kg-m^2 [oz-in-sec^2]	5.1 x 10^{-9} [7.3 x 10^{-7}]	1.0 x 10^{-6} [1.4 x 10^{-4}]
Operating Temperature ºC [ºF]	-10 to +70 [+14 to +158]	-20 to +100 [-4 to +212]
Storage Temperature ºC [ºF]	-20 to +80 [-4 to +176]	-25 to +100 [-13 to +212]
*Not an option. Encoder is standard equipment on the B23 motor.		

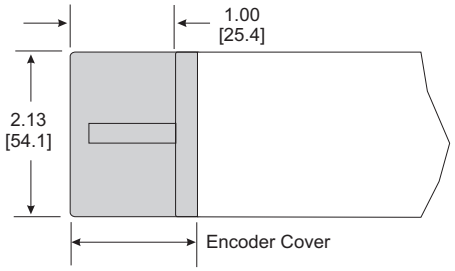
Dimensions

S32, B23 Motors: Encoder is enclosed within the standard motor housing. No dimensional changes

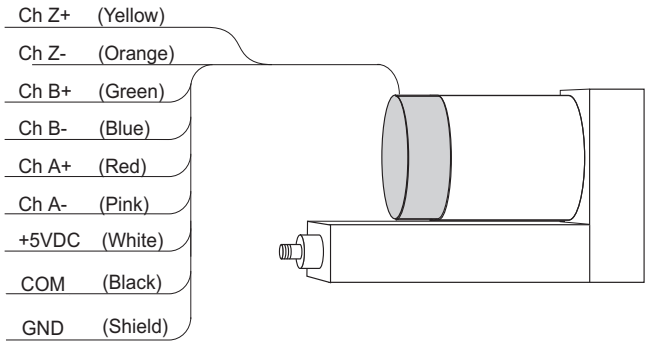
H Motor



D, P22 Motor



Electrical Connections



Linear Potentiometer Option (-L)

The Linear Potentiometer resides within the cylinder housing and is energized by an external DC power supply. The potentiometer wiper moves in conjunction with the cylinder thrust tube providing an analog voltage feedback signal which is proportional to the linear displacement.

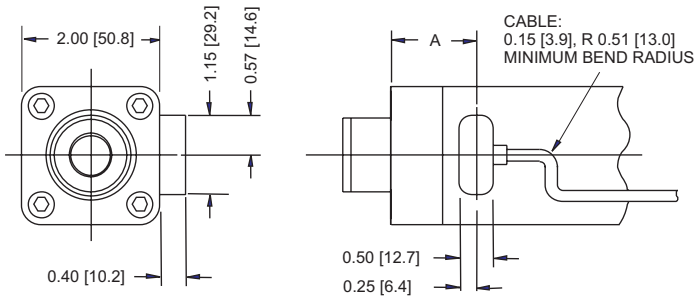
Example: Using a 5 volt supply, 0VDC = 0% Stroke; 2.5VDC = 50% Stroke; and 5 VDC = 100% Stroke

Application Notes
1. This option is not recommended for high vibration environments.
2. This option is required when the N2 is used with IDC D2500, H3500, H4500, and B8500 series controls.
3. For improved accuracy, users may want to "map" or calibrate each unit.

Specifications

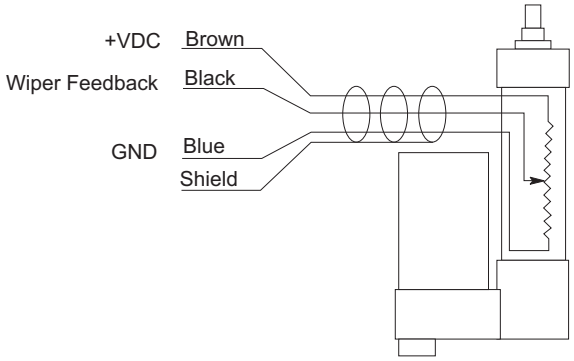
Stroke (inches)	Resistance (ohms)	Max. Non-Linearity
2	3000 ± 20%	±1%
4	6000 ± 20%	±1%
6	9000 ± 20%	±1%
8	9000 ± 30%	±1%
10	9000 ± 30%	±1%
12	7000 ± 30%	±1% (5% to 95% of function)
18-DB (16.5 actual)	7000 ± 30%	±1% (5% to 95% of function)

Dimensions
(side-mounted Linear Pot)



N2 Cylinder Type	DIM "A" with 2, 4, 6, 8, 10" Stroke in [mm]	DIM "A" with 12, 18" Stroke in [mm]
ACME	1.69 [42.9]	1.69 [42.9]
BALL	1.25 [31.7]	1.38 [35.1]

Electrical Connections



5. Factory Service and Routine Field Maintenance

While we recommend factory service in most cases, we recognize that it may occasionally be necessary to perform minor repairs or maintenance in the field. Such cases include replacing worn or broken components (i.e. belts, rod ends, or mounting hardware) and lubrication of leadscrew or gears as required in extreme applications.

All routine maintenance procedures must be performed by qualified personnel, using only IDC-supplied or IDC-recommended parts and supplies. Improper routine maintenance which causes damage or premature wear will void the factory warranty.

The table below is provided as a quick reference to help users decide whether to return a unit to the factory or allow qualified personnel to perform routine maintenance in the field.

Factory Service Required	Routine Maintenance Procedures	Page #
Belt/Pulley Ratio Conversion (1:1, 1.5:1, 2:1)	Pulley and Pinion Installation	19
Helical Gear System Ratio Conversion (2.5:1, 3.1:1, 3.5:1, 12:1)	Lubricating the Leadscrew (excluding -W, -BS, -L options, or cylinders with gear reduction)	20
Leadscrew Modification	Checking and Adjusting Drive Belt Tension*	21
Motor Orientation Modification	Lubricating Gears	22
Mounting or Rod End Modification	Aligning Motor Pinion*	23
Cylinder Option Modification (-W, -BS, -L)		
Any Repair to Motor Pulley, Drive Belt, Gear, Motor Pinion, Intermediate Gear, or Inline Coupling/Sleeve		

*This procedure was developed for users of IDC motors, but it may also be applicable to certain customer-supplied motors.

Performing Inspections and Routine Maintenance

- **Why Perform Inspections and Routine Maintenance in the Field?**
  Periodic inspection and routine maintenance can extend the life of your cylinder, especially under *extreme operating conditions*.

- **What are Extreme Operating Conditions?**
  Applications such as continuous high speed operation, high speed stops/starts, or exposure to harsh environments.

- **When Should Routine Maintenance be Performed?**
  In such extreme applications, it is recommended that the leadscrew and gears be re-lubricated, and an internal inspection be completed every 1,000,000 inches of cylinder travel. Inspection/re-lubrication typically consists of partial disassembly, followed by cleaning, visual evaluation, and lubrication.

Routine Maintenance Procedures

Routine maintenance procedures are provided in the remainder of this section. Order parts and supplies from your local IDC Distributor.

Prevent Injury to Personnel

Do not attempt to perform any routine maintenance procedure while power is connected to the motor/ cylinder.

Hardware Torque

Before attempting any routine maintenance procedure, become familiar with the Torque Specification Table below. **Always refer to this table before applying torque to any of the listed parts**.

Torque Specification Table			
Description of Part	**Reference # (see Exploded Parts Diagrams)**	**Hardware Size**	**Maximum Torque (in-lbs)**
Bolt, Guide Cylinder	16, 22, 32, 44	1/4 - 20 UNC	50
Screw, Set, Coupler	45	1/4 - 20 UNC	40
Bolt, Motor Mounting	24	10 - 32 UNF 8 - 32 UNC	32 20
Screw, Set, Pulley/Pinion	29	8 - 32 UNC	20
Screw, Cover Plate	28, 35	8 - 32 UNC	20

Lubricants and Adhesives

When a specific lubricant or adhesive is required, it will be specified within the applicable procedure.

Installing a Pulley, Pinion, or Coupling

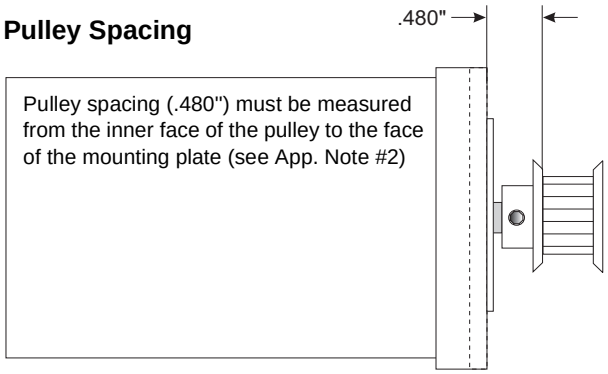
Refer to the appropriate illustration and/or table for your pulley, pinion, or coupling.

1. Clean the motor shaft and bore free of any grease.
2. Apply Loctite #680 (green) to the motor shaft and the bore of the pulley, pinion, or coupling.
3. Slide pulley, pinion, or coupling onto the motor shaft with a rotating motion to evenly distribute the Loctite.
4. Position pulley, pinion, or coupling according to the appropriate "spacing" table or drawing (see App. Note #2).
5. Ensure that one setscrew is positioned on a flat, in a dimple, over a key or keyway.
6. Apply Loctite #262 (red) to the setscrew(s).
7. Tighten setscrew(s).
8. Refer to the motor-mounting procedure on the previous page.

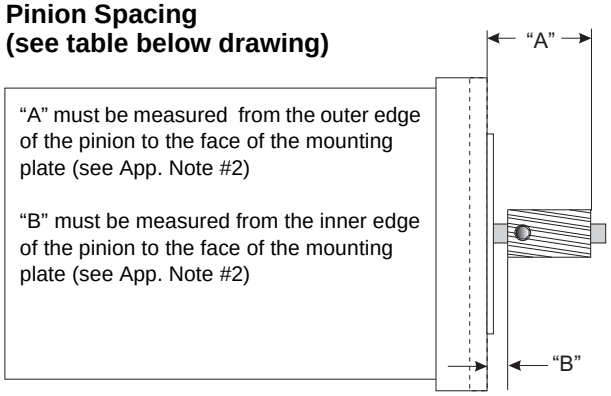
Application Notes

1. **WARNING!** The combination of pulley placement and operating torque may exceed motor shaft load capacity. It is the user's responsibility to verify adequate shaft load capacity.
2. If a supplemental mounting plate or adapter is used, it must be installed *before* measuring pulley, pinion, or coupling spacing.
3. All spacing dimensions for pulleys, pinions, or couplings have a tolerance of ±.005 inches.

Pulley Spacing

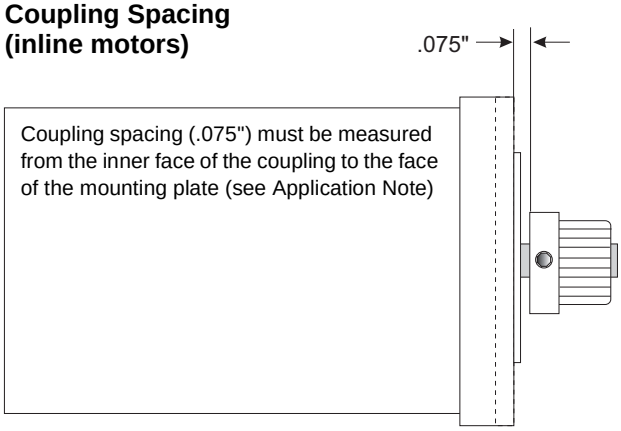


Pinion Spacing (see table below drawing)



Gear Ratio	Dimension "A" Pinion Spacing	Dimension "B" Pinion Spacing
2.5:1	1.018"	
3.1:1	1.018"	
3.1:1 (H Motor only)		.155"
12:1		.233"

Coupling Spacing (inline motors)



Lubricating the Leadscrew

Note: Do not attempt to lubricate the leadscrew of a cylinder with the -L (Linear Potentiometer) Option. This procedure must be done at the factory.

Recommended Lubricants

Type of Leadscrew	Type of Lubricant
Ballscrews With 2B and 5B Screws	NLGI Grade 2, Synthetic Base Lithium Grease
Acme Screws with Bronze Acme Nut (5A and 8A Screws)	NLGI Grade 2, Synthetic Base Grease with PTFE Additive
Acme Screws with Polyacetal Plastic Acme Nut (5A and 8A Screws)	NLGI Grade 2, Synthetic Base Lithium Grease

1. Remove upper cover plate from the gear housing by removing two (2) mounting-screws (8/32 Phillips).

2. Remove lower cover plate by removing two (2) mounting-screws (8/32 Phillips) and two (2) socket head cap screws (1/4-20). The two SHCS are also used to secure the lower part of the guide housing.

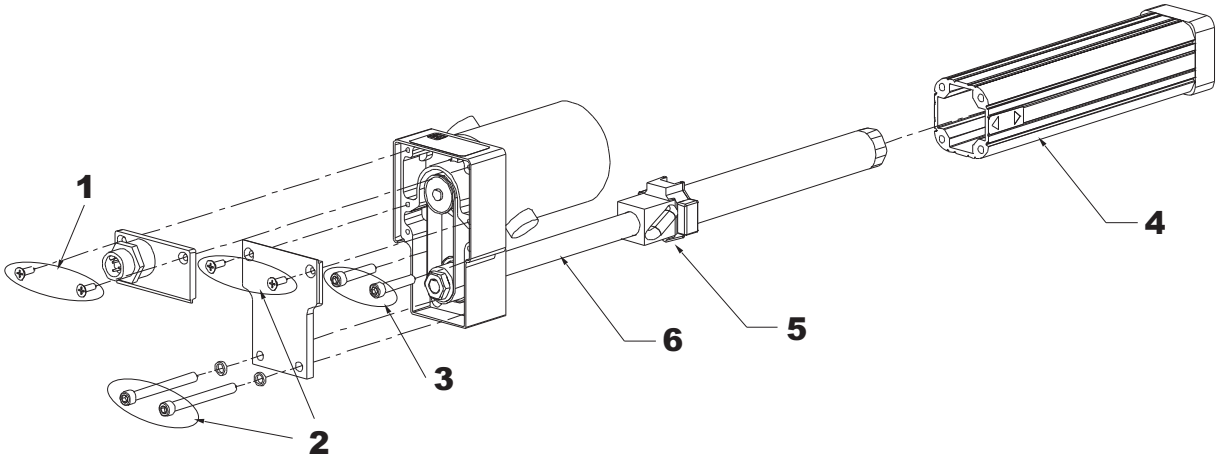
3. Remove two (2) SHCS (inside gear housing) that secure the upper part of the guide housing.

4. Remove guide housing by sliding it away from the thrust tube.

5. Move the drive nut (attached to thrust tube) to the far end of the leadscrew.

6. Remove as much of the old grease from the cylinder as possible.

7. With most of the leadscrew exposed, apply a thin coat (no more than 1/32 ") of the recommended lubricant over the length of the screw. Run the drivenut over the screw length to spread the grease evenly. Wipe off any excess grease that the drivenut expels from the leadscrew. Reassemble Unit.



Checking/Adjusting Drive Belt Tension

1. Remove upper and lower cover plates. For cover plate removal, refer to steps 1 and 2 in "Lubricating the Leadscrew" on the previous page.

2. Using finger pressure, push the drive belt inward. The belt should not deflect more than 1/8 inch from a stationary centerline. If the drive belt deflects more than 1/8 inch, proceed to the following section that applies to your motor.

Adjusting Belt Tension on D and H Motors

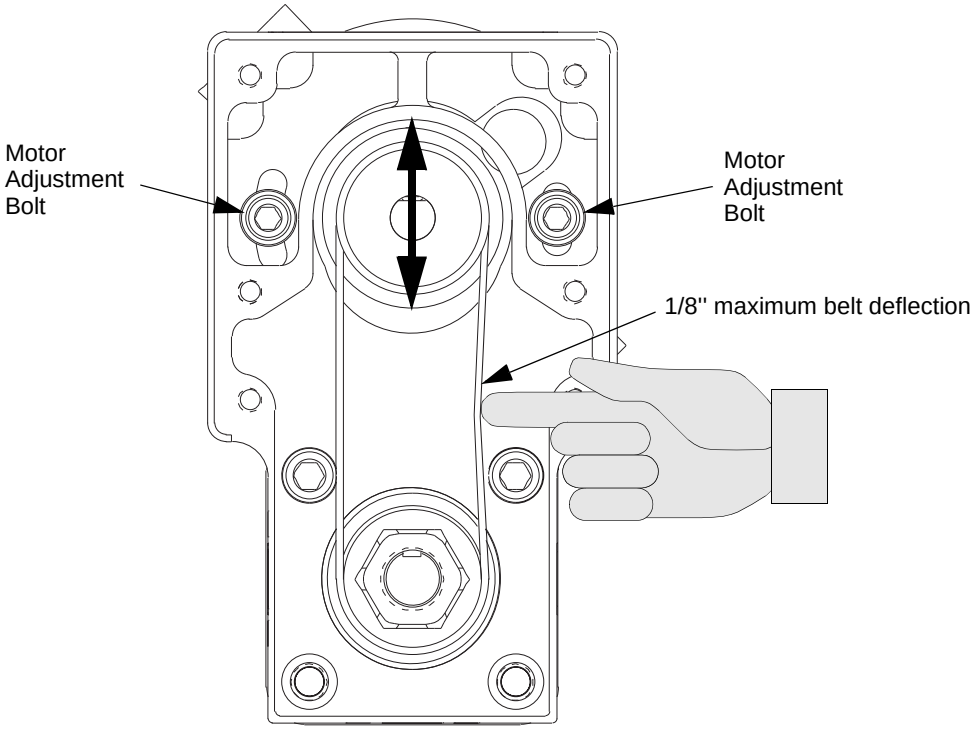
1. Loosen two (2) motor-adjustment bolts (shown below) just enough to allow the motor to move. Both bolts are in slots which allows up/down movement of the motor to change belt tension.

2. Move the motor up or down to adjust belt tension. While maintaining proper tension by hand, tighten both bolts. Check belt tension again and reassemble unit.

Adjusting Belt Tension on P22, S32, and B23 Motors

1. Loosen four (4) motor mounting/adjustment bolts (not shown) just enough to allow the motor to move. All bolts are in clearance holes which allow just enough up/down movement to adjust the belt tension.

2. Move the motor up or down to adjust belt tension. While maintaining proper tension by hand, tighten all bolts. Check belt tension again and reassemble unit.



Lubricating Gears

Recommended Lubricant: NLGI Grade 2, Synthetic Base Lithium Complex EP Grease

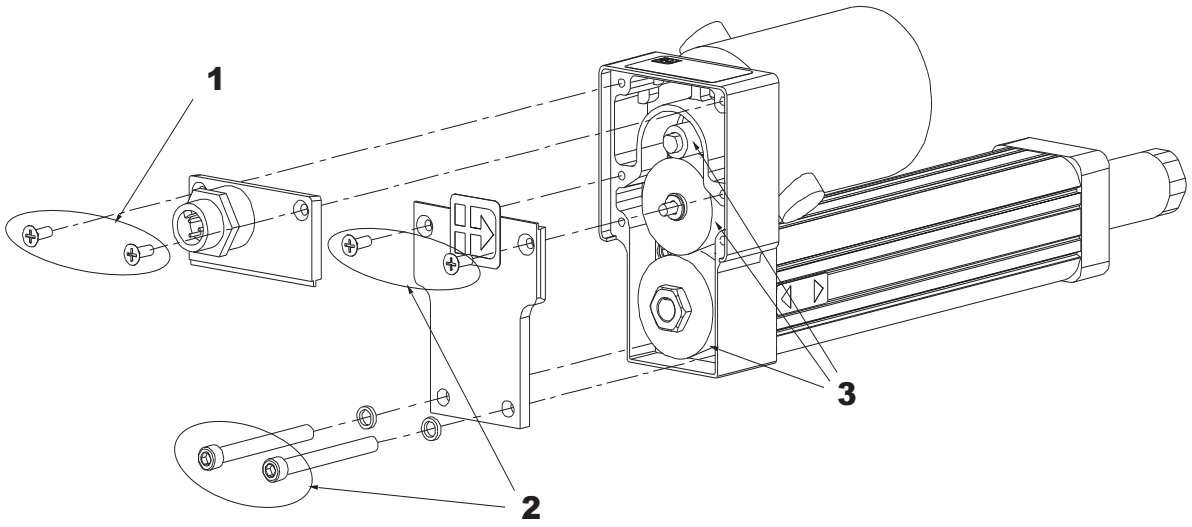
1. Remove upper cover plate by removing two mounting-screws (8/32 Phillips) securing cover plate to housing.

   Note: Cylinder with -BS (Brake on Leadscrew) option requires removal of the top cover plate only. If your cylinder has the -BS option, proceed to step 3.

2. Remove lower cover plate by removing two mounting-screws (8/32 Phillips) and two Hex Cap Screws (1/4-20).

3. Remove as much of the old grease from the gears as possible.

4. With the gears exposed, apply an ample amount of lubricant (1/4" or more) to all surface contact areas of gear train. Reassemble unit.



Aligning Motor Pinion

1. Ensure power to the motor is OFF.

2. Remove upper and lower cover plates for inspection. For cover plate removal, refer to steps 1 and 2 in "Lubricating Gears" on the previous page. Reinstall lower cover plate.

Aligning Motor Pinion on D, and H Motors (shown below)

1. Loosen two (2) mounting/alignment bolts just enough to allow the motor to move. Both bolts are in slots which allow up/down movement of the motor to align the motor pinion.

2. Move the motor pinion into the fully-meshed or seated position against the intermediate gear (i.e. pinion will not move any farther). See #2 in photo below.

3. From the fully-meshed position, back off or move the pinion gear away from the intermediate gear .003 to .008 inch. See #3 in photo below.

4. While maintaining proper position by hand, tighten mounting/alignment bolts. Install upper cover plate.

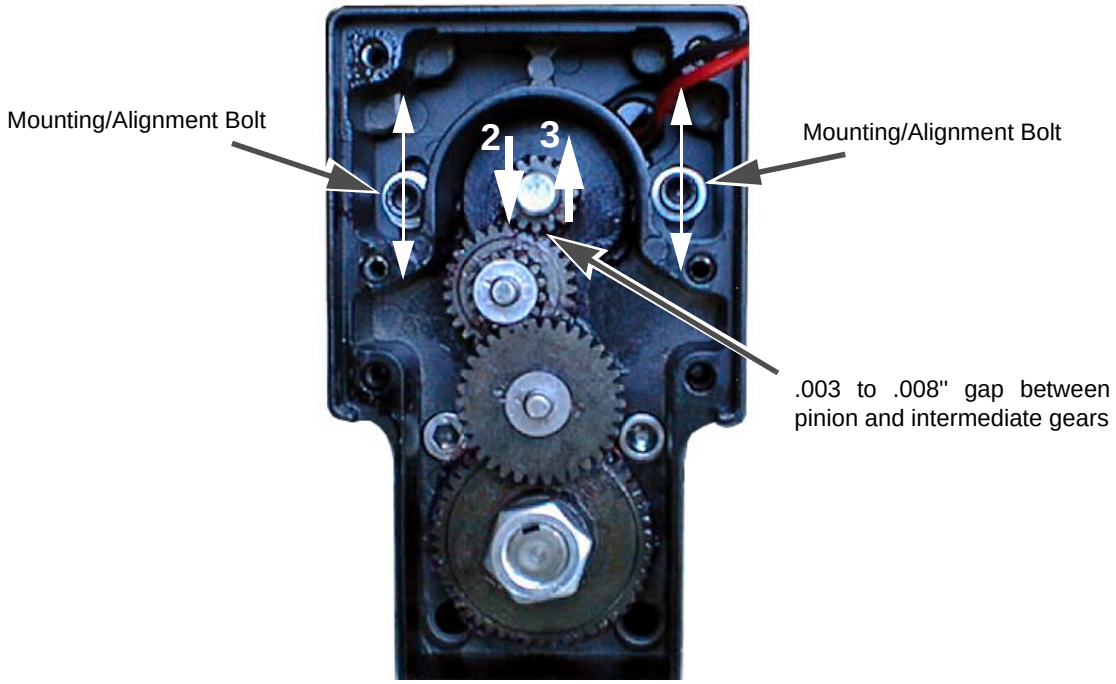
Aligning Motor Pinion on P22, S32, and B23 Motors (not shown)

1. Loosen four (4) adjusting bolts (not shown) just enough to allow the motor to move. All bolts are in clearance holes which allow just enough up/down movement to adjust the motor pinion.

2. Move the motor pinion into the fully-meshed or seated position against the intermediate gear (i.e. pinion will not move any farther).

3. From the fully-meshed position, back off or move the pinion gear away from the intermediate gear .003 to.008 inch.

4. While maintaining proper position by hand, tighten mounting/alignment bolts. Install upper cover plate.



6. Mounting a Customer Supplied Motor

This procedure is provided for the user who will be mounting a non-IDC motor on an N2 Cylinder. For this procedure it is assumed that the N2 cylinder has been received without a motor.

1. Remove upper cover plate from the gear housing by removing two mounting-screws (8/32 Phillips).

   Note: Step 1 applies only to parallel-mounted motors.

2. Remove motor-mounting bolts and washers from the cylinder motor mount.

   Note: If motor mounting bolts and washers are not installed in the motor mount, they can be found packaged in a separate bag.

3. Install the motor pulley, gear pinion, or inline coupling per the installation procedure on the next page.

4. Using the following method appropriate to your application, insert the motor shaft and motor pilot into the gear housing through the hole in the mounting plate.

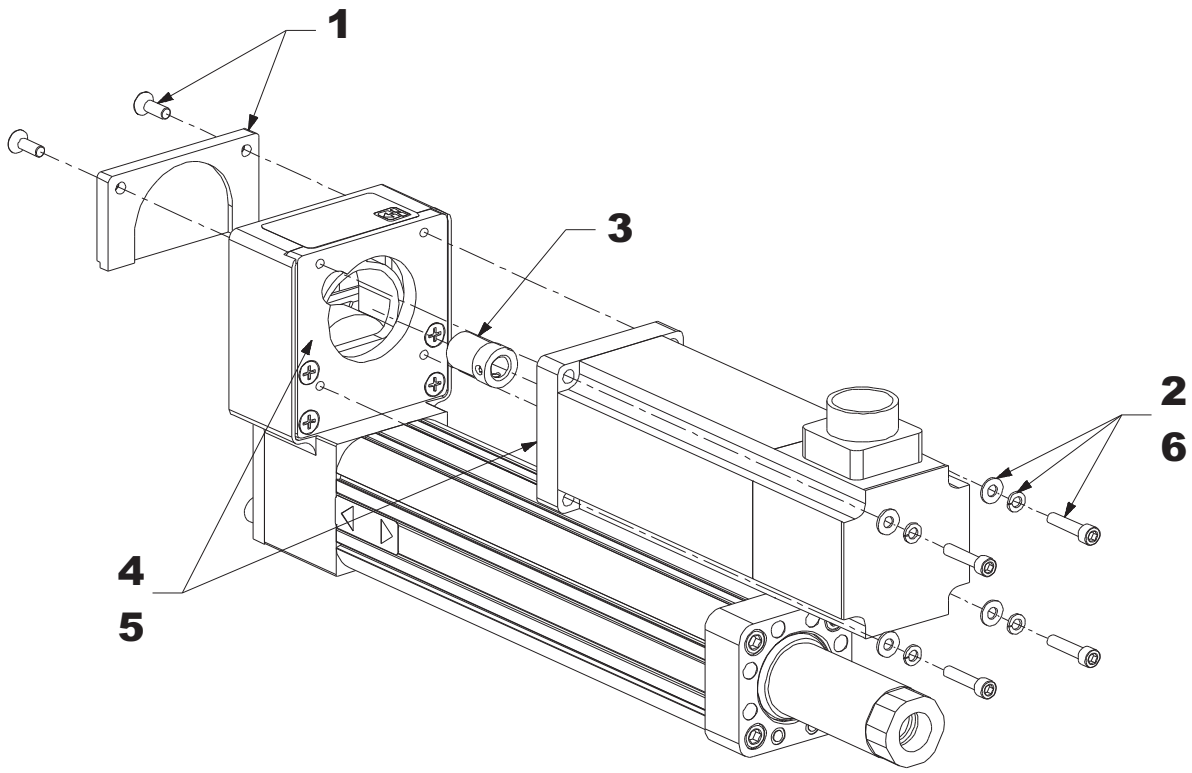
   Drive Belt: As you slide the motor and pulley through the mounting plate, lift the drive belt onto the teeth of the drive pulley. Refer to "Checking/Adjusting Drive Belt Tension" in section 5.

   Gear Drive: As you slide the motor and gear pinion through the mounting plate, gently engage and mesh the pinion with the intermediate gear. Refer to "Aligning Motor Pinion" in section 5.

   Inline Mounting: As you slide the motor and coupling through the mounting plate, rotate the motor coupling until it lines up the coupling sleeve inside the actuator.

5. Continue to slide the motor shaft through the mounting plate until motor flange is flush with the motor mounting plate and the motor pilot is centered inside the mounting plate.

6. Secure the motor to the mounting plate using the motor mounting hardware previously removed.



7. Troubleshooting

This section offers assistance when troubleshooting basic cylinder problems related to mechanical operation. When troubleshooting cylinder problems, the cause may be related to the drive or motor used with the cylinder. Refer to your drive/control user's manual for additional assistance on troubleshooting your system.

The following categories are covered in this section:

A. Audible Noise Emitting from Cylinder
B. Cylinder Motion
C. Positioning and Travel Length
D. Thrust Tube
E. Cylinder Parts and Options

Category/Symptom	Possible Cause	Possible Remedy
A. Audible Noise Emitting from Cylinder		
Knocking, squealing or grinding during operation	Misalignment of internal components	Send back to factory for evaluation.
	Excessive Side-loading	Check side-load rating. Reduce side-load.
	Internal lubrication dried	Remove old lubricant. Re-lubricate the leadscrew and/or gear.
	Entry of foreign matter into cylinder body	Send back to factory for evaluation.
B. Cylinder Motion		
Stalls/Binds/Sticks during a move (erratic motion)	Load too great for cylinder/motor	Check cylinder rating. Reduce load.
	Excessive thrust tube side-loading	Check side-load rating. Reduce side load.
	Motor pulley, gear pinion, or coupling slipping	Re-install pulley, gear, or coupling onto the motor.
	Erratic motor/controller operation	Ensure functionality of the controller. Replace motor.
	Drive nut or internal bearing seizing (locking up) typically due to excessive duty cycle/temperature or entry of foreign matter into cylinder	Send back to factory for evaluation.
Running rough, not running smoothly	Misalignment of internal components	Send back to factory for evaluation.
	Excessive side-loading	Check side-load ratings. Reduce side-load.
	Internal lubrication dried	Remove old lubricant. Re-lubricate the leadscrew and/or gear.
	Entry of foreign matter into cylinder body	Send back to factory for evaluation.
Extends when it should retract (and visa versa)	Motor polarity reversed	Reverse motor polarity at the control.

Category/Symptom	Possible Cause	Possible Remedy
Vibrates during motion	Motor Unstable (servo gains, stepper resonance)	Reduce motor gain for servo-motors. Increase step resolution for step motors.
	Cylinder being operated at critical speed	Check critical speed limit. Reduce speed to less than critical speed.
	Misalignment of internal components	Send back to factory for evaluation.
No motor movement when commanded to move	Motor not connected or is damaged	Reconnect the motor. Replace the motor.
	Load too great for cylinder/motor	Check the load limit. Reduce the load.
	Problem with drive/control	Check output of drive/controller.
Does not move (or is erratic) although motor is rotating	Gear pinion, pulley, or coupling not secured to motor shaft	Secure gear pinion, pulley, or coupling to the motor shaft.
	Belt is loose or damaged	Adjust belt tension. Replace belt
	Bad gear alignment	Adjust gear pinion placement.
	Stripped teeth on gear	Send back to factory for evaluation.
	Threads are stripped on the drive nut (Acme)	Send back to factory for evaluation
Not running at rated speed	Load is too great for desired speed	Ensure cylinder is being operated below the speed/thrust curve. Decrease the load.
	Limited by critical speed (oscillation) of screw	Check the critical speed limits. Reduce the speed.
	Incorrect screw pitch or drive ratio	Enter the correct screw-pitch or drive ratio the controller.

C. Positioning and Travel Length

Cylinder backdriving (without holding torque on motor)	Backdriving force generated by load is greater than the static holding capacity of the cylinder	Check the rated backdriving force for the cylinder. Reduce backdriving force.
	Excessive external vibration	Mounting requires modification to isolate or reduce vibration
Cylinder backdriving (with holding torque on the motor	Backdriving force generated by load is greater than the holding capacity of the screw/nut of the cylinder and the holding torque of the motor	Reduce backdriving force.
	Loss of motor holding torque (servo and steppers)	Recycle power to the motor and controller

Category/Symptom	Possible Cause	Possible Remedy
Not enough travel	Position-Sensors reducing "actual" travel	Adjust sensors to increase cylinder travel without allowing cylinder to hit its internal hard-stop bumper.
	Cylinder option (e.g. -DB option) may be limiting stroke. -DB (Double Bearing) option reduces usable cylinder travel by 1.5 inches.	Return cylinder to factory for modification (remove -DB option). Your application may require a cylinder with longer travel.
	Excessive side-loading	Check side-load rating for the cylinder. Reduce side-load.
	Customer mounting is physically limiting travel	Re-design mounting
Expected linear travel distance not corresponding to number of motor revs	Incorrect screw pitch or drive ratio	Check screw-pitch and drive ratio of the cylinder. Enter correct pitch and ratio in the controller
	Incorrect scaling factor (programmable controllers)	Enter correct scaling factor in the controller
Expected stop position not repeatable (in same direction)	Load varies from cycle to cycle.	Change load to be more consistent from cycle to cycle
	Erratic Motor/Control operation	Contact motor/control vendor for more information.

D. Thrust Tube

Wobbles during extension	Leadscrew or thrust tube is bent	Send back to factory for evaluation
	Excessive wear on leadscrew/nut	Send back to factory for evaluation
	Improper mounting of cylinder	Ensure cylinder travel is aligned with the travel of the load
Deflects too much during extension (Excessive lateral endplay)	Leadscrew/nut or internal bearings are worn	Send back to factory for evaluation
	Excessive side-loading	Check side-load rating. Reduce side load.
	Improper cylinder mounting	Ensure that cylinder travel is in line with the travel of the load
Bent thrust tube	Load too great for cylinder	Send back to factory for evaluation
	Excessive side-loading	
	Improper cylinder mounting	
Rotates (excessive radial play)	Internal guide flange is damaged	Send back to factory for evaluation
	Thrust tube not fully engaged on drivenut	Rotate thrust tube clockwise until it stops turning. The maximum torque exerted on the thrust tube is 50 ft. lbs.

Category/Symptom	Possible Cause	Possible Remedy
Stuck in fully extended or retracted position	Drive nut physically jammed into end of travel	Remove both rear covers and rotate the leadscrew, gear, pulley, or coupling until the leadscrew turns freely. If jammed in extend, rotate CW. If jammed in retract, rotate CCW.
	Load too great for cylinder/motor	Check cylinder load rating. Reduce load
	Excessive side loading	Check side-load rating. Reduce side-load.
	Pulley, gear, or coupling slipping	Re-install pulley, gear, or coupling onto the motor.
	Erratic motor/drive operation	Contact motor/drive vendor for more information
Excessive axial endplay (system backlash)	Leadscrew/nut is worn	Send back to factory for evaluation
	Gears worn	Send back to factory for evaluation
	Belt stretching	Re-tension belt

E. Cylinder Parts and Options

Driving belt breaking or gears stripping	Motor torque is too great	Reduce Accel and Decel
		Reduce load
	Motor accel/decel too great for given load	Reduce Accel or Decel
	Load is too great for cylinder	Check load rating of cylinder. Reduce load.
	Excessive shock loading (running into physical hardstop, rapid change in direction)	Reduce Accel/Decel of cylinder. Stop motion just before the hard stop.
Position Sensors not being activated by internal magnet	Misalignment of internal components	Send back to factory for evaluation
	Weak or missing internal magnet	Send back to factory for evaluation
	Switch/sensor is damaged or miswired	Check/correct switch wiring
		Send back to factory for evaluation
	Cylinder speed too fast	Reduce cylinder speed
Linear Potentiometer (LP) not reading properly	LPO wiper lifting off track (misalignment or LP bending due to excessive load	Ensure cylinder travel is in line with travel of the load
		Reduce load
	Damaged / contaminated LP (by liquid/particle)	Send back to factory for evaluation

Category/Symptom	Possible Cause	Possible Remedy
Motor overheating	Duty cycle too high	Check duty cycle rating. Reduce duty cycle
	High ambient temperature	Use an external fan to cool the motor
	Incorrect current setting on drive	Check the control/drive user's manual for correct current settings. Reset the control/drive with correct current setting.
Brake not holding load	Brake not coupled to motor or leadscrew properly	Send back to factory for evaluation
	Load exceeds holding capacity of cylinder/brake	Check brake load rating. Reduce the load.
	Brake damaged	Send back to factory for evaluation
	Brake wired incorrectly	Check wiring and make corrections or repairs
Encoder reading improperly	Encoder damaged	Send back to factory for evaluation
	Encoder wired incorrectly	Check wiring and make corrections or repairs
	Incorrect supply voltage to encoder	Check encoder voltage rating. Ensure correct voltage is supplied to the encoder.

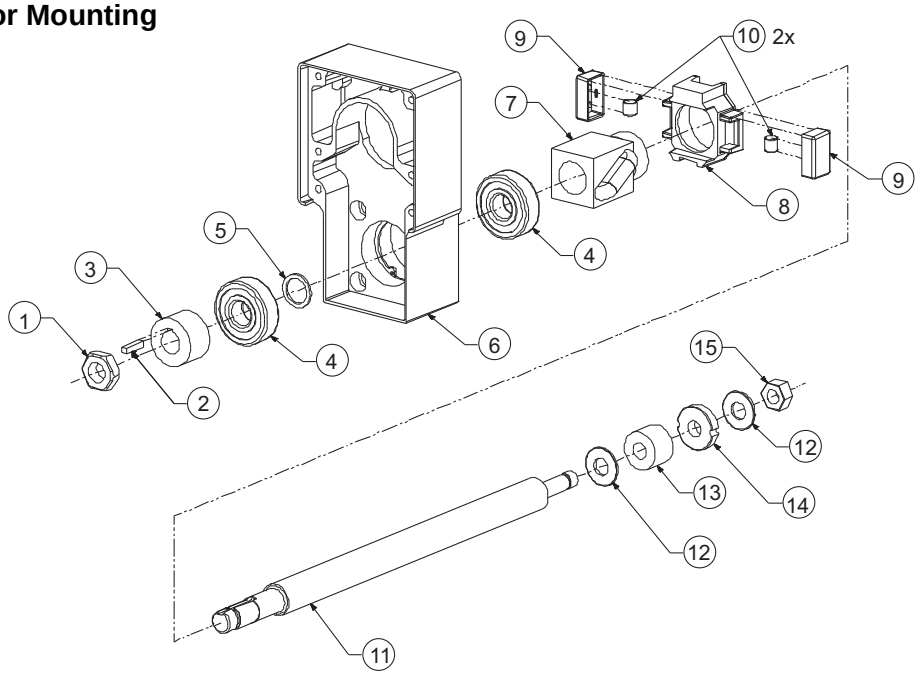
8. Parts List and Exploded Parts Diagrams

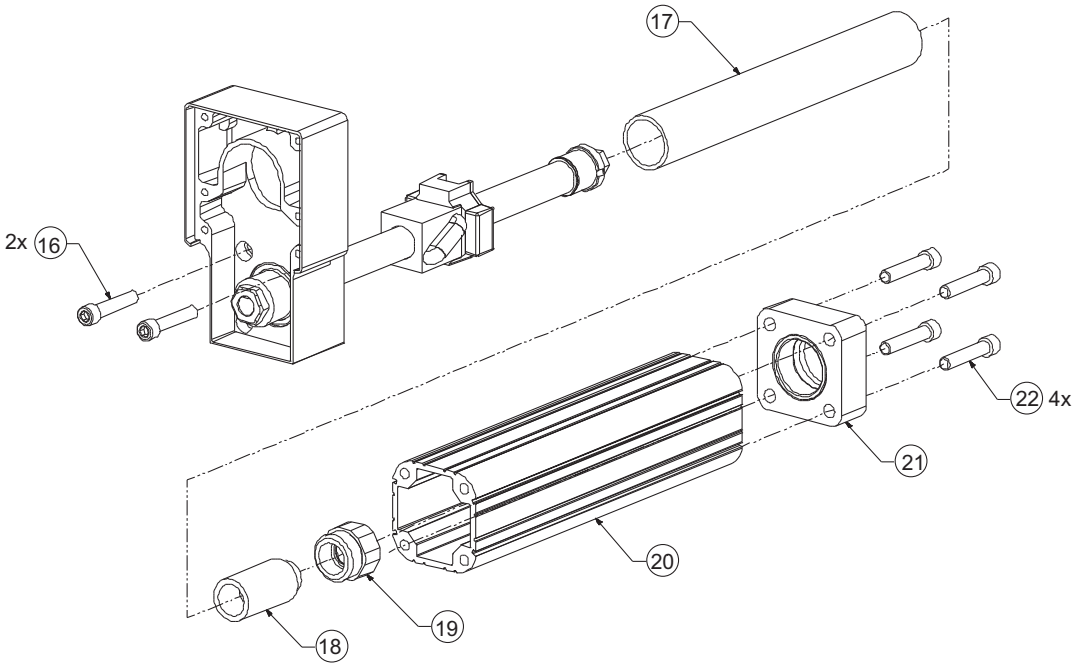
Parts can be ordered through your local IDC distributor. Kits include all essential parts and instructions. Item numbers below correspond with numbered items on the Exploded Parts Diagrams (see following pages).

Reference # on Exploded Parts Diagram	Description of Part
1	Nut, Jam, Rear
2	Key, Pulley, Gear, or Coupling
3	Pulley (Driven), Gear (Driven), or Coupling (Driven)
4	Bearing, Leadscrew
5	Bearing Spacer
6	Drive Housing
7	Drive Nut
8	Guide Flange Body
9	Guide Flange Bushings
10	Magnet, Limit Switch
11	Leadscrew
12	Washer
13	Bumper
14	Bushing, Leadscrew
15	Nut, Jam, Front
16	Bolt, Guide Cylinder, Upper, Rear
17	Thrust Tube
18	Spacer, Bumper (Optional)
19	Rod End
20	Guide Cylinder
21	Assembly, Rod End Housing
22	Bolt, Guide Cylinder, Front
23	Belt, Timing
24	Bolt, Motor Mounting
25	Washer, Lock, Motor Mounting
26	Washer, Motor Mounting
27	Plate, Motor Mounting
28	Screw, Motor Mounting Plate
29	Drive Pulley or Gear Pinion
30	Motor
31	Brushes, Motor
32	Bolt, Guide Cylinder, Lower, Rear
33	Washer, Lock, Guide Cylinder Bolts
34	Label, IDC Decal
35	Screw, Rear Cover Plate
36	Quick Disconnect
37	Plate, Cover, Lower
38	Plate, Cover, Upper
39	Label, IDC Serial Tag
40	Label, Limit Switch (Positioning Sensor)
41	Assembly, Gear, First Stage
42	Assembly, Gear, Second Stage
43	Snap Ring, Internal
44	Bolt, Guide Cylinder, Rear
45	Coupling, Drive
46	Sleeve, Coupling

Exploded Parts Diagram - Parallel Motor Mounting

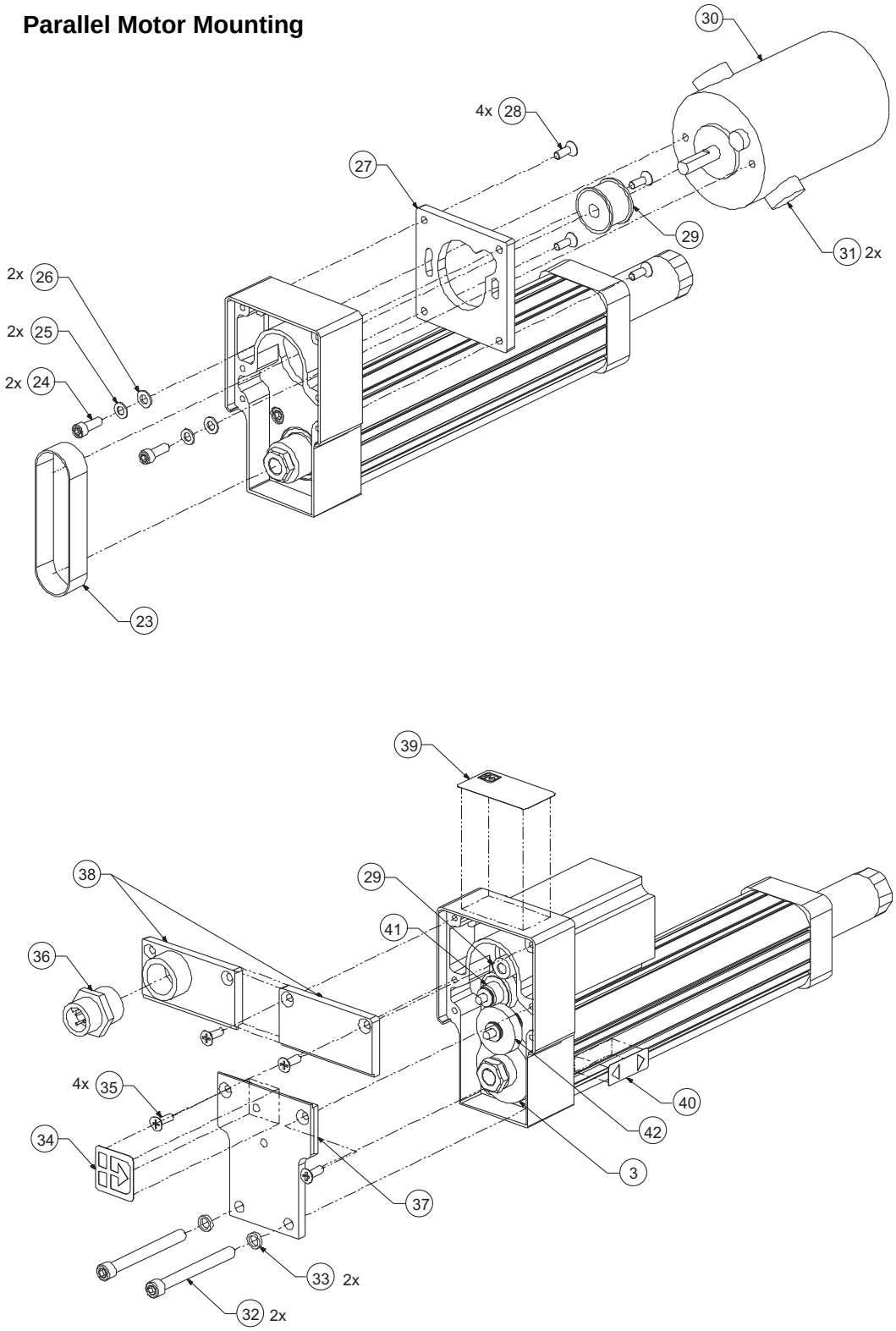
Parallel Motor Mounting





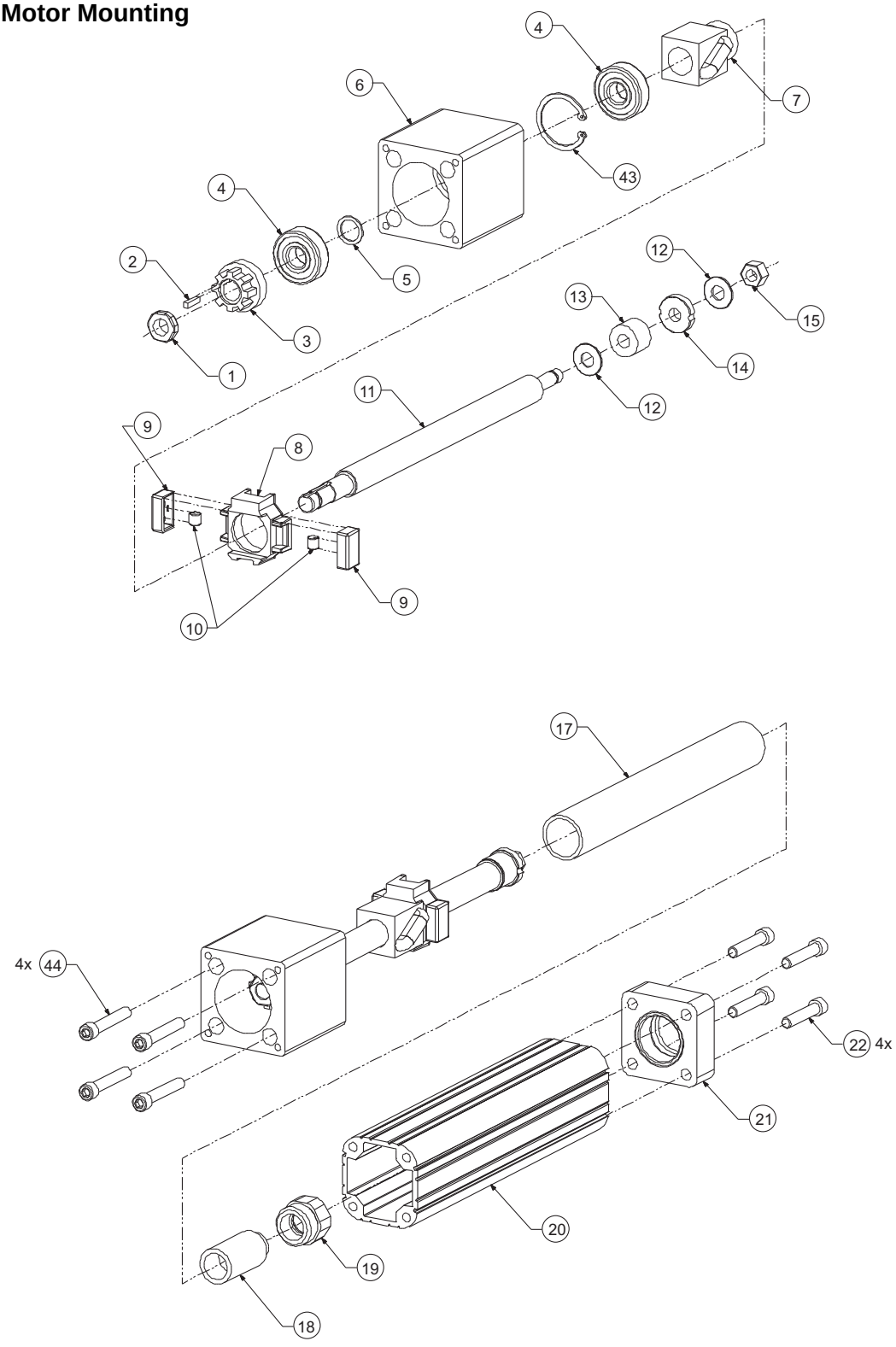
Exploded Parts Diagram - Parallel Motor Mounting

Parallel Motor Mounting

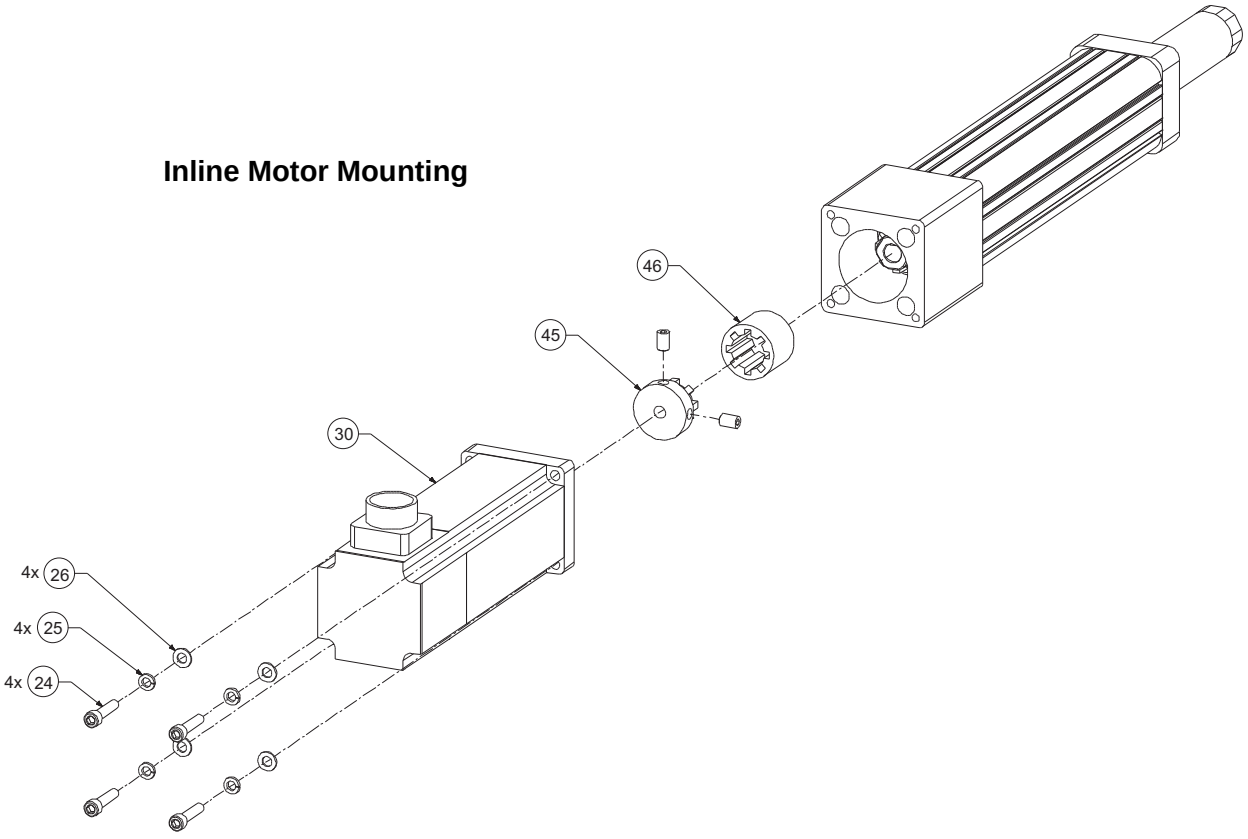


Exploded Parts Diagram - Inline Motor Mounting

Inline Motor Mounting



Exploded Parts Diagram - Inline Motor Mounting



9. Warranty and Service Coverage

Industrial Devices Corporation warrants all N2 Cylinders to be free of defects in material & workmanship for a period of one year from the date of shipment to the user. Products returned prepaid to the factory will be repaired or replaced at our option at no charge, and returned prepaid to the user.

Products that fail due to improper use or misapplication are not subject to the terms of this warranty.

Technical Support

Industrial Devices offers technical support through its factory authorized and trained Distributors, and through its factory-based Applications Engineering and Inside Sales department.

If an application problem exists or if the product has failed, contact your Distributor or Industrial Devices for technical assistance. Contact our factory at 1-800-747-0064, outside the U.S. at 707-789-1000.

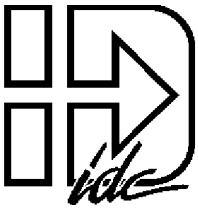
Factory Repair Service

Product repairs are performed at our factory in Petaluma, California. Prior approval by Industrial Devices is required before returning a product for any reason. All returned products must be accompanied by an Industrial Devices supplied RMA (Return Material Authorization) number.

In Case of Failure

1. Get the Model and Serial Number of the defective unit, and document the nature of the failure using the RMA Data Form to help us repair the unit.
2. Prepare a purchase order for the repair cost in case the unit is out of warranty.
3. Contact your IDC Distributor or Industrial Devices Corporation (at 1-800-747-0064) for an RMA#.
4. Ship the unit prepaid, with the RMA number and documentation to:

Industrial Devices Co., LLC
3925 Cypress Drive
Petaluma, CA 94954
Attn.: RMA # _____



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