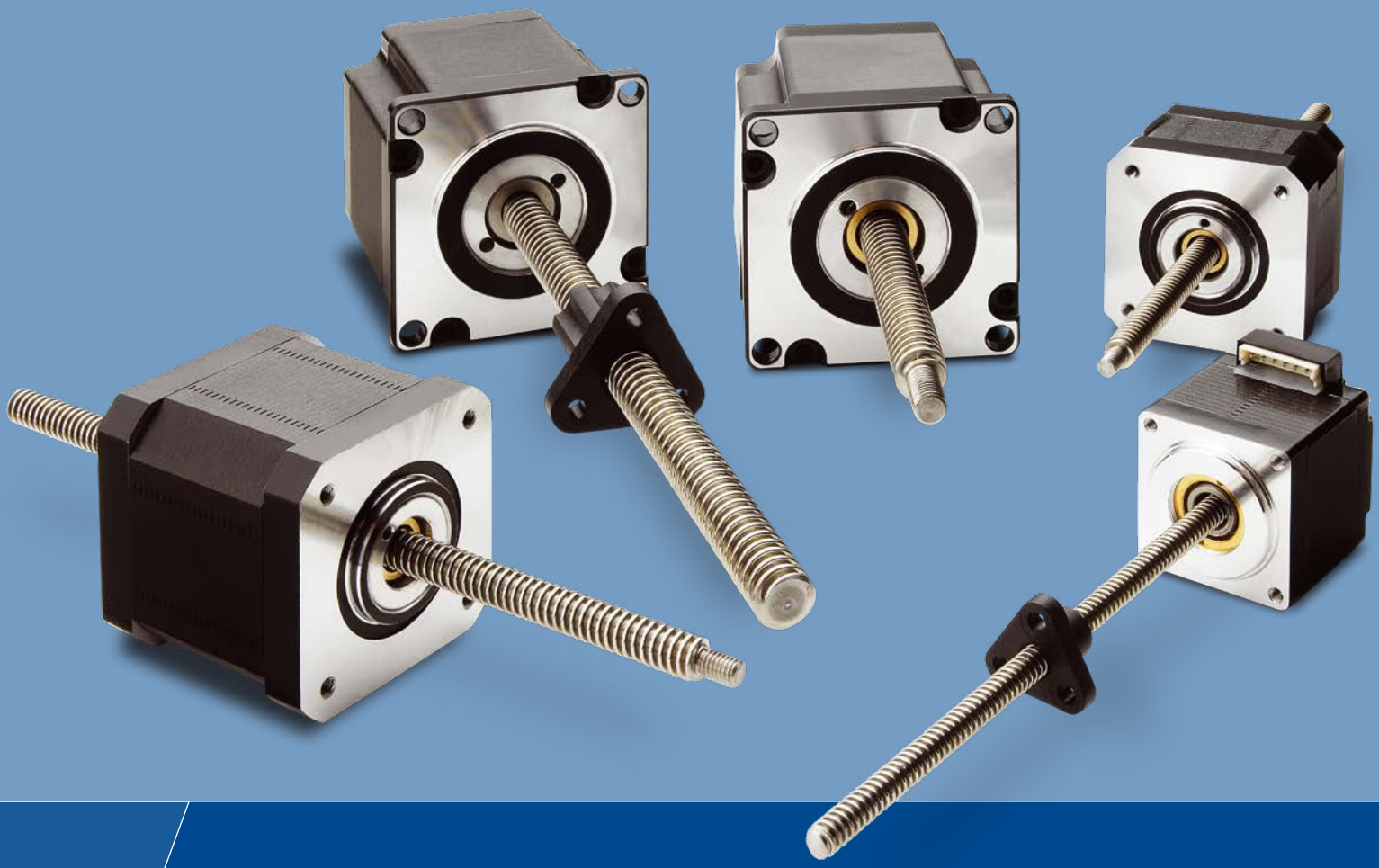


# Motorized Lead Screws

## Stepper Motor Linear Actuator

www.thomsonlinear.com

THOMSON®

*Linear Motion.* ***Optimized.***™

# Motorized Lead Screws

## Precision engineered to be compact, powerful, quiet and efficient

New Motorized Lead Screws from Thomson combine a hybrid stepper motor and a precision lead screw together in one compact envelope. Patent-pending Taper-Lock technology allows quick decoupling and secure, properly aligned connections. This combination offers several advantages over a traditional solution.

### Increased Torque Density

Thomson Motorized Lead Screws offer increased torque density over alternative solutions. By optimizing the motor performance and matching this with the ideal lead screw and nut design, Thomson has been able to increase the load capacity by up to 30% while maintaining the same motor footprint.

### Improved Efficiency

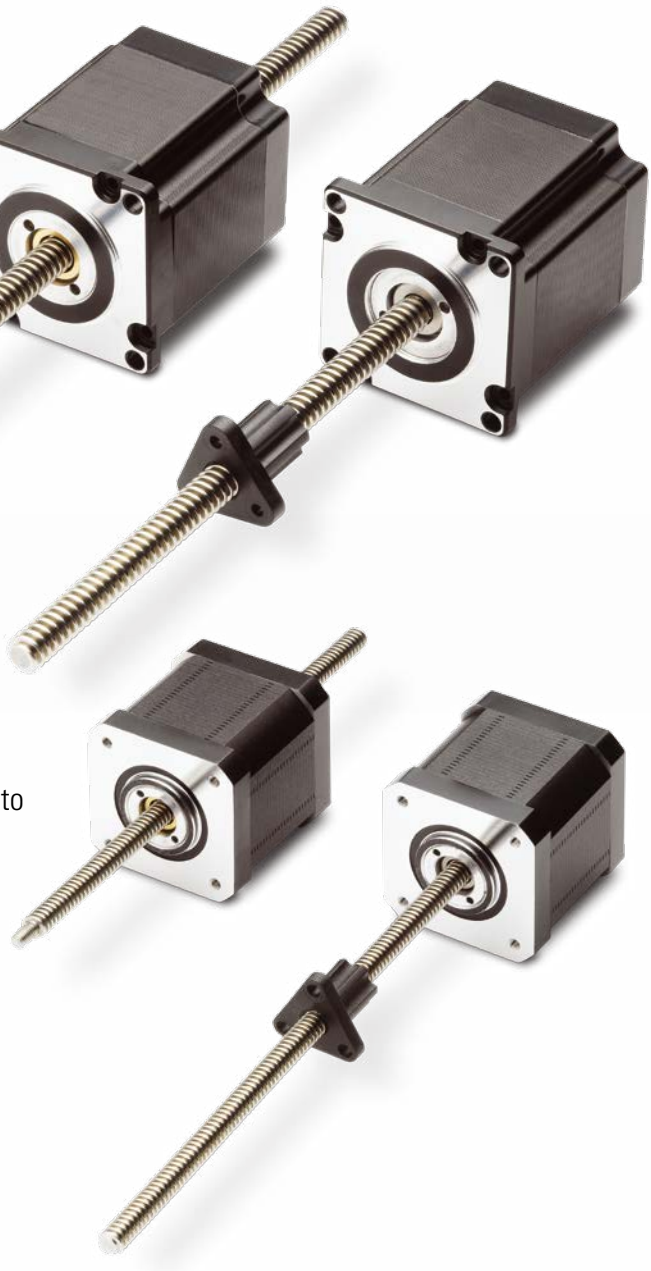
Thomson provides a more efficient solution to reduce power consumption, improve operating battery life, and decrease motor footprint. With this improved efficiency, an increase in system load performance or a reduction in power consumption can be expected – all while having a lower cost of ownership.

### The Taper-Lock Advantage

The patent-pending Taper-Lock design provides the ability to quickly decouple the lead screw from the stepper motor. The connection is secure, robust, and self-aligning.

### Reduced Noise

Thomson can optimize your motor configuration and windings to limit motor harmonics and reduce motor noise at your application operating points.

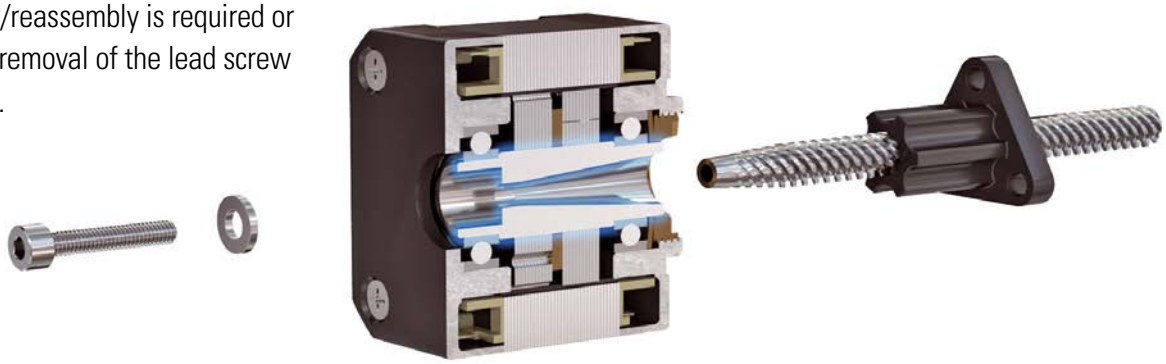


# Technology Overview

Thomson Motorized Lead Screws come in two basic configurations – rotating screw (S) and rotating nut (N). Rotating screw assemblies actuate by having the motor rotate a lead screw and translate a load that is attached to the lead nut. Rotating nut assemblies actuate by rotating a nut within the motor body. Motion is achieved by constraining the motor and translating a load attached to the lead screw or constraining the lead screw and translating a load attached to the motor.

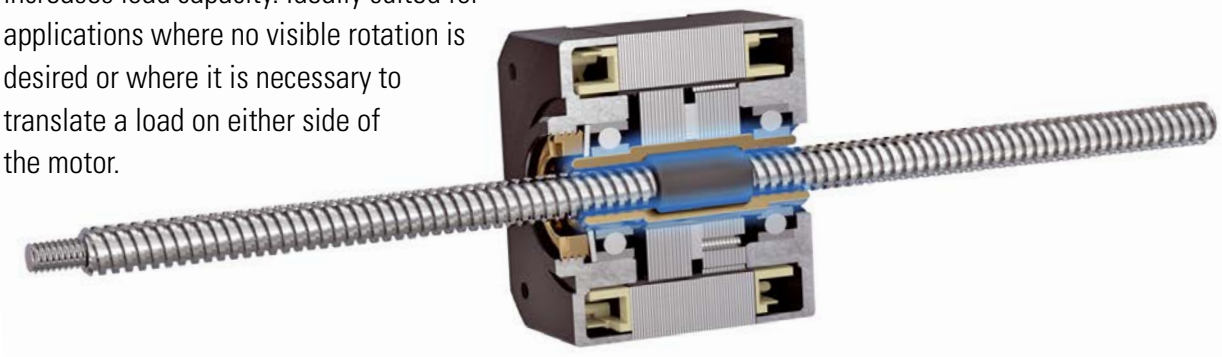
### Rotating Screw Configuration (S)

The rotating screw design features our patent-pending Taper-Lock design to connect the lead screw to the motor shaft. This design allows for rapid prototyping, field serviceability and reduced inventory. Ideally suited for applications where high levels of maintenance are anticipated, frequent disassembly/reassembly is required or where easy removal of the lead screw is necessary.



### Rotating Nut Configuration (N)

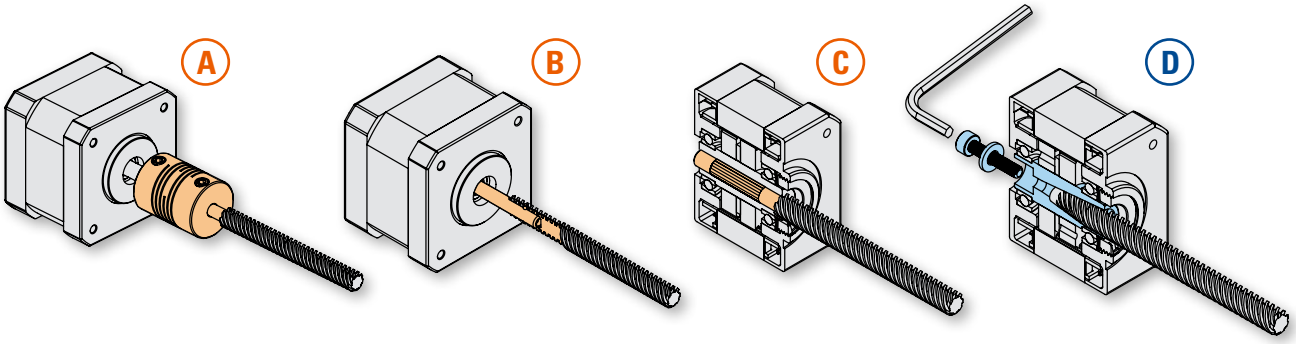
The rotating nut design features our patent-pending integration of a lead nut into the motor rotor to maximize screw diameter which increases load capacity. Ideally suited for applications where no visible rotation is desired or where it is necessary to translate a load on either side of the motor.



# Thomson Advantage

## The Thomson Taper-Lock

Fixing the motor to the lead screw usually requires a coupling assembly (A), a counter-bore press fit (B) or a hollow shaft press fit (C). The assembly process may also entail the use of adhesives or welding, but the bottom line is that all these solutions make it difficult or impossible to change lead screws or perform maintenance. Thomson has solved this issue with our patent-pending Taper-Lock coupling (D) that requires only a single retention fastener.




**Coupling assembly**
- space demanding
- reduces stroke
- increases system inertia
- requires radial support bearing
- may reduce accuracy

**Counter-bore press fit**
- reduces stroke
- requires machining
- difficult to assemble
- run-out and alignment issues
- difficult to replace quickly

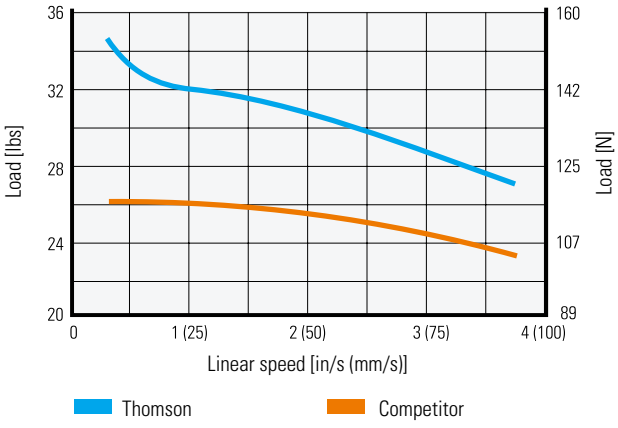
**Hollow shaft press fit**
- requires machining
- difficult to assemble
- run-out and alignment issues
- difficult to replace quickly

**Thomson Taper-Lock**
- high accuracy
- requires no extra space
- easy to replace quickly
- easy assembly and alignment

## Thrust Force Comparison

Thomson optimized motors will result in up to a 30% increase in thrust over the competition. That means you will get a smaller and more efficient solution with the same power output.

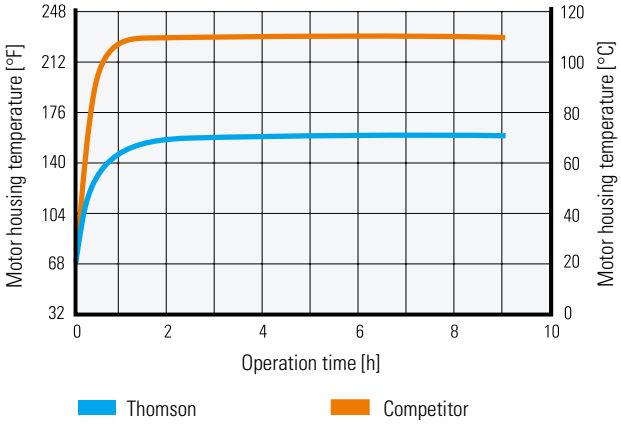
Load vs. Speed




## Temperature Rise Comparison

Thomson offers more efficient motors where more torque can be output with less heat loss – meaning that our motors can be operated with higher power input while maintaining lower heat generation.

Temperature vs. Operation Time




The curves where generated with a 1.5 A / 2.33 V, 1.8° NEMA 17 single stack, rotating screw stepper motor. Test ran with a 0.9°, 24 VDC chopper drive and a 4-2516 lead screw at an ambient temperature of 20 °C.

# Application Examples

## Where to Use Motorized Lead Screws

Lead screws convert rotary motion into linear motion. Stepper motors and lead screws are complementary products. They operate within the same design specifications for speed, load and life. A typical method to marry these products into an application is by using external bearing supports and a drive coupling. Although this is acceptable, it is not the most economical approach, requires more components and a larger footprint. The ideal solution is to directly couple the screw and motor, eliminating the external supports and coupling.

### Rotating Screw Applications

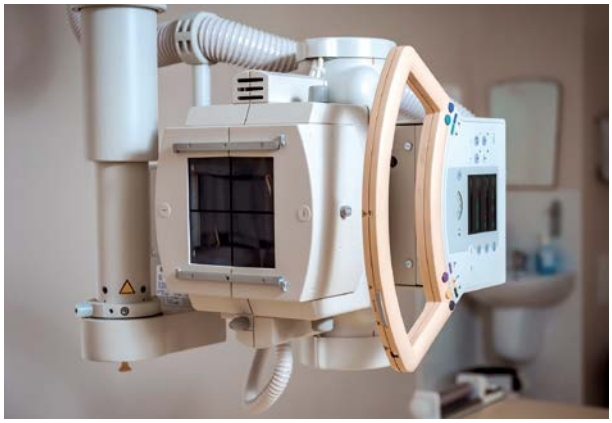
A rotating screw Motorized Lead Screw is ideal for applications that require precise linear motion and have dedicated external supports such as linear bearings or profile rails. Examples are:

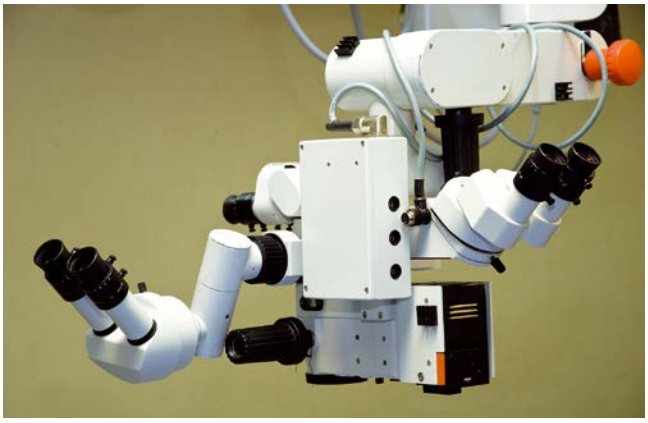
- Medical devices
- X-Y stages
- 3D printers

### Rotating Nut Applications

A rotating nut Motorized Lead Screw is ideal for applications that require precise linear motion and also have integrated anti-rotation. Examples includes:

- Fluid/syringe pumps
- HVAC control valves
- Pipetting devices
- CNCs



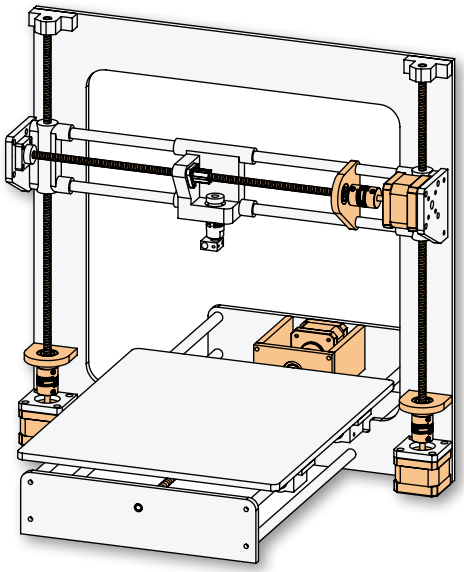


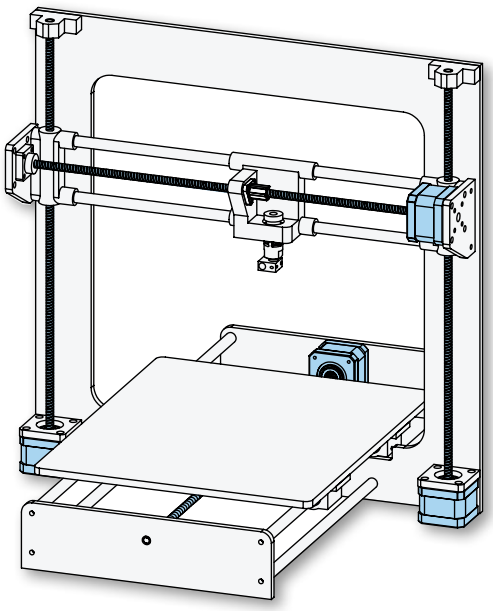
# Application Examples

These common applications show that the Motorized Lead Screw will not only reduce the total number of components but also will reduce the overall footprint and make assembly and maintenance quicker and easier.

## 3D Printing

Innovative multi-axis printers are revolutionizing rapid prototyping and consumer products. A printer equipped with the Motorized Lead Screw can achieve key design advantages as outlined in the table below. Elimination of supports and couplings improves the print volume while reducing the component count and system cost.





**Generic design**

**Thomson Motorized Lead Screw design!**

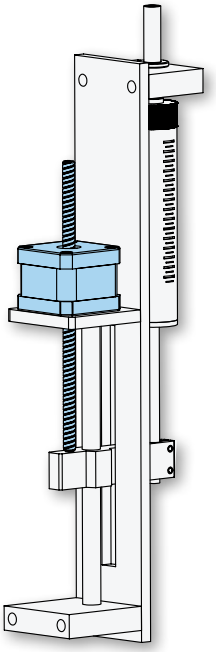
| Generic vs. Thomson | | |
|---|---|---|
| | Generic | Thomson |
| Z-Axis Stroke [in (mm)] | 9.6 (244) | 11.4 (289) |
| XY-Stroke [in (mm)] | 8.7 × 14.2 (220 × 360) | 10.6 × 16.8 (270 × 427) |
| Number of Unique Linear Motion Components | 28 | 16 |
| Interchangeable Lead Screws | Yes | Yes |
| Self-Aligning Assembly | No | Yes |
| External Support Bearing Required | Yes | No |

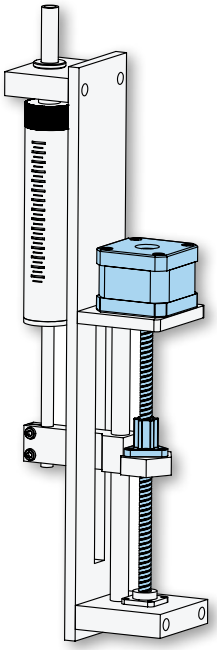
# Application Examples

## Fluid Pump

Syringe pumps represent a significant segment of the medical industry and the design requirements require high torque density and efficiency. Regardless of the mounting configuration, a Motorized Lead Screw can increase pump pressure, reduce equipment footprint, and more accurately disperse fluid.

Rotating Nut
(configuration N)



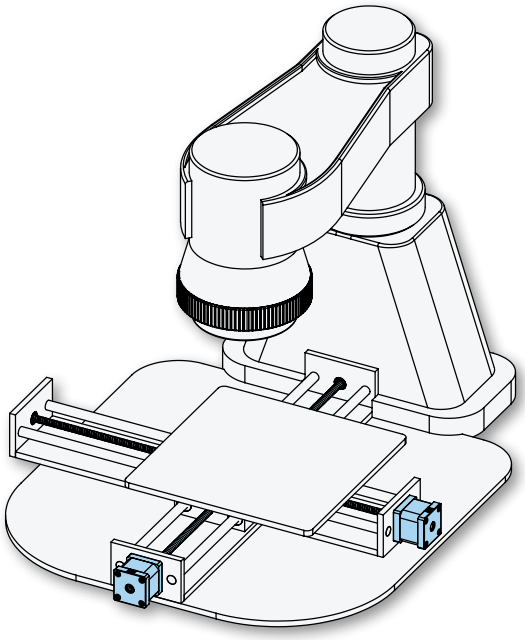


Rotating Screw
(configuration S)

**Other Applications**

The Motorized Lead Screw provides higher performance in a smaller and less complicated package. Designed for simple transport or critical applications, a Motorized Lead Screw solution eliminates redundant components, increases stroke length, provides greater axial force, and reduces power consumption. Other applications include:

- X-Y stages
- HVAC control valves
- CNCs
- Pipetting
- Robotics
- Packaging
- Scanning
- Lens focusing
- Plumbing
- Laser cutting



## Medical Scanner

When it comes to planar motion, a Motorized Lead Screw can outperform the competition by delivering more thrust, more stroke, and lead screw interchangeability – making it the easiest to maintain Motorized Lead Screw on the market.

# Lead Screw Sizes

## Inch Lead Screws

| Linear travel / full step [in] | Lead [in] | Type and screw diameter [in] | | | | |
|---|---|---|---|---|---|---|
| | | ML11 | ML14 | ML17 | ML23 | |
| | | 0.188 | 0.250 | 0.250 | 0.313 | 0.375 |
| 0.00015625 | 0.0313 | | • | • | | |
| 0.00025000 | 0.0500 | • | | | | |
| 0.00031250 | 0.0625 | | • | • | | • |
| 0.00041670 | 0.0833 | | | | • | |
| 0.00050000 | 0.1000 | • | | | | • |
| 0.00062500 | 0.1250 | | • | • | | |
| 0.00083300 | 0.1666 | | | | • | • |
| 0.00100000 | 0.2000 | • | | | | |
| 0.00125000 | 0.2500 | | • | • | • | • |
| 0.00200000 | 0.4000 | • | | | | |
| 0.00250000 | 0.5000 | | • | • | • | • |
| 0.00375000 | 0.7500 | | • | • | | |
| 0.00500000 | 1.0000 | | | | • | • |

## Metric Lead Screws

| Linear travel / full step [mm] | Lead [mm] | Type and screw diameter [mm] | | | | |
|---|---|---|---|---|---|---|
| | | ML11 | ML14 | ML17 | ML23 | |
| | | 4 | 6 | 6 | 8 | 10 |
| 0.005 | 1.00 | • | • | • | | |
| 0.010 | 2.00 | | | | • | • |
| 0.015 | 3.00 | | | | | • |
| 0.020 | 4.00 | • | | | • | |
| 0.025 | 5.00 | | | | | • |
| 0.030 | 6.00 | | • | • | | |
| 0.040 | 8.00 | • | | | • | |
| 0.050 | 10.00 | | | | | • |
| 0.060 | 12.00 | | • | • | • | |
| 0.100 | 20.00 | | | | • | • |

Note: Other sizes and leads available – please contact Thomson for more information about custom lead screw availability.

# Specifications

## Basic Specifications

### Lead Screw

| | | | | | |
|---|---|---|---|---|---|
| Material | | 303 Stainless Steel | | | |
| Standard Coating [1] | | None | | | |
| Standard Lead Accuracy | [in/ft (µm/300 mm)] | 0.010 (250) | | | |
| Precision Lead Accuracy | [in/ft (µm/300 mm)] | 0.003 (75) | | | |
| Straightness | [in/ft (µm/300 mm)] | 0.005 (125) | | | |

### Lead Nut

| | | | | | |
|---|---|---|---|---|---|
| Standard Material | | Internally lubricated acetal | | | |
| High Performance Material | | Internally lubricated engineered thermoplastic | | | |
| Nut Efficiency [2] | [%] | 35 to 85 | | | |
| Typical Linear Travel Life | [in (km)] | $10 \times 10^{6}$ (250) | | | |

### Motor

| | | | | | |
|---|---|---|---|---|---|
| Frame Size | | NEMA 11 | NEMA 14 | NEMA 17 | NEMA 23 |
| Step Size | [°] | 1.8 | 1.8 | 1.8 | 1.8 |
| Max. Axial Load [3] | [lbs (N)] | 20 (89) | 50 (222) | 75 (334) | 200 (890) |
| Max. Radial Play | [in @ lbs (mm @ N)] | 0.001 @ 1 (0.03 @ 4) | | | |
| End Play | [in @ lbs (mm @ N)] | 0.002 @ 2 (0.05 @ 9) | | | |
| Concentricity of Mounting Pilot to Shaft | [in (mm)] | 0.003 (0.08) TIR | | | |
| Perpendicularity of Shaft to Mounting Face | [in (mm)] | 0.003 (0.08) TIR | | | |
| Max. Case Temperature | [ °F (°C)] | 140 (60) | 176 (80) | | |
| Storage Temperature | [ °F (°C)] | -4 to 122 (-20 to 50) | | | |
| Max. Humidity (non-condensing) | [%] | 85 | | | |
| Magnet Wire Insulation | | Class B 130 °C (266 °F) | | | |
| Insulation Resistance | | 100 Mohm @ 500 VDC | | | |
| Dielectric Strength | | 500 VAC for 1 minute | | | |

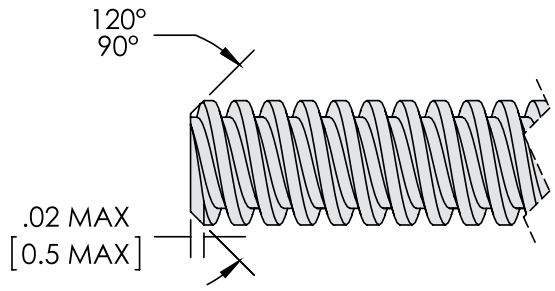
### Assembly

| | | |
|---|---|---|
| Max. Backlash with Standard Nut | [in (mm)] | 0.010 (0.25) |
| Max. Backlash with XC Anti-Backlash Nut | [in (mm)] | 0 (0) |
| Runout | [in/ft (µm/300 mm)] | 0.007 (175) |
| Operating Temperature | [ °F (°C)] | 15 to 125 (- 10 to 50) |

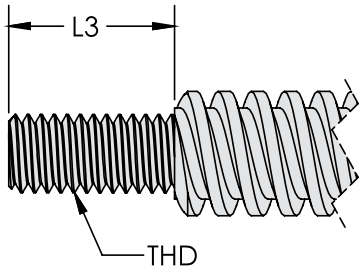
(1) Contact Thomson for optional lead screw coatings.
(2) Depending on lead.
(3) Max. axial load based on a L10 life of 10000 hours of continuous motion at speeds of 100 to 300 RPM.

# Lead Screw End Machining

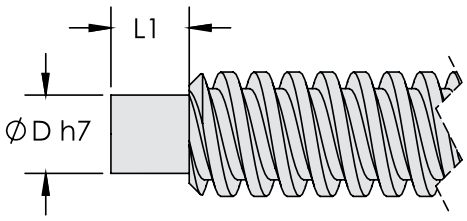
## Standard For Rotating Screw (S) Configurations



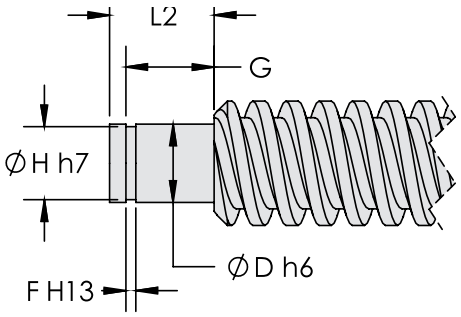

## Standard For Rotating Nut (N) Configurations




## Non Standard End Machining Alternative*




## Non Standard End Machining Alternative*




* These are just some examples of non standard end-machining alternatives that are available. Please contact Thomson for more information.

## Inch Lead Screw End Machining Dimensions

| Screw Diameter [in] | Screw Lead [in] | Recommended Bearing | | | | Dimensions [in] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | OD [mm] | ID [mm] | W [mm] | Bearing Trade No. | ØD | L1 | L2 | F | G | ØH | L3 | THD |
| 0.188 | all | 7 | 2.5 | 2.5 | 692X | 0.098 | 0.098 | 0.157 | 0.022 | 0.120 | 0.075 | 0.250 | #4-40 |
| 0.250 | all | 13 | 4 | 5 | 624 | 0.157 | 0.197 | 0.256 | 0.020 | 0.217 | 0.150 | 0.250 | #8-32 |
| 0.313 | all | 16 | 5 | 5 | 625 | 0.197 | 0.197 | 0.276 | 0.028 | 0.224 | 0.189 | 0.375 | #10-24 |
| 0.375 | all | 19 | 6 | 6 | 626 | 0.236 | 0.236 | 0.315 | 0.030 | 0.266 | 0.220 | 0.500 | 1/4-20 |

## Metric Lead Screw End Machining Dimensions

| Screw Diameter [mm] | Screw Lead [mm] | Recommended Bearing | | | | Dimensions [mm] | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | OD [mm] | ID [mm] | W [mm] | Bearing Trade No. | ØD | L1 | L2 | F | G | ØH | L3 | THD |
| 4 | all | 7 | 2.5 | 2.5 | 692X | 2.50 | 2.50 | 4.00 | 0.56 | 3.05 | 1.91 | 6.35 | M3X0.5 |
| 6 | all | 13 | 4 | 5 | 624 | 4.00 | 5.00 | 6.50 | 0.51 | 5.51 | 3.81 | 6.35 | M4X0.7 |
| 8 | all | 16 | 5 | 5 | 625 | 5.00 | 5.00 | 7.00 | 0.70 | 5.70 | 4.80 | 9.53 | M5X0.8 |
| 10 | all | 19 | 6 | 6 | 626 | 6.00 | 6.00 | 8.00 | 0.76 | 6.76 | 5.59 | 12.70 | M6X1.0 |

# Ordering Key

## Ordering Key

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| **ML** | **23A155** | **S** | **M08-02** | **-23000** | **S** | **FSS** | **-001** |

1. Product type
ML = motorized lead screw

2. Motor code [1]
xxxyyy = see Motor Options tables

3. Configuration
N = rotating nut
S = rotating screw

4. Lead screw code [2]
xyy-zzzz = see Lead Screw Options tables

5. Lead screw length (Ls)
-xxxxx = xx.xxx inch (for inch lead screw units only)
-xxxxx = xxx.xx mm (for metric lead screw units only)

6. Lead screw accuracy
S = standard
P = precision

7. Nut configuration code [3]
XXX = rotating nut configuration default
FSS = rotating screw configuration with standard flanged nut
FSH = rotating screw configuration with standard flanged nut in high performance material
FAS = rotating screw configuration with standard flanged anti-backlash nut
TAS = rotating screw configuration with standard threaded anti-backlash nut

8. Custom design code (issued by Thomson)
-001 = default (standard design)

(1) The exact motor codes are found in the Motor Options tables on the product pages.
The code consist of two parts (xxxyyy) where "xxx" describes frame size and stack number, and "yyy" the current draw of the motor.

(2) The exact lead screw codes are found in the Lead Screw Options tables on the product pages. The code consist of three parts (xyy-zzzz) where "x" describes if the lead screw is inch (no letter) or metric (letter M), "yy" the diameter and "zzzz" the lead of the screw.

(3) Rotating nut configurations must always have code "XXX" in this position while rotating screw configurations must have one of the other codes. For custom threaded nut dimensions contact Thomson.

Example 1:

ML11A051 S 18-0100-04000S FSS-001

ML11A051 S: NEMA 11 motor, single stack, 0.51 A, rotating screw.
18-0100-04000S: Lead screw with a 0.1875 inch diameter, 0.100 inch lead, 4 inch length and standard accuracy.
FSS: Flanged nut, standard backlash, standard performance material.
-001: Default Motorized Lead Screw configuration.

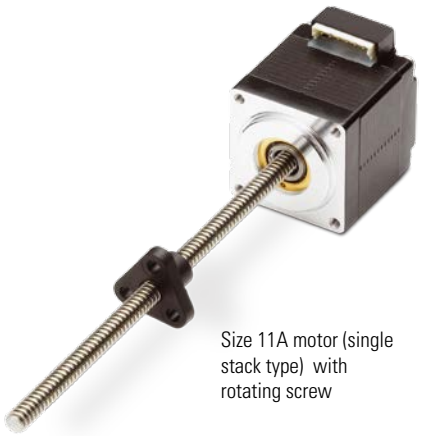
Example 2:

ML17B150 N M06-12-20000S XXX-001

ML17B150 N: NEMA 17 motor, double stack, 1.50 A, rotating nut.
M06-12-20000S: Lead screw with a 6 mm diameter, 12 mm lead, 200 mm length and standard accuracy.
XXX: Default nut sequence for rotating nut.
-001: Default Motorized Lead Screw configuration.

Note: Please visit thomsonlinear.com/motorized to access our online Motorized Lead Screw selector and part number generator.

# Specifications – ML11



Size 11A motor (single stack type) with rotating screw

## Features and Benefits

- Higher torque density than the competition.
- NEMA 11 motor (size 28 mm).
- Rotating screw version only.
- Choose between a variety of inch and metric lead screws.
- Recommended max. thrust force 20 lbs (89 N).
- Recommended max. lead screw length of 4 in (102 mm) for optimal performance. Longer length lead screws available, see diagrams on page 24.

## Motor Options

| Motor code | Holding torque | | Voltage / phase* [V] | Current / phase [A] | Resistance [Ω] | Inductance [mH] | Power draw [W] | Step angle [ ° ] | Motor length (Lm) | | Rotor inertia [oz-in²] | Motor weight [lbs] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [oz-in] | [N-m] | | | | | | | [in] | [mm] | | |
| 11A051 | 9.3 | 0.066 | 3.85 | 0.51 | 7.54 | 5.22 | 1.96 | 1.8 | 1.26 | 32.0 | 0.06 | 0.24 |
| 11A100 | 10.1 | 0.071 | 2.19 | 1.00 | 2.19 | 1.53 | 2.19 | 1.8 | 1.26 | 32.0 | 0.06 | 0.24 |

* Applied voltage can be any value above this number as long as the driver output current is controlled at the rated RMS current.

## Inch Lead Screw Options

| Screw code | Diameter [in] | Lead [in] | Travel / step [in] |
|---|---|---|---|
| 18-0050 | 0.188 | 0.050 | 0.00025 |
| 18-0100 | | 0.100 | 0.00050 |
| 18-0200 | | 0.200 | 0.00100 |
| 18-0400 | | 0.400 | 0.00200 |

## Metric Lead Screw Options

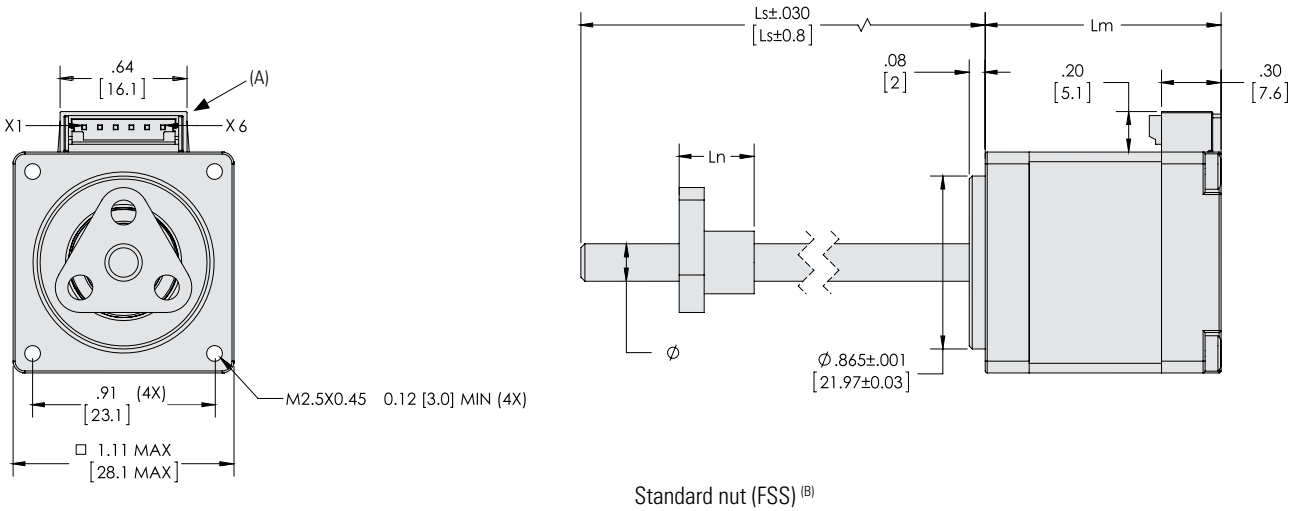
| Screw code | Diameter [mm] | Lead [mm] | Travel / step [mm] |
|---|---|---|---|
| M04-01 | 4 | 1 | 0.00500 |
| M04-04 | | 4 | 0.02000 |
| M04-08 | | 8 | 0.04000 |

Note: Other diameters and leads available – please contact Thomson for more information about custom lead screw availability.

# Dimensions – ML11

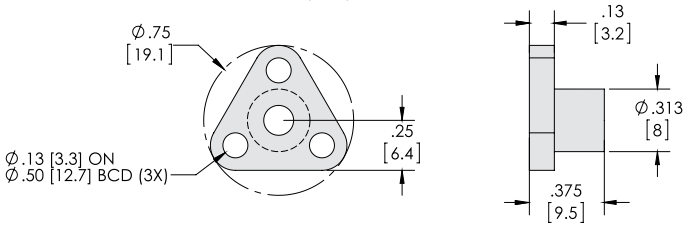
## ML11xxxxxxS (rotating screw)

| Dimensions | Projection |
|---|---|
| Inch [mm] | |




| Maximum Stroke (Smax) |
|---|
| Smax = Ls - Ln - 0.08 in (2 mm) |

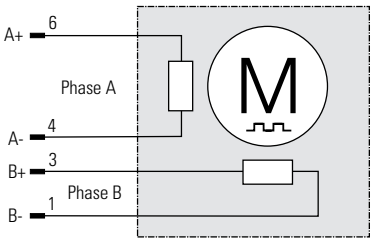
Standard nut (FSS) (B)




(A) 6-pin connector as standard. Custom connection solutions possible. Contact Thomson for more information.
(B) For dimensions and data on anti-backlash nut, please contact Thomson for more information.

## Motor Connection

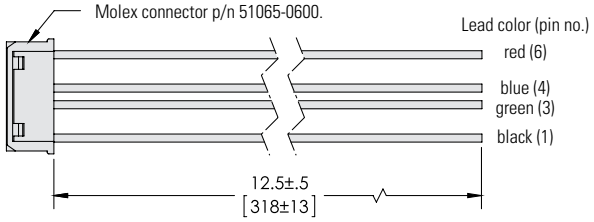
| Molex Connector * | |
|---|---|
| Pin | Phase |
| 1 | B- |
| 2 | not used |
| 3 | B+ |
| 4 | A- |
| 5 | not used |
| 6 | A+ |




* Molex connector p/n 53253-0670. Mates with Molex connector p/n 51065-0600.

## Motor Connector Kit with Flying Leads - Optional

- Compatible with the above motor connector.
- Lead length 12.5 in (318 mm).
- 26 AWG lead wires.
- Part number MC11-001.
- Contact Thomson for more information.



# Specifications – ML14

Size 14A motor (single stack type) with rotating screw

## Features and Benefits

- Higher torque density than the competition.
- NEMA 14 motor (size 35 mm).
- Rotating screw versions only.
- Choose between a variety of inch and metric lead screws.
- Recommended max. thrust force 50 lbs (222 N).
- Recommended max. lead screw length of 8 in (203 mm) for optimal performance. Longer length lead screws available, see diagrams on page 24.

## Motor Options

| Motor code | Holding torque | | Voltage / phase* [V] | Current / phase [A] | Resistance [Ω] | Inductance [mH] | Power draw [W] | Step angle [ ° ] | Motor length (Lm) | | Rotor inertia [oz-in²] | Motor weight [lbs] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [oz-in] | [N-m] | | | | | | | [in] | [mm] | | |
| 14A088 | 25.8 | 0.182 | 3.42 | 0.88 | 3.89 | 5.51 | 3.01 | 1.8 | 1.34 | 34.0 | 0.10 | 0.41 |
| 14A135 | 23.0 | 0.162 | 1.71 | 1.35 | 1.27 | 1.79 | 2.31 | 1.8 | 1.34 | 34.0 | 0.10 | 0.41 |

* Applied voltage can be any value above this number as long as the driver output current is controlled at the rated RMS current.

## Inch Lead Screw Options

| Screw code | Diameter [in] | Lead [in] | Travel / step [in] |
|---|---|---|---|
| 25-0031 | 0.250 | 0.0313 | 0.00016 |
| 25-0062 | | 0.0625 | 0.00031 |
| 25-0125 | | 0.1250 | 0.00063 |
| 25-0250 | | 0.2500 | 0.00125 |
| 25-0500 | | 0.5000 | 0.00250 |
| 25-0750 | | 0.7500 | 0.00375 |

## Metric Lead Screw Options

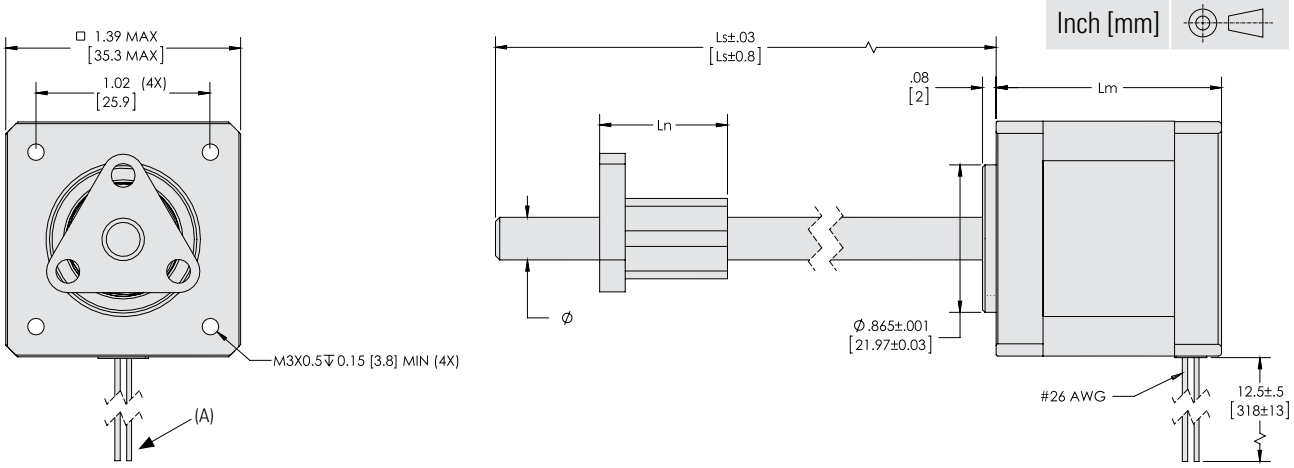
| Screw code | Diameter [mm] | Lead [mm] | Travel / step [mm] |
|---|---|---|---|
| M06-01 | 6 | 1 | 0.00500 |
| M06-06 | | 6 | 0.03000 |
| M06-12 | | 12 | 0.06000 |

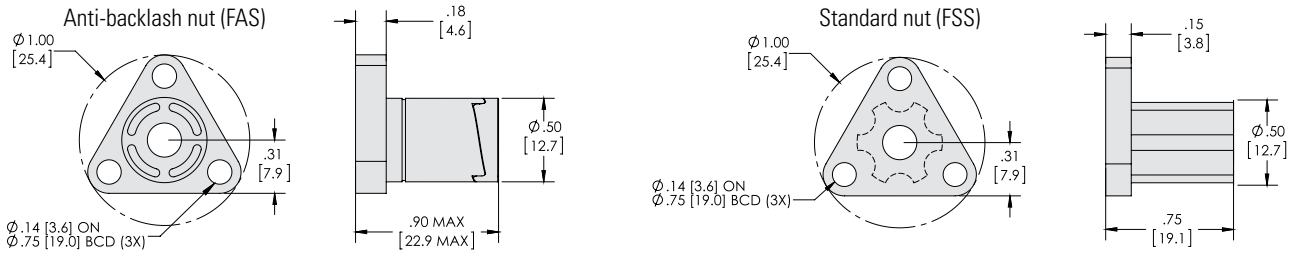
Note: Other diameters and leads available – please contact Thomson for more information about custom lead screw availability.

# Dimensions – ML14

## ML14xxxxxxS (rotating screw)

| Dimensions | Projection |
|---|---|
| Inch [mm] | |



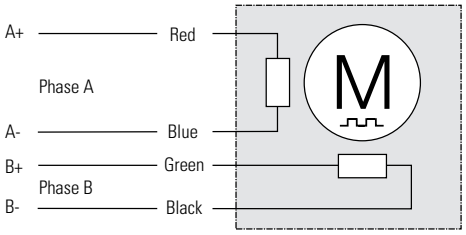

| Maximum Stroke (Smax) |
|---|
| Smax = Ls - Ln - 0.08 in (2 mm) |

(A) Flying leads are standard. Custom connection solutions possible. Contact Thomson for more information.

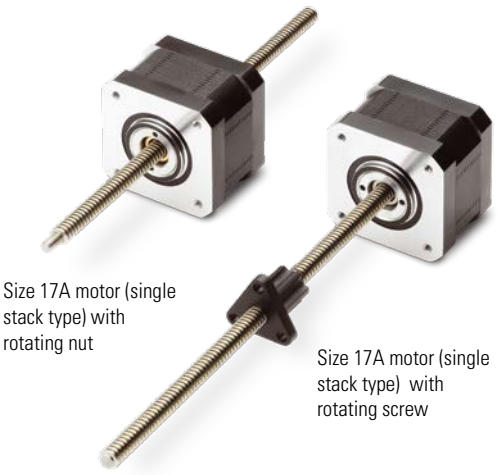
## Motor Connection*

| Flying Leads | |
|---|---|
| Lead color | Phase |
| Red | A+ |
| Blue | A- |
| Green | B+ |
| Black | B- |

*Table valid for ML14, ML17 and ML23 motors.

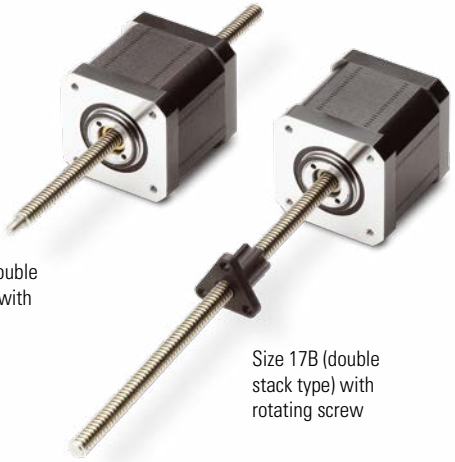


# Specifications – ML17



Size 17A motor (single stack type) with rotating nut

Size 17A motor (single stack type) with rotating screw



Size 17B (double stack type) with rotating nut

Size 17B (double stack type) with rotating screw

## Features and Benefits

- Higher torque density than the competition.
- NEMA 17 motor (size 42 mm).
- Rotating screw and rotating nut versions available.
- Choose between a variety of inch and metric lead screws.
- Recommended max. thrust force 75 lbs (334 N).
- Recommended max. lead screw length of 8 in (203 mm) for optimal performance. Longer length lead screws available, see diagrams on page 24.

## Motor Options

| Motor code | Holding torque | | Voltage / phase* [V] | Current / phase [A] | Resistance [Ω] | Inductance [mH] | Power draw [W] | Step angle [ ° ] | Motor length (Lm) | | Rotor inertia [oz-in²] | Motor weight [lbs] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [oz-in] | [N-m] | | | | | | | [in] | [mm] | | |
| 17A100 | 77.0 | 0.544 | 2.33 | 1.00 | 2.33 | 5.61 | 2.33 | 1.8 | 1.34 | 34.0 | 0.23 | 0.4 |
| 17A150 | 92.0 | 0.650 | 1.76 | 1.50 | 1.17 | 3.26 | 2.63 | 1.8 | 1.34 | 34.0 | 0.23 | 0.4 |
| 17B100 | 107.0 | 0.756 | 1.69 | 1.00 | 1.69 | 5.66 | 1.69 | 1.8 | 1.89 | 48.0 | 0.47 | 0.7 |
| 17B150 | 102.0 | 0.720 | 1.31 | 1.50 | 0.87 | 2.7 | 1.96 | 1.8 | 1.89 | 48.0 | 0.47 | 0.7 |

* Applied voltage can be any value above this number as long as the driver output current is controlled at the rated RMS current.

## Inch Lead Screw Options

| Screw code | Diameter [in] | Lead [in] | Travel / step [in] |
|---|---|---|---|
| 25-0031 | 0.250 | 0.0313 | 0.00016 |
| 25-0062 | | 0.0625 | 0.00031 |
| 25-0125 | | 0.1250 | 0.00063 |
| 25-0250 | | 0.2500 | 0.00125 |
| 25-0500 | | 0.5000 | 0.00250 |
| 25-0750 | | 0.7500 | 0.00375 |

## Metric Lead Screw Options

| Screw code | Diameter [mm] | Lead [mm] | Travel / step [mm] |
|---|---|---|---|
| M06-01 | 6 | 1 | 0.00500 |
| M06-06 | | 6 | 0.03000 |
| M06-12 | | 12 | 0.06000 |

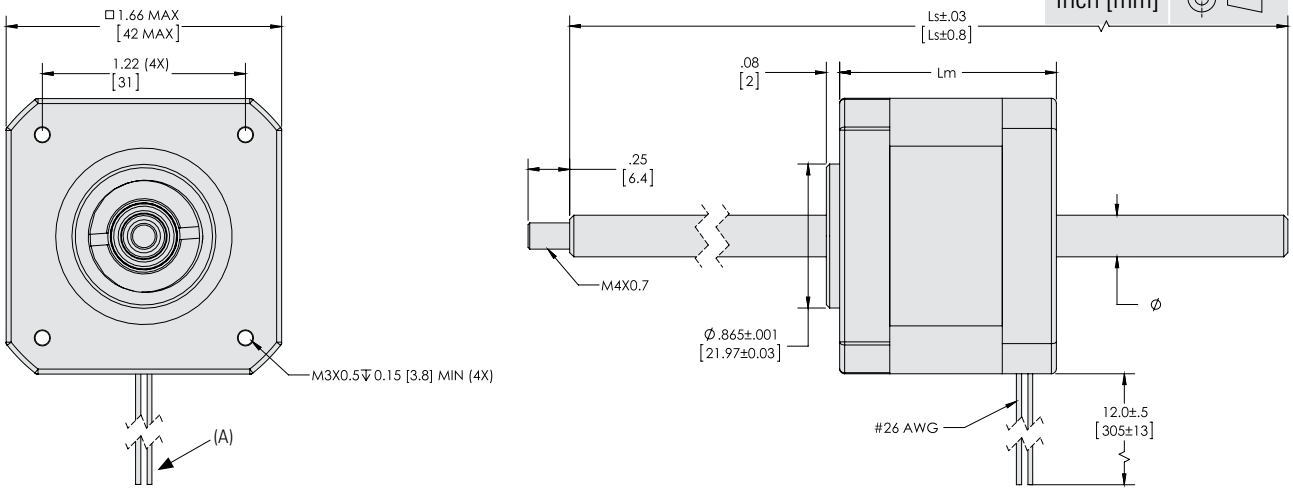
Note: Other diameters and leads available – please contact Thomson for more information about custom lead screw availability.

# Dimensions – ML17

## ML17xxxxxxN (rotating nut)

Dimensions | Projection

Inch [mm]




| Maximum Stroke (Smax) |
|---|
| Smax = Ls - Lm - 0.08 in (2 mm) |

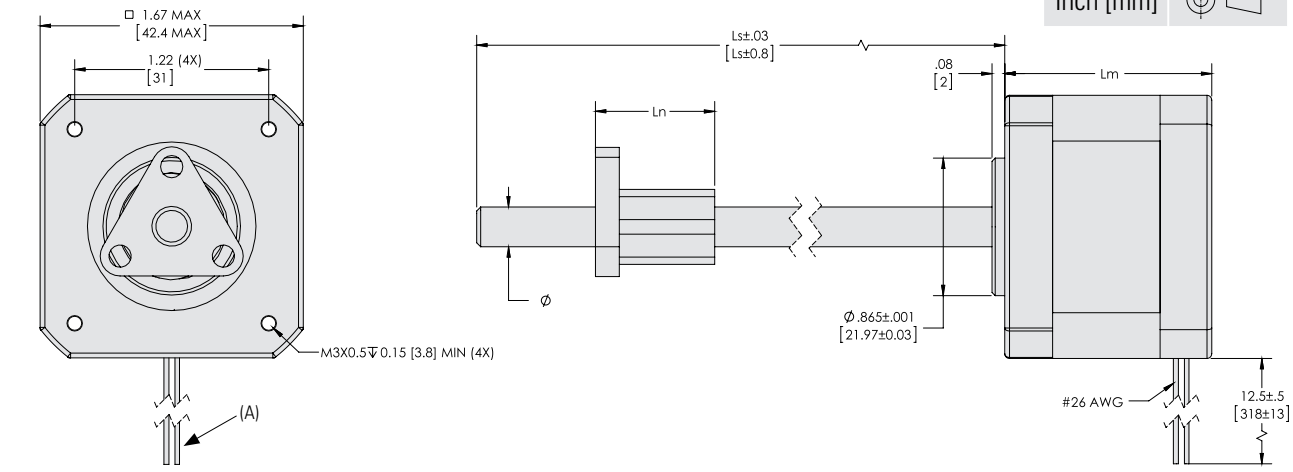
(A) Flying leads are standard. Custom connection solutions possible. Contact Thomson for more information.

**Motor connection information!** See table on page 15.

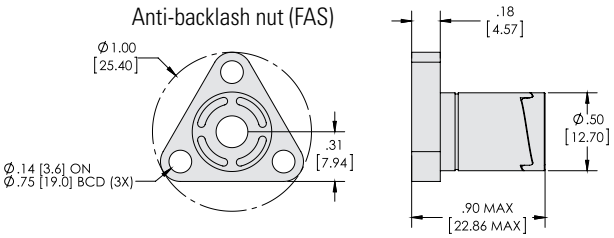
## ML17xxxxxxS (rotating screw)

Dimensions | Projection

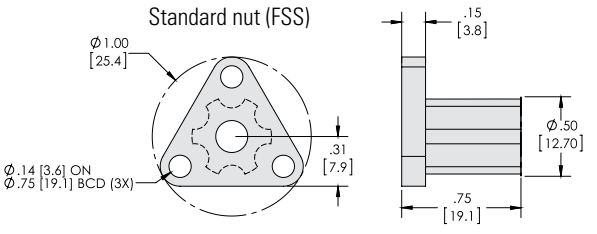
Inch [mm]




Anti-backlash nut (FAS)




Standard nut (FSS)

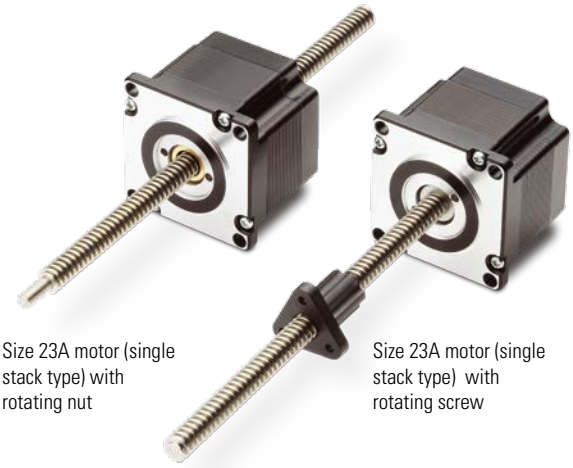



| Maximum Stroke (Smax) |
|---|
| Smax = Ls - Ln - 0.08 in (2 mm) |

(A) Flying leads are standard. Custom connection solutions possible. Contact Thomson for more information.

**Motor connection information!** See table on page 15.

# ML23 – Specifications



Size 23A motor (single stack type) with rotating nut

Size 23A motor (single stack type) with rotating screw

Size 23B (double stack type) with rotating nut

Size 23B (double stack type) with rotating screw

## Features and Benefits

- Higher torque density than the competition.
- NEMA 23 motor (size 57 mm).
- Rotating screw and rotating nut versions available.
- Choose between a variety of inch and metric lead screws.
- Recommended max. thrust force 200 lbs (890 N).
- Recommended max. lead screw length of 12 in (305 mm) for diameter 0.313 in and 8 mm, and 16 in (406 mm) for diameter 0.375 in and 10 mm for optimal performance. Longer length lead screws available, see diagrams on page 24.

## Motor Options

| Motor code | Holding torque | | Voltage / phase* [V] | Current / phase [A] | Resistance [Ω] | Inductance [mH] | Power draw [W] | Step angle [ ° ] | Motor length (Lm) | | Rotor inertia [oz-in$^2$] | Motor weight [lbs] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | [oz-in] | [N-m] | | | | | | | [in] | [mm] | | |
| 23A155 | 121.0 | 0.854 | 3.77 | 1.55 | 2.43 | 4.20 | 5.84 | 1.8 | 1.78 | 45.2 | 1.04 | 1.13 |
| 23A300 | 123.8 | 0.875 | 1.74 | 3.00 | 0.58 | 1.16 | 5.22 | 1.8 | 1.78 | 45.2 | 1.04 | 1.13 |
| 23B190 | 251.2 | 1.774 | 3.80 | 1.90 | 2.00 | 5.84 | 7.22 | 1.8 | 2.59 | 65.8 | 2.13 | 1.70 |
| 23B390 | 260.8 | 1.842 | 1.99 | 3.90 | 0.51 | 1.45 | 7.76 | 1.8 | 2.59 | 65.8 | 2.13 | 1.70 |

* Applied voltage can be any value above this number as long as the driver output current is controlled at the rated RMS current.

## Inch Lead Screw Options

| Screw code | Diameter [in] | Lead [in] | Travel / step [in] |
|---|---|---|---|
| 31-0083 | 0.313 | 0.083 | 0.00042 |
| 31-0167 | | 0.167 | 0.00083 |
| 31-0250 | | 0.250 | 0.00125 |
| 31-0500 | | 0.500 | 0.00250 |
| 31-1000 | | 1.000 | 0.00500 |
| 37-0063 | 0.375 | 0.063 | 0.00031 |
| 37-0100 | | 0.100 | 0.00050 |
| 37-0167 | | 0.167 | 0.00083 |
| 37-0250 | | 0.250 | 0.00125 |
| 37-0500 | | 0.500 | 0.00250 |
| 37-1000 | | 1.000 | 0.00500 |

## Metric Lead Screw Options

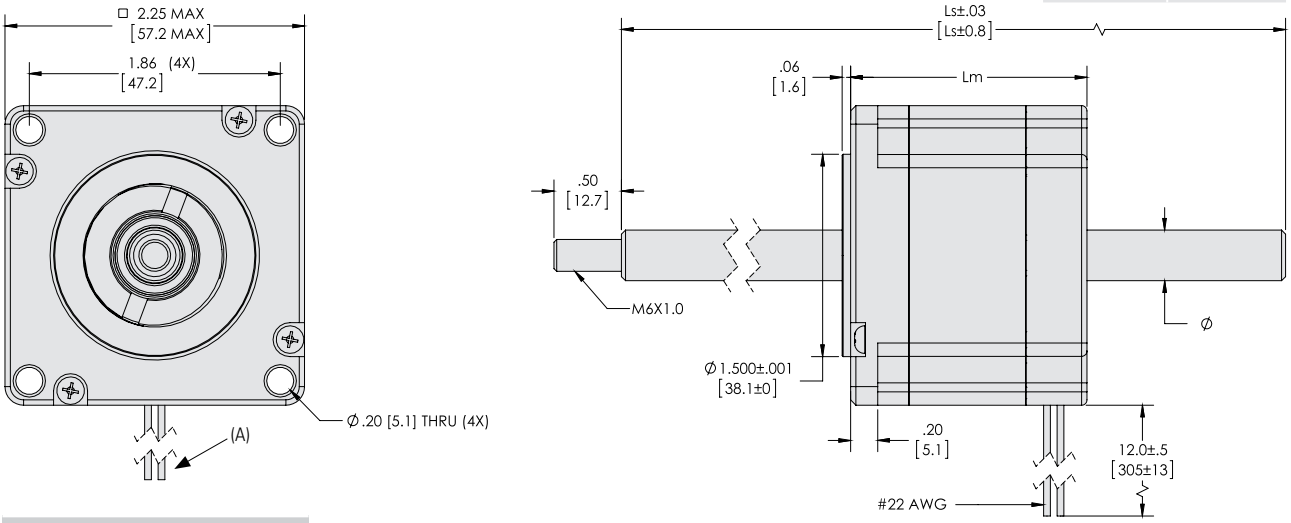
| Screw code | Diameter [mm] | Lead [mm] | Travel / step [mm] |
|---|---|---|---|
| M08-02 | 8 | 2 | 0.01000 |
| M08-04 | | 4 | 0.02000 |
| M08-08 | | 8 | 0.04000 |
| M08-12 | | 12 | 0.06000 |
| M08-20 | | 20 | 0.10000 |
| M10-02 | 10 | 2 | 0.01000 |
| M10-03 | | 3 | 0.01500 |
| M10-05 | | 5 | 0.02500 |
| M10-10 | | 10 | 0.05000 |
| M10-20 | | 20 | 0.10000 |

Note: Other diameters and leads available – please contact Thomson for more information about custom lead screw availability.

# ML23 – Dimensions

## ML23xxxxxxN (rotating nut)

| Dimensions | Projection |
|---|---|
| Inch [mm] | |



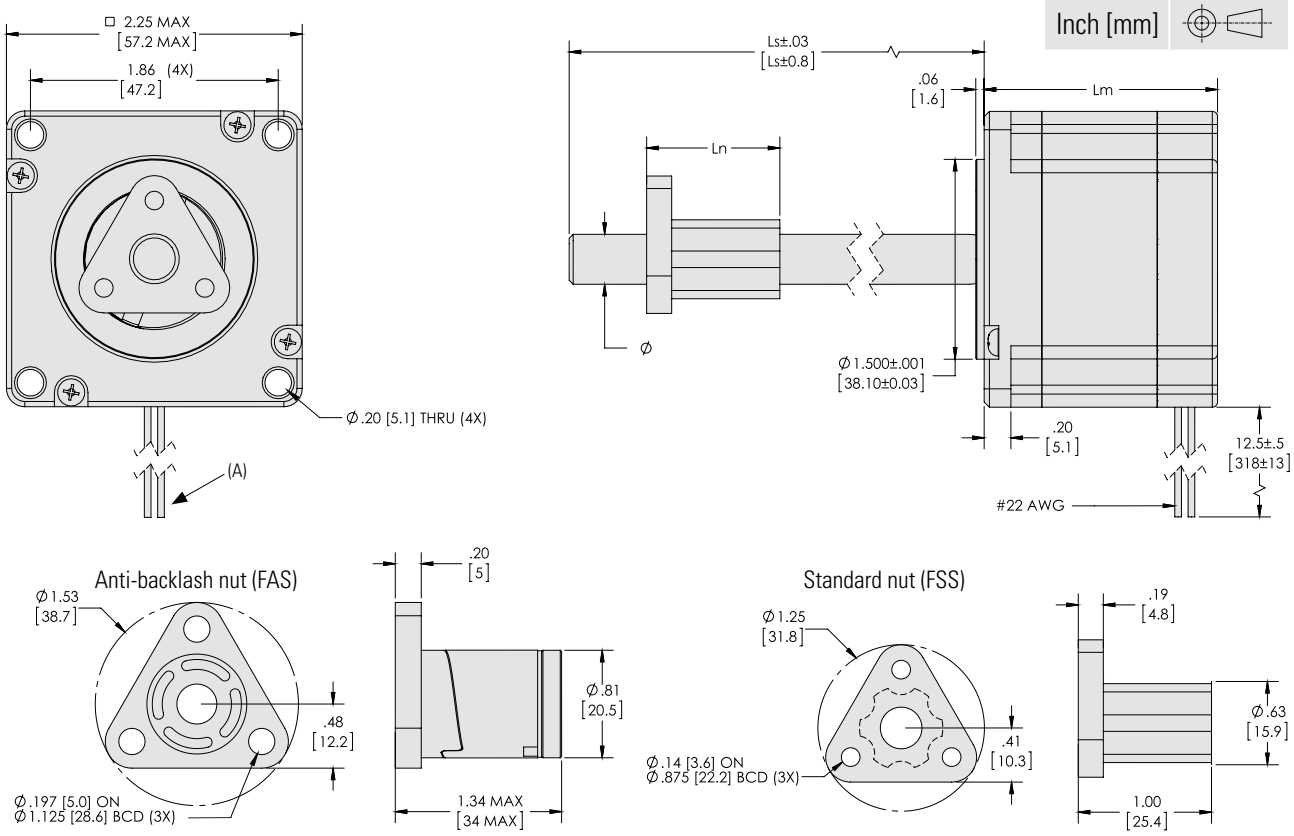

| Maximum Stroke (Smax) |
|---|
| Smax = Ls - Lm - 0.06 in (1.6 mm) |

(A) Flying leads are standard. Custom connection solutions possible. Contact Thomson for more information.

**Motor connection information!** See table on page 15.

## ML23xxxxxxS (rotating screw)

| Dimensions | Projection |
|---|---|
| Inch [mm] | |



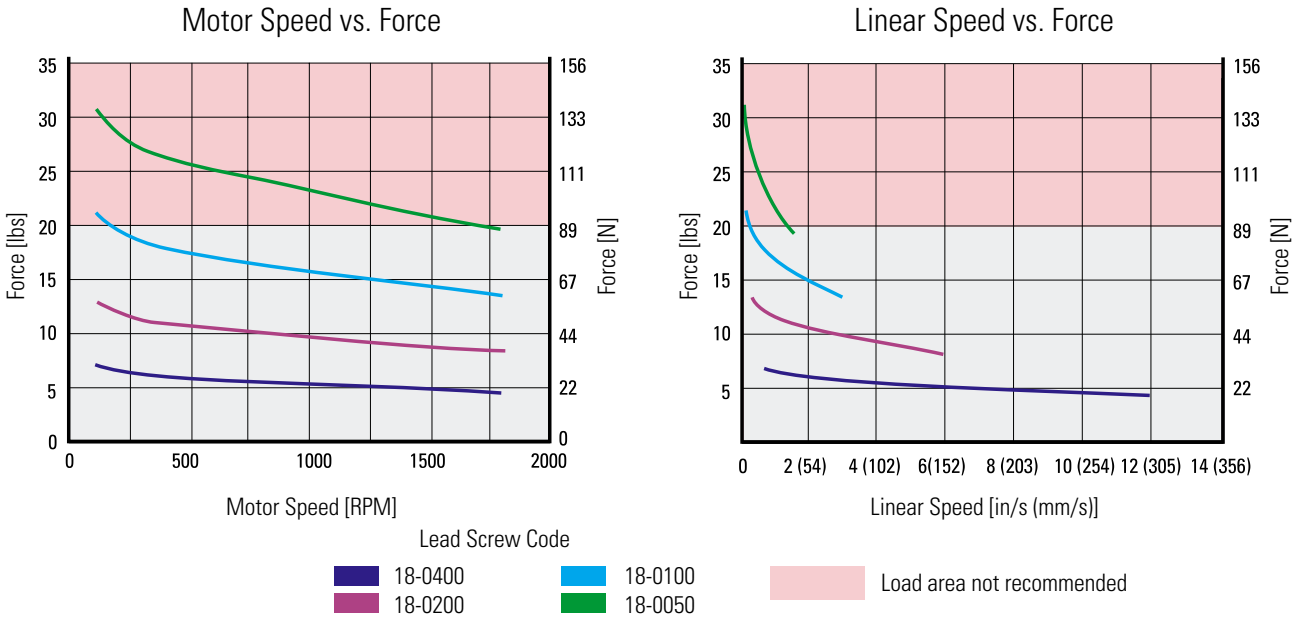

| Maximum Stroke (Smax) |
|---|
| Smax = Ls - Ln - 0.06 in (1.6 mm) |

(A) Flying leads are standard. Custom connection solutions possible. Contact Thomson for more information.

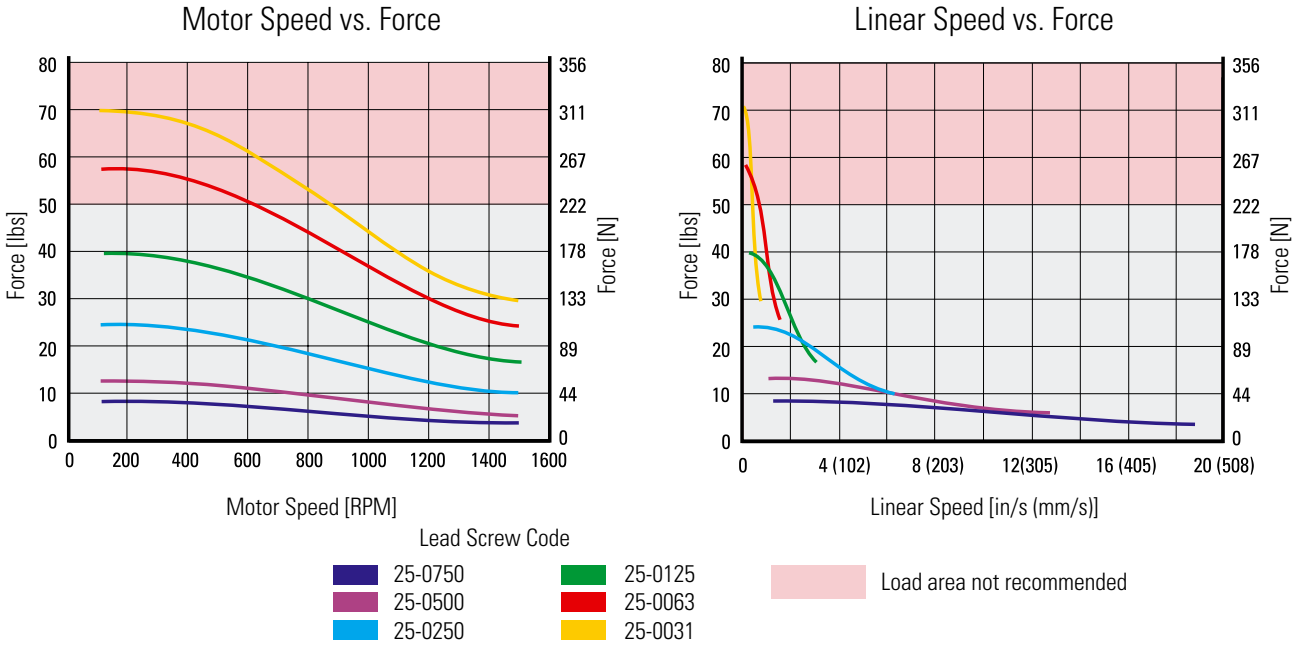
**Motor connection information!** See table on page 15.

# ML11, ML14 – Performance Diagrams

## ML11A100



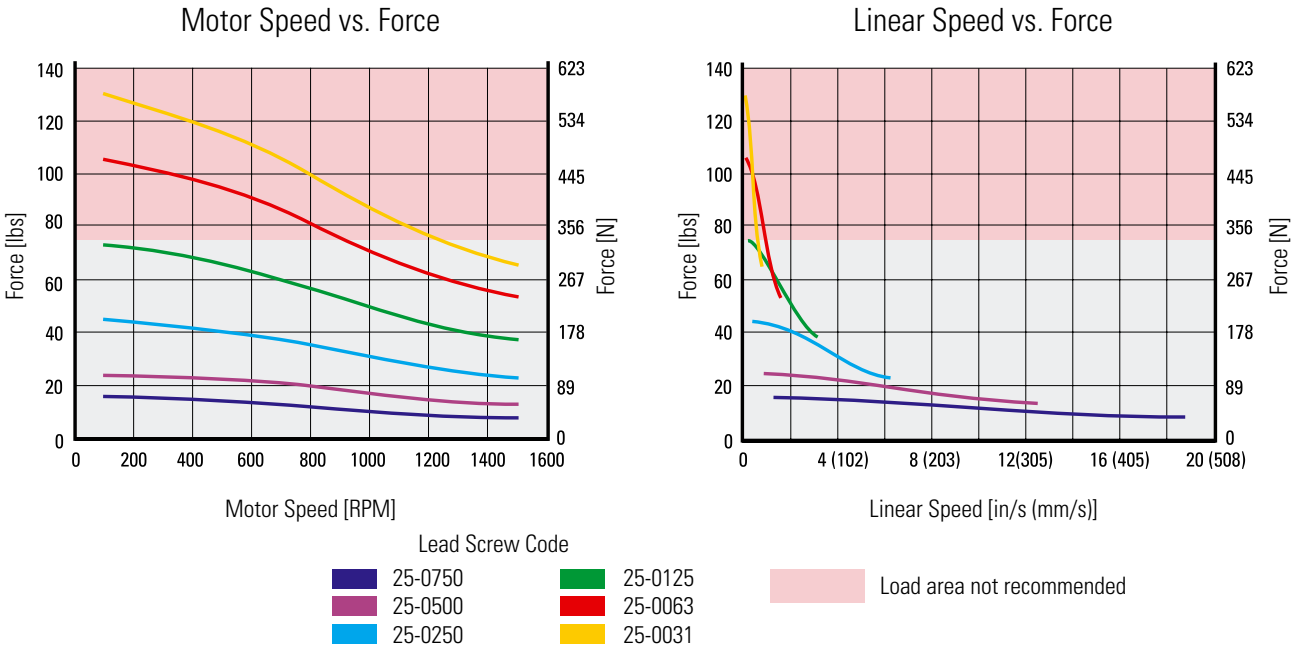

## ML14A088



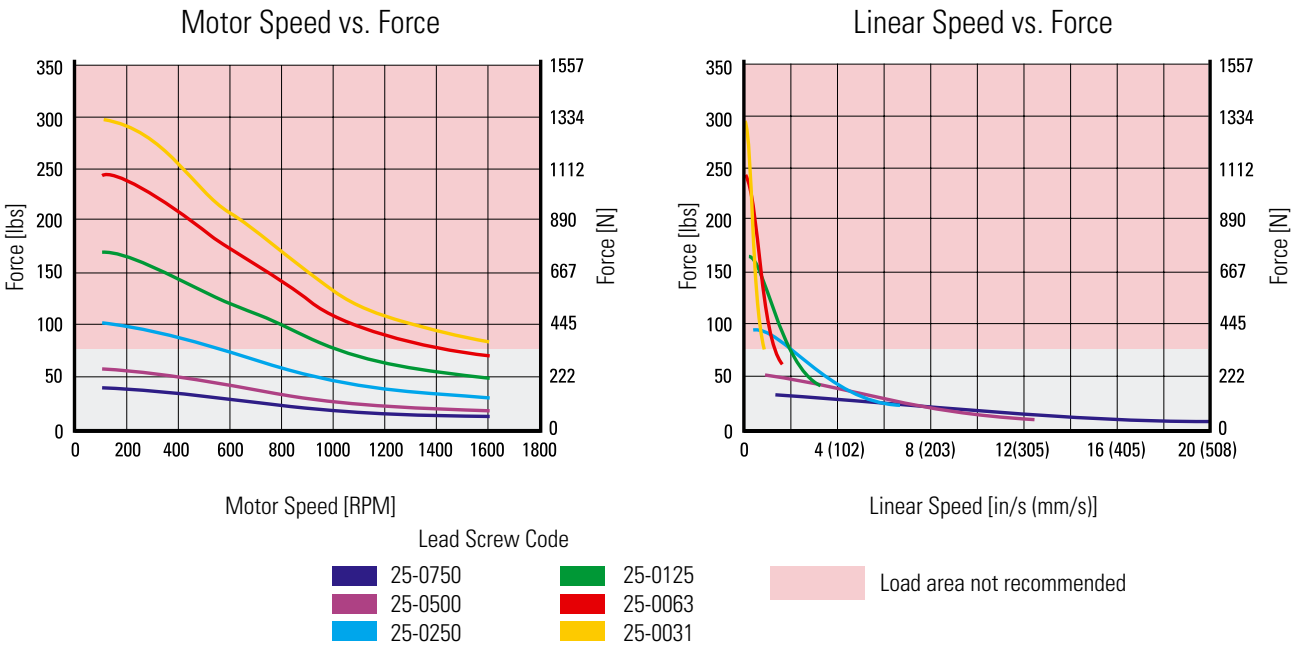

**Note!** All motor load curves were generated with a 40 VDC, 2-phase ON driver and full stepped at the motor rated current. Performance plots for other lead screw and motor winding configurations can be generated at thomsonlinear.com/motorized.

# ML17 – Performance Diagrams

## ML17A150



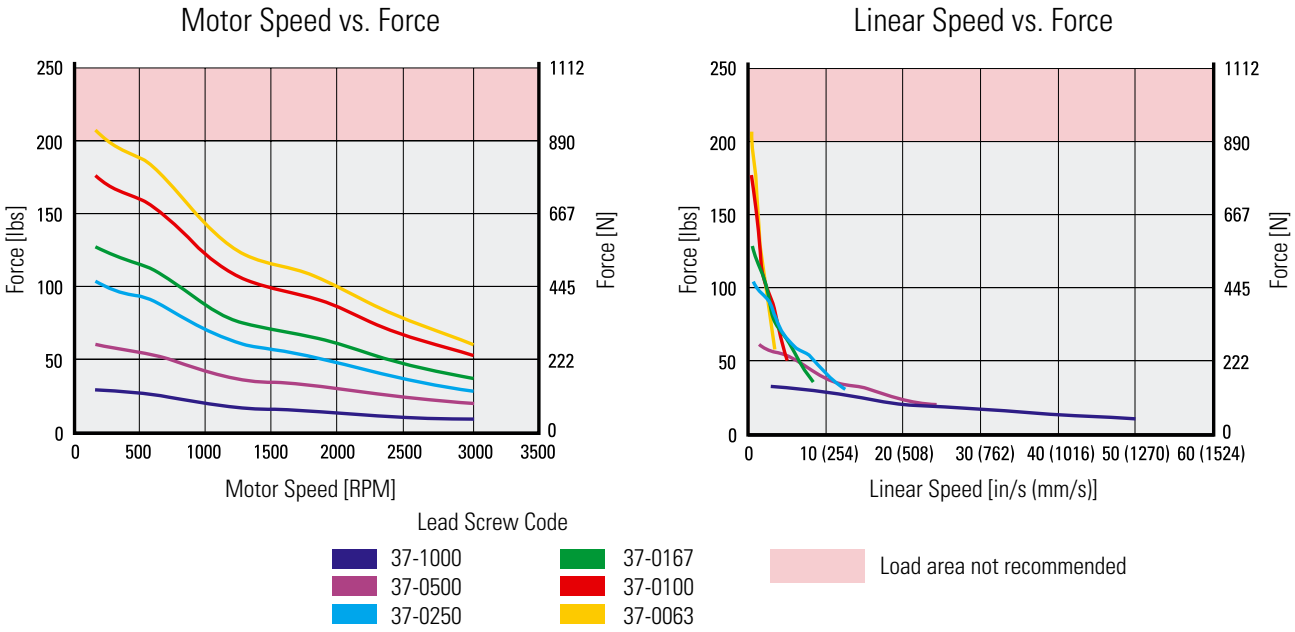

## ML17B150



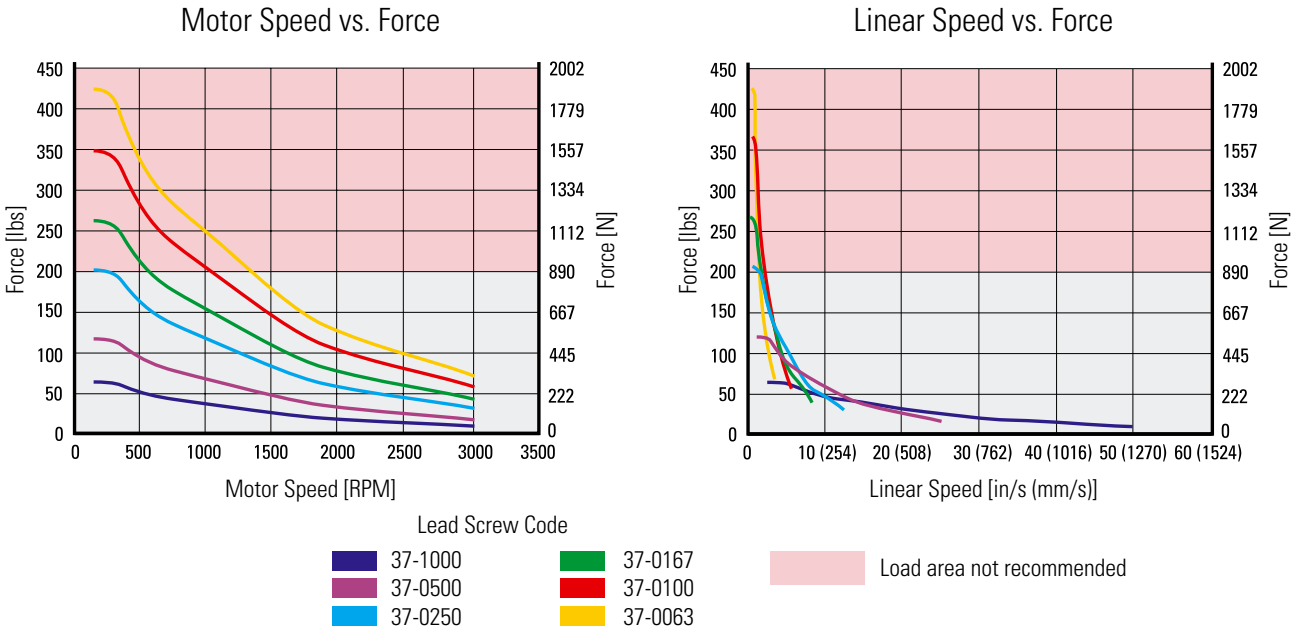

**Note!** All motor load curves were generated with a 40 VDC, 2-phase ON driver and full stepped at the motor rated current. Performance plots for other lead screw and motor winding configurations can be generated at thomsonlinear.com/motorized.

# ML23 – Performance Diagrams

## ML23A300




## ML23B300



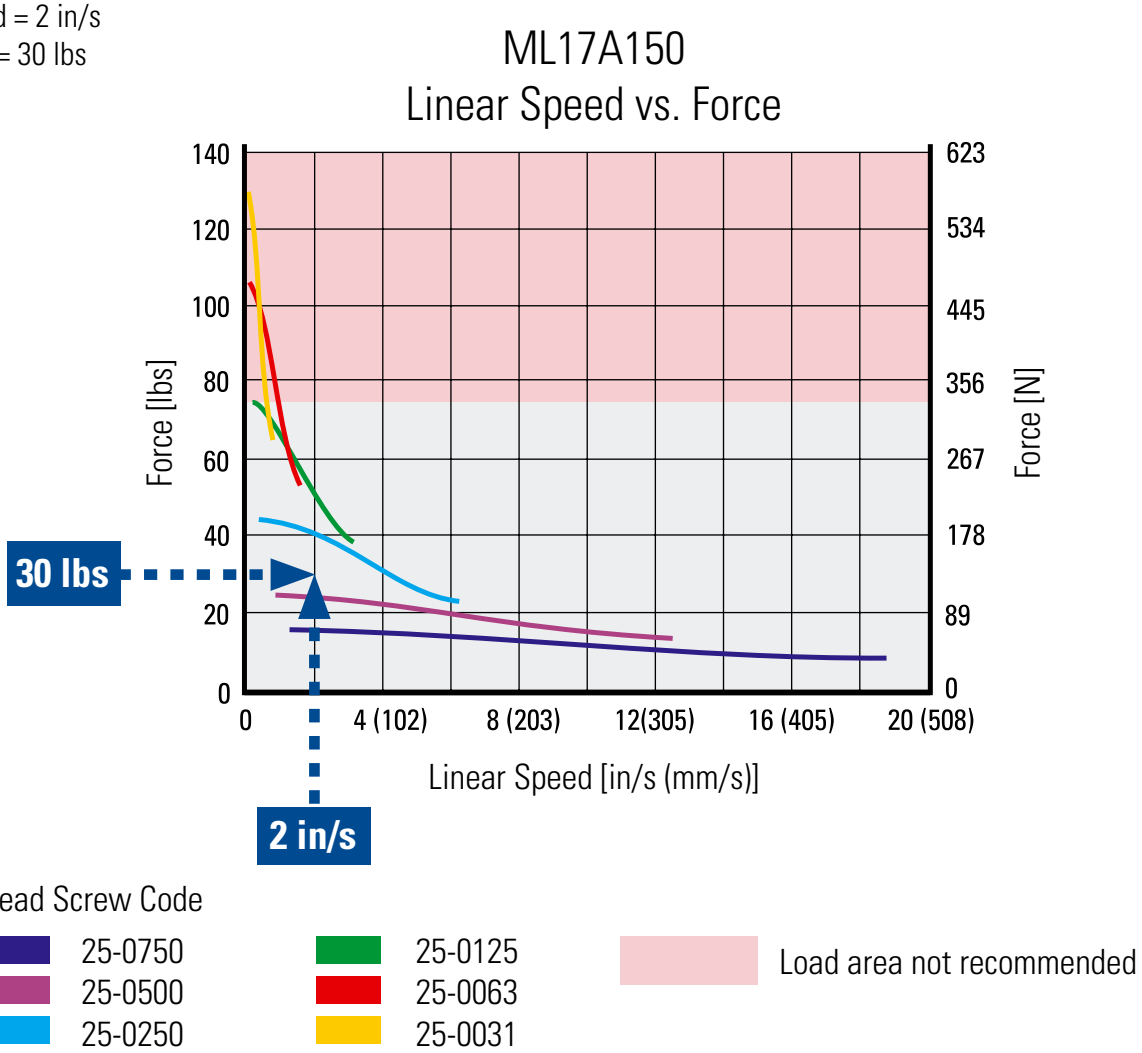

**Note!** All motor load curves were generated with a 40 VDC, 2-phase ON driver and full stepped at the motor rated current. Performance plots for other lead screw and motor winding configurations can be generated at thomsonlinear.com/motorized.

# Sizing and Selection Guidelines

### How to Select Motor and Lead Screw

For a basic sizing determination, use performance charts to find appropriate screw lead and diameter for desired motor size. Use linear travel speed and dynamic load.

Example:
Speed = 2 in/s
Load = 30 lbs




Given the speed and load requirements of 2 in/s and 30 lbs, respectively, a ML17A150 motor with an inch lead screw with a diameter and lead of 0.25 inch (25-0250) will be a sufficient Motorized Lead Screw assembly for this application*.

Please visit www.thomsonlinear.com/motorized for a more detailed sizing calculator or call Thomson to speak with a Motorized Lead Screw sizing specialist.

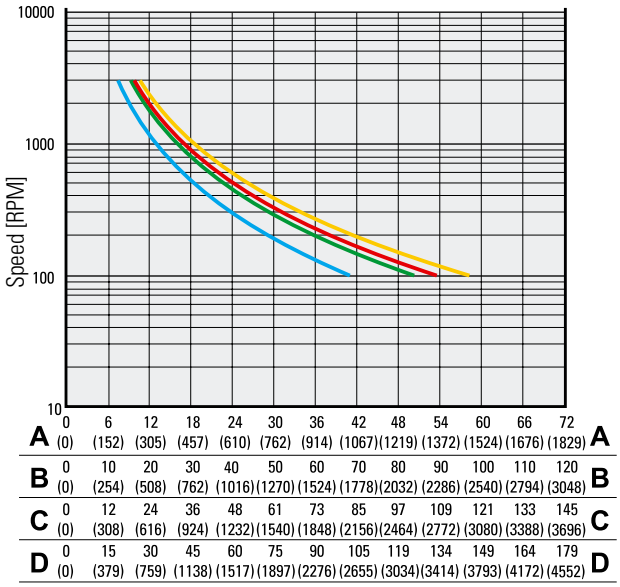
*Performance curve upper limits should be avoided for critical and/or high duty cycle applications. Generally a safety factor of 2 is recommended when sizing an application.

# Sizing and Selection Guidelines

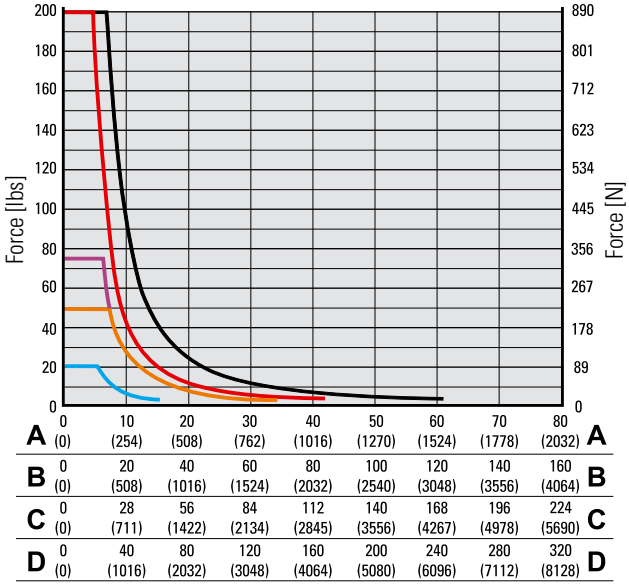
## How to Determine Maximum Permissible Screw Length

In order to determine the maximum possible lead screw length for your Motorized Lead Screw assembly, the following charts can be used. These charts take in to consideration the maximum rotational speed and compression load as well as the end fixity of your system.

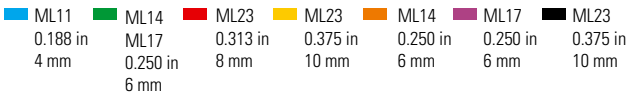
Critical Speed
Motor Speed vs. Maximum Screw Length



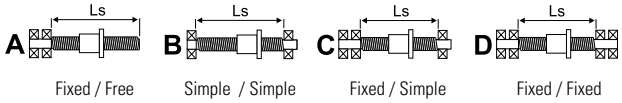

Column Load
Compression Force vs. Maximum Screw Length




Unit Size and Lead Screw Diameter Combination




Type of Screw End Fixity




### 1. Determine Maximum Motor Speed

Calculate what the maximum motor speed will be for your specific application.

### 2. Decide Type of Screw End Fixity

There are four basic types of end fixity (A, B, C and D). The maximum screw length (Ls) for a given motor speed, unit size and screw diameter will vary depending on the selection.

### 3. Check Critical Screw Speed

Check Critical Speed diagram for your maximum speed, lead screw diameter and end fixity to determine the maximum permissible screw length for your application. For rotating screw configurations (S), the Taper-Lock connection within the motor can be considered fixed.

### 4. Check Column Loading

Another limiting factor for the screw length is how much column loading (buckling) the screw is subjected to. Check the Column Load diagram to see that your load and desired maximum screw length are compatible with regards to the unit size, lead screw diameter and end fixity being used.

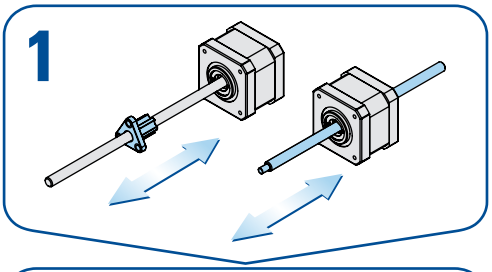
# Installation Guidelines

## Installation

The successful integration of a Motorized Lead Screw in an application is primarily dependent on the screw alignment and subsequent screw runout. If incorrectly mounted, a lead screw assembly will have significantly reduced system life and may be noisy or inaccurate. Thomson methodically straightens all screws prior to assembly to minimize vibration and runout. The Taper-Lock coupling method also was designed to provide a concentric interface and optimize alignment. Proper alignment, end support configuration and lead nut selection are important factors to achieve a well designed installation that will exceed expectations.

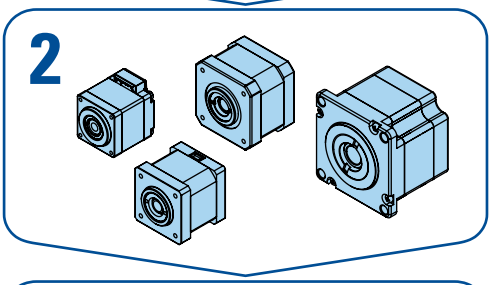
### 1. Select Motorized Lead Screw Configuration

Determine which of the two types of configurations – rotating screw (S) or rotating nut (N) – the application requires. See page 3 and 5 for more information.



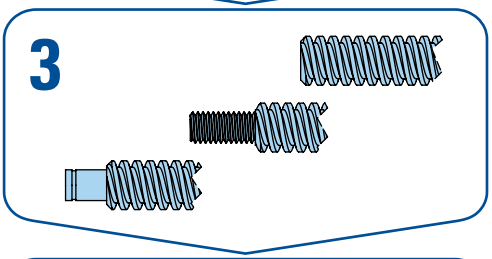

### 2. Select Motor Size

Select the appropriate size based on desired performance, motor frame size, etc. Thomson offers four base models (ML11, ML14, ML17 and ML23) with optional motor windings, linear travel and load capacity selection.



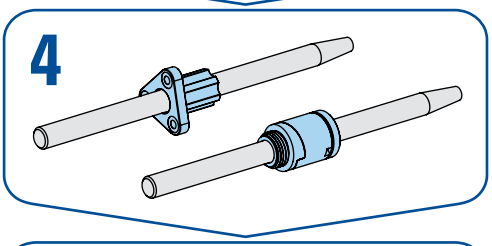

### 3. Select Lead Screw

Select the lead screw diameter and length with regard to the required stroke of the application and the type of end machining the screw requires.



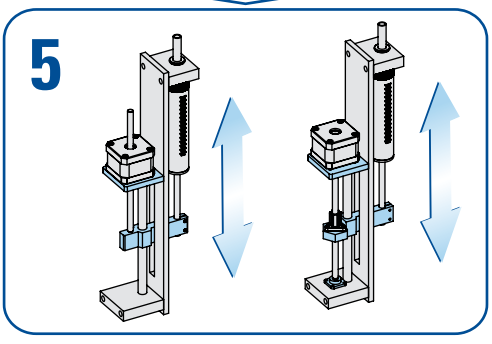

### 4. Select Nut

For rotating screw (S) configurations, choose between various nut mounting styles, materials, and backlash options. Rotating nut (N) configurations as default always come in a high performance material, standard backlash nut.




### 5. Mount the Motorized Lead Screw

Mount the unit into the application using the tolerance guidelines shown on page 9.

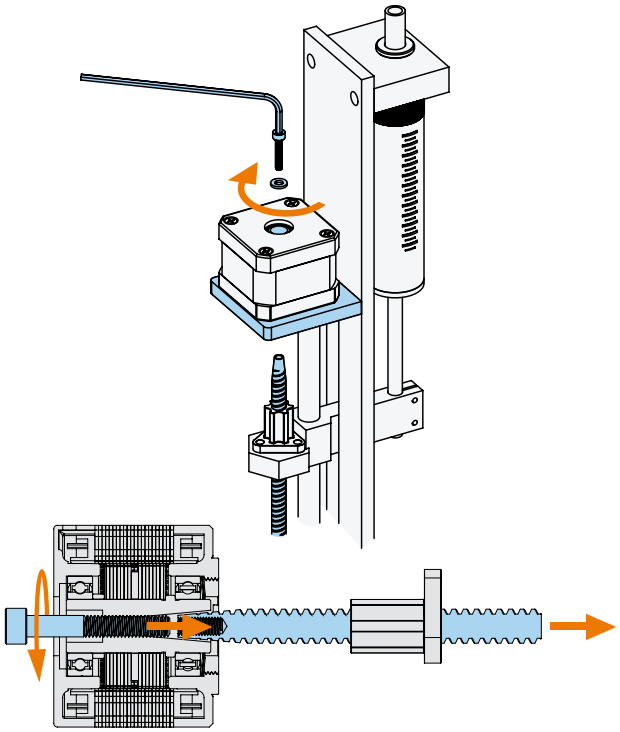


# Comissioning, Service and Maintenance Advantages

Quick and easy comissioning, service and maintenance are some key points to a successfull installation. The Motorized Lead Screw will enable just that while keeping spare parts stock and tools required to a minimum.

## Rotating Screw Lead Screw Swapping

The unique Taper-Lock coupling allows for quick and easy assembly and disassembly. This means that one can easily try out different lead screw motor combinations in an application. This capability to swap out lead screws and motors enables the end user to rapidly prototype, validate designs, replace damaged parts or simply upgrade to higher performance components – all with a simple hex wrench.



## Lead Screw Removal - Optional

Due to the secure connection of the Taper-Lock coupling, an additional feature may be added to facilitate the removal of the lead screw. Remove the fastener securing the lead screw and use the oversize removal screw to gently push the lead screw out. Removal screw thread sizes are shown in the table below.*

### Taper-Lock Removal Thread Specifications

| Motor code | Lead scew code | Fastener screw size | Recommended fastener screw length [mm] | Recommended fastener screw torque [lbs-in (Nm)] | Removal screw size |
|---|---|---|---|---|---|
| ML11AxxxS | 18-xxxx<br>M04-xx | M2.5×0.45 | 17 | 10.9 (1.2) | M3×0.5 |
| ML14AxxxS | 25-xxxx<br>M06-xx | M3×0.5 | 21 | 19.5 (2.2) | M4×0.7 |
| ML17AxxxS | 25-xxxx<br>M06-xx | M3×0.5 | 14 | 19.5 (2.2) | M4×0.7 |
| ML17BxxxS | 25-xxxx<br>M06-xx | M3×0.5 | 21 | 19.5 (2.2) | M4×0.7 |
| ML23AxxxS | 31-xxxx<br>M08-xx | M4×0.7 | 17 | 45.3 (5.1) | M5×0.8 |
| ML23BxxxS | 31-xxxx<br>M08-xx | M4×0.7 | 33 | 45.3 (5.1) | M5×0.8 |
| ML23AxxxS | 37-xxxx<br>M10-xx | M5×0.8 | 25 | 91.5 (10.3) | M6×1.0 |
| ML23BxxxS | 37-xxxx<br>M10-xx | M5×0.8 | 41 | 91.5 (10.3) | M6×1.0 |

*Removal thread does not come standard in Motorized Lead Screw assemblies – contact Thomson if internal shaft thread is required.

# Glossary

| | |
|---|---|
| Accuracy | A measurement of precision. Perfect accuracy, for example, means advancing a lead nut linearly one inch from any point on a screw will always require the exact same number of revolutions. |
| Axial Load | A load passing through the center axis of the lead screw. |
| Backdrive | Application of a force on a lead nut to cause rotation of the screw; in essence, converting linear to rotary motion. |
| Backlash | The axial or radial free motion between the lead nut and lead screw; a measure of system stiffness and repeatability. |
| Bipolar Motor | Motor with two phases and a single winding per phase (4 lead wires). All Thomson standard stepper motors are bipolar. |
| Chopper Drive | A constant current stepper motor drive that operates by quickly cycling power on and off, or "chopping." |
| Column Load | Column loading is the compression load on the screw. This load has a tendency to buckle the screw and is dependent on screw diameter, screw length and type of mounting. |
| Concentricity | Condition where the median points of two or more radially-disposed features are congruent with the axis (or center point). |
| Critical Speed | The condition where the rotary speed of the assembly sets up harmonic vibrations. These vibrations are the result of shaft diameter, unsupported length, type of bearing support, lead nut mounting method and/or screw rpm. Vibrations may also be caused by a bent screw or faulty installation alignment. |
| Drag Torque | The amount of torque required to drive the unloaded lead screw. |
| Driving Torque | The amount of effort required to turn the lead screw and move the load. |
| Dynamic Load | Load applied to Motorized Lead Screw assembly while in motion. |
| Efficiency (Lead Screw) | Expressed as a percentage, the ability of a lead screw assembly to convert torque to thrust with minimal mechanical loss. Thomson lead screws range in efficiency from 35 to 85%. |
| Efficiency (Motor) | Expressed as a percentage, the motor's ability to turn electrical energy into mechanical energy with minimal thermal loss. Thomson stepper motors range in efficiency from 65 to 90%. |
| End Fixity or End Bearing Support | How the ends of the lead screw are fixed or supported. |
| Holding Torque | Torque required to rotate motor shaft while all coils are fully energized with a steady state DC current. |
| Inertia | The level of rotational resistance of a lead screw or shaft. |
| Lead | The axial distance a screw travels during one revolution. If thread is 1 start, lead = pitch. |
| Microstepping | Dividing the motors natural full step by smaller increments. Example: 1.8 º step motor microstepped at 64× will mean that 1 pulse is now 1.8 º/64 = 0.028 º. |
| Perpendicularity | Condition of a surface, center plane, or axis at a right angle to a plane or axis. |
| Pitch | Distance measured between adjacent threads of the lead screw - if thread is 1 start, then pitch = lead. |
| Pulse Rate | The number of pulses per second (pps) applied to the windings of the motor. 1 pulse = 1 step. |
| Repeatability | A measure of constancy that is directly related to axial backlash. Higher backlash equates to lower repeatability and may be corrected by preloading the lead nut if required. |
| Resolution | The linear distance the Motorized Lead Screw will actuate the lead nut or screw per input pulse. |
| Resonance | Vibration occurring when a mechanical system operates within an unstable range. |
| Runout | Composite tolerance used to control the functional relationship of one or more features of a part to an axis. |
| Side Load (Radial) | A load applied perpendicular to the lead screw axis. Not recommended for lead screw applications as it will reduce functional life. |
| Static Load | Static load is the maximum non-operating load capacity above which failure of the motor and/or lead nut occurs. |
| Straightness | Condition where an element of a surface, or an axis, is in a straight line. |
| Stroke | The maximum length of extension of a lead nut on the lead screw. |
| Thrust Force or Thrust Load | Thrust load is loading parallel to and concentric with the centerline of the screw which acts continuously in one direction. Thrust loading is the proper method of attaching the load to the lead screw assembly. |
| Travel/Step or Travel Rate | The linear translation of a lead nut or screw for one full step of the motor. |

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