

# Lead Screw

## Lead Screws - Overview

### Feed Screw Comparison

| Type                                       | Slide Screw                                                                                                                | Lead Screw                                                                        | Rolled Ball Screw                                                                         | Precision Ball Screw                                                                |
|--------------------------------------------|----------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| Shape                                      |                                           |  |          |  |
| Features                                   | Simple feed and adjust mechanisms, etc.<br>Made of stainless steel shaft and plastic nut. No-grease operation is possible. | Optimal for the case where thrust loads and high loadings exist.                  | Can be applied at reasonable costs when precision ball screw accuracies are not required. | Optimal for the case where high positioning and velocity accuracy are required.     |
| App. Example                               | Stoppers In/Out and Transfer pitch changeover                                                                              | Transfer pitch changeover Jacks, Feed Screw for Lathes                            | Transfer Line                                                                             | Measurement Instruments                                                             |
| Allowable Rotational Speed                 | Low Speed                                                                                                                  | Medium Speed                                                                      | High Speed                                                                                | High Speed                                                                          |
| Accuracy                                   | ★★                                                                                                                         | ★★                                                                                | ★★★★                                                                                      | ★★★★★                                                                               |
| Allowable Axial Load ( ) is for Reference. | △<br>(max540N)                                                                                                             | ◎<br>(max30000N)                                                                  | ○<br>(max9960N)                                                                           | ○<br>(max9960N)                                                                     |

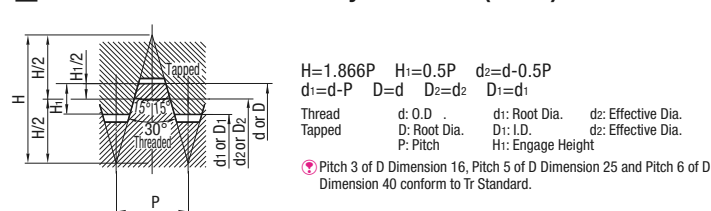
### Lineup : Lead Screws

| Lead Screw Type                          | Shape                                                                               | Right-Hand Thread | Left-Hand Thread | Fine Pitch Right-Hand Thread | Right and Left-Hand Thread | Precision Right and Left-Hand Thread | Page  |
|------------------------------------------|-------------------------------------------------------------------------------------|-------------------|------------------|------------------------------|----------------------------|--------------------------------------|-------|
| Both Ends Stepped                        |    | ○                 | ○                | ○                            | ○                          | ○                                    | P.801 |
| One End Stepped / One End Double Stepped |    | ○                 | ○                | -                            | ○                          | ○                                    | P.803 |
| One End Stepped / One End Double Stepped |    | ○                 | -                | -                            | -                          | -                                    | P.805 |
| Both Ends Double Stepped                 |   | ○                 | ○                | -                            | -                          | -                                    | P.807 |
| Straight                                 |  | ○                 | ○                | -                            | ○                          | -                                    | P.808 |

### Lead Screw Accuracy Standards

| Item                              | Content                   |
|-----------------------------------|---------------------------|
| Allowable Dimension and Tolerance | JISB0217 0218             |
| Screw Accuracy                    | 7e Grade                  |
| Nut Accuracy                      | 7H Grade                  |
| Single Pitch Error                | ±0.02                     |
| Accumulated Pitch Error           | ±0.15/300mm               |
| Shaft Maximum Runout              | See table below           |
| Length Tolerance                  | JIS B 0405 (Medium Class) |

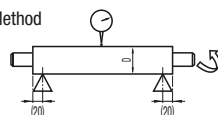
### Lead Screw Thread Geometry Standards (JIS Tr)



### Lead Screw Specifications

| Shaft Dia. | Pitch | Screw Shaft Effective Dia. | Screw Shaft Minor Dia. (MIN.) | Screw Shaft Lead Angle | Screw Shaft Runout (Max.) |         |         |         |         |         |         |          |           |           |           |
|------------|-------|----------------------------|-------------------------------|------------------------|---------------------------|---------|---------|---------|---------|---------|---------|----------|-----------|-----------|-----------|
|            |       |                            |                               |                        | Shaft Overall Length      |         |         |         |         |         |         |          |           |           |           |
|            |       |                            |                               |                        | ~125                      | 126~200 | 201~315 | 315~400 | 401~500 | 501~630 | 631~800 | 801~1000 | 1001~1250 | 1251~1600 | 1601~2000 |
| 8          | 1.5   | 7.25                       | (5.9)                         | 3°46'                  | 0.1                       | 0.14    | 0.21    | 0.27    | 0.35    | -       | -       | -        | -         | -         | -         |
| 10         | 2     | 9                          | (7.2)                         | 4°03'                  | 0.09                      | 0.12    | 0.16    | 0.21    | 0.27    | 0.35    | 0.46    | 0.58     |           |           |           |
| 12         | 2     | 11                         | (9.2)                         | 3°19'                  | 0.09                      | 0.11    | 0.13    | 0.16    | 0.2     | 0.25    | 0.32    | 0.42     |           |           |           |
| 14         | 3     | 12.5                       | (10.1)                        | 4°22'                  |                           |         |         |         |         |         |         |          |           |           |           |
| 16         | 2     | 15                         | (13.18)                       | 2°25'                  |                           |         |         |         |         |         |         |          |           |           |           |
| 16         | 3     | 14.5                       | (12.1)                        | 3°46'                  |                           |         |         |         |         |         |         |          |           |           |           |
| 18         | 4     | 16                         | (13.1)                        | 4°33'                  | -                         | 0.09    | 0.11    | 0.13    | 0.16    | 0.19    | 0.23    | 0.3      | 0.38      | 0.5       | 0.69      |
| 20         | 2     | 19                         | (17.18)                       | 1°55'                  |                           |         |         |         |         |         |         |          |           |           |           |
|            | 4     | 18                         | (15.1)                        | 4°03'                  | -                         | 0.11    | 0.11    | 0.11    | 0.13    | 0.15    | 0.17    | 0.22     | 0.27      | 0.34      | 0.46      |
| 22         | 5     | 19.5                       | (16.1)                        | 4°40'                  |                           |         |         |         |         |         |         |          |           |           |           |
| 25         | 5     | 22.5                       | (19)                          | 4°03'                  |                           |         |         |         |         |         |         |          |           |           |           |
| 28         | 5     | 25.5                       | (22)                          | 3°34'                  |                           |         |         |         |         |         |         |          |           |           |           |
| 32         | 6     | 29                         | (24.5)                        | 3°46'                  | -                         | 0.11    | 0.11    | 0.11    | 0.13    | 0.15    | 0.17    | 0.22     | 0.27      | 0.34      | 0.46      |
| 36         | 6     | 33                         | (28.5)                        | 3°19'                  |                           |         |         |         |         |         |         |          |           |           |           |
| 40         | 6     | 37                         | (32.5)                        | 2°57'                  |                           |         |         |         |         |         |         |          |           |           |           |
| 50         | 8     | 46                         | (40.4)                        | 3°10'                  |                           |         |         |         |         |         |         |          |           |           |           |

• Runout Measurement Method



# Lead Screw

## Lead Screw Specifications / Technical Calculations

### Nuts for Lead Screw Specifications

| Shaft Dia. | Pitch | Part Number / Type                                                                  |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
|------------|-------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
|            |       | MTS□□/Standard                                                                      | MTSP□□/Compact                                                                      | MTSJ□□/Pilot                                                                        | MTSQR/Slotted Holes                                                                 | MTRFR/RoHS Compliant                                                                | MTBLR/Anti-Backlash                                                                 | MTSM□□/ Lubrication-Free                                                            | MTSR□□/ High Strength Plastic                                                       | MTSF□□/ Plastic Type                                                                |
|            |       |  |  |  |  |  |  |  |  |  |
| 8          | 1.5   | P.795                                                                               | P.795                                                                               | P.795                                                                               | P.795                                                                               | P.796                                                                               | P.796                                                                               | P.797                                                                               | P.798                                                                               | P.798                                                                               |
|            |       | Allowable Dynamic Thrust (N)                                                        |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |                                                                                     |
| 10         | 2     | 1470                                                                                | -                                                                                   | -                                                                                   | -                                                                                   | 2550                                                                                | -                                                                                   | 2550                                                                                | 278                                                                                 | 255                                                                                 |
| 12         | 2     | 2550                                                                                | 2020                                                                                | -                                                                                   | -                                                                                   | 3920                                                                                | 3390                                                                                | 3920                                                                                | 428                                                                                 | 392                                                                                 |
| 14         | 3     | 3920                                                                                | 3140                                                                                | -                                                                                   | -                                                                                   | 4900                                                                                | -                                                                                   | 4900                                                                                | 536                                                                                 | 490                                                                                 |
| 16         | 2     | 4900                                                                                | 3920                                                                                | 4900                                                                                | 4900                                                                                | 6670                                                                                | -                                                                                   | 6670                                                                                | -                                                                                   | -                                                                                   |
|            | 3     | -                                                                                   | -                                                                                   | 6670                                                                                | 6670                                                                                | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   |
| 18         | 4     | 6670                                                                                | 5340                                                                                | -                                                                                   | -                                                                                   | 6670                                                                                | 6290                                                                                | 6670                                                                                | 686                                                                                 | 628                                                                                 |
|            | 2     | 8720                                                                                | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | 954                                                                                 | 873                                                                                 |
| 20         | 2     | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | 10100                                                                               | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   |
|            | 4     | 9810                                                                                | 7850                                                                                | 9810                                                                                | 9810                                                                                | 9810                                                                                | 9320                                                                                | 9810                                                                                | 1071                                                                                | 980                                                                                 |
| 22         | 5     | 12360                                                                               | 9890                                                                                | 12360                                                                               | 12360                                                                               | -                                                                                   | -                                                                                   | 12360                                                                               | -                                                                                   | -                                                                                   |
| 25         | 5     | 14220                                                                               | 11380                                                                               | 14220                                                                               | 14220                                                                               | 14220                                                                               | -                                                                                   | 14220                                                                               | -                                                                                   | 1412                                                                                |
| 28         | 5     | 17950                                                                               | 14420                                                                               | 17950                                                                               | 17950                                                                               | 17950                                                                               | -                                                                                   | 17950                                                                               | -                                                                                   | 1765                                                                                |
| 32         | 6     | 21080                                                                               | 16940                                                                               | 21080                                                                               | 21080                                                                               | 21080                                                                               | -                                                                                   | 21080                                                                               | -                                                                                   | 2050                                                                                |
| 36         | 6     | 25780                                                                               | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | 25780                                                                               | -                                                                                   | -                                                                                   |
| 40         | 6     | 33830                                                                               | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | 33830                                                                               | -                                                                                   | -                                                                                   |
| 50         | 8     | 40310                                                                               | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   | -                                                                                   |

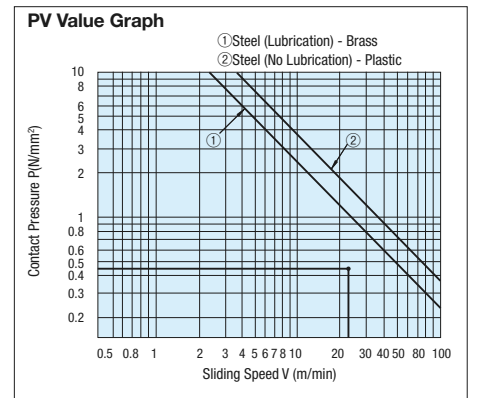
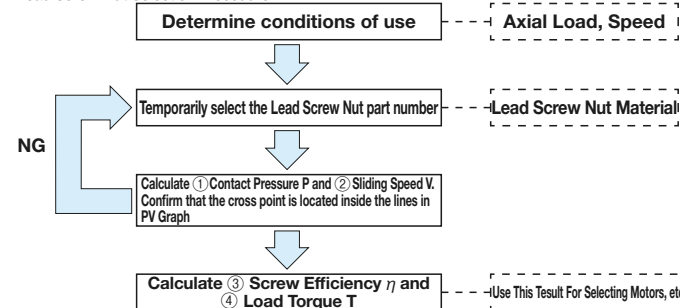
### Lead Screw Technical Calculations

Calculate Contact Pressure P and Sliding Velocity V based on conditions of use to check that no abnormal wear will occur.

Calculate cross point based on the calculated P and V values in PV Graph.

When the cross point is located inside the line ① or ② in PV Value Graph, it can be stated that no abnormal wear will occur.

Lead Screw Nut Selection Procedure



#### ① Contact Pressure P (N/mm²)

$$P = \frac{F_s}{F_o} \times \alpha$$
  
Fs : Axial Load (N)  
Fo : Allowable Dynamic Thrust (N) >> Nuts for Lead Screw Specifications  
The thrust when the contact pressure acting on the screw shaft and nuts is 9.8 (0.98N)/mm²  
α : 9.8 (Brass), 0.98 (Resin)

#### ② Sliding Speed V (m/min)

$$V = \frac{\pi \cdot d_2 \cdot n}{\cos(d)} \times 10^{-3}$$
  
d2 : Screw Shaft Effective Dia. >> Nuts for Lead Screw Specifications  
n : Screw Shaft Lead Angle (Degree) >> Nuts for Lead Screw Specifications  
n : Screw Shaft Revolution Frequency per Minute (min⁻¹)

#### ③ Screw Efficiency η

$$\eta = \frac{1 - \mu \tan(d)}{1 + \mu \tan(d)}$$
  
μ : Dynamic Friction Coefficient  
d : Screw Shaft Lead Angle (Degree)

#### Dynamic Friction Coefficient Reference Value

| Thread Shaft            | Nut                                          | Dynamic Friction Coefficient μ |
|-------------------------|----------------------------------------------|--------------------------------|
| Steel (Lubrication)     | Brass                                        | 0.21                           |
| Steel (Non Lubrication) | Polyacetal / PPS Resin with Sliding Property | 0.13                           |

#### ④ Load Torque T (N · cm)

$$T = \frac{F_s \cdot R}{2\pi \cdot \eta}$$
  
Fs : Axial Load  
η : Screw Efficiency  
R : Lead (cm)

#### Calculation Example

In case of using MTSRW16 shaft, pitch 3 and MTSFR16 brass flanged nut when the axial load is 300N as rotational speed at 500min⁻¹.

① Contact Pressure P (N/mm²)

$$P = \frac{F_s}{F_o} \times \alpha = \frac{300}{6670} \times 9.8 = 0.44 \text{ (N/mm}^2\text{)}$$

② Sliding Speed V (m/min)

$$V = \frac{\pi \cdot d_2 \cdot n}{\cos(d)} \times 10^{-3} = \frac{\pi \times 14.5 \times 500}{\cos(3^\circ 46')} \times 10^{-3} = 22.8 \text{ (m/min)}$$

When the PV Graph is viewed based on the calculated P and V values, the cross point V=22.8(m/min) when P=0.44(N/mm²) is located inside the line ① on the PV Graph, thus it can be stated that no abnormal wear will occur.

#### Calculation Example

Required Torque when using MTSRW16 shaft, pitch 3, and MTSFR16 brass (flanged nut.)

③ Screw Efficiency η

$$\eta = \frac{1 - \mu \tan(d)}{1 + \mu \tan(d)} = \frac{1 - 0.21 \tan(3^\circ 46')}{1 + 0.21 \tan(3^\circ 46')} = 0.24$$

Also, in a case of calculating for the Load Torque T (N · cm) when the axial load is 300N.

④ Load Torque T (N · cm)

$$T = \frac{F_s \cdot R}{2\pi \cdot \eta} = \frac{300 \times 0.3}{2\pi \times 0.24} = 59.7 \text{ (N · cm)}$$