SLIDE SCREW

The NB slide screw converts rotational motion into linear motion by utilizing the friction between radial ball bearings and a shaft. This simple mechanism eases maintenance and installation work. The slide screw is most commonly used as transport devices in many types of machines, and is not intended for accurate positioning requirements.

STRUCTURE AND ADVANTAGES

The NB slide screw consists of two aluminum blocks, each with three radial bearings with a fixed angle between them. A round shaft is inserted between the two blocks, and its rotation produces linear motion determined by the contact angle between the shaft and the bearings. For variable loads, the thrust is adjusted by turning the spring loaded thrust adjustment bolts.

Linear Motion on Round-shaft

The NB slide screw is suitable for long-stroke applications using a standard linear shaft.

High Machine Efficiency

The slide screw utilizes the rotational motion of the bearings and drive shaft to achieve machine efficiency as high as 90%.

No Lubrication Required

The bearings are pre-lubricated with grease prior to shipment, so there is no need to apply lubrication other than to the drive shaft to prevent corrosion.

Excessive Load Prevention Mechanism

When an excessive load is applied, the screw will stop due to slippage, thereby preventing accidents.

Rated Life

The rated life is expressed in terms of the number of revolutions of the drive shaft by Equation (4). The corresponding total travel distance and life time are given in Equations (5) and (6) respectively.

Required Thrust

Tightening of the bolts creates a thrust force by pushing the bearings against the shaft. This results in a constant force being applied to the bearings regardless of the load.

The thrust should not be greater than required force in the application.

For the horizontal application, the frictional resistance is calculated by the following equation.

F1 = μ · g · W ........................................ (1)

F: frictional resistance (N)  μ: friction coefficient  
W: mass of work (kg)  g: gravitational acceleration (9.8 m/sec²)

A sufficient safety margin should be achieved by setting μ = 0.01. Also, the inertia at starting and stopping should be taken into consideration.

F2 = W · dv / dt ........................................ (2)

F: frictional resistance (N)  W: mass of work (kg)  
dv/dt: acceleration (9.8 m/sec²)

Therefore, the required thrust is its maximum at starting point due to the combination of frictional resistance and inertia.

F = F1 + F2 ........................................... (3)

F: thrust (N)  F1: frictional resistance (N)  F2: inertia (N)

<table>
<thead>
<tr>
<th>part number</th>
<th>C: basic dynamic load rating (thrust) (N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS 6</td>
<td>98</td>
</tr>
<tr>
<td>SS 8</td>
<td>294</td>
</tr>
<tr>
<td>SS10</td>
<td>441</td>
</tr>
<tr>
<td>SS12</td>
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<td>SS16</td>
<td>784</td>
</tr>
<tr>
<td>SS20</td>
<td>1,080</td>
</tr>
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<td>SS25</td>
<td>1,470</td>
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<tr>
<td>SS30</td>
<td>2,160</td>
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</table>
Allowable Rotational Speed

When the rotational speed is increased and approaches the shaft resonant frequency, the shaft is disabled from further operation. This speed is called the critical speed and can be obtained by the following equation. In order to leave a sufficient safety margin, the maximum operating speed should be set at about 80% of the calculated value.

\[
N_c = \frac{60 \lambda^2}{2\pi L^2} \frac{E I}{\gamma A} \quad \text{(7)}
\]

\[
N_c = 12.2 \cdot \frac{\lambda^2}{L^2} \cdot \frac{D}{10^6} \quad \text{(8)}
\]

**Figure I-2 Critical Speed and Support Distance**

Calculation Example

1. Selecting a slide screw that satisfies the following conditions:
   - Support method: fixed-supported
   - Support distance: 1,500 mm
   - External force: 98 N
   - Table mass: 50 kg
   - Stroke distance: 1,200 mm
   - Friction coefficient: 0.01
   - Maximum speed of transfer: 12 m/min
   - Cycles per minute: 4

   **● Determination of required thrust:**
   \[
   F = 98 + (0.01 \times 50 \times 9.8) = 102.9 \text{ N}
   \]
   Therefore, based on the maximum thrust in the dimension table, at least SS10 is required in size.

   **● Allowable rotational speed:**
   From Equation (8), according to the conditions, the critical speed \(N_c\) is:
   \[
   N_c = 12.2 \cdot \frac{\lambda^2}{L^2} \cdot \frac{D}{10^6} = 83.6 \text{ rpm}
   \]
   Applying a safety factor of 0.8, the maximum speed is given by:
   \[
   0.8 \cdot N_c \cdot \frac{\ell V_{max}}{1000} = 9.6 \text{ m/min}
   \]

2. Determining the maximum speed of transfer under the following conditions:
   - Support method: fixed-supported
   - Support distance: 2,000 mm
   - Slide screw selected: SS16-16

   The critical speed is obtained from Equation (8):
   \[
   N_c = 12.2 \cdot \frac{\lambda^2}{L^2} \cdot \frac{D}{10^6} = 752 \text{ rpm}
   \]
   Applying a safety factor of 0.8, the maximum speed of transfer is:
   \[
   0.8 \cdot N_c \cdot \frac{\ell V_{max}}{1000} = 9.6 \text{ m/min}
   \]

**Table I-2 Maximum Speed**

<table>
<thead>
<tr>
<th>Part number</th>
<th>Shaft diameter D (mm)</th>
<th>Lead (\ell) (mm)</th>
<th>Critical speed (N_c) (rpm)</th>
<th>Maximum speed (V_{max}) (m/min)</th>
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<tbody>
<tr>
<td>SS10-10</td>
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<td>836</td>
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</table>

Therefore, the SS13-15 and SS16-16 slide screws satisfy the given conditions.
1. Clean dust from drive shaft.
2. Place shaft between upper and lower blocks. Lightly tighten thrust adjustment bolts until the clearance between the shaft and the bearings diminishes.
3. Temporarily attach the slide screw to the table.
4. Adjust the parallelism between the slide screw and the linear motion guides by manually moving the table back and forth. Fix the shaft accurately after the required parallelism is achieved.
5. Tighten the thrust adjustment bolts evenly while applying a thrust force to the table until slippage disappears. Care should be required to avoid excessive tightening which results in shortening the rated life.

**USE AND HANDLING PRECAUTIONS**

- It is recommended to use a heat-treated ground shaft such as NB shaft to prevent wear and to obtain smooth motion. (refer to page F-2)
- Since the slide screw utilizes the friction between the bearings and the shaft, the lead varies due to the effect of load variation, movement direction, and shaft conditions. As the values of standard lead are advisory, highly accurate positioning can be obtained by attatching a linear scale to the table.
- If the slide screw and linear motion guides are not parallel, an unbalanced load will be applied to the slide screw. Exercise care in controlling the parallelism.

**SPECIAL REQUIREMENTS**

NB can fabricate slide screws to meet special requirements, including screws with a special lead or a reverse lead. Contact NB for further information.

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**REVERSE LEAD**

Contact NB for further information. NB can fabricate slide screws to meet special requirements, including screws with a special lead or a reverse lead. Contact NB for further information.

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**PART NUMBER STRUCTURE**

Example: SS 16-16-N

- **SS6~SS16**
  - Slide screw
  - Shaft diameter
  - Additional mounting holes
  - Lead

- **SS20~SS30**
  - Slide screw
  - Additional mounting holes

**MAJOR DIMENSIONS**

<table>
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<tr>
<th>Part number</th>
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<th>Major dimensions</th>
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**PART NUMBER**

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<th>W1</th>
<th>fz</th>
<th>a</th>
<th>b</th>
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</table>

1. The mounting holes are machined on request.
2. H1 is the minimum height when the maximum thrust is applied.
3. The values of standard lead are advisory.