



# Lead Screw Nut

THK General Catalog

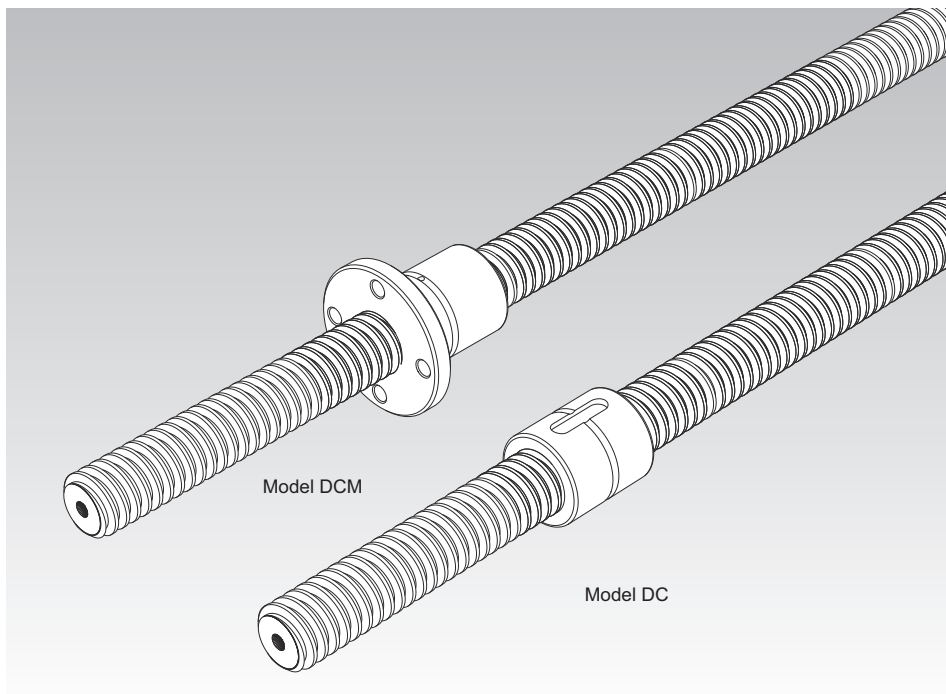
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## Features of the Lead Screw Nut



### Structure and Features

The lead Screw Nut models DCM and DC are manufactured to meet the standards for the 30° trapezoidal threads. They use a special alloy (see **A16-3**) for the nuts and have a precision male thread, formed through die casting, as the core. As a result, these bearings achieve less unevenness in accuracy and higher accuracy and wear resistance than the machined lead screw nuts.

For the screw shafts to be used with this product, the rolled shafts are available as the standard.

In addition, the cut screw shafts and the ground screw shafts are also available according to the application. Contact THK for details.

## Features of the Special Rolled Shafts

The dedicated rolled shafts with the standardized lengths are available for the Lead Screw Nut.

### [Increased Wear Resistance]

The shaft teeth are formed by cold gear rolling, and the surface of the tooth surface is hardened to over 250 HV and are mirror-finished. As a result, the shafts are highly wear resistant and achieve significantly smooth motion when used in combination with lead screw nuts.

### [Improved Mechanical Properties]

Inside the teeth of the rolled shaft, a fiber flow occurs along the contour of the tooth surface of the shaft, making the structure around the teeth roots dense. As a result, the fatigue strength is increased.

### [Additional Machining of the Shaft End Support]

Since each shaft is rolled, additional machining of the support bearing of the shaft end can easily be performed by lathing or milling.

## High Strength Zinc Alloy

The high strength zinc alloy used in the lead screw nuts is a material that is highly resistant to seizure and the wear and has a high load carrying capacity. Information on mechanical properties, physical properties, and wear resistance is presented below.

\* The figures shown are target values—these figures are not guaranteed.

### [Mechanical Properties]

Table1

Item	Description
Tensile strength	275 to 314 N/mm <sup>2</sup>
Tensile yield strength (0.2%)	216 to 245 N/mm <sup>2</sup>
Compressive strength	539 to 686 N/mm <sup>2</sup>
Compressive yield strength (0.2%)	294 to 343 N/mm <sup>2</sup>
Fatigue strength	132 N/mm <sup>2</sup> × 10 <sup>7</sup> (Schenk bending test)
Charpy impact	0.098 to 0.49 N-m/mm <sup>2</sup>
Elongation	1 to 5 %
Hardness	120 to 145 HV

## [Physical Properties]

Table2

Item	Description
Specific gravity	6.8
Specific heat	460 J/ (kg·K)
Melting point	390 °C
Thermal expansion coefficient	$24 \times 10^{-6}$

## [Wear Resistance]

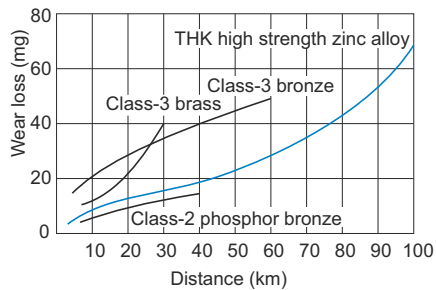


Fig.1 Wear Resistance of the High Strength Zinc Alloy

Table3 [Test conditions: Amsler wear-tester]

Item	Description
Test piece rotational speed	185 min <sup>-1</sup>
Load	392 N
Lubricant	Dynamo oil

## Selecting a Lead Screw Nut

### [Permissible Dynamic Thrust]

The permissible dynamic thrust ( $F$ ) is the level of thrust at which the contact surface pressure exerted by the bearing on the screw tooth surface is  $9.8 \text{ N/mm}^2$ . This value indicates the strength of the Screw Nut.

### [pV Value]

With a sliding bearing, a pV value, which is the product of the contact surface pressure ( $p$ ) and the sliding speed ( $V$ ), is used as a measuring stick to judge whether the assumed model can be used. Use the corresponding pV value indicated in Fig.1 as a guide for selecting a lead screw nut. The pV value varies also according to the lubrication conditions.

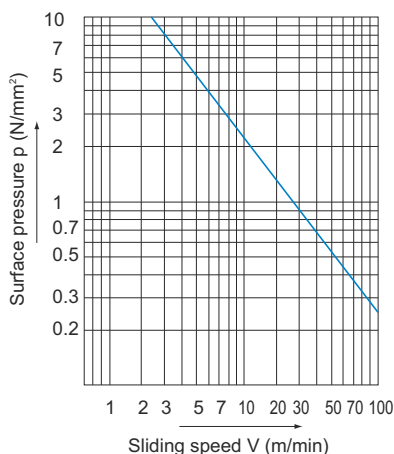


Fig.1 pV Value

### ● $f_s$ : Safety Factor

To calculate a load applied to the lead screw nut, it is necessary to accurately obtain the effect of the inertia that changes with the weight and dynamic speed of an object. In general, with the reciprocating or the rotating machines, it is not easy to accurately obtain all the factors such as the effect of the start and stop, which are always repeated. Therefore, if the actual load cannot be obtained, it is necessary to select a bearing while taking into account the empirically obtained safety factors ( $f_s$ ) shown in Table1.

Table1 Safety Factor ( $f_s$ )

Type of load	Lower limit of $f_s$
For a static load less frequently used	1 to 2
For an ordinary single-directional load	2 to 3
For a load accompanied by vibrations/impact	4 or greater

### ● $f_r$ : Temperature Factor

If the temperature of the screw nut exceeds the normal temperature range, the seizure resistance of the nut and the strength of the material will decrease. Therefore, it is necessary to multiply the dynamic permissible thrust (F) by the corresponding temperature factor indicated in Fig.2.

Accordingly, when selecting a lead screw nut, the following equations need to be met in terms of its strength.

Static permissible thrust(F)

$$f_s \leq \frac{f_r \cdot F}{P_F}$$

$f_s$  : Safety factor (see Table1 on **A16-5**)

$f_r$  : Temperature factor (see Fig.2)

F : Dynamic permissible thrust (N)

$P_F$  : Axial load (N)

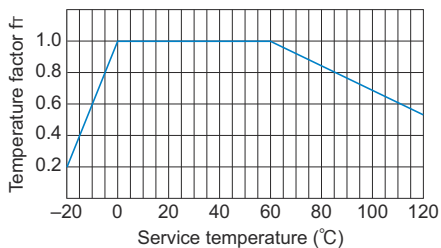


Fig.2 Temperature Factor

### ● Hardness of the Surface and the Wear Resistance

The hardness of the shaft significantly affects the wear resistance of the lead screw nut. If the hardness is equal to or less than 250 HV, the abrasion loss increases as indicated in Fig.3. The roughness of the surface should preferably be 0.80a or less.

A special rolled shaft achieves the surface hardness of 250 HV or greater, through hardening as a result of rolling, and surface roughness of 0.20a or less. Therefore, the dedicated rolled shaft is highly wear resistant.

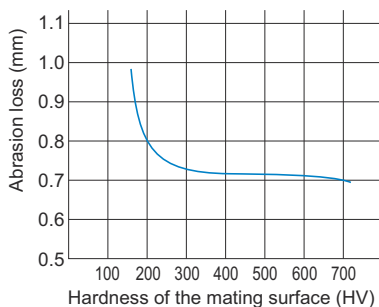


Fig.3 Hardness of the Surface and Wear Resistance

## Point of Selection

### Selecting a Lead Screw Nut

#### [Calculating the Contact Surface Pressure p]

The value of "p" is obtained as followed.

$$p = \frac{P_F}{F} \times 9.8$$

p : Contact surface pressure on the tooth from an axial load ( $P_F$  N) (N/mm<sup>2</sup>)

F : Dynamic permissible thrust (N)

$P_F$  : Axial load (N)

#### [Calculating the Sliding Speed V on the Teeth]

The value of "V" is obtained as followed.

$$V = \frac{\pi \cdot D_o \cdot n}{\cos \alpha \times 10^3}$$

V : Sliding speed (m/min)

$D_o$  : Effective diameter (see specification table) (mm)

n : Revolutions per minute (min<sup>-1</sup>)

$$n = \frac{S}{R \times 10^{-3}}$$

S : Feeding speed (m/min)

R : Lead (mm)

$\alpha$  : Lead angle (see specification table) (°)

## Efficiency and Thrust

The efficiency ( $\eta$ ) at which the screw transfers a torque into thrust is obtained from the following equation.

$$\eta = \frac{1 - \mu \tan \alpha}{1 + \mu / \tan \alpha}$$

$\eta$  : Efficiency

$\alpha$  : Lead angle

$\mu$  : Frictional resistance

Fig.4 shows the result of the above equation.

The thrust generated when a torque is applied is obtained from the following equation.

$$F_a = \frac{2 \cdot \pi \cdot \eta \cdot T}{R \times 10^{-3}}$$

$F_a$  : Thrust generated (N)

$T$  : Torque (input) (N-m)

$R$  : Lead (mm)

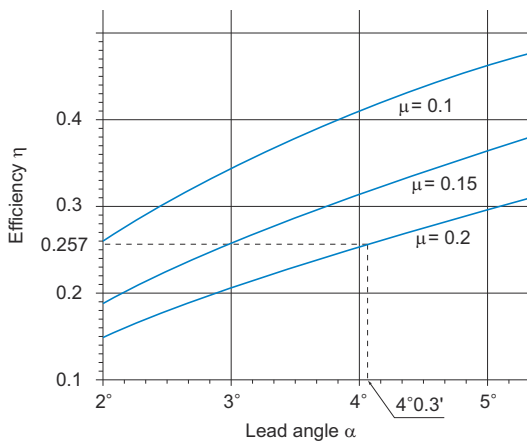


Fig.4 Efficiency



# Accuracy Standards

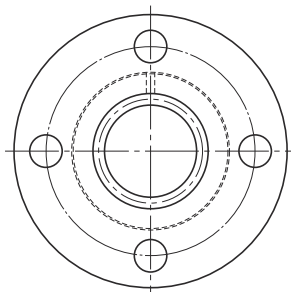
Table2 Accuracy of the Screw Shaft of Models DCM and DC

Unit: mm

Shaft symbol	Rolled shaft	Cut shaft	Ground shaft
Accuracy	T <sup>Note</sup>	K <sup>Note</sup>	G <sup>Note</sup>
Single pitch error (max)	±0.020	±0.015	±0.005
Accumulated pitch error (max)	±0.15/300	±0.05/300	±0.015/300

Note) Symbols T, K and G indicate machining methods for the screw shaft. The cut shafts and ground shafts are build-to-order. For maximum shaft lengths of cut shafts or ground shafts, contact THK.

# Model DCM



Lead Screw Nut Model No.	Outer dimensions			Lead screw nut dimensions						
	Outer diameter		Length L	Flange diameter D <sub>1</sub>	H	B	PCD	r	F	d
	D	Tolerance h9								
DCM 12	22	0 -0.052	30	44	6	5.4	31	1.5	7	1.5
DCM 14	22		30	44	6	5.4	31	1.5	7	1.5
DCM 16	28		35	51	7	6.6	38	1.5	8	1.5
DCM 18	32	0 -0.062	40	56	7	6.6	42	1.5	10.5	2
DCM 20	32		40	56	7	6.6	42	1.5	10.5	2
DCM 22	36		50	61	8	6.6	47	2	14	2.5
DCM 25	36		50	61	8	6.6	47	2	14	2.5
DCM 28	44		56	76	10	9	58	2	15	2.5
DCM 32	44		56	76	10	9	58	2	15	2.5
DCM 36	52	0 -0.074	60	84	10	9	66	2.5	17	3
DCM 40	58		70	98	12	11	76	2.5	19	3
DCM 45	64		75	104	12	11	80	2.5	21.5	4
DCM 50	68		80	109	12	11	85	2.5	24	4

Note1) Cut shafts (K) and ground shafts (G) are build-to-order. In the specification table, "standard shaft length" and "maximum shaft length" are values for rolled shafts (T).

For maximum shaft lengths of cut shafts (K) or ground shafts (G), contact THK.

Note2) The dynamic permissible thrust (F) indicates the torque at which the contact surface pressure on the screw tooth surface is 9.8 N/mm<sup>2</sup>.

The maximum axial load (both when stopped and during operation) is set to the dynamic permissible thrust or below, and it must be selected while taking into consideration the safety factors of Table1 on **A16-5**.

Note3) The static permissible load (P) of the flange indicates the strength of the flange against the load as shown in the figure on the right.

## Model number coding

Combination of lead screw nut and screw shaft

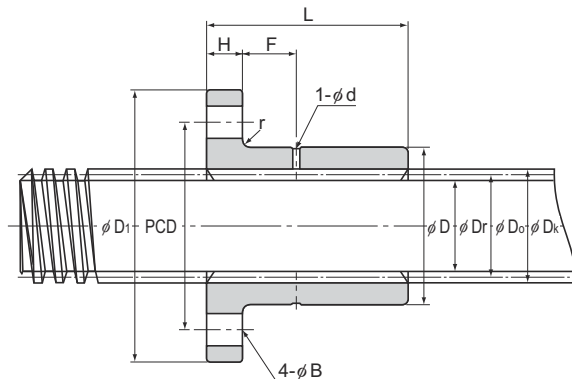
**2 DCM20 +1500L T**

Overall screw shaft length  
(in mm)

Model number of  
lead screw nut

How the screw shaft is processed  
(T: rolled shaft)

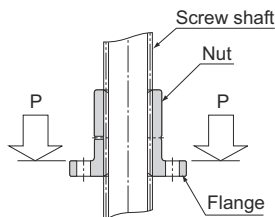
Number of lead screw nuts used on the same shaft



Unit: mm

Screw shaft	Screw shaft details						Standard shaft length	Maximum shaft length	Dynamic permissible thrust $F$ <sup>(note 2)</sup> N	Static permissible load of the flange $P$ <sup>(note 3)</sup> N	Mass	
	Model No. <sup>(note)</sup>	Outer diameter	Effective diameter	Thread minor diameter	Lead	Lead angle					Screw nut	Screw shaft
		$D_k$	$D_0$	$D_r$	R	$\alpha$						
CS 12	12	11	9.5	2	3°19'	1000	1500	3920	20200	100	0.8	
CS 14	14	12.5	10.5	3	4°22'	1000	1500	4900	16900	85	1	
CS 16	16	14.5	12.5	3	3°46'	1000	1500	6670	31500	160	1.3	
CS 18	18	16	13.5	4	4°33'	1000	2000	8730	42000	230	1.6	
CS 20	20	18	15.5	4	4°03'	1500	2000	9800	37200	210	2	
CS 22	22	19.5	16.5	5	4°40'	1500	2500	12400	48600	320	2.3	
CS 25	25	22.5	19.5	5	4°03'	1500	3000	14200	39800	290	3.1	
CS 28	28	25.5	22.5	5	3°34'	2000	3000	17900	69200	550	4	
CS 32	32	29	25.5	6	3°46'	2000	4000	21100	54200	490	5.2	
CS 36	36	33	29.5	6	3°19'	2000	4000	25800	84500	670	6.7	
CS 40	40	37	33.5	6	2°57'	2000	4000	33800	106000	980	8.4	
CS 45	45	41	36.5	8	3°33'	3000	5000	42100	125000	1310	10.4	
CS 50	50	46	41.5	8	3°10'	3000	5000	50100	128000	1430	13	

Lead Screw Nut



## Model number coding

- Lead screw nut only

**DCM20**

Model number of lead screw nut

- Screw shaft

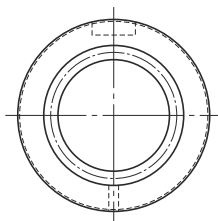
**CS20 T +1500L**

Model number of screw shaft

How the screw shaft is processed (T: rolled shaft)

Overall screw shaft length (in mm)

# Model DC



Lead Screw Nut  Model No.	Outer dimensions			Lead screw nut dimensions					
	Outer diameter		L	Keyway dimensions				d	r
	D	Tolerance h9		b	Tolerance N9	t	ℓ		
			0					0	0
DC 12	22	-0.052	22	4	-0.030	2	16	1.5	1
DC 14	22		22	4		2	16	1.5	1
DC 16	28		26	5		2.5	18	1.5	1
DC 18	32	-0.062	31	7	-0.036	2.5	22	2	1
DC 20	32		31	7		2.5	22	2	1
DC 22	36		40	7		2.5	26	2.5	1
DC 25	36		40	7		2.5	26	2.5	1
DC 28	44	-0.074	45	10	-0.043	4	32	2.5	1.5
DC 32	44		45	10		4	32	2.5	1.5
DC 36	52		49	12		4.5	40	3	1.5
DC 40	58	-0.074	57	15	-0.043	5	42	3	1.5
DC 45	64		62	15		5	48	4	1.5
DC 50	68		67	15		5	52	4	1.5

Note1) Cut shafts (K) and ground shafts (G) are build-to-order. In the specification table, "standard shaft length" and "maximum shaft length" are values for rolled shafts (T).

For maximum shaft lengths of cut shafts (K) or ground shafts (G), contact THK.

Note2) The dynamic permissible thrust (F) indicates the torque at which the contact surface pressure on the screw tooth surface is 9.8 N/mm<sup>2</sup>. The maximum axial load (both when stopped and during operation) is set to the dynamic permissible thrust or below, and it must be selected while taking into consideration the safety factors of Table1 on **A16-5**.

## Model number coding

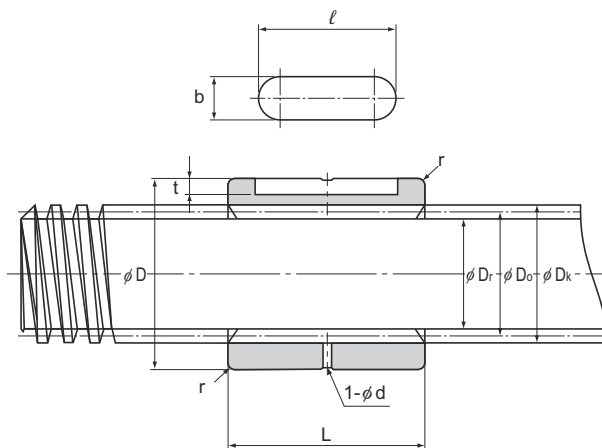
Combination of lead screw nut and screw shaft

**2 DC20 +1500L T**

Overall screw shaft length (in mm)

Model number of lead screw nut      How the screw shaft is processed (T: rolled shaft)

Number of lead screw nuts used on the same shaft



Unit: mm

Screw shaft	Screw shaft details						Standard shaft length	Maximum shaft length	Dynamic permissible thrust F <sup>(note 2)</sup> N	Mass	
	Model No. <sup>(note)</sup>	Outer diameter D <sub>e</sub>	Effective diameter D <sub>o</sub>	Thread minor diameter D <sub>r</sub>	Lead R	Lead angle α				Screw nut g	Screw shaft kg/m
CS 12	12	11	9.5	2	3°19'	1000	1500	2840	40	0.8	
CS 14	14	12.5	10.5	3	4°22'	1000	1500	3630	45	1	
CS 16	16	14.5	12.5	3	3°46'	1000	1500	4900	75	1.3	
CS 18	18	16	13.5	4	4°33'	1000	2000	6860	120	1.6	
CS 20	20	18	15.5	4	4°03'	1500	2000	7650	110	2	
CS 22	22	19.5	16.5	5	4°40'	1500	2500	9900	180	2.3	
CS 25	25	22.5	19.5	5	4°03'	1500	3000	11400	155	3.1	
CS 28	28	25.5	22.5	5	3°34'	2000	3000	14400	280	4	
CS 32	32	29	25.5	6	3°46'	2000	4000	17100	230	5.2	
CS 36	36	33	29.5	6	3°19'	2000	4000	21200	380	6.7	
CS 40	40	37	33.5	6	2°57'	2000	4000	27500	520	8.4	
CS 45	45	41	36.5	8	3°33'	3000	5000	34900	730	10.4	
CS 50	50	46	41.5	8	3°10'	3000	5000	42100	810	13	

Lead Screw Nut

**Model number coding**

- Lead screw nut only

**DC20**

Model number of lead screw nut

- Screw shaft

**CS20 T +1500L**

Model number of screw shaft

How the screw shaft is processed (T: rolled shaft)

Overall screw shaft length (in mm)

## Fit

For the fitting between the screw nut outer diameter and the housing, we recommend a loose fit.  
Housing inner-diameter tolerance: G7

## Installation

### [About Chamfer of the Housing's Mouth]

To increase the strength of the root of the flange of the lead screw nut, the corner is machined to have an R shape. Therefore, it is necessary to chamfer the inner edge of the housing's mouth.

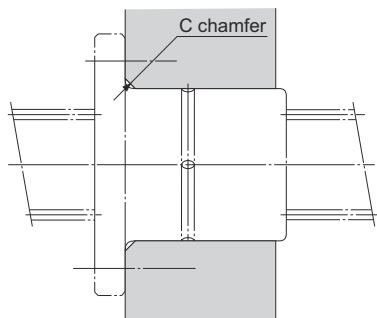


Fig.1

Table1 Chamfer of the Housing's Mouth

Unit: mm

Model No.	Chamfer of the mouth C (Min.)
DCM	
12	2
14	
16	
18	
20	
22	2.5
25	
28	
32	
36	3
40	
45	
50	

**[Example of Installation]**

Fig.2 shows examples of mounting the lead screw nuts. When mounting a lead screw nut, secure sufficient tightening strength in the axial direction. For the housing inner-diameter tolerance, see the section concerning fitting on **A16-14**.

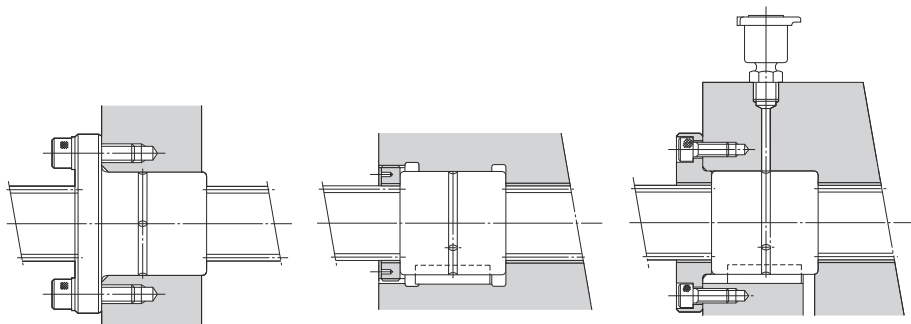


Fig.2 Examples of Installing the Lead Screw Nut

## Lubrication

The Screw Nut is not lubricated when delivered. Once the bearing has been mounted, the Screw Nut must be treated with an appropriate volume of grease or lubricant. The lubrication method should be determined based on usage conditions.

**[Lubricating with oil]**

THK recommends lubricating the Lead Screw Nut with oil. Oil-bath lubrication or drip-feed lubrication are both effective. The most effective method is oil-bath lubrication, which is suitable for high-speed operation, heavy loads, high external temperatures, and other demanding conditions, and helps cool the Lead Screw Nut. Drip-feed lubrication is suitable for low and medium speeds and light and medium loads. Criteria for selecting the appropriate lubricant are shown in Table2.

Table2 Selection of a Lubricant

Condition	Types of Lubricants
Low speed, high load, high temperature	High-viscosity sliding surface oil or turbine oil
High speed, light load, low temperature	Low-viscosity sliding surface oil or turbine oil

**[Lubricating with Grease]**

For usage in lower-speed operations, which is a less common scenario, the user can lubricate the slide system by periodically applying grease to the shaft by hand, or use the oil hole on the Lead Screw Nut. THK recommends using lithium grease no. 2.

## Model Number Coding

Model number configurations differ depending on the model features. Refer to the corresponding sample model number configuration.

### [Lead Screw Nut]

#### ● Models DCM, DC and CS

- Lead screw nut only

**DC20**

Model No. of  
lead screw nut

- Screw shaft

**CS20 T +1500L**

How the screw shaft  
is processed  
(T: rolled shaft)      Overall screw shaft length  
(in mm)

Model number of  
screw shaft

- Combination of  
lead screw nut and screw shaft

**2 DC20 +1500L T**

Number of lead screw nuts  
used on the same shaft

Model No. of  
lead screw nut

Overall screw  
shaft length  
(in mm)

How the screw shaft is processed  
(T: rolled shaft)



**[Handling]**

- (1) Make sure the Lead Screw Nut is not dropped or subjected to any sudden impact, as this could cause injury and damage the product. Even if there is no outward indication of damage, a sudden impact could prevent the unit from functioning properly.
- (2) When handling the product, wear protective gloves, safety shoes, etc., as necessary to ensure safety.

**[Precautions on Use]**

- (1) Prevent foreign material, such as cutting chips or coolant, from entering the product. Failure to do so may cause damage.
- (2) If the product is used in an environment where cutting chips, coolant, corrosive solvents, water, etc., may enter the product, use bellows, covers, etc., to prevent them from entering the product.
- (3) If foreign material such as cutting chips adheres to the product, replenish the lubricant after cleaning the product.
- (4) Do not forcibly drive a pin, key, or other positioning device into this product; this could create indentations on the sliding surface and impair the product's function.
- (5) Skewing or misalignment of the Lead Screw Nut and the element that supports the screw shaft can drastically reduce service life. Inspect the components carefully and make sure they are mounted correctly.
- (6) If the unit will be positioned vertically, install safety equipment or take other measures to prevent it from toppling over.
- (7) To avoid damaging the product, use the Lead Screw Nut in combination with an LM Guide, Ball Spline, or other guide element.
- (8) Insufficient rigidity or accuracy of mounting members causes the bearing load to concentrate on one point and the bearing performance will drop significantly. Accordingly, give sufficient consideration to the rigidity/accuracy of the housing and base and strength of the fixing bolts.

**[Lubrication]**

- (1) Thoroughly wipe off anti-rust oil and feed lubricant before using the product.
- (2) Do not mix different lubricants. Even lubricants containing the same type of thickening agent may, if mixed, interact in an adverse manner due to disparate additives or other ingredients.
- (3) When using the product in locations exposed to constant vibrations or in special environments such as clean rooms, vacuum and low/high temperature, use the grease appropriate for the specification/environment.
- (4) Following lubrication, perform several warm-up strokes with the unit to ensure that lubricant permeates the interior.
- (5) Lubricant viscosity can vary depending on the temperature. Please keep in mind that the Lead Screw Nut's sliding resistance may be affected by changes in viscosity.
- (6) Following lubrication, stirring-resistance within the lubricant can cause the Lead Screw Nut to exhibit increased rotational torque. Before commencing operations, make sure to run the unit through several warm-up cycles to ensure that the lubricant is adequately integrated and dispersed.
- (7) Excess grease may scatter immediately after lubrication, so wipe off scattered grease as necessary.
- (8) The properties of grease deteriorate and its lubrication performance drops over time, so grease must be checked and added properly according to the use frequency of the machine.

- (9) The greasing interval varies depending on the use condition and service environment. Set the final lubrication interval/amount based on the actual machine.
- (10) If a lubricant will be used, the application must be designed in such a way that the direction in which the Lead Screw Nut is installed does not prevent lubricant from circulating.

**[Storage]**

Lead Screw Nuts should be stored horizontally in their original packaging in an indoor location where they are not exposed to abnormally high or low temperatures or high humidity.

**[Disposal]**

Dispose of the product properly as industrial waste.



# Lead Screw Nut

THK General Catalog

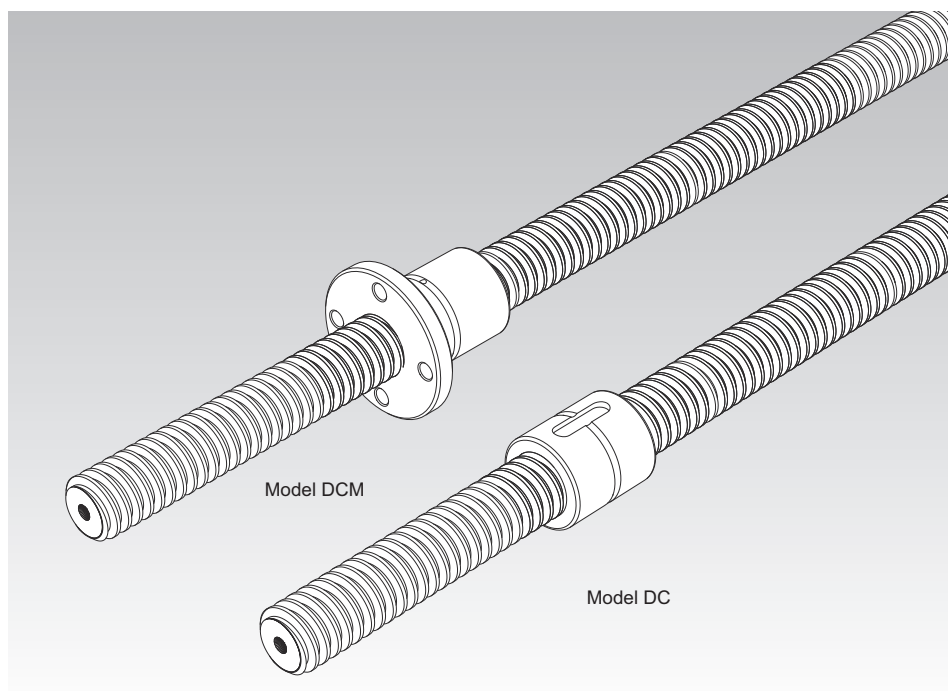
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## Features of the Lead Screw Nut



### Structure and Features

The lead Screw Nut models DCM and DC are manufactured to meet the standards for the 30° trapezoidal threads. They use a special alloy (see [B 16-3](#)) for the nuts and have a precision male thread, formed through die casting, as the core. As a result, these bearings achieve less unevenness in accuracy and higher accuracy and wear resistance than the machined lead screw nuts. For the screw shafts to be used with this product, the rolled shafts are available as the standard.

In addition, the cut screw shafts and the ground screw shafts are also available according to the application. Contact THK for details.

## Features of the Special Rolled Shafts

The dedicated rolled shafts with the standardized lengths are available for the Lead Screw Nut.

### [Increased Wear Resistance]

The shaft teeth are formed by cold gear rolling, and the surface of the tooth surface is hardened to over 250 HV and are mirror-finished. As a result, the shafts are highly wear resistant and achieve significantly smooth motion when used in combination with lead screw nuts.

### [Improved Mechanical Properties]

Inside the teeth of the rolled shaft, a fiber flow occurs along the contour of the tooth surface of the shaft, making the structure around the teeth roots dense. As a result, the fatigue strength is increased.

### [Additional Machining of the Shaft End Support]

Since each shaft is rolled, additional machining of the support bearing of the shaft end can easily be performed by lathing or milling.

## High Strength Zinc Alloy

The high strength zinc alloy used in the lead screw nuts is a material that is highly resistant to seizure and the wear and has a high load carrying capacity. Information on mechanical properties, physical properties, and wear resistance is presented below.

\* The figures shown are target values—these figures are not guaranteed.

### [Mechanical Properties]

Table1

Item	Description
Tensile strength	275 to 314 N/mm <sup>2</sup>
Tensile yield strength (0.2%)	216 to 245 N/mm <sup>2</sup>
Compressive strength	539 to 686 N/mm <sup>2</sup>
Compressive yield strength (0.2%)	294 to 343 N/mm <sup>2</sup>
Fatigue strength	132 N/mm <sup>2</sup> × 10 <sup>7</sup> (Schenk bending test)
Charpy impact	0.098 to 0.49 N-m/mm <sup>2</sup>
Elongation	1 to 5 %
Hardness	120 to 145 HV

## [Physical Properties]

Table2

Item	Description
Specific gravity	6.8
Specific heat	460 J/ (kg·K)
Melting point	390 °C
Thermal expansion coefficient	$24 \times 10^{-6}$

## [Wear Resistance]

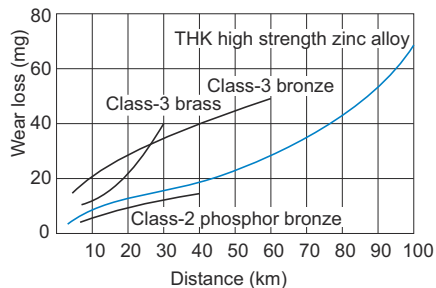


Fig.1 Wear Resistance of the High Strength Zinc Alloy

Table3 [Test conditions: Amsler wear-tester]

Item	Description
Test piece rotational speed	185 min <sup>-1</sup>
Load	392 N
Lubricant	Dynamo oil

## Selecting a Lead Screw Nut

### [Permissible Dynamic Thrust]

The permissible dynamic thrust ( $F$ ) is the level of thrust at which the contact surface pressure exerted by the bearing on the screw tooth surface is  $9.8 \text{ N/mm}^2$ . This value indicates the strength of the Screw Nut.

### [pV Value]

With a sliding bearing, a pV value, which is the product of the contact surface pressure ( $p$ ) and the sliding speed ( $V$ ), is used as a measuring stick to judge whether the assumed model can be used. Use the corresponding pV value indicated in Fig.1 as a guide for selecting a lead screw nut. The pV value varies also according to the lubrication conditions.

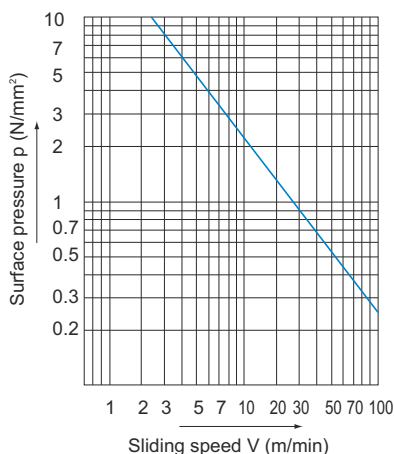


Fig.1 pV Value

### ● $f_s$ : Safety Factor

To calculate a load applied to the lead screw nut, it is necessary to accurately obtain the effect of the inertia that changes with the weight and dynamic speed of an object. In general, with the reciprocating or the rotating machines, it is not easy to accurately obtain all the factors such as the effect of the start and stop, which are always repeated. Therefore, if the actual load cannot be obtained, it is necessary to select a bearing while taking into account the empirically obtained safety factors ( $f_s$ ) shown in Table1.

Table1 Safety Factor ( $f_s$ )

Type of load	Lower limit of $f_s$
For a static load less frequently used	1 to 2
For an ordinary single-directional load	2 to 3
For a load accompanied by vibrations/impact	4 or greater

### ● $f_r$ : Temperature Factor

If the temperature of the screw nut exceeds the normal temperature range, the seizure resistance of the nut and the strength of the material will decrease. Therefore, it is necessary to multiply the dynamic permissible thrust (F) by the corresponding temperature factor indicated in Fig.2.

Accordingly, when selecting a lead screw nut, the following equations need to be met in terms of its strength.

Static permissible thrust( $F$ )

$$f_s \leq \frac{f_r \cdot F}{P_F}$$

$f_s$  : Safety factor (see Table1 on [B16-5](#))

$f_r$  : Temperature factor (see Fig.2)

F : Dynamic permissible thrust (N)

$P_F$  : Axial load (N)

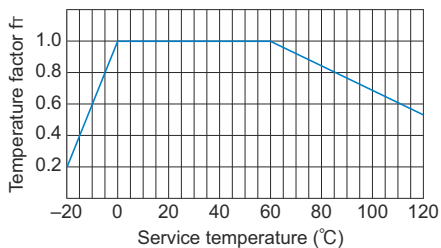


Fig.2 Temperature Factor

### ● Hardness of the Surface and the Wear Resistance

The hardness of the shaft significantly affects the wear resistance of the lead screw nut. If the hardness is equal to or less than 250 HV, the abrasion loss increases as indicated in Fig.3. The roughness of the surface should preferably be 0.80a or less.

A special rolled shaft achieves the surface hardness of 250 HV or greater, through hardening as a result of rolling, and surface roughness of 0.20a or less. Therefore, the dedicated rolled shaft is highly wear resistant.

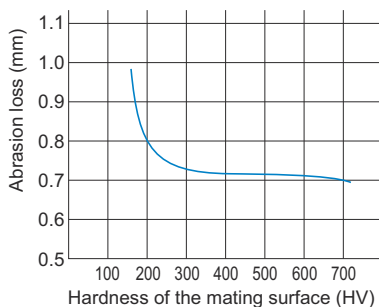


Fig.3 Hardness of the Surface and Wear Resistance



## Point of Selection

### Selecting a Lead Screw Nut

#### [Calculating the Contact Surface Pressure p]

The value of "p" is obtained as followed.

$$p = \frac{P_F}{F} \times 9.8$$

p : Contact surface pressure on the tooth from an axial load ( $P_F$  N) (N/mm<sup>2</sup>)

F : Dynamic permissible thrust (N)

$P_F$  : Axial load (N)

#### [Calculating the Sliding Speed V on the Teeth]

The value of "V" is obtained as followed.

$$V = \frac{\pi \cdot D_o \cdot n}{\cos \alpha \times 10^3}$$

V : Sliding speed (m/min)

$D_o$  : Effective diameter (see specification table) (mm)

n : Revolutions per minute (min<sup>-1</sup>)

$$n = \frac{S}{R \times 10^{-3}}$$

S : Feeding speed (m/min)

R : Lead (mm)

$\alpha$  : Lead angle (see specification table) (°)

### Example of selection calculation

Assuming that Lead Screw Nut model DCM is used, select a lead screw nut that travels at feed speed  $S = 3$  m/min while receiving an axial load  $P_F = 1,080$  N, which is applied in one direction. First, tentatively select model DCM32 (dynamic permissible thrust  $F = 21,100$  N). Obtain the contact surface pressure (p).

$$p = \frac{P_F}{F} \times 9.8 = \frac{1080}{21100} \times 9.8 \doteq 0.50 \text{ N/mm}^2$$

Obtain the sliding speed (V).

The rotation speed per minute (n) of the screw shaft needed to move it at feed speed  $S = 3$  m/min is calculated as follows.

$$n = \frac{S}{R \times 10^{-3}} = \frac{3}{6 \times 10^{-3}} = 500 \text{ min}^{-1}$$

$$V = \frac{\pi \cdot D_o \cdot 500}{\cos \alpha \times 10^3} = \frac{\pi \times 29 \times 500}{\cos 3^\circ 46' \times 10^3} \doteq 45.6 \text{ m/min}$$

From the diagram of pV values (see Fig.1 on **B16-5**), it is judged that there will be no abnormal wear if the sliding speed (V) is 47 m/min or below against the "p" value of 0.50 N/mm<sup>2</sup>. Second, obtain the safety factor ( $f_s$ ) against the dynamic permissible thrust (F). Given the conditions: temperature factor  $f_T = 1$  and applied load  $P_F = 1,080$  N, the safety factor is calculated as follows.

$$f_s \leq \frac{f_T \cdot F}{P_F} = \frac{1 \times 21100}{1080} = 19.5$$

Since the required strength will be met if " $f_s$ " is at least 2 because of the type of load, it is appropriate to select model DCM32.

## Efficiency and Thrust

The efficiency ( $\eta$ ) at which the screw transfers a torque into thrust is obtained from the following equation.

$$\eta = \frac{1 - \mu \tan \alpha}{1 + \mu / \tan \alpha}$$

$\eta$  : Efficiency

$\alpha$  : Lead angle

$\mu$  : Frictional resistance

Fig.4 shows the result of the above equation.

The thrust generated when a torque is applied is obtained from the following equation.

$$F_a = \frac{2 \cdot \pi \cdot \eta \cdot T}{R \times 10^{-3}}$$

$F_a$  : Thrust generated (N)

$T$  : Torque (input) (N-m)

$R$  : Lead (mm)

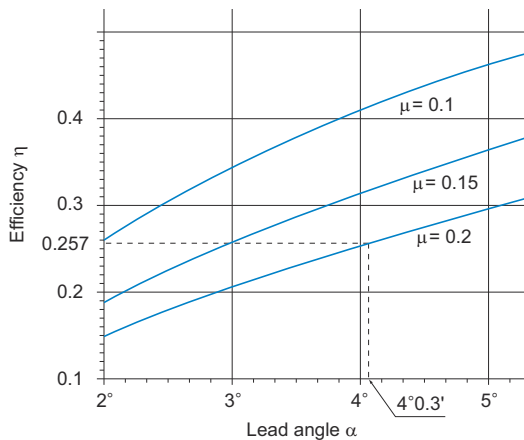


Fig.4 Efficiency

### Example of thrust force calculation

Assuming that Lead Screw Nut model DCM20 is used and the input torque  $T = 19.6$  N-m, obtain the thrust to be generated.

Calculate the efficiency ( $\eta$ ) when  $\mu = 0.2$ .

The lead angle ( $\alpha$ ) of model DCM20:  $4^{\circ}03'$

From the diagram in Fig.4, the efficiency ( $\eta$ ) when the friction coefficient  $\mu = 0.2$  is obtained as  $\eta = 0.257$ .

Obtain the thrust generated.

$$F_a = \frac{2 \cdot \pi \cdot \eta \cdot T}{R \times 10^{-3}} = \frac{2 \times \pi \times 0.257 \times 19.6}{4 \times 10^{-3}} \doteq 7700 \text{ N}$$

## Installation

### [About Chamfer of the Housing's Mouth]

To increase the strength of the root of the flange of the lead screw nut, the corner is machined to have an R shape. Therefore, it is necessary to chamfer the inner edge of the housing's mouth.

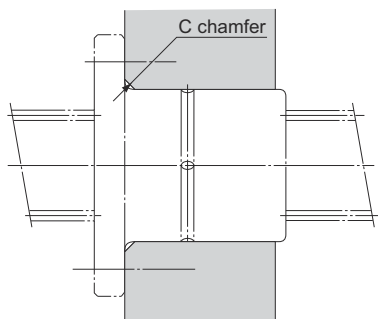


Fig.1

Table1 Chamfer of the Housing's Mouth

Unit: mm

Model No.	Chamfer of the mouth C (Min.)
DCM	
12	2
14	
16	
18	
20	2.5
22	
25	
28	
32	3
36	
40	
45	
50	

### [Example of Installation]

Fig.2 shows examples of mounting the lead screw nuts. When mounting a lead screw nut, secure sufficient tightening strength in the axial direction. For the housing inner-diameter tolerance, see the section concerning fitting on **A16-14**.

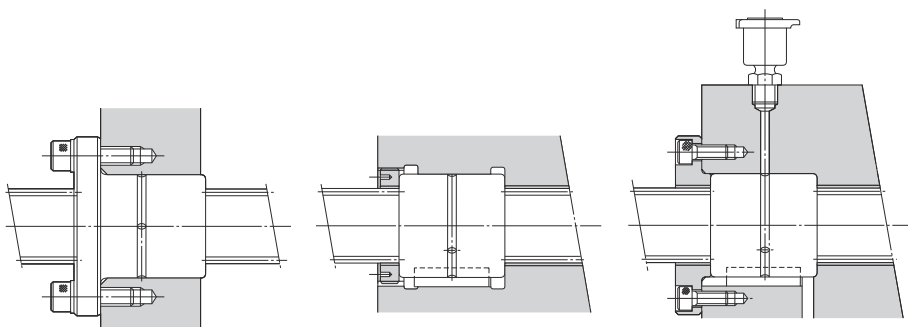


Fig.2 Examples of Installing the Lead Screw Nut

## Lubrication

The Screw Nut is not lubricated when delivered. Once the bearing has been mounted, the Screw Nut must be treated with an appropriate volume of grease or lubricant. The lubrication method should be determined based on usage conditions.

### [Lubricating with oil]

THK recommends lubricating the Lead Screw Nut with oil. Oil-bath lubrication or drip-feed lubrication are both effective. The most effective method is oil-bath lubrication, which is suitable for high-speed operation, heavy loads, high external temperatures, and other demanding conditions, and helps cool the Lead Screw Nut. Drip-feed lubrication is suitable for low and medium speeds and light and medium loads. Criteria for selecting the appropriate lubricant are shown in Table2.

Table2 Selection of a Lubricant

Condition	Types of Lubricants
Low speed, high load, high temperature	High-viscosity sliding surface oil or turbine oil
High speed, light load, low temperature	Low-viscosity sliding surface oil or turbine oil

### [Lubricating with Grease]

For usage in lower-speed operations, which is a less common scenario, the user can lubricate the slide system by periodically applying grease to the shaft by hand, or use the oil hole on the Lead Screw Nut. THK recommends using lithium grease no. 2.

## Model Number Coding

Model number configurations differ depending on the model features. Refer to the corresponding sample model number configuration.

### [Lead Screw Nut]

#### ● Models DCM, DC and CS

- Lead screw nut only

**DC20**

Model No. of  
lead screw nut

- Screw shaft

**CS20 T +1500L**

How the screw shaft  
is processed  
(T: rolled shaft)      Overall screw shaft length  
(in mm)

Model number of  
screw shaft

- Combination of  
lead screw nut and screw shaft

**2 DC20 +1500L T**

Number of lead screw nuts  
used on the same shaft

Model No. of  
lead screw nut

Overall screw  
shaft length  
(in mm)

How the screw shaft is processed  
(T: rolled shaft)

## Precautions on Use

## Lead Screw Nut

### [Handling]

- (1) Make sure the Lead Screw Nut is not dropped or subjected to any sudden impact, as this could cause injury and damage the product. Even if there is no outward indication of damage, a sudden impact could prevent the unit from functioning properly.
- (2) When handling the product, wear protective gloves, safety shoes, etc., as necessary to ensure safety.

### [Precautions on Use]

- (1) Prevent foreign material, such as cutting chips or coolant, from entering the product. Failure to do so may cause damage.
- (2) If the product is used in an environment where cutting chips, coolant, corrosive solvents, water, etc., may enter the product, use bellows, covers, etc., to prevent them from entering the product.
- (3) If foreign material such as cutting chips adheres to the product, replenish the lubricant after cleaning the product.
- (4) Do not forcibly drive a pin, key, or other positioning device into this product; this could create indentations on the sliding surface and impair the product's function.
- (5) Skewing or misalignment of the Lead Screw Nut and the element that supports the screw shaft can drastically reduce service life. Inspect the components carefully and make sure they are mounted correctly.
- (6) If the unit will be positioned vertically, install safety equipment or take other measures to prevent it from toppling over.
- (7) To avoid damaging the product, use the Lead Screw Nut in combination with an LM Guide, Ball Spline, or other guide element.
- (8) Insufficient rigidity or accuracy of mounting members causes the bearing load to concentrate on one point and the bearing performance will drop significantly. Accordingly, give sufficient consideration to the rigidity/accuracy of the housing and base and strength of the fixing bolts.

### [Lubrication]

- (1) Thoroughly wipe off anti-rust oil and feed lubricant before using the product.
- (2) Do not mix different lubricants. Even lubricants containing the same type of thickening agent may, if mixed, interact in an adverse manner due to disparate additives or other ingredients.
- (3) When using the product in locations exposed to constant vibrations or in special environments such as clean rooms, vacuum and low/high temperature, use the grease appropriate for the specification/environment.
- (4) Following lubrication, perform several warm-up strokes with the unit to ensure that lubricant permeates the interior.
- (5) Lubricant viscosity can vary depending on the temperature. Please keep in mind that the Lead Screw Nut's sliding resistance may be affected by changes in viscosity.
- (6) Following lubrication, stirring-resistance within the lubricant can cause the Lead Screw Nut to exhibit increased rotational torque. Before commencing operations, make sure to run the unit through several warm-up cycles to ensure that the lubricant is adequately integrated and dispersed.
- (7) Excess grease may scatter immediately after lubrication, so wipe off scattered grease as necessary.
- (8) The properties of grease deteriorate and its lubrication performance drops over time, so grease must be checked and added properly according to the use frequency of the machine.

## Precautions on Use

- (9) The greasing interval varies depending on the use condition and service environment. Set the final lubrication interval/amount based on the actual machine.
- (10) If a lubricant will be used, the application must be designed in such a way that the direction in which the Lead Screw Nut is installed does not prevent lubricant from circulating.

### [Storage]

Lead Screw Nuts should be stored horizontally in their original packaging in an indoor location where they are not exposed to abnormally high or low temperatures or high humidity.

### [Disposal]

Dispose of the product properly as industrial waste.

