APEX Leadscrews

A COMPREHENSIVE

PRODUCT CATALOG

Analysing, Innovating and Providing Best Solution To Customer By Adding Value In Engineering Products

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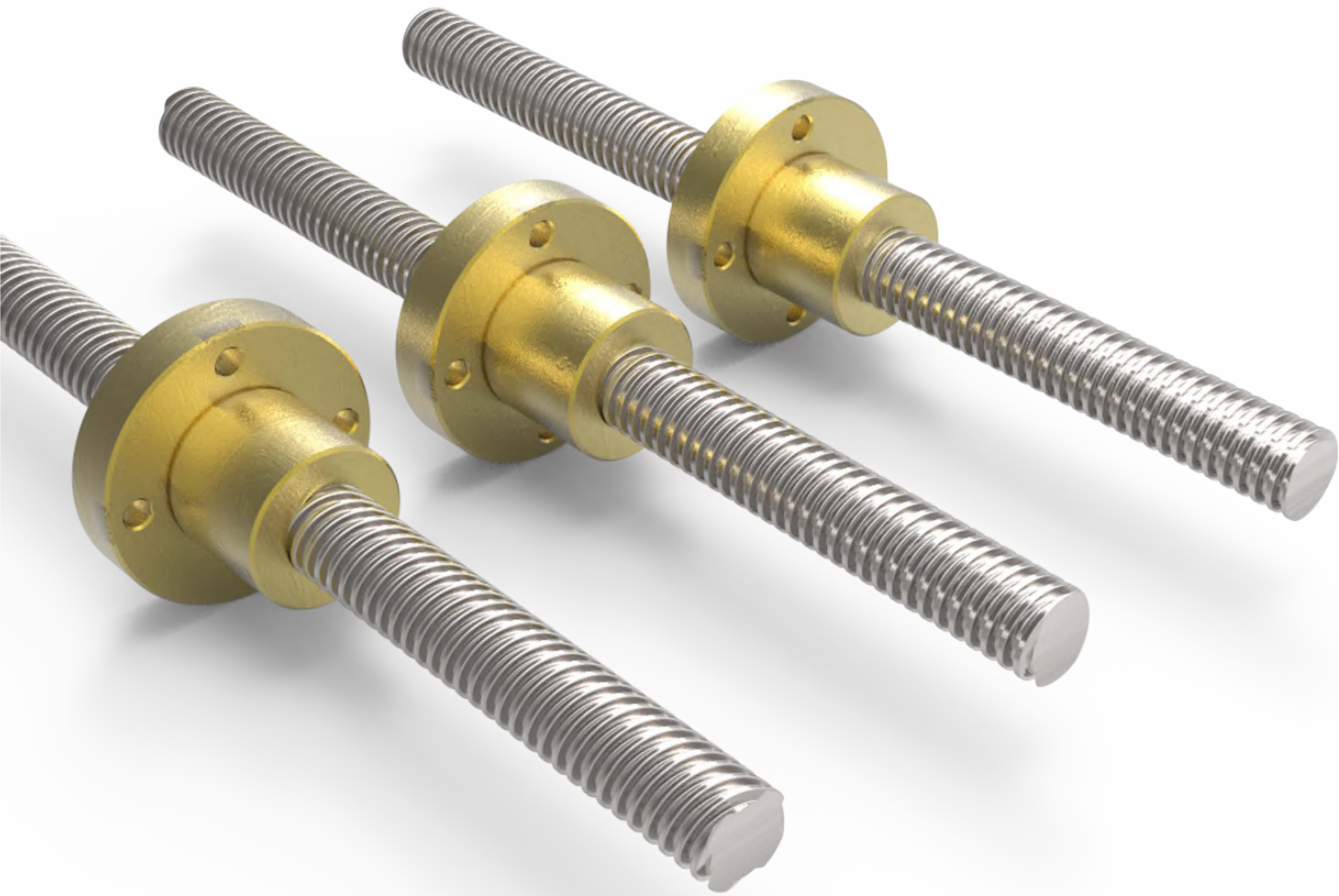
A Quality Product From The House of

Malkar INDUSTRIES
Since 1972

APEX offers a wide variety of single & multi start Lead screw to our clients that are exclusively used as vital part in several machines. Lead screw is designed to translate turning motion into linear motion. **APEX** Lead screws are manufactured by Thread Forming, Thread cutting process and Thread grinding process. **APEX** Lead screws are made in Carbon steel, Alloy steel & SS.



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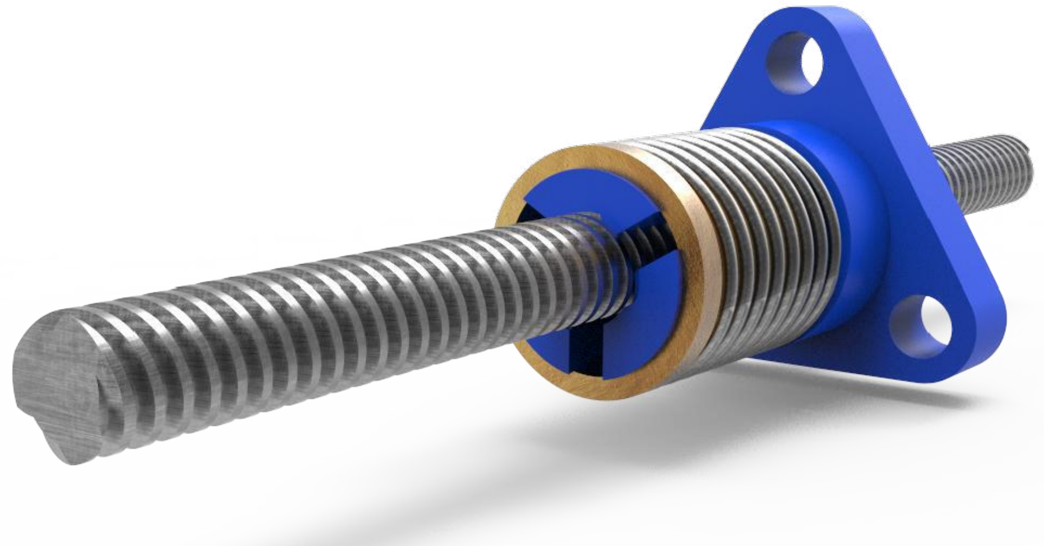


APEX LEAD SCREW FEATURES

- APEX offers accurate and precision lead screws.
- APEX lead screw assemblies are reliable, cost-effective linear actuation
- APEX screws outperform other actuation methods. Compared to bulky, noisy and expensive hydraulic or pneumatic actuator systems, Apex lead screws are compact, quiet and very affordable.
- All tools are manufactured in-house hence LEAD TIME for delivery is reduced.
- APEX have off the shelf stock of standard Leadscrews.
- Standard lead screws are available in various pitches, different thread profile and in required length.
- APEX offers lead screw with standard flange nut or any special type nut.

APEX Leadscrews

APEX LEAD SCREW FEATURES

PROCESS COMPARISON:

Process	Thread Forming	Thread Cutting	Thread Grinding
Price	Less	Medium	Expensive
Accuracy	Good	Better	Very Precise
Profile Finish	Accurate Profile	Medium Accurate	Very Accurate
Run-Out	Medium (up to 0.1)	Medium (up to 0.1)	Less (up to 0.03max)
Pitch Accuracy per meter	300 µm	500 µm	50 µm
Production Time for 1000 nos.	1-2 Weeks	2-4 Weeks	5-9 Weeks
Screw Material	MS, En8, SS303, SS304, SS316	EN8, EN19, WPS, EN24, EN36, SS303,SS304, SS316, SS410, SS420	All Ferrous Material

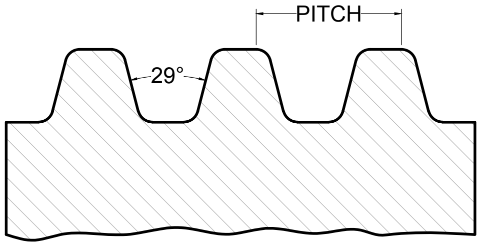
AVAILABILITY OF THREAD PROFILE:

Process	Thread Forming	Thread Cutting	Thread Grinding
Trapezoidal Profile	●	●	●
ACME Profile	●	●	●
Metric Profile	●	●	●
Square Profile	-	●	-
Multi-start (High Helix)	●	●	●

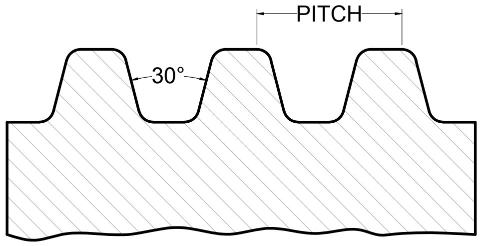
TYPES OF THREAD:

Based on included thread angle, following types of thread profiles are:

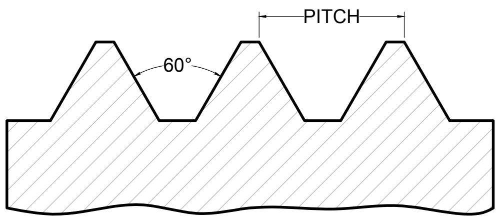
1) ACME THREAD



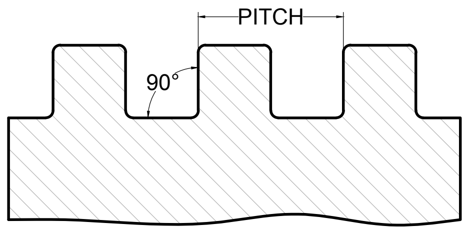
2) TRAPEZOIDAL THREAD



3) METRIC THREAD



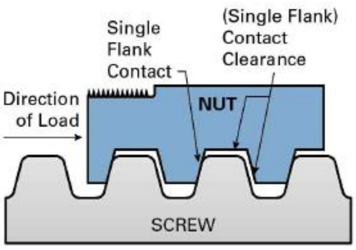
4) SQUARE THREAD



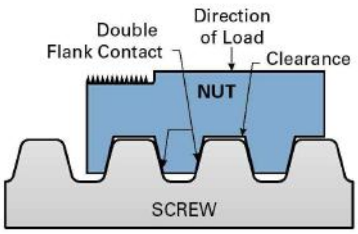
The acme thread form, established over 100 years ago, replaced square thread screw, which had straight-sided flanks and were difficult to manufacture. There are three main classes of acme thread forms: general purpose (G), centralizing (C), and stub acme. The General Purpose and Centralizing thread forms have a nominal depth of thread of 0.50×Pitch and have a 29° included thread angle. Trapezoidal thread forms have a 30° included thread angle. Metric thread forms have have a 60° angle. Compared to general-purpose thread forms, centralizing threads are manufactured with tighter tolerances and reduced clearance on the major diameter. Stub acme threads follow the same basic design, but have a thread depth less than one half the pitch.

If an acme nut is side loaded with a radial load, a “G” class will “wedge” when the nut thread flanks come in contact with the screw thread flanks. To prevent wedging, less clearance and tighter tolerances are allowed between the major diameter of the nut and the major diameter of the screw.

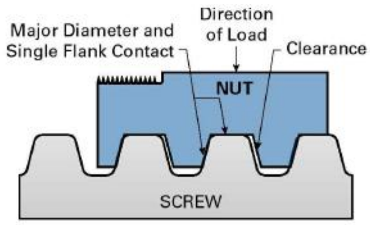
CAUTION - Although a side load will not cause a centralizing thread to wedge, the nut is not designed to operate with a side load such as a pulley, drive belt, etc.



Normally Loaded Nut



Side Loaded Conventional



Side Loaded Centralized 'C' Class Nut

TECHNICAL DEFINATIONS

MAJOR DIAMETER -
The outside diameter of the screw.

PITCH DIAMETER -
On an acme screw, this diameter is approximately halfway between the land diameter and the root diameter. It is the diameter at which the thread thickness is equal to the space between threads.

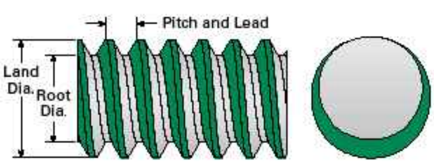
ROOT (MINOR) DIAMETER -
The diameter of the screw measured at the bottom of the thread.

PITCH -
The axial distance between threads. Pitch is equal to the lead in a single start screw.

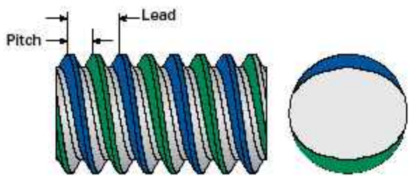
LEAD -
The axial distance the nut advances in one revolution of the screw. The lead is equal to the pitch times the number of starts. **PITCH × STARTS = LEAD**

LEAD ACCURACY -
Lead accuracy is the difference between the actual distance traveled versus the theoretical distance traveled based on lead.

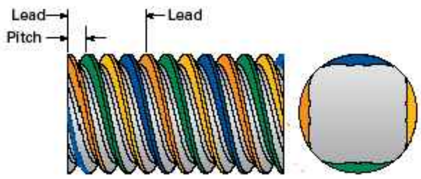
SCREW STARTS -
The number of independent threads on the screw shaft; example one, two or four.



Single Start (Lead = Pitch)



Double Start (Lead = 2 x Pitch)



Four Start (Lead = 4 x Pitch)

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TECHNICAL DEFINATIONS

STATIC LOAD -
The maximum thrust load – including shock – that should be applied to a non-moving nut assembly. Actual maximum static load may be reduced based on end machining and screw mounting hardware.

DYNAMIC LOAD -
The maximum recommended thrust load which should be applied to the lead screw and nut assembly while in motion.

PV LOAD -
Any material which carries a sliding load is limited by heat buildup caused by friction. The factors that affect heat generation rate in an application are the pressure on the nut in pounds per square inch of contact area and the surface velocity in feet per minute at the major diameter. The product of these factors provides a measure of the severity of an application.

TENSION LOAD -
A load that tends to “stretch” the screw.

COMPRESSION LOAD -
A load that tends to “squeeze” the screw.

THRUST LOAD -
A load parallel to and concentric with the axis of the screw.

OVERTURNING LOAD -
A load that tends to rotate the nut radially around the longitudinal axis of the screw.

SIDE LOAD -
A load that is applied radially to the nut.

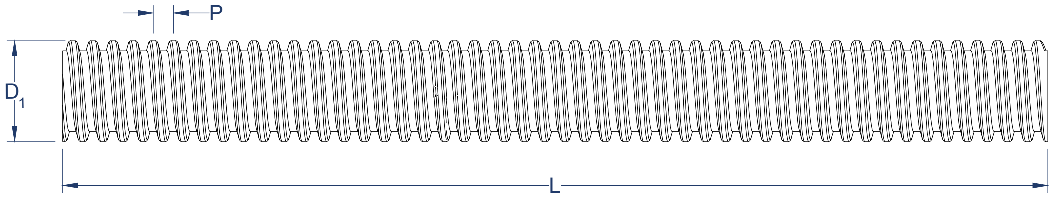
Leadscrews

APEX
LEAD SCREW

APEX Leadscrews

SINGLE START LEAD SCREW

Thread Type: Trapezoidal, ACME
Thread process: Rolled, Ground
Screw Material: SS, EN8
Hand : Right-Hand, Left-Hand
Standard length of screws : 1000mm



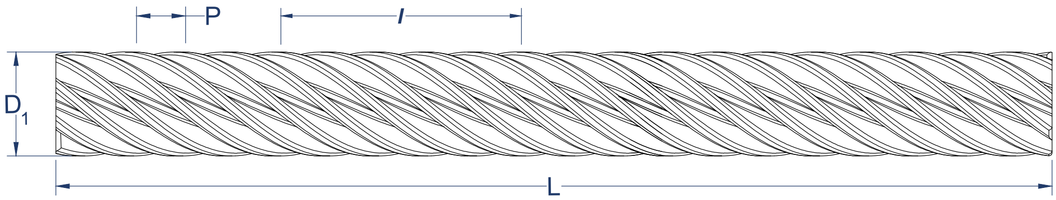
Where,
D_1 = Major Diameter
L = length
P = Pitch

SCREW CODE	MAJOR DIA.	PITCH	START	LEAD	PCD
D8x2P2	8	2	1	2	7.00
D10x2P2	10	2	1	2	9.00
D10x3P3	10	3	1	3	8.50
D12x2P2	12	2	1	2	11.00
D12x3P3	12	3	1	3	10.50
D16x2P2	16	2	1	2	15.00
D16x4P4	16	4	1	4	14.00
D16x5P5	16	5	1	5	13.50
D18x3P3	18	3	1	3	16.50
D20x4P4	20	4	1	4	18.00
D20x5P5	20	5	1	5	17.50
D22x2P2	22	2	1	2	21.00
D24x5P5	24	5	1	5	21.50
D25x3P3	25	3	1	3	23.50
D25x5P5	25	5	1	5	22.50
D25.4x6P6	25.4	6	1	6	22.40
D30x3P3	30	3	1	3	28.50
D30x4P4	30	4	1	4	28.00
D30x6P6	30	6	1	6	27.00
D32x6P6	32	6	1	6	29.00
D36x6P6	36	6	1	6	33.00

APEX Leadscrews

MULTI START LEAD SCREW

Thread Type: Trapezoidal, ACME
Thread process: Rolled, Ground
Screw Material: SS, EN8
Hand : Right-Hand, Left-Hand
Standard length of screws = 1000mm



Where,
D_1 = Major Diameter
L = length
P = Pitch
l = Lead (Pitch x Start)

SCREW CODE	MAJOR DIA.	PITCH	START	LEAD	PCD
D6.35x24P3	6.35	3	8	24	4.85
D8x4P2	8	2	2	4	7.00
D8x10P2.5	8	2.5	4	10	6.75
D8.5x15P3	8.5	3	5	15	7.00
D9.5x4P2	9.5	2	2	4	8.50
D10x12P3	10	3	4	12	8.50
D12x16P4	12	4	4	16	10.00
D12x25P5	12	5	5	25	9.50
D14x10P2.5	14	2.5	4	10	12.75
D15x24P4	15	4	6	24	13.00
D16x20P4	16	4	5	20	14.00
D16x12P2	16	2	6	12	15.00
D16x16P2	16	2	8	16	15.00
D18x24P4	18	4	6	24	16.00
D24x10P5	24	5	2	10	21.50

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Leadscrews

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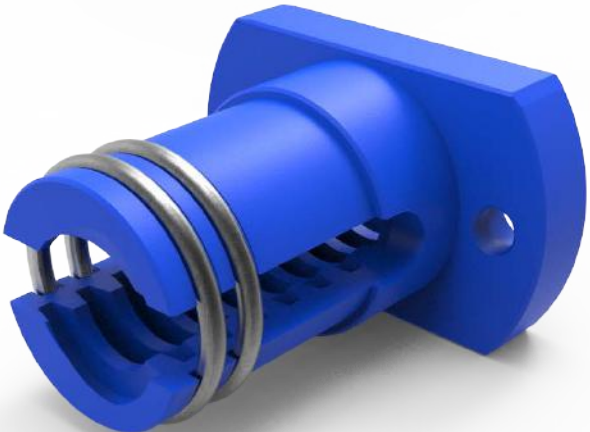
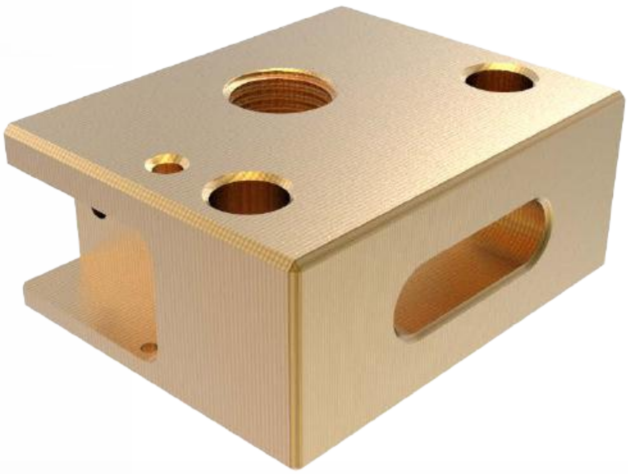
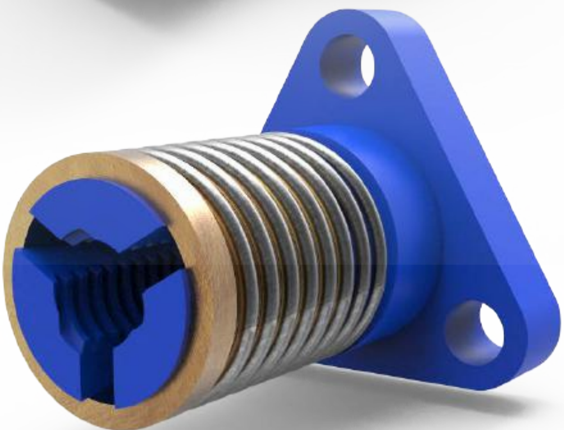
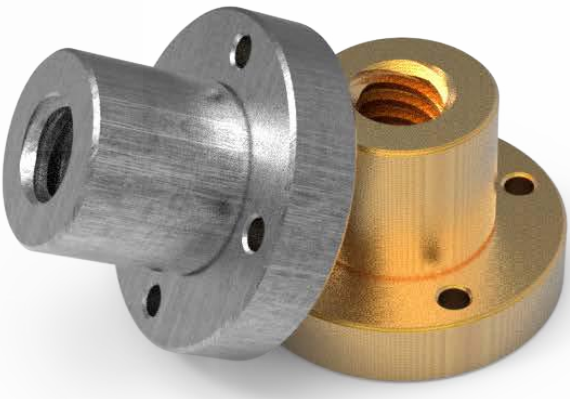
LEAD NUT



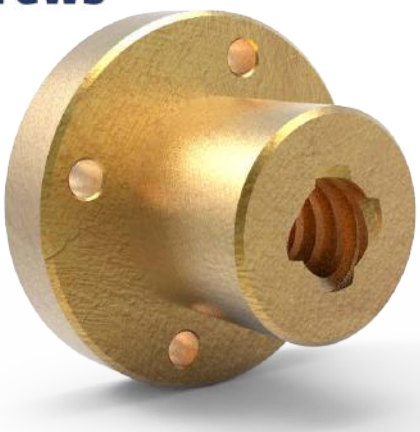


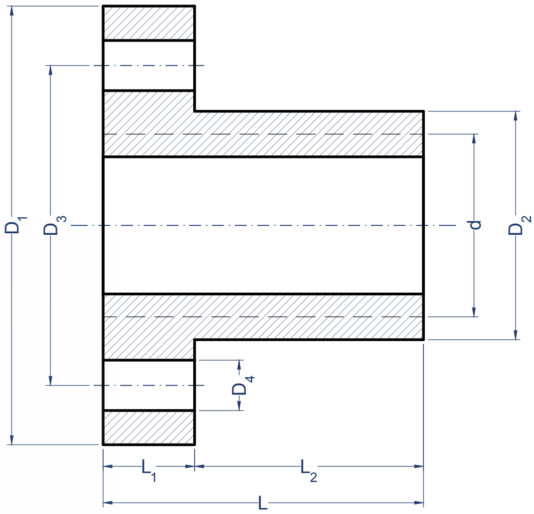




APEX Leadscrews

FLANGE LEAD NUT





THREADING TYPES: ACME, Trapezoidal
MATERIAL OF NUT: Brass, SS

SIZE	d	Pitch	Start	D_1	D_2	D_3	D_4	L_1	L_2	L
D6.35x24P3	6.35	3	8	26	12	19	3	6	14	20
D8x2P2	8	2	1	32	18	25	3	7	15	22
D8x4P2	8	2	2	32	18	25	3	7	15	22
D8x10P2.5	8	2.5	4	32	18	25	3	7	15	22
D8.5x15P3	8..5	3	5	32	18	25	3	7	15	22
D9.5x4P2	9.5	2	2	32	18	25	3	7	15	22
D10x2P2	10	2	1	32	18	25	3	7	15	22
D10x3P3	10	3	1	32	18	25	3	7	15	22
D10x12P3	10	3	4	32	18	25	3	7	15	22
D12x2P2	12	2	1	32	18	25	3	7	15	22
D12x3P3	12	3	1	32	18	25	3	7	15	22
D12x16P4	12	4	4	32	18	25	3	7	15	22
D12x25P5	12	5	5	32	18	25	3	7	15	22
D14x10P2.5	14	2.5	4	36	22	29	3	7	15	22
D15x24P4	15	4	6	36	22	29	3	7	15	22
D16x2P2	16	2	1	36	22	29	3	7	15	22
D16x12P2	16	2	6	36	22	29	3	7	15	22
D16x16P2	16	2	8	36	22	29	3	7	15	22
D16x4P4	16	4	1	36	22	29	3	7	15	22
D16x20P4	16	4	5	36	22	29	3	7	15	22
D16x5P5	16	5	1	36	22	29	3	7	15	22
D18x3P3	18	3	1	48	25	35	5.5	10	25	35
D18x24P4	18	4	6	48	25	35	5.5	10	25	35
D20x4P4	20	4	1	48	25	35	5.5	10	25	35
D20x5P5	20	5	1	48	25	35	5.5	10	25	35

ANTIBACKLASH LEAD NUT

Eliminating backlash from lead screw nut designs has always been a demanding task. To eliminate the backlash often meant a sacrifice in drag torque. With some innovative nut designs, our anti-Backlash lead nuts are available for use with several standard thread forms. The anti-backlash nut ranges feature compensation for clearance or wear between leadscrew and nut when reversing the direction of movement

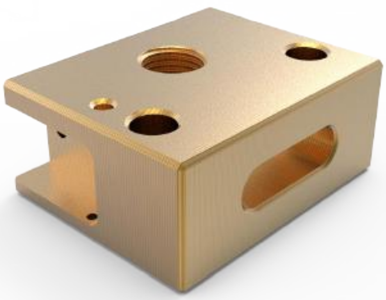
MODIFIED, CUSTOM NUTS

In addition to the standard nut types, custom configurations are available as well as simple modifications such as different mounting bore patterns or mounting threads, small dimensional changes or special materials.

Custom designs can offer multi functionality, eliminating additional components, simplifying product manufacture, saving space and reducing cost. Custom nuts can be produced using special machining to integrate components into the nut, such as guide bushings, carriages, timing pulleys, gears, syringe components, sensor mounts and flags, encoder features, clamps and many other complementary elements. In addition, custom designed nuts can offer quick release mounts, partial thread engagement, half nut construction or alternative shapes and geometries.

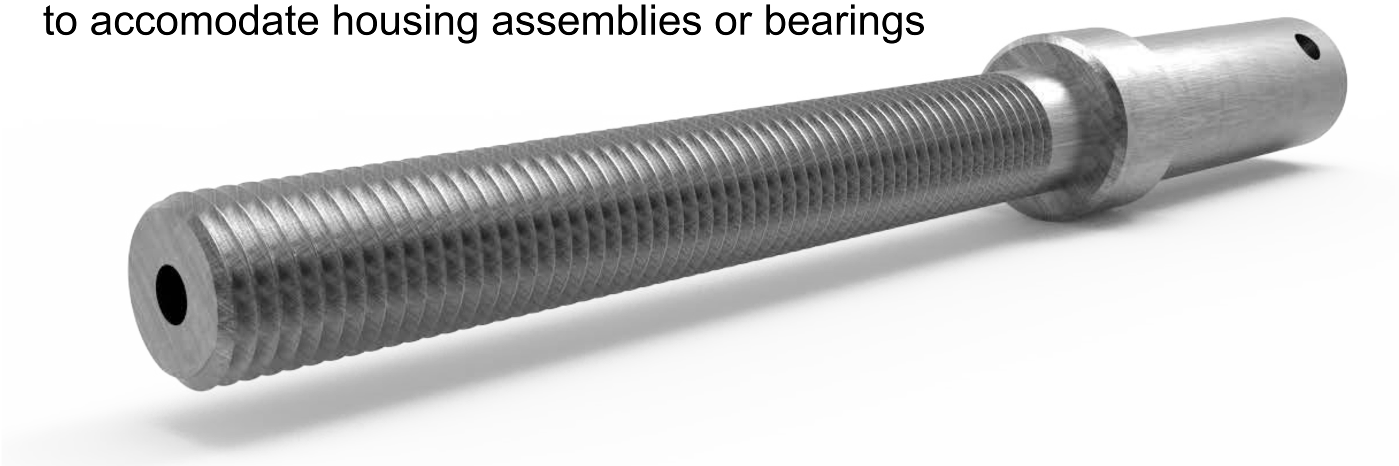
Special materials are available to extend the performance of the assemblies. We offer metallic as well as a range of polymer materials such as Delrin, PEEK, polyester, Torlon, Vespel. Materials can be chosen for extreme temperature, chemical compatibility, autoclaving, agency approvals, special loadings and many other specific requirements. Custom geometries and materials can be combined for a wide variety of product application requirements.

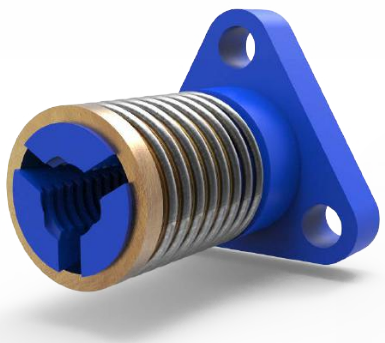
Small quantities of custom nuts can be machined individually to suit specific requirements; alternatively large quantities can be manufactured for reduced costs. To achieve the most effective nut design we consider acombination of tolerances and geometric shape of the nut.

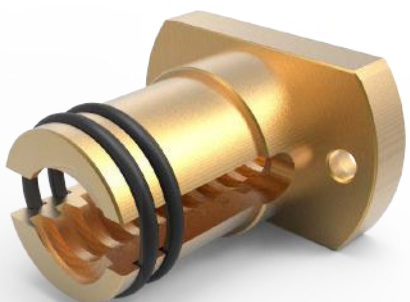


MODIFIED, CUSTOM NUTS

APEX offers custom lead screw with desired end machining as per customers needs and specifications. This end machining can be done by various operations such as grinding, milling, broching or threading to accomodate housing assemblies or bearings







LEAD SCREW SELECTION

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 N/mm^2. This value indicates the strength of 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.

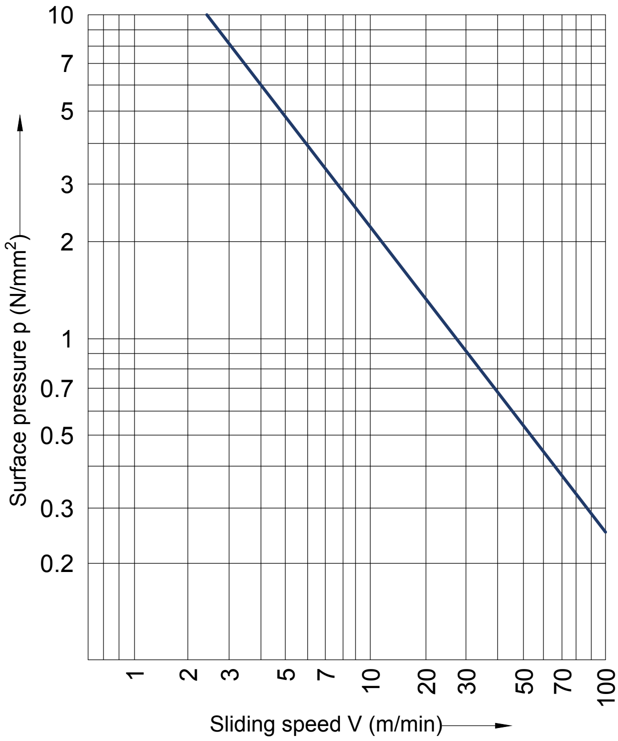


Fig.1 pV value

fS : 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 shown in Table1 .

Types of load	Lower limit of fS
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

Table 1 Safety Factor fS

fT 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 temp. factor indicated in Fig.2 .

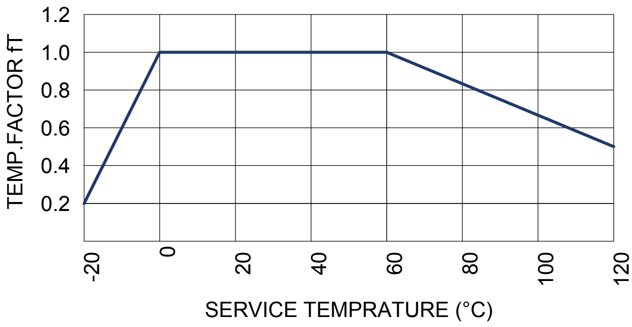


Fig.2 Temprature Factor

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

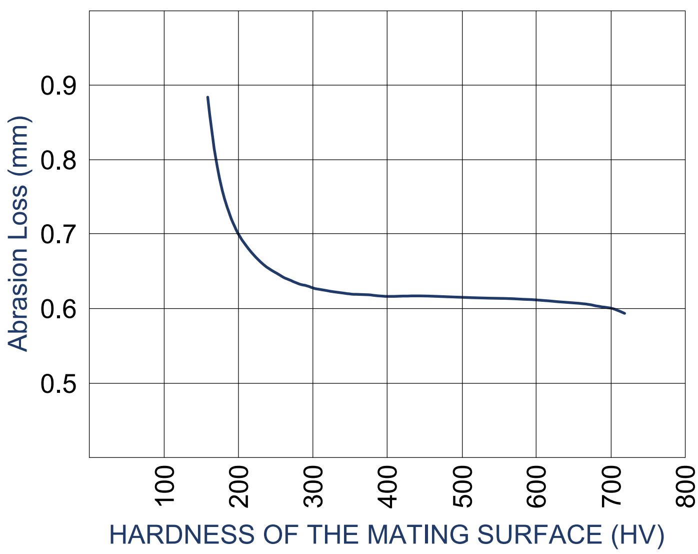
Static permissible thrust(F)-

$$f_S = \frac{f_T x F}{P_F}$$

f_S : Safety factor (see Table1)
f_T : Temperature factor (see Fig.2)
F : Dynamic permissible thrust (N)
P_F : Axial load (N)

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, abrasion loss increases as indicated in Fig.3 . The roughness of 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. Thererfore, the dedicated rolled shaft is highly wear resistant.



Contact Surfrace Pressure p-

$$p = \frac{P_r x 9.8}{F}$$

p : Contact surface pressure on the tooth from an axial load (N/mm^2)
F : Dynamic permissible thrust (N)
P_f : Axial load (N)

Sliding Speed V on the Teeth-

$$V = \frac{\pi \times D_O \times n}{COS\alpha \times 10^3}$$

V : Sliding speed (m/min)
D_O : Effective diameter(mm)
n : Revolutions per minute (rpm)
$n = S/(R \times 10^{-3})$
S : Feeding speed (m/min)
R : Lead (mm)
α : Lead angle (°)

Efficiency(η)-

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

η : Efficiency
α : Lead angle
μ : Frictional resistance

Fig.4 shows the result of the above equation.

Thrust(F_a)-

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

F_a : Thrust generated (N)
T : Torque (input) (N-m)
R : Lead (mm)

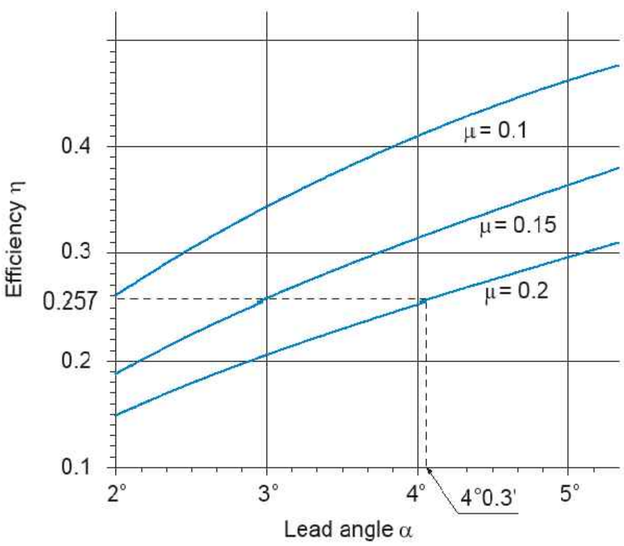


Fig.4 Efficiency

CRITICAL SPEED:

Once the load, speed, length and end fixity are identified, the next factor to consider is the critical speed. The speed that excites the natural frequency of the screw is referred to as the critical speed. Resonance at the natural frequency of the screw will occur regardless of the screw orientation (vertical, horizontal etc.) or if the system is designed so the nut rotates about the screw. The critical speed will vary with the diameter, unsupported length, end fixity and rpm. Since critical speed can also be affected by shaft straightness and assembly alignment, it is recommended that the maximum speed be limited to 80% of the calculated critical speed. The theoretical formula to calculate critical speed in rpm is:

$$N = \frac{C_S \times 4.76 \times 10^6 \times d}{L^2}$$

N = Critical Speed (rpm)
d = Root Diameter of Screw (inch)
L = Length Betw. Bearing Supports (inch)
Cs = 0.36 for one end fixed, one end free
1.00 for both ends simple
1.47 for one end fixed, one end simple
2.23 for both ends fixed

COLUMN STRENGTH

When a screw is loaded in compression, its limit of elastic stability can be exceeded and the screw will fail through bending or buckling. Theoretical formula to calculate the column strength in pounds is:

$$P_{cr} = \frac{14.03 \times 10^6 \times F_c \times d^4}{L^2}$$

Pcr = Maximum Load (lb.)
Fc = End Fixity Factor
0.25 for one end fixed, one end free
1.00 for both ends supported
2.00 for one end fixed, one end simple
4.00 for both ends rigid
d = Root Diameter of Screw (inch)
L = Distance betw. nut & load carrying bearing (inch)

If the selected lead screw does not meet critical speed and/or compression load criteria, consider the following options:

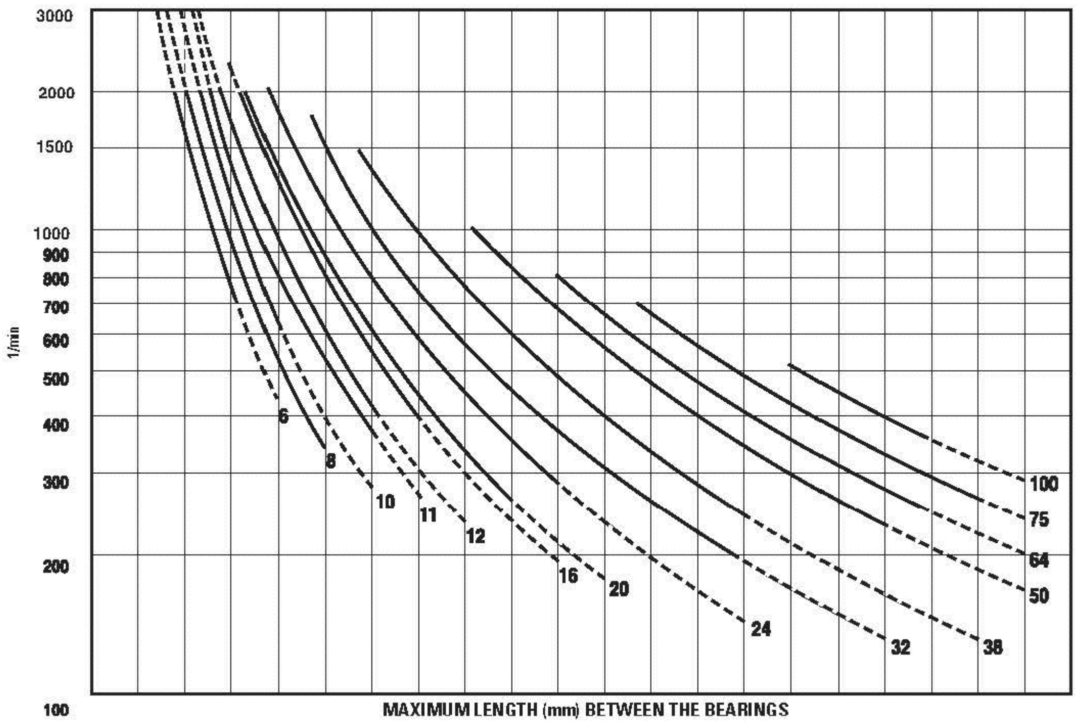
a) Increase screw lead and reduce rpm
b) Change end fixity (e.g. simple to fixed)
c) Increase screw diameter
d) Design to use screw in tension load

APEX Leadscrews

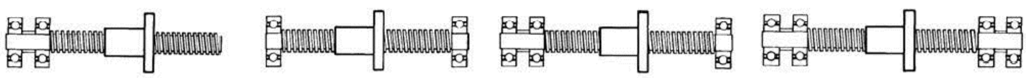
CRITICAL ROTATIONAL SPEED LIMIT VALUES

Every lead screw has a rotational speed limit. This is the point at which the rotational speed sets up heavy vibration. This critical point changed depending on the end bearing supports used and the bearing combination.To use this chart, you must determine the speed of rotation required and the maximum length between the bearing supports. Then select one of the four bearing combinations shown below. The critical speed limit can be found by locating the point at which the speed of rotation (horizontal lines) intersects with the unsupported shaft length (vertical lines) as modified by the bearing combination listed below. It is recommended that the lead screws be operated at no more than 80% of the critical speed limit value.

*Warning: The graphs for the shaft diameters illustrated are based on the smallest minor diameter of a standard shaft within the nominal size range & are cut off at the maximum speed of rotation for the nut. Value for the rotational speed **MAY NOT BE EXCEEDED**, whatever the shaft length.*



Bearing scenario 1	150	300	460	610	760	910	1070	1220	1370	1520	1680	1830	1980	2130	2290	2440	2590	2740	3050	3200
Bearing scenario 2	250	510	760	1020	1270	1520	1780	2030	2290	2540	2790	3050	3300	3560	3810	4060	4320	4570	4830	5080
Bearing scenario 3	300	610	910	1220	1550	1850	2160	2460	2770	3070	3380	3910	4010	4320	4620	4930	5230	5540	5840	6150
Bearing scenario 4	380	760	1140	1520	1910	2290	2670	3020	3400	3780	4170	4550	4930	5310	5690	6070	6450	6830	7210	7570

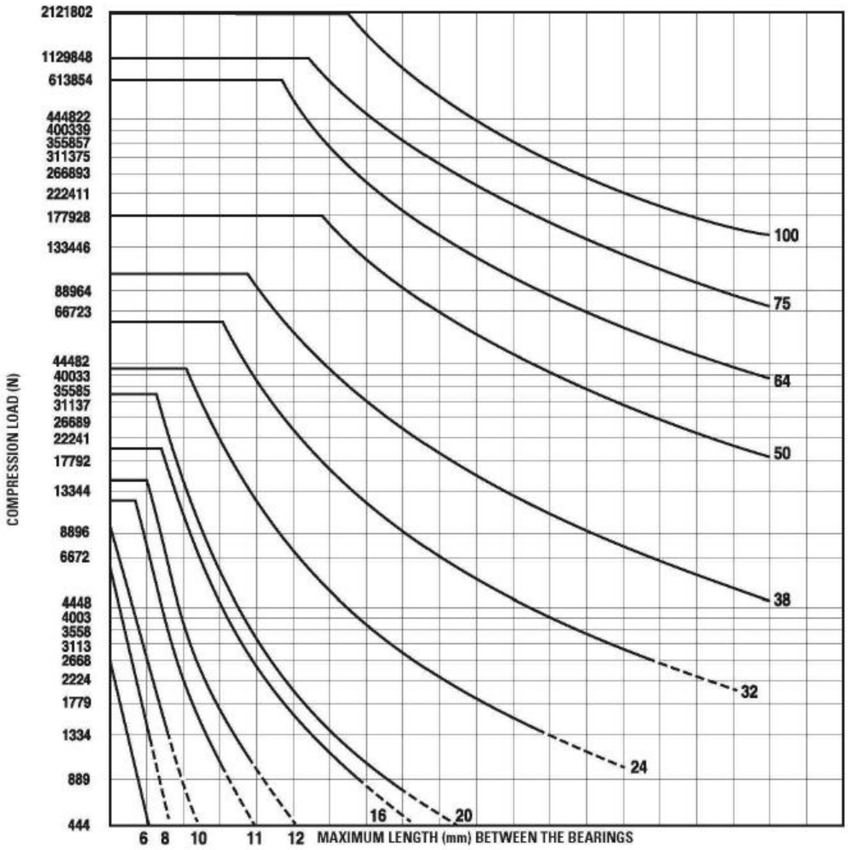


Bearing scenario 1 Bearing scenario 2 Bearing scenario 3 Bearing scenario 4

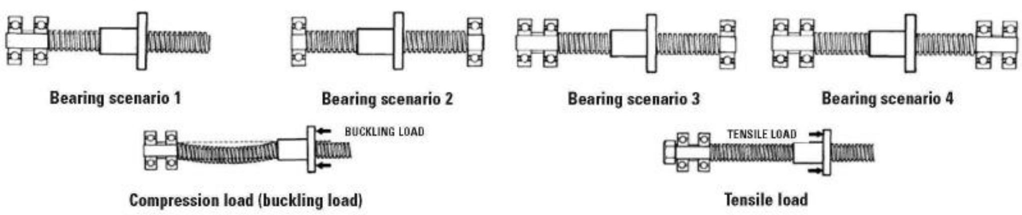
CRITICAL BUCKLING FORCE LIMIT VALUE

This graph is used to determine the maximum compression loading on the shafts. Normally, shafts operated under tensile stress are capable of withstanding a loading up to the design load capacity of the nut. The bearing combinations influence the load capacity of the shaft. The four standard variants are listed below with the corresponding bearing scenarios. To determine the safe minimum diameter of the shaft, you must determine the point at which the graphs for the compressive load (horizontal) and the shaft length (vertical) intersect.

Warning: The load capacity of the nuts MAY NOT BE EXCEEDED. The curves for the shaft diameter are based on the smallest minor diameter of a standard shaft within the nominal size range.



Bearing scenario 1	130	250	380	510	640	760	890	1020	1140	1270	1400	1520	1650	1780	1910	2030	2160	2290	2410
Bearing scenario 2	250	510	760	1020	1270	1520	1780	2030	2290	2540	2790	3050	3300	3560	3810	4060	4320	4570	4830
Bearing scenario 3	360	710	1070	1450	1800	2160	2510	2870	3230	3580	3960	4320	4670	5030	5380	5740	6100	6480	6860
Bearing scenario 4	510	1020	1520	2030	2540	3050	3560	4060	4570	5080	5590	6100	6600	7110	7620	8130	8640	9140	9650



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Leadscrews

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