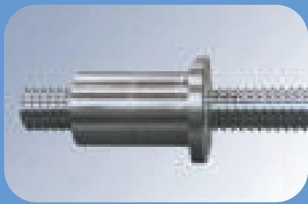
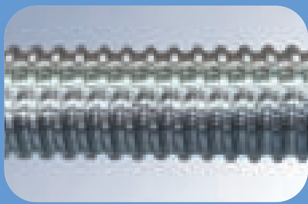




SKF ground ball screws

North American range

General

SKF Group

The SKF Group is an international industrial unit owned by AB SKF. Founded in 1907, the company has some 39,000 employees, 80 manufacturing sites and a sales network via its own sales companies, distributors and dealers, covering 150 countries around the world. SKF is the world leader in the rolling bearing business.

SKF Linear Motion

SKF Linear Motion is part of the SKF Group and specializes in the manufacture and sales of a wide range of high precision components, units and systems for linear movements, providing solutions for guiding, driving, actuation and positioning tasks.

In addition, SKF Linear Motion offers an extensive assortment of industrial products which complement our linear motion products, providing complete solutions to customers.

SKF Linear Motion is composed of product lines with 10 specialized sales companies in Europe and North America. Additionally, product availability and product application support is provided world-wide by the international sales network of the SKF Group.

SKF Linear Motion: a complete range from a single source for all linear motion functions.

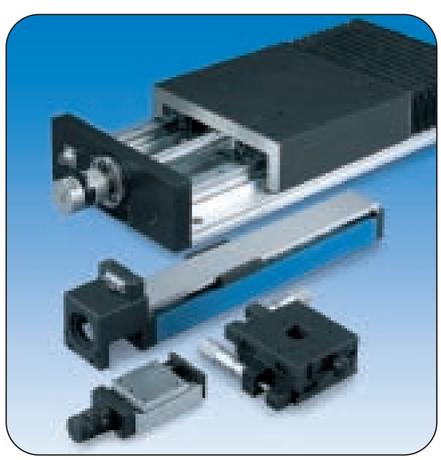
A complete range from a single source for all linear motion functions.

Guiding

Driving

Actuation

Positioning



Contents

"Made by SKF" stands for excellence. It symbolizes our consistent endeavor to achieve total quality in everything we do. "Made by SKF" implies three main benefits:

Reliability – SKF provides modern, efficient products, worldwide application know-how, optimized materials, forward-looking designs and the most advanced production techniques.

Cost effectiveness – SKF offers a favorable balance between our product quality and service facilities, and the purchase price of our products.

Market lead – Increased operating time and reduced downtime, as well as improved output and product quality are keys to helping our customers gain an advantage in their market.

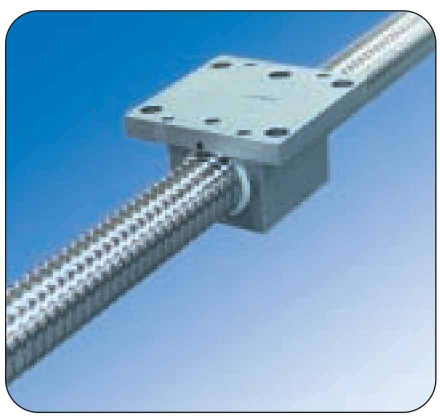
SKF-TCM: A history of precision for more than 50 years.

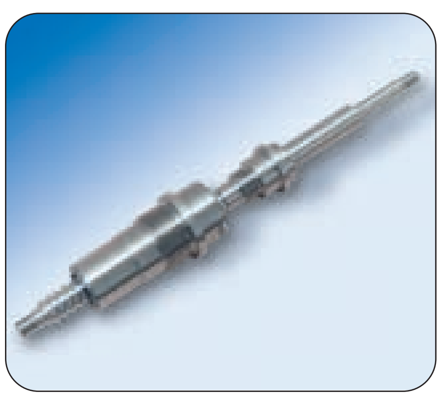
TCM's long history of precision began in 1946, founded by a returning soldier using a GI loan for seed money. From its beginnings as a small machine shop north of Detroit, TCM developed a reputation as a company willing to take on challenging jobs in precision machining, machine building and deep-hole drilling.

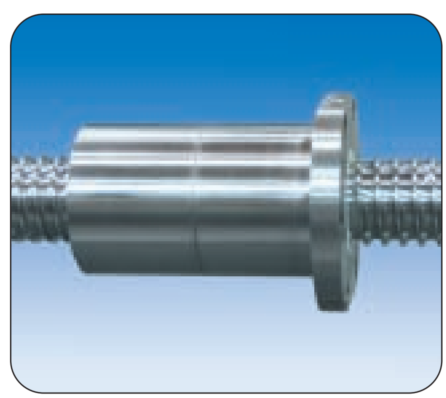
Demand for TCM products and services soon grew larger than could be contained in its original location. A new and larger facility was built in the northern suburbs of Detroit in the 1950s. The enhanced size and capabilities of the new facility enabled greater design and machining potential, leading to the addition of new products and services.

In 1966 TCM began to manufacture, market, and service precision ball screws. Over the next few years TCM ball screws developed a reputation for precision and superior durability. Demand for the product increased steadily over time. In 1994 TCM relocated again to its current facility in Armada, Michigan, approximately 30 miles north of Detroit. In 2003 TCM was purchased by SKF USA Inc. and became SKF-TCM.

SKF-TCM today resides in a 100,000 plus square foot facility situated on a 10-acre plot. The manufacturing floor combines state of the art CNC machinery with a highly experienced, skilled work force capable of manufacturing parts which meet and exceed the demands of the marketplace today. The engineering staff uses advanced CAD design capability, combined with decades of engineering records, to produce new OEM designs or replacement parts as necessary. These forces combine to satisfy the machine tool, automotive, aerospace and nuclear industries with consistent quality products and service.







Selection

NB:
Only basic selection parameters are included. To make the very best selection of a ball screw, the designer should specify such critical parameters as the load profile, the linear or rotational speed, the rates of acceleration and deceleration, the cycle rate, the environment, the required life, the lead accuracy, the stiffness, and any other special requirement. If in doubt, please consult an SKF ball screw specialist before placing an order.

Basic dynamic load rating (Ca)

The dynamic rating is used to compute the fatigue life of ball screws. It is the axial load constant in magnitude and direction, and acting centrally under which the nominal life (as defined by ISO) reaches one million revolutions.

Nominal fatigue life L10

The nominal life of a ball screw is the number of revolutions (or the number of operating hours at a given constant speed) which the ball screw is capable of enduring before the first sign of fatigue (flaking, spalling) occurs on one of the rolling surfaces.

It is ,however, evident from both laboratory tests and practical experience that seemingly identical ball screws operating under identical conditions have different lives, hence the notion of **nominal life**. It is, in accordance with ISO definition, the life achieved or exceeded by 90% of a sufficiently large group of apparently identical ball screws, working in identical conditions (alignment, axial and centrally applied load, speed, acceleration, lubrication, temperature and cleanliness).

Service life

The actual life achieved by a specific ball screw before it fails is known as “service life.” Failure is generally by wear, not by fatigue (flaking or spalling); wear of the recirculation system, corrosion, contamination, and, more generally, by loss of the functional characteristics required by the application.

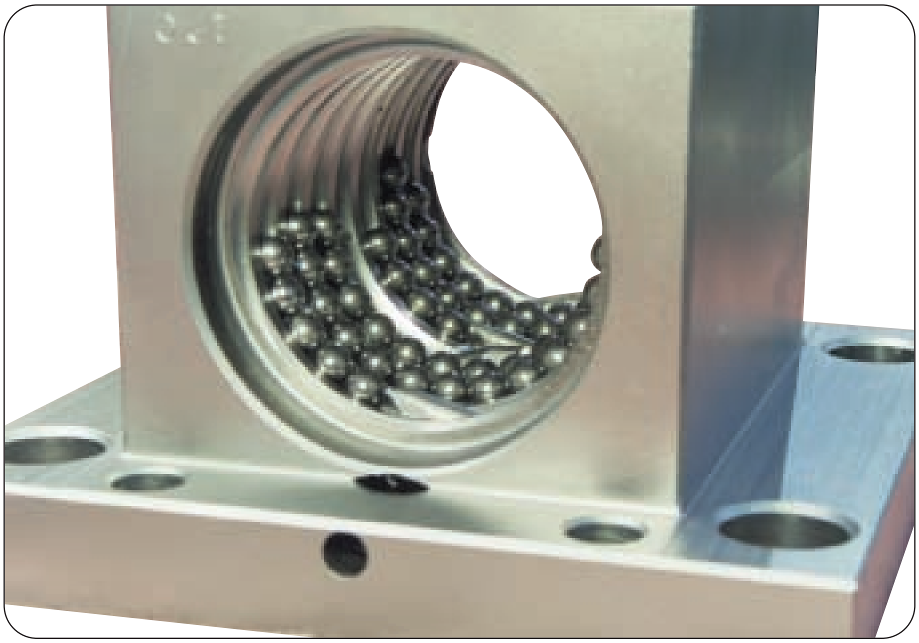
Experience acquired with similar applications will help to select the proper screw to obtain the required service life. One must also take into account structural requirements such as the strength of screw ends and nut attachments, due to the loads applied on these elements in service.

Equivalent dynamic loads

The loads acting on the screw can be calculated according to the laws of mechanics if the external forces (e.g. power transmission, work, rotary and linear inertia forces) are known or can be calculated. It is necessary to calculate the equivalent dynamic load: this load is defined as that hypothetical load, constant in magnitude and direction, acting axially and centrally on the screw which, if applied, would have the same influence on the screw life as the actual loads to which the screw is subjected.

Radial and moment loads must be taken by linear bearing systems. It is extremely important to resolve these problems **at the earliest conceptual stage**. These forces are detrimental to the life and the expected performance of the screw.

Fluctuating load
When the load fluctuates during the working cycle, it is necessary to calculate the equivalent dynamic load: this load is defined as that hypothetical load, constant in magnitude and direction, acting axially and centrally on the screw which, if applied, would have the same influence on the screw life as the actual loads to which the screw is
subjected. Additional loads resulting from misalignment, uneven loading, shocks, etc., must be taken into account. Consult SKF for advice.



Static axial stiffness of a complete assembly

This is the ratio of the external axial load applied to the system and the axial displacement of the face of the nut in relation with the fixed (anchored) end of the screw shaft. The inverse of the rigidity of the total system is equal to the sum of all the inverses of the rigidity of each of the components (screw shaft, nut as mounted on the shaft, supporting bearing, supporting housings, etc.).

Because of this, the rigidity of the total system is always less than the smallest individual rigidity.

Nut rigidity

When a preload is applied to a nut, first the internal play is eliminated, then the Hertzian elastic deformation increases as the preload is applied, so that the overall rigidity increases. The theoretical deformation does not take into account machining inaccuracies, actual sharing of the load between the different contact surfaces, the elasticity of the nut and of the screw shaft. The practical stiffness values given in the catalogue are lower than the theoretical values for this reason. The rigidity values given in the SKF ball screw catalogue are individual practical values for the assembled nut. They are determined by SKF based on the value of the selected basic preload and an external load equal to twice this preload.

Elastic deformation of screw shaft

This deformation is proportional to its length and inversely proportional to the square of the root diameter.

According to the relative importance of the screw deformation (see rigidity of the total system), too large an increase in the preload of the nut and supporting bearings yields a limited increase of rigidity and notably increases the preload torque and therefore the running temperature. Consequently, the preload stated in the catalogue for each dimension is optimum and should not be increased.

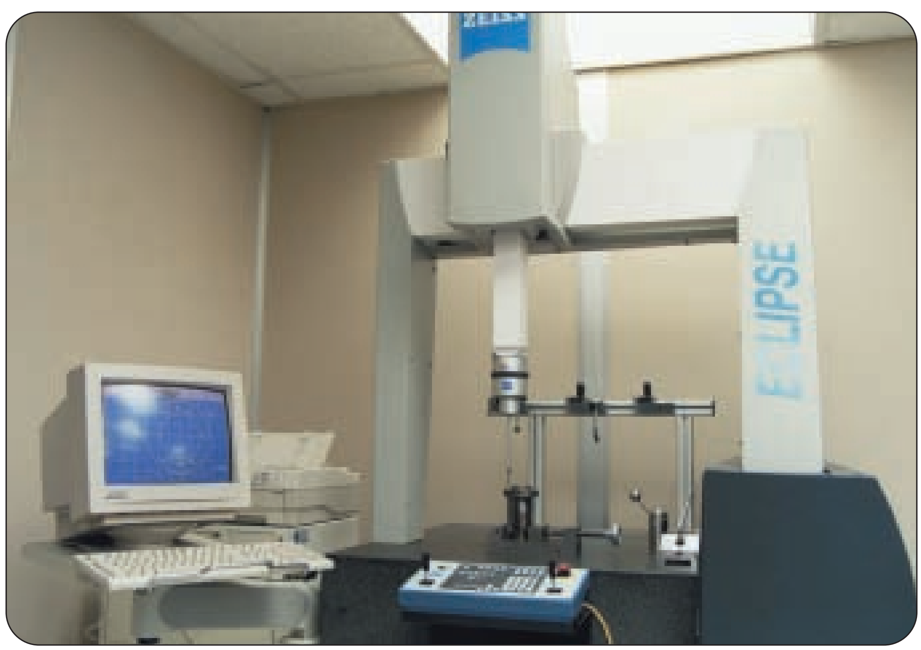
Screw shaft buckling

The column loading of the screw shaft must be checked when it is submitted to compression loading (whether dynamically or statically). The maximum permissible compressive load is calculated using the Euler formulas. It is then multiplied by a safety factor of 3 to 5, depending on the application.

The type of end mounting of the shaft is critical to select the proper coefficients to be used in the Euler formulas.

When the screw shaft comprises a single diameter, the root diameter is used for the calculation. When the screw comprises different sections with various diameters, calculations becomes more complex (1).

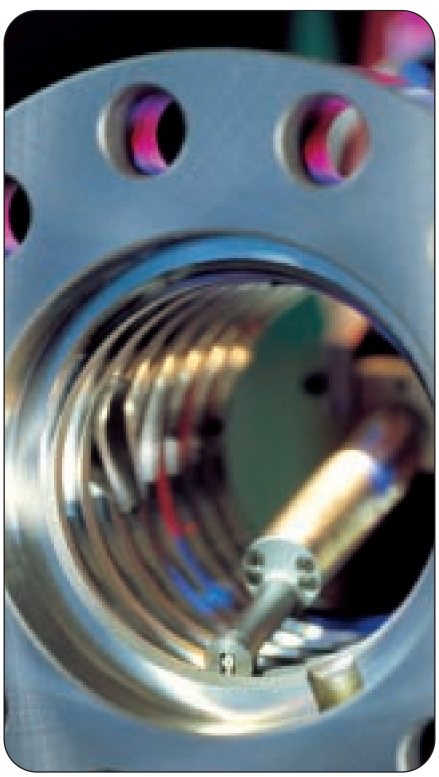
(1) SKF can help you to define this value in relation with the actual conditions of service.



Static load carrying capacity (C_{0a})

Ball screws should be selected on the basis of the basic static load rating C_{0a} instead of on bearing life when they are submitted to continuous or intermittent shock loads, while stationary or rotating at very low speed for short duration. The permissible load is determined by the permanent deformation caused by the load acting at the contact points. It is defined by ISO standards as the purely axially and centrally applied static load which will create, by calculation, a total (rolling element + thread surface) permanent deformation equal to .0001 of the diameter of the rolling element.

A ball screw must be selected by its basic static load rating, which must be at least equal to the product of the maximum axial static load applied and a safety factor “so.” The safety factor is selected in relation with past experience of similar applications and requirements of running smoothness and noise level(1).



Critical rotating speed for screw shafts

The shaft is equated to a cylinder, the diameter of which is the root diameter of the thread. The formulas use a parameter, the value of which is dictated by the mounting of the screw shaft (whether it is simply supported or fixed). As a rule, the nut is not considered as a support of the screw shaft. Because of the potential inaccuracies in the mounting of the screw assembly, a safety factor of .80 is applied to the calculated critical speeds.

Calculations which consider the nut as a support of the shaft, or reduce the safety factor, require practical tests and possibly an optimization of the design(1).

(1) SKF can help you to define this value in relation with the actual conditions of service.

Permissible speed limit

The permissible speed limit is that speed which a screw cannot reliably exceed at any time. It is generally the limiting speed of the recirculation system in the nut. It is expressed as the product of the rpm and the nominal diameter of the screw shaft (in mm).

The speed limits quoted in this catalogue are the **maximum speeds that may be applied through very short periods** and in optimized running conditions of alignment, light external load and preload with monitored lubrication. Running a screw continuously at the permissible speed limit may lead to a reduction of the calculated life of the nut mechanism.

The lubrication of screws rotating at high speed must be properly considered in quantity and quality. The volume, spread and frequency of the application of the lubricant (oil or grease) must be properly selected and monitored). At high speed, the lubricant spread on the surface of the screw shaft may be thrown off by centrifugal forces. It is important to monitor this phenomenon during the first run at high speed and possibly adapt the frequency of relubrication or the flow of lubricant, or select a lubricant with a different viscosity. Monitoring the steady temperature reached by the nut permits the frequency of relubrication or the oil flow rate to be optimized.

ATTENTION!:
High speed associated with high load requires a large input torque and yields a relatively short nominal life (1).
In the case of high acceleration and deceleration, it is recommended to either work under a nominal external load or to apply a light preload to the nut to avoid internal sliding during reversal. The value of preload of screws submitted to high velocity must be that preload which ensures that the rolling elements do not slide (1).
Too high a preload will create unacceptable increases of the internal temperature.

Efficiency and back-driving

The performance of a screw is mainly dependent on the geometry of the contact surfaces and their finish as well as the helix angle of the thread. It is also dependent on the working conditions of the screw (load, speed, lubrication, preload, alignment, etc.).

The "**direct efficiency**" is used to define the input torque required to transform the rotation of one member into the translation of the other. Conversely, the "**indirect efficiency**" is used to define the axial load required to transform the translation of one member into the rotation of the other one. It is also used to define the braking torque required to prevent that rotation.

It is safe to consider that these screws are reversible or back-driveable under almost all circumstances. It is therefore necessary to design a brake mechanism if backdriving is to be avoided (gear reducers or brake).

Preload torque:
Internally preloaded screws exhibit a torque due to this preload. This persists even when they are not externally loaded. Preload torque is measured at 100 rpm (without wipers) when assembly is lubricated with ISO grade 68 oil.

Starting torque:
This is defined as the torque needed to overcome the following to start rotation:

a) the total inertia of all moving parts accelerated by the energy source (including rotation and linear movement).

b) the internal friction of the screw/nut assembly, bearing and associated guiding devices.

In general, torque to overcome inertia (a) is greater than friction torque (b).

The coefficient of friction of the high efficiency screw when starting μs is estimated at up to double the dynamic coefficient μ, under normal conditions of use.

Axial play and preload

Preloaded nuts are subject to much less elastic deformation than non-preloaded nuts. Therefore they should be used whenever the accuracy of positioning under load is important.

Preload is that force applied to a set of two half nuts to either press them together or push them apart with the purpose of eliminating backlash or increasing the rigidity or stiffness of the assembly. The preload is defined by the value of the preload torque (see under that heading in the previous paragraph). The torque depends on the type of nut and on the mode of preload (elastic or rigid).

Manufacturing precision

Generally speaking, the precision indication given in the designation defines the lead precisions see page 8 – Lead precision according to ISO – (ex. G5 - G3-G1).

Parameters other than lead precision correspond to our internal standards (generally based on ISO 3408-3 class 5).

If you require special tolerances (for example class 5) please specify when requesting a quotation or ordering.

Materials and heat treatments

Standard screw shafts are machined from steel which is surface hardened by induction (AISI 4150 or equivalent).

Standard nuts are machined in steel which is carburized and through hardened (AISI 8620 or equivalent).

Hardness of the contact surfaces is 58-62 HRc, depending on diameter, for standard screws.

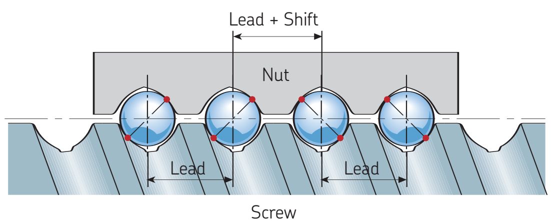
Number of circuits of balls
A nut is defined by the number of ball turns which support the load.

The number changes according to the product and the combination diameter/lead.

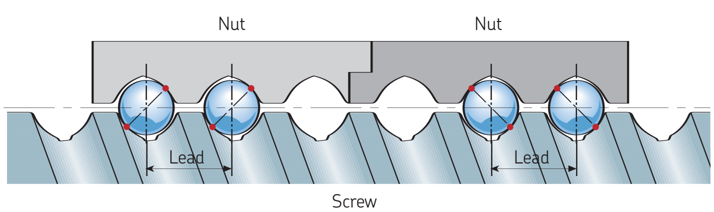
It is defined by the number of circuits and their type.

Working environment
Our products have not been developed for use in an explosive atmosphere, consequently we cannot take any responsibility for the use in this field.

Preload torque



PGF
PGC
PGD
PCD



PGFM
PGEM
PGDM

SKF

Assembly procedure

Note:
Ground ball screws are precision components and should be handled with care to avoid shocks. When stored out of the shipping crate they must lie on wooden or plastic vee blocks and should not be allowed to sag.
Screw assemblies are shipped wrapped in a heavy gauge plastic tube, which protects them from foreign material and possible pollution. They should stay wrapped until they are used.

Radial and moment loads

Any radial or moment load on the nut will overload some of the contact surfaces, thus significantly reducing its life.

Alignment

SKF linear guidance components should be used for correct alignment and to avoid non-axial loading.

The parallelism of the screw shaft with the guiding devices must be checked. If external linear guidance prove impractical, we suggest mounting the nut on trunnions or gimbals and the screw shaft in self-aligning bearings.

Mounting the screw in tension helps align it properly and eliminates buckling.

Lubrication

Good lubrication is essential for the proper functioning of the screw and for its long term reliability.

Before shipping, the screw is coated with a protective fluid that dries to a film. **This protective film is not a lubricant.**

Depending on the selected lubricant, it may be necessary to remove this film before applying the lubricant (there may be a risk of non-compatibility).

If this operation is performed in a potentially polluted atmosphere it is highly recommended to proceed with a thorough cleaning of the assembly.

Designing the screw shaft ends

Generally speaking, when the ends of the screw shaft are specified by the customer's engineering personnel, it is their responsibility to check the strength of these ends. However, on pages 40–43 of this catalog, we offer a choice of standard machined ends. As far as possible, we recommend their use.

A minimum shoulder should be sufficient to maintain the internal bearing. A special design with sleeves can also be offered upon request.

Starting-up the screw

After the assembly has been cleaned, mounted and lubricated, it is recommended that the nut is allowed to make several full strokes at low speed to check the proper positioning of the limit switches or reversing mechanism before applying the full load and the full speed.

Operating temperature

Screws made from standard steel and operating under normal loads can sustain temperatures in the range – 20° – + 110° Celsius (-4° F – +230° F).

Above 110° Celsius, materials adapted to the temperature of the application should be selected.

Consult SKF for advice.

Note:
Operating at high temperature will lower the hardness of the steel, alter the accuracy of the thread and may increase the oxidability of the materials.

Lead precision according to ISO

Lead precision according to ISO 3408-3

Lead precision is measured at 20 °C on the useful stroke l_u, which is the threaded length decreased, at each end, by the length l_e equal to the screw shaft diameter see (table 1) and (fig 1).

table 1

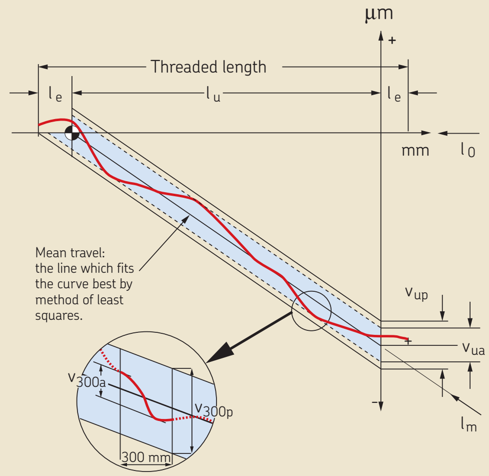
		G1		G3		G5		G7	
max permitted deviation over 300 mm		6		12		23		35	
		e_p	V_{up}	e_p	V_{up}	e_p	V_{up}	e_p	V_{up}
useful travel (mm)		µm	µm	µm	µm	µm	µm	µm	µm
0	315	6	6	12	12	23	23	52	35
315	400	7	6	13	12	25	25	57	40
400	500	8	7	15	13	27	26	63	46
500	630	9	7	16	14	32	29	70	52
630	800	10	8	18	16	36	31	80	57
800	1000	11	9	21	17	40	34	90	63
1000	1250	13	10	24	19	47	39	105	70
1250	1600	15	11	29	22	55	44	125	80
1600	2000			35	25	65	51	150	90
2000	2500			41	29	78	59	175	105
2500	3150					96	69	210	125
3150	4000					115	82	260	150
4000	5000					140	99	320	175
5000	6000					170	119	390	210

max permitted deviation over 1 foot		0.00023		0.00046		0.00088		0.00133	
		e_p	V_{up}	e_p	V_{up}	e_p	V_{up}	e_p	V_{up}
useful travel (ft)		in	in	in	in	in	in	in	in
0.0000	1.0335	0.00024	0.00024	0.00047	0.00047	0.00091	0.00091	0.00205	0.00138
1.0335	1.3123	0.00028	0.00024	0.00051	0.00047	0.00098	0.00098	0.00224	0.00157
1.3123	1.6404	0.00031	0.00028	0.00059	0.00051	0.00106	0.00102	0.00248	0.00181
1.6404	2.0669	0.00035	0.00028	0.00063	0.00055	0.00126	0.00114	0.00276	0.00205
2.0669	2.6247	0.00039	0.00031	0.00071	0.00063	0.00142	0.00122	0.00315	0.00224
2.6247	3.2808	0.00043	0.00035	0.00083	0.00067	0.00157	0.00134	0.00354	0.00248
3.2808	4.1010	0.00051	0.00039	0.00094	0.00075	0.00185	0.00154	0.00413	0.00276
4.1010	5.2493	0.00059	0.00043	0.00114	0.00087	0.00217	0.00173	0.00492	0.00315
5.2493	6.5617			0.00138	0.00098	0.00256	0.00201	0.00591	0.00354
6.5617	8.2021			0.00161	0.00114	0.00307	0.00232	0.00689	0.00413
8.2021	10.3346					0.00378	0.00272	0.00827	0.00492
10.3346	13.1234					0.00453	0.00323	0.01024	0.00591
13.1234	16.4042					0.00551	0.00390	0.01260	0.00689
16.4042	19.6850					0.00669	0.00469	0.01535	0.00827

e_p = tolerance over the specified travel

V_{up} = maximum permitted travel variation over the useful travel l_u

fig. 1

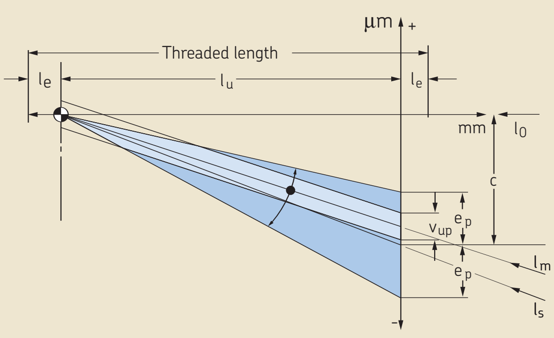


l_u = useful travel
l_e = excess travel (no lead precision required)
l_o = nominal travel
l_s = specified travel
c = travel compensation (difference between l_s and l_0 to be defined by the customer, for instance to compensate an expansion)
e_p = tolerance over the specified travel
V = travel variation (or permissible band width)
V_{300p} = maximum permitted travel variation over 300 mm
V_{up} = maximum permitted travel variation over the useful travel l_u
V_{300a} = measured travel variation over 300 mm
V_{ua} = measured travel variation over the useful travel

2

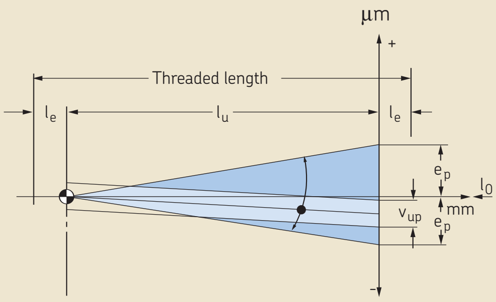
Case with value of c specified by the customer

fig. 2



Case with c = 0 = standard version in case of no value given by the customer

fig. 3



Geometric tolerances

The standard manufacturing tolerances are class 5: class 5 applies to screws with lead precision G1, G3 and G5.

If you require class 1 or class 3 manufacturing tolerances please specify when requesting a quotation or ordering.

The axial run-out t8 is applicable to surfaces of at least 1.5 mm radial size.

Ball screws with nominal diameter greater than 125 mm are not available in class 1.

All values of t are in µm and represent maximum permissible deviations.

table 2

Class 5 **t5** radial run-out of ball screw shaft

d0 (mm)	l1/d0<10	<20	<40	<60	<80	<100
<=20	35	40	50	75	125	200
<=63	35	40	50	75	125	200
<=125	35	40	50	75	125	200
<=160	35	40	50	75	125	200

Class 3 **t5** radial run-out of ball screw shaft

d0 (mm)	l1/d0<10	<20	<40	<60	<80	<100
<=20	30	40	50	75	125	200
<=63	30	40	50	75	125	200
<=125	30	40	50	75	125	200
<=160	30	40	50	75	125	200

Class 1 **t5** radial run-out of ball screw shaft

d0 (mm)	l1/d0<10	<20	<40	<60	<80	<100
<=20	25	35	40	60	100	160
<=63	25	35	40	60	100	160
<=125	25	35	40	60	100	160

table 3

Class 5 **t6** radial run-out of bearing diameter

d0 (mm)	la<80	<125	<200	<315	>=315
<=20	20	0.25 x la			
<=63		25	0.2 x la		
<=125			32	0.16 x la	
<=160				40	0.13 x la

Class 3 **t6** radial run-out of bearing diameter

d0 (mm)	la<80	<125	<200	<315	>=315
<=20	12	0.15 x la			
<=63		16	0.12 x la		
<=125			20	0.10 x la	
<=160				25	0.08xla

Class 1 **t6** radial run-out of bearing diameter

d0 (mm)	la<80	<125	<200	<315	>=315
<=20	8	0.12 x la			
<=63		12	0.10 x la		
<=125			16	0.08 x la	

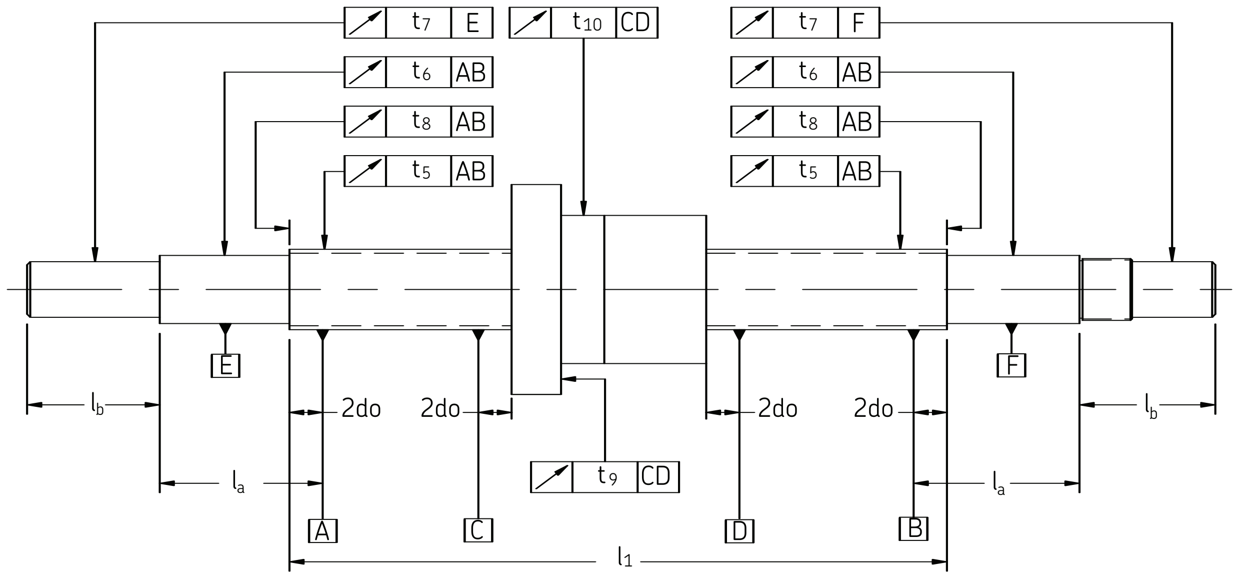


table 4

Class 5 **t7** radial run-out of journal related to bearing diameter t8 t9 t10

d0 (mm)	**lb<80**	**<125**	**<200**	**<315**	**>=315**	t8	t9	t10
<=20	8	0.1 x lb				5	20	20
<=63		10	0.08 x lb			5	25	25
<=125			12	0.06 x lb		6	32	32
<=160				16	0.05 x lb	8	40	40

Class 3 **t7** radial run-out of journal related to bearing diameter t8 t9 t10

d0 (mm)	**lb<80**	**<125**	**<200**	**<315**	**>=315**	t8	t9	t10
<=20	6	0.075 x lb				4	16	16
<=63		8	0.064 x lb			4	20	20
<=125			10	0.05 x lb		5	25	25
<=160				12	0.038 x lb	6	32	32

Class 1 **t7** radial run-out of journal related to bearing diameter t8 t9 t10

d0 (mm)	**lb<80**	**<125**	**<200**	**<315**	**>=315**	t8	t9	t10
<=20	5	0.062 x lb				3	12	12
<=63		6	0.048 x lb			3	16	16
<=125			8	0.04 x lb		4	20	20

Design and functional specifications

Geometric profile of the track/ball area

Ball/track contact pressures and, therefore, axial load capacity are optimized through in-depth study of the profile of the groove consisting of two gothic arcs that are in a specific ratio to the radius of the ball $D_W/2$, so as to generate the optimal contact angle α (**fig 4**).

According to the direction of the load, the ball/track contact points are at B or A. The displacement Δa of the ball from point A to point B is the effective axial play of the ball screw. Under stationary conditions, the radial play Δr of the system is related to this.

Preload

Two nuts are used forced apart according to a preload force at rest F_{pr} in order to enhance positioning accuracy, eliminating axial and radial play, and to improve system rigidity.

Application of an external load F_A increases the load and deformation on nut 2 to the values $F_{(2)}$ and $\Delta l_{b/t(2)}$ while nut 1 is detensioned to the same extent. When the external load reaches the value $F_l = 2.83$ F_{pr}, the preload is eliminated (condition of no play), (**diagram 1**).

Figure 5 and Diagram 2 show the different behavior of nuts preloaded or with play. The optimal preload depends on a wide range of application parameters and must be "purpose-designed" for harsher uses. TCM recommends an optimal preload of maximum 8 to 10% of the basic dynamic axial load rating C_{am}.

Preload must be defined according to the load applied and the required rigidity. With external loads F_A, the preload value that ensures conditions of no play is, as seen above, equal to $F_A/2.83$.

fig. 4

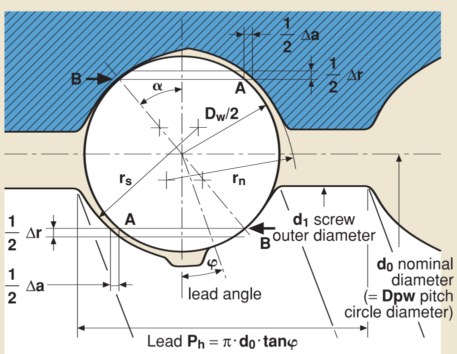


diagram 1

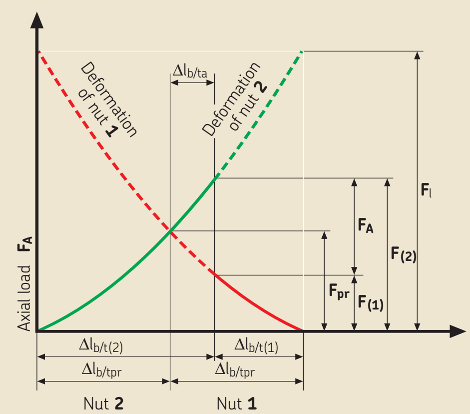


diagram 2

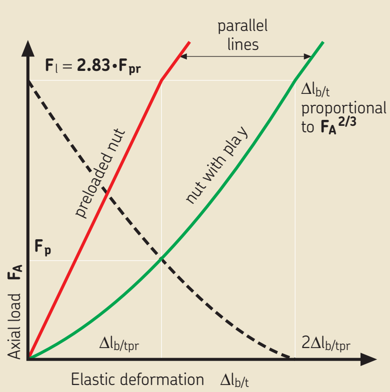
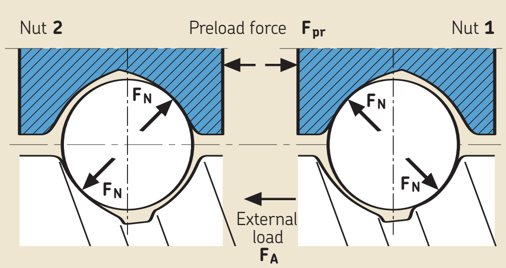


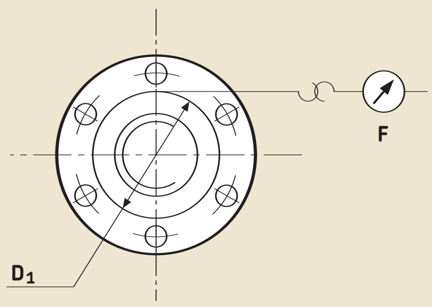
diagram 5



Once the ball screw has been dimensioned with the calculated required rigidity, a further increase in the preload does not lead to any noticeable increase in rigidity but tends to reduce ball screw life due to the increase in the operating torque and in temperature.

Each time the temperature increases by one degree above 20 °C, there is an approx. 0.01 mm elongation per degree and per meter in the steel used to construct the precision ball screw.

fig. 6



Preloading systems

In addition to the above-mentioned system, in which two preloaded nuts are used, the single preloaded nut system can be applied by using larger-sized balls (with four contact points) or with a shift in the lead of the nut tracks.

Permissible deviations for the preload torque (ISO 3608-3 Standard)

Table 5 gives the maximum permissible tolerance values ± ΔT_{pp} in % in relation to the nominal torque T_{po}; the effective values T_{pa} and ± ΔT_{pa} measured with the procedure outlined in the paragraph above must be within this range.

Materials and thermal expansions

TCM ball screw shafts are made of particularly impurity-free steels, able to withstand the heat treatments applied without cracking or uncontrolled deformations.

The track-ball contact area is surface-hardened by applying strictly controlled induction hardening procedures for the screw shafts and case-hardening procedures for the nuts followed by deep freeze treatment (for the residual austenite) and soft tempering. Constant hardening thicknesses of ≥ 2 mm are thus obtained with hardness values of 59 – 62 HRC.

The ends of the screws are usually hardened and tempered (R = 80 – 90 daN/mm^2).

The thermal expansion coefficient of the screw is K_a = 12.10 $^{-6}$/degree; the resulting axial elongation at a thermal gradient of $\Delta\theta$ [°C] is therefore:

$$\Delta l = K_a \, \Delta\theta \iota \, L \text{ [mm]}$$

This should be taken into account when selecting the correct preload and lead compensation in order to obtain optimal working conditions.

2

table 5 — Preload torque tolerances

T_{po} [Nm]		ΔT_{pp} (% of T_{p0})											
		L_μ/d_0<40: L_μ<4000 mm				L_μ/d_0<60; L_μ<4000mm				L_μ>4000mm			
from	to	ISO 1	ISO 3	IOS 5	ISO 7	ISO 1	ISO 3	ISO 5	ISO 7	ISO 1	ISO 3	ISO 5	ISO 7
0.2	0.4	35	40	50	-	40	50	60	-	-	-	-	-
0.4	0.6	25	40	40	-	33	40	45	-	-	-	-	-
0.6	1.0	25	30	35	40	30	35	40	45	-	40	45	50
1	2.5	20	25	30	35	25	30	35	40	-	35	40	45
2.5	6.3	15	20	25	30	20	25	30	35	-	35	40	45
6.3	10	-	15	20	30	-	20	25	35	-	25	30	35

Application of precision ball screw

Lubrication

Oil

A centralized recirculating oil system is ideal because it continuously changes the oil in the nut with cooled, filtered oil from the reservoir. This system is prescribed when the temperature is likely to affect positioning accuracy. The flow of oil can be regulated to optimize film thickness and removal of heat.

TCM has deep hole drilling capabilities which can also be used for the lubrication path through the shaft, for example.

Please consult our engineering department for design advice.

Selection of oil

Mineral oil normally used to lubricate other rotating parts such as bearings and gears may be used for the screw. The viscosity of the oil is defined by the speed, running temperature and load. For most applications we can have a viscosity in the range ISO VG68 to ISO VG100 at the running temperature. In conformity with DIN 51519, the ISO VG viscosity grade can be obtained from **Diagram 3** based on screw shaft diameter, average speed and operating temperature for the application.

At low speed (<10 rpm) the viscosity should be increased (150 to 200 ISO) in relation to the running temperature. Under heavy load, an EP additive to improve the film strength is recommended. Corrosion resistant and stabilizing additives may also be used.

Grease

Where oil lubrication is not practical, the grease recommended for the support bearings of the screw may also be used for the screw. After a few full strokes the grease will be spread evenly over the useful threaded length of the screw shaft, which also helps to protect the screw against corrosion. Grease on the screw shaft will age more quickly than that in the support bearings due to direct exposure to the air and to particles, so more frequent regreasing is needed, especially in a dirty environment. If the screw cannot be dismounted and cleaned before regreasing, it is necessary to thoroughly clean the old grease from the screw shaft. This can be done with a spatula and then with a clean, lint-proof cloth. For more thorough cleaning, use a cloth wet with a solvent. We do not advise using brushes to remove old or spread new grease (risk of bristles coming out). Also apply the new grease through the nut to push out the old from inside the nut.

The grease type is defined above all by the operating temperature, environment and load on the screw. Speed, starting torque and chemical compatibility may also be taken into consideration. Normally, bearing greases of NLGI consistency 2 are used. A grease which is too hard at low temperature may restrict rotation, or one which is too soft at high temperature may run off.

Selection of grease

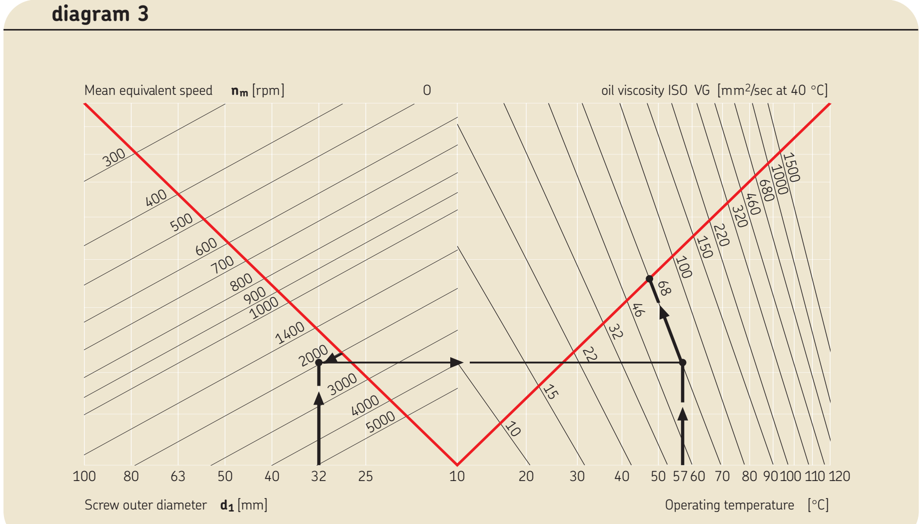
Lithium base greases are generally suitable for use from –30°C to +110°C, are virtually insoluble in water, and very work stable. However, they absorb large quantities of water when worked to extremes. Other soaps are advised in the presence of a lot of water. At low speed or heavy load, lithium base greases with EP additives are recommended as they adhere well to rolling surfaces and are insoluble in water. As a rule, EP greases are recommended for medium- and large-sized screws.

Lubrication interval and amount

The lubrication interval depends on the working cycle of the screw and whether the lubricant is polluted during use. General advice is difficult but the following will help you to define the interval. On start-up, check the grease quality regularly (i.e. every month). If the viscosity or consistency of the grease sample has increased, it needs to be replaced. If the grease sample is darker than new it may indicate oxidation or presence of metallic particles. If it is discolored, it is probably mixed with water. It is helpful to take samples not only from the part of the screw where running has occurred, but also from unused parts of the screw where grease acts as a corrosion preventer.

The amount of oil required also depends on the application conditions. An oil volume of 2 – 5 cm3/h is usually prescribed for each ball turn (1 impulse every 5 to 30 minutes). In case of oil immersed horizontal screws, the level of lubricant must reach the axis of the lowest ball. In the case of application with operating conditions other than normal, oil flow may have to be increased to dissipate the heat generated by the running and to minimize wear effect. The total volume of grease needed for a ball screw is the sum of the quantities needed for the screw shaft and the nut. A thin layer should be spread over the whole threaded length of the shaft. The volume of grease for the nut is about 1/3 of the free volume in the nut. The grease should be injected through the

diagram 3



lubrication hole while turning the shaft. Before applying load, the nut should be run twice along the complete stroke to ensure grease is evenly spread.

SKF Automatic lubrication SYSTEM 24 is also fully suitable for screw lubrication.[(1)]

Protective covers

To prevent dirt which may fall on grease from entering the nut, wipers should be mounted in each end of the nut. TCM standard precision ball screws are supplied complete with nylon wiper rings. Wipers can also be used with oil lubrication to reduce leakage and, as with grease, to limit penetration of external impurities.

Other wiper designs made of special plastic or felt are available for applications in high contaminated environment. Bellows and spring telescopic covers are also useful in these cases.

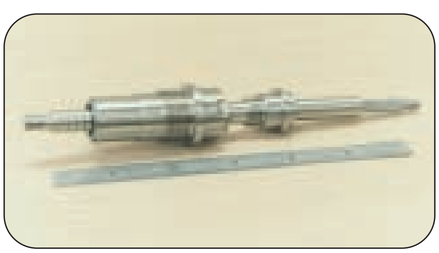
[(1)]For additional information, please consult SKF.

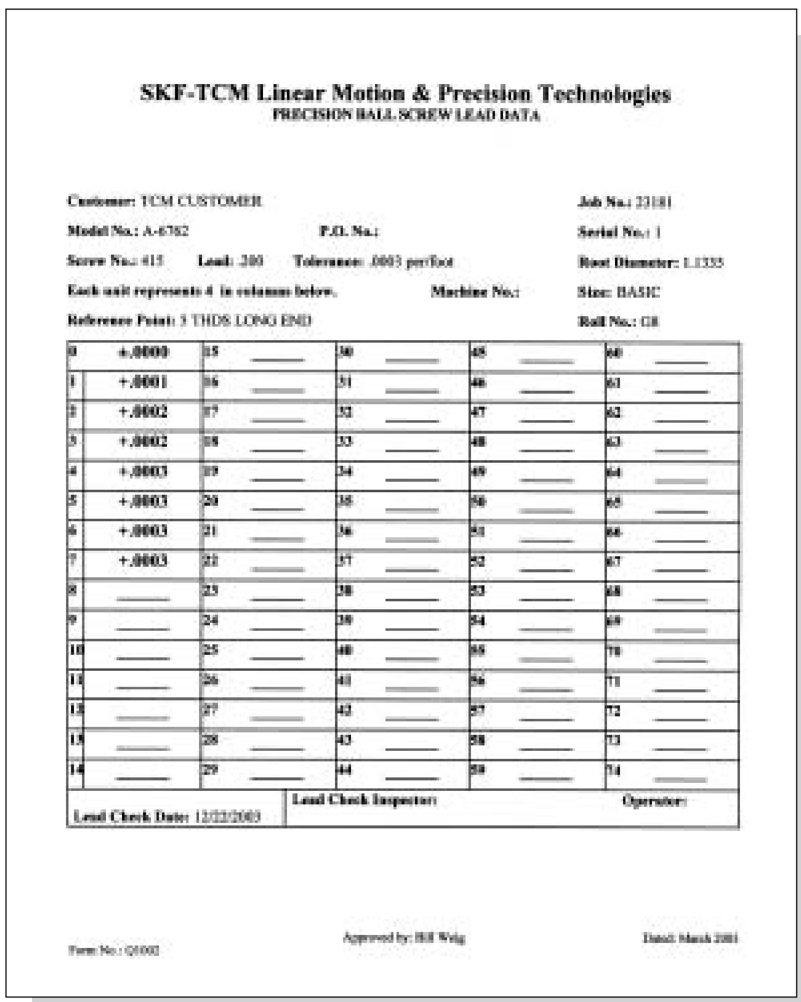
Product inspection and certification

SKF-TCM ball screws are shipped with a lead accuracy report (pictured at right). The lead error is charted against specifications with the actual data measured and recorded.

Special inspection reports or certificates can be provided and tailored to individual needs on request. The following are available:

1. Certificate of conformance
2. Laser plotting of lead error
3. Dimensional inspection reports
4. Material and treatment certificates





SKF-TCM Linear Motion & Precision Technologies

PRECISION BALL SCREW LEAD DATA

Customer: TCM CUSTOMER **Job No.:** 23181

Model No.: A-6782 **P.O. No.:** **Serial No.:** 1

Screw No.: 415 **Lead:** .200 **Tolerance:** .0003 per/foot **Root Diameter:** 1.1335

Each unit represents 4 in columns below. **Machine No.:** **Size:** BASIC

Reference Point: 3 THDS LONG END **Ball No.:** C8

0	+.0000	15		30		45		60	
1	+.0001	16		31		46		61	
2	+.0002	17		32		47		62	
3	+.0002	18		33		48		63	
4	+.0003	19		34		49		64	
5	+.0003	20		35		50		65	
6	+.0003	21		36		51		66	
7	+.0003	22		37		52		67	
8		23		38		53		68	
9		24		39		54		69	
10		25		40		55		70	
11		26		41		56		71	
12		27		42		57		72	
13		28		43		58		73	
14		29		44		59		74	

Lead Check Date: 12/22/2003 **Lead Check Inspector:** **Operator:**

Form No.: Q1002 Approved by: Bill Weig Dated: March 2001

Inch series

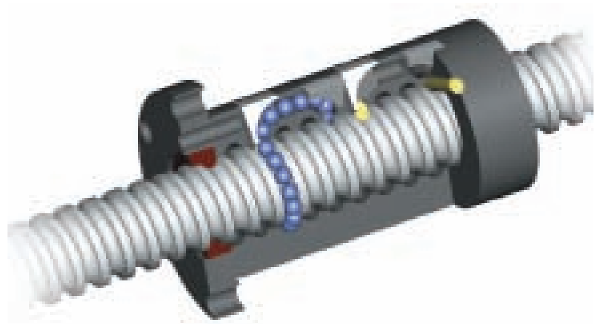
PGF single nut preloaded end flange

Precision ground screw

Screw diameter from 0.625 to 4 inches
Lead from 0.1 to 0.75 inches

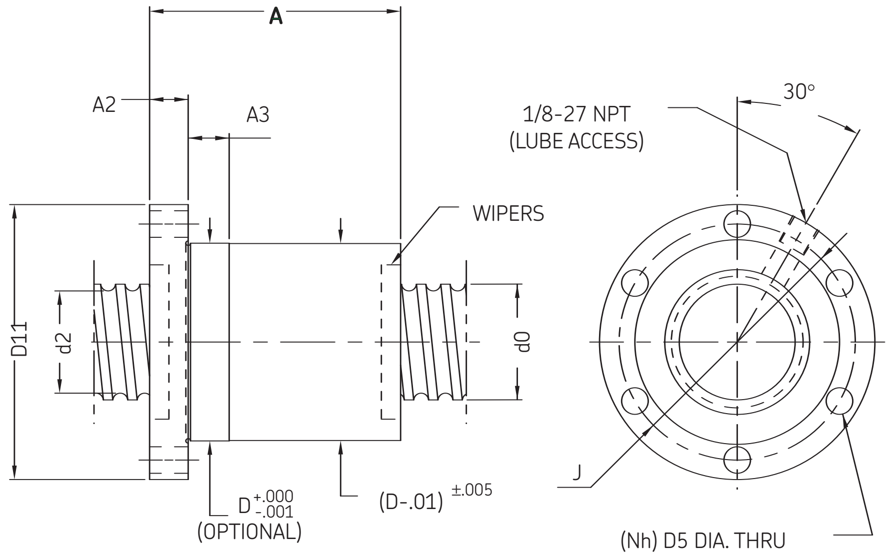
Other leads and diameters can be supplied upon request. Ball nuts as shown are with wipers supplied at each end. Compact nut with integral flange for simple mounting. Internal preload set for optimum rigidity & efficiency. Preload adjustable upon request.

Screw bearing support units FLRBU, FLBU, PLBU or BUF (see pages 44–50).



Designation	Screw diameter	Lead	Number of circuits of balls	Basic load ratings dynamic	static	Preload torque	Nut stiffness
	d0	Ph		Ca	Coa	Tpr	Rn
	in	in		lbf	lbf	in.lbf	x1E6 lbf/in
PGF 0.625X0.1	0.625	0.1	2x3	1028	2126	0.51	3.07
PGF 0.75X0.1	0.75	0.1	2x4	1457	3559	0.87	4.72
PGF 0.75X0.2	0.75	0.2	2x4	2754	4718	1.65	3.79
PGF 1X0.2	1	0.2	2x4	4262	9223	3.41	6.64
PGF 1X0.25	1	0.25	2x4	6908	12572	5.53	6.65
PGF 1.25X0.2	1.25	0.2	2x4	4698	11648	4.70	7.79
PGF 1.25X0.25	1.25	0.25	2x4	8084	17036	8.08	8.33
PGF 1.5X0.2	1.5	0.2	2x4	5066	14072	6.08	8.82
PGF 1.5X0.25	1.5	0.25	2x4	8802	20656	10.56	9.52
PGF 1.5X0.5	1.5	0.5	2x4	20063	36024	22.57	9.61
PGF 1.75X0.2	1.75	0.2	2x4	5474	16887	7.66	9.98
PGF 1.75X0.25	1.75	0.25	2x4	9418	24274	13.19	10.63
PGF 1.75X0.5	1.75	0.5	2x4	22276	43286	27.29	10.82
PGF 2X0.2	2	0.2	2x4	5757	19310	9.21	10.88
PGF 2X0.25	2	0.25	2x4	9964	27890	15.94	11.63
PGF 2X0.5	2	0.5	2x4	24180	50548	33.85	12.15
PGF 2.25X0.25	2.25	0.25	2x4	10456	31504	18.82	12.48
PGF 2.25X0.5	2.25	0.52	2x4	25853	57810	40.72	13.44
PGF 2.5X0.25	2.5	0.25	2x4	11089	35996	22.18	13.63
PGF 2.5X0.5	2.5	0.5	2x4	27349	65072	47.86	14.63
PGF 2.5X0.75	2.5	0.75	2x3	21780	50390	38.12	11.64
PGF 3X0.25	3	0.25	2x4	11880	43226	28.51	15.06
PGF 3X0.5	3	0.5	2x4	30815	83057	41.60	15.21
PGF 3X0.75	3	0.75	2x3	23783	61320	35.67	12.06
PGF 3.5X0.5	3.5	0.5	2x4	32975	97605	51.93	16.99
PGF 3.5X0.75	3.5	0.75	2x3	25500	72239	44.62	13.57
PGF 4X0.5	4	0.5	2x4	34886	112145	55.82	17.96
PGF 4X0.75	4	0.75	2x3	27015	83151	54.03	14.96

Inch series



UNITS : INCH

Shaft root diameter	Locating diameter	Flange diameter	Bolt circle	Hole size	Number of holes	Nut length	Flange thickness	Locating length (optional)
d2	D	D1	J	D5	Nh	A	A2	A3
in	in	in	in	in		in	in	in
0.567	1.125	2	1.5	0.281	4	1.75	0.437	0.5
0.692	1.25	2.25	1.75	0.344	4	1.937	0.437	0.5
0.634	1.562	2.562	2.062	0.344	4	2.812	0.437	0.5
0.883	1.812	2.812	2.312	0.344	4	3.25	0.5	0.5
0.825	2.125	3.125	2.625	0.344	4	3.875	0.5	0.5
1.133	2.062	3.062	2.562	0.344	4	3.25	0.5	0.5
1.075	2.312	3.312	2.812	0.344	4	3.875	0.5	0.5
1.383	2.312	3.312	2.812	0.344	6	3.375	0.625	0.5
1.325	2.562	3.562	3.062	0.344	6	4	0.625	0.5
1.15	3.25	4.5	3.875	0.406	6	6.937	0.625	0.6
1.633	2.625	3.875	3.25	0.406	6	3.5	0.75	0.5
1.575	2.875	4.125	3.5	0.406	6	4.125	0.75	0.5
1.4	3.5	4.75	4.125	0.406	6	7.062	0.75	0.6
1.883	2.937	4.187	3.562	0.406	6	3.5	0.75	0.5
1.825	3.125	4.375	3.75	0.406	6	4.125	0.75	0.5
1.65	3.75	5.5	4.625	0.531	6	7.062	0.75	0.6
2.075	3.312	5	4.187	0.531	6	4.125	0.75	0.5
1.899	4.125	5.875	5	0.531	6	7.062	0.75	0.6
2.325	3.625	5.375	4.5	0.531	6	4.125	0.75	0.5
2.149	4.375	6.375	5.375	0.656	6	7.062	0.75	0.6
2.149	4.375	6.375	5.375	0.656	6	7.937	0.875	1
2.825	4.125	6.125	5.125	0.656	6	4.25	0.875	0.6
2.649	4.812	6.812	5.812	0.656	6	7.187	0.875	0.6
2.649	4.812	6.812	5.812	0.656	6	7.937	0.875	1
3.149	5.375	7.375	6.375	0.656	6	7.312	1	0.6
3.149	5.375	7.375	6.375	0.656	6	8.062	1	1
3.649	5.875	7.875	6.875	0.656	6	7.562	1.25	0.6
3.649	5.875	7.875	6.875	0.656	6	8.312	1.25	1

Inch series

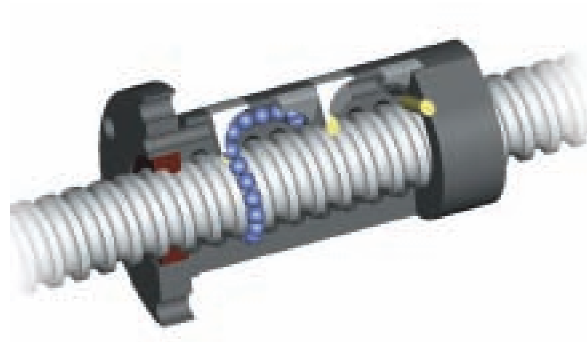
PGC single nut preloaded cam shaped

Precision ground screw

Screw diameter from 0.625 to 3 inches
Lead from 0.1 to 0.5 inches

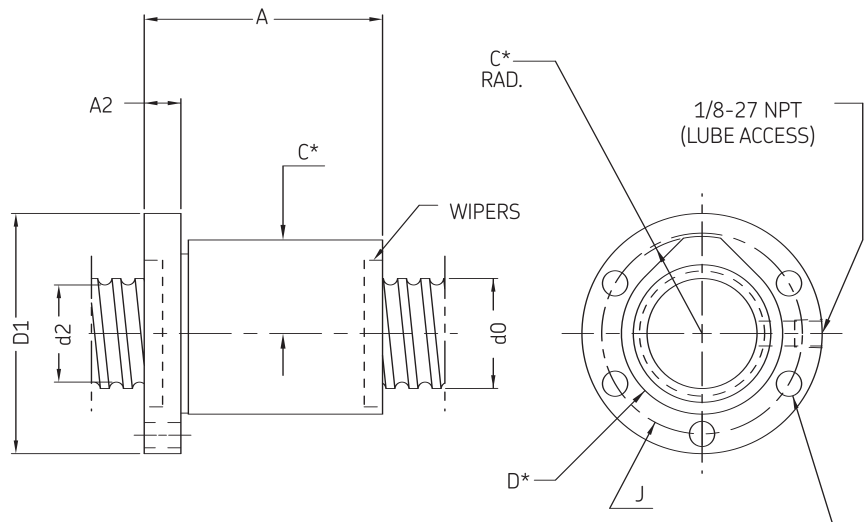
Other leads and diameters can be supplied upon request. Ball nuts as shown are with wipers supplied at each end. Compact nut with integral flange for simple mounting. Design interchangeable with any tube recirculation design. Internal preload set for optimum rigidity & efficiency. Preload adjustable upon request.

Screw bearing support units FLRBU, FLBU, PLBU or BUF (see pages 44–50).



Designation	Screw diameter	Lead	Number of circuits of balls	Basic load ratings dynamic	static	Preload torque	Nut stiffness
	d0	Ph		Ca	Coa	Tpr	Rn
	in	in		lbf	lbf	in.lbf	x1E6lbf/in
PGC 0.625X0.1	0.625	0.1	2x3	1028	2126	0.51	2.99
PGC 0.75X0.1	0.75	0.1	2x3	1131	2645	0.68	3.44
PGC 0.75X0.2	0.75	0.2	2x3	2754	4718	1.65	3.72
PGC 0.875X0.2	0.875	0.2	2x3	3095	5911	2.17	4.33
PGC 0.875X0.25	0.875	0.25	2x3	3089	5903	2.16	4.40
PGC 1X0.2	1	0.2	2x4	4262	9223	3.41	6.49
PGC 1X0.25	1	0.25	2x4	6908	12572	5.53	6.44
PGC 1.25X0.2	1.25	0.2	2x4	4698	11648	4.70	7.43
PGC 1.25X0.25	1.25	0.25	2x4	8084	17036	8.08	8.03
PGC 1.5X0.2	1.5	0.2	2x4	5066	14072	6.08	8.43
PGC 1.5X0.25	1.5	0.25	2x4	8802	20656	10.56	9.07
PGC 1.5X0.5	1.5	0.5	2x3	15347	26199	17.27	7.06
PGC 1.75X0.2	1.75	0.2	2x5	6652	21207	9.31	11.99
PGC 1.75X0.25	1.75	0.25	2x4	9418	24274	13.19	10.10
PGC 1.75X0.5	1.75	0.5	2x3	17095	31632	20.94	7.97
PGC 2X0.2	2	0.2	2x5	6994	24236	11.19	12.39
PGC 2X0.25	2	0.25	2x5	12122	35080	19.39	13.36
PGC 2X0.5	2	0.5	2x4	24180	50548	33.85	12.01
PGC 2.25X0.25	2.25	0.25	2x5	12715	39599	22.89	14.47
PGC 2.25X0.5	2.25	0.5	2x4	25853	57810	40.72	13.21
PGC 2.5X0.25	2.5	0.25	2x5	13478	45214	26.96	15.49
PGC 2.5X0.5	2.5	0.5	2x4	27349	65072	44.44	14.02
PGC 3X0.25	3	0.25	2x5	14433	54253	30.31	15.03
PGC 3X0.5	3	0.5	2x4	30815	83057	41.60	14.86

Inch series



Shaft root diameter	**Locating diameter**	**CAM radius**	**Flange diameter**	**Bolt circle**	**Hole size**	**Number of holes**	**Nut length**	**Flange thickness**
d2	D	C	D1	J	D5	Nh	A	A2
in	in	in	in	in	in		in	in
0.567	0.937	0.562	2	1.5	0.281	3	1.812	0.437
0.692	1.062	0.625	2.125	1.625	0.281	3	1.875	0.5
0.634	1.187	0.781	2.25	1.75	0.281	5	2.875	0.5
0.76	1.25	0.843	2.25	1.75	0.281	5	2.875	0.5
0.76	1.25	0.843	2.25	1.75	0.281	5	3.312	0.5
0.883	1.5	0.906	2.625	2.125	0.281	5	3.312	0.5
0.825	1.5	1.062	2.625	2.125	0.281	5	4	0.5
1.133	1.687	1.031	2.875	2.312	0.344	5	3.312	0.5
1.075	1.812	1.156	3	2.437	0.344	5	4	0.5
1.383	2	1.156	3.25	2.625	0.344	5	3.312	0.5
1.325	2.062	1.281	3.25	2.625	0.344	5	4	0.5
1.15	2.75	1.625	4.625	3.75	0.344	5	6	0.625
1.633	2.375	1.312	3.875	3.125	0.406	5	3.875	0.625
1.575	2.375	1.437	3.875	3.125	0.406	5	4.125	0.625
1.4	3	1.75	4.875	4	0.531	5	6	0.625
1.883	2.5	1.468	4	3.25	0.406	5	3.875	0.625
1.826	2.562	1.562	4	3.25	0.406	5	4.625	0.625
1.65	3.25	1.875	5.125	4.25	0.531	5	7.125	0.75
2.075	2.875	1.656	4.375	3.625	0.406	5	4.75	0.75
1.899	3.5	2.062	5.5	4.5	0.531	5	7.125	0.75
2.325	3.125	1.812	4.625	3.875	0.406	5	4.75	0.75
2.149	3.75	2.187	5.75	4.75	0.531	5	7.125	0.75
2.825	3.5	2.062	5	4.25	0.406	5	4.75	0.75
2.649	4.25	2.406	6.25	5.25	0.531	5	7.125	0.75

Inch series

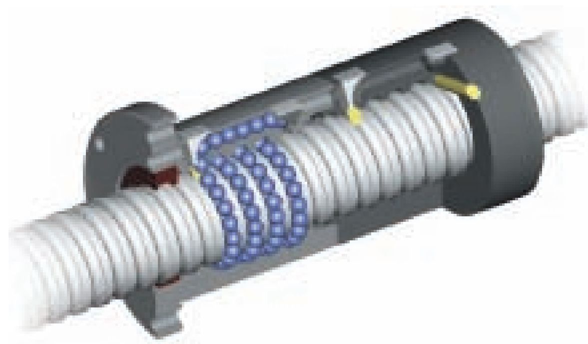
PGFM double nut preloaded end flange

Precision ground screw

Screw diameter from 0.5 to 6 inches
Lead from 0.1 to 1 inch

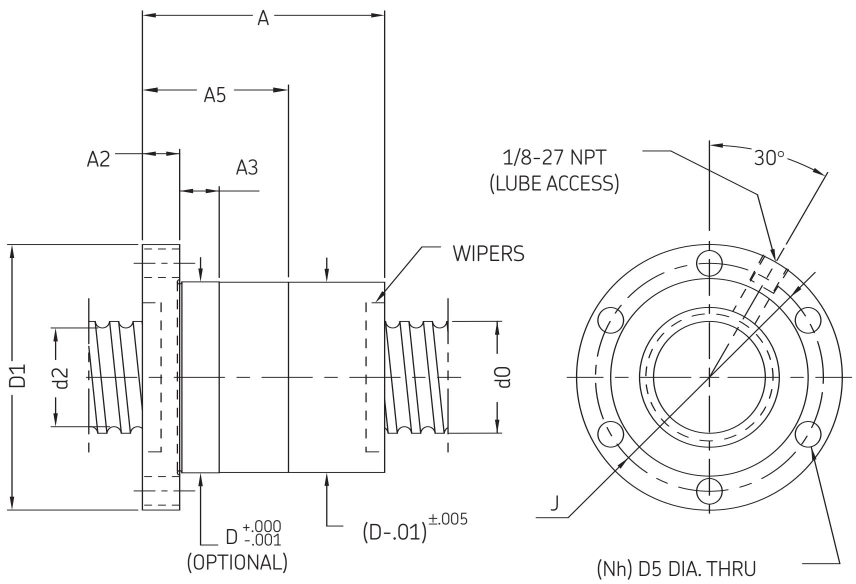
Other leads and diameters can be supplied upon request. Ball nuts as shown are with wipers supplied at each end. Assembly of an integrated flanged nut and a cylindrical pilot nut. Internal preload set for optimum rigidity & efficiency. Preload adjustable upon request.

Screw bearing support units FLRBU, FLBU, PLBU or BUF (see pages 44–50).



Designation		Screw diameter	Lead	Number of circuits of balls per nut	Basic load ratings dynamic	static	Preload torque	Nut stiffness
		d0	Ph		Ca	Coa	Tpr	Rn
		in	in		lbf	lbf	in.lbf	x1E6lbf/in
PGFM	0.5X0.1	0.5	0.1	1x4	1204	2270	0.48	3.46
PGFM	0.5X0.2	0.5	0.2	1x4	2037	3302	0.81	3.70
PGFM	0.625X0.1	0.625	0.1	1x4	1327	2867	0.66	4.07
PGFM	0.625X0.2	0.625	0.2	1x4	3213	5205	1.61	4.33
PGFM	0.625X0.25	0.625	0.25	1x4	4124	6220	2.06	4.34
PGFM	0.75X0.1	0.75	0.1	1x4	1457	3559	0.87	4.72
PGFM	0.75X0.2	0.75	0.2	1x4	3573	6416	2.14	5.08
PGFM	0.75X0.25	0.75	0.25	1x4	4804	8076	2.88	5.33
PGFM	0.875X0.2	0.875	0.2	1x4	4006	8009	2.80	6.01
PGFM	0.875X0.25	0.875	0.25	1x4	5163	9357	3.61	5.94
PGFM	1X0.1	1	0.1	1x4	1626	4752	1.30	5.75
PGFM	1X0.2	1	0.2	1x4	4262	9223	3.41	6.64
PGFM	1X0.25	1	0.25	1x4	6908	12572	5.53	6.65
PGFM	1.25X0.2	1.25	0.2	1x4	4698	11648	4.70	7.79
PGFM	1.25X0.25	1.25	0.25	1x4	6348	14366	6.35	8.13
PGFM	1.25X0.5	1.25	0.5	1x4	11147	20759	11.15	8.28
PGFM	1.5X0.2	1.5	0.2	1x4	5066	14072	6.08	8.82
PGFM	1.5X0.25	1.5	0.25	1x4	8802	20656	10.56	9.52
PGFM	1.5X0.5	1.5	0.5	1x4	20063	36024	22.57	9.61
PGFM	1.75X0.2	1.75	0.2	1x4	5474	16887	7.66	9.98
PGFM	1.75X0.25	1.75	0.25	1x4	9418	24274	13.19	10.63
PGFM	1.75X0.5	1.75	0.5	1x4	22276	43286	27.29	10.82
PGFM	1.75X0.75	1.75	0.75	1x4	22129	43065	29.04	11.11
PGFM	2X0.2	2	0.2	1x4	5757	19310	9.21	10.88
PGFM	2X0.25	2	0.25	1x4	9964	27890	15.94	11.63
PGFM	2X0.5	2	0.5	1x4	24180	50548	33.85	12.15

Inch series



UNITS : INCH

Shaft root diameter	Locating diameter	Flange diameter	Bolt circle	Hole size	Number of holes	Nut length	Flange thickness	Locating length (optional)	Single nut length
d2	D	D1	J	D5	Nh	A	A2	A3	A5
in	in	in	in	in		in	in	in	in
0.441	1	1.875	1.437	0.281	3	2.25	0.437	0.5	1.35
0.412	1.25	2.125	1.687	0.281	3	3.625	0.437	0.5	2.225
0.567	1.125	2	1.562	0.281	3	2.25	0.437	0.5	1.35
0.509	1.375	2.25	1.812	0.281	3	3.5	0.437	0.5	1.9
0.479	1.625	2.5	2.062	0.281	3	3.937	0.437	0.5	2.187
0.692	1.25	2.25	1.75	0.344	4	2.25	0.437	0.5	1.35
0.634	1.562	2.562	2.062	0.344	4	3.5	0.437	0.5	1.9
0.604	1.625	2.625	2.125	0.344	4	3.937	0.437	0.5	2.187
0.76	1.687	2.687	2.187	0.344	4	3.5	0.437	0.5	1.9
0.729	1.75	2.75	2.25	0.344	4	3.937	0.437	0.5	2.187
0.942	1.625	2.625	2.125	0.344	4	2.312	0.5	0.5	1.412
0.883	1.812	2.812	2.312	0.344	4	3.562	0.5	0.5	1.962
0.825	2.125	3.125	2.625	0.344	4	4.312	0.5	0.5	2.312
1.133	2.062	3.062	2.562	0.344	4	3.562	0.5	0.5	1.962
1.104	2.125	3.125	2.625	0.344	4	4	0.5	0.5	2.25
1.016	2.5	3.5	3	0.344	4	7.125	0.5	0.6	3.812
1.383	2.312	3.312	2.812	0.344	6	3.687	0.625	0.5	2.087
1.325	2.562	3.562	3.062	0.344	6	4.437	0.625	0.5	2.437
1.15	3.25	4.5	3.875	0.406	6	7.375	0.625	0.6	3.875
1.633	2.625	3.875	3.25	0.406	6	3.812	0.75	0.5	2.212
1.575	2.875	4.125	3.5	0.406	6	4.562	0.75	0.5	2.5
1.4	3.5	4.75	4.125	0.406	6	7.5	0.75	0.6	4
1.4	3.5	4.75	4.125	0.406	6	10.125	0.875	1	4.875
1.883	2.937	4.187	3.562	0.406	6	3.812	0.75	0.5	2.212
1.826	3.125	4.375	3.75	0.406	6	4.562	0.75	0.5	2.562
1.65	3.75	5.5	4.625	0.531	6	7.5	0.75	0.6	3.812

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Inch series

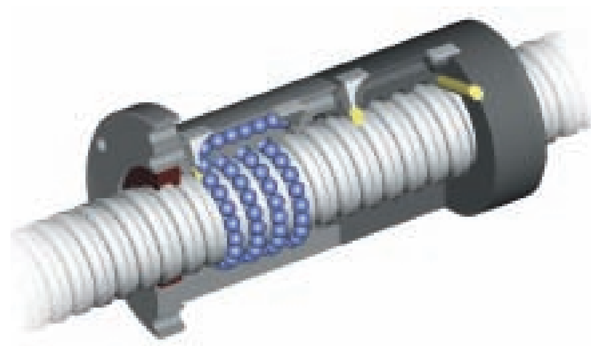
PGFM double nut preloaded end flange

Precision ground screw

Screw diameter from 0.5 to 6 inches
Lead from 0.1 to 1 inch

Other leads and diameters can be supplied upon request. Ball nuts as shown are with wipers supplied at each end. Assembly of an integrated flanged nut and a cylindrical pilot nut. Internal preload set for optimum rigidity & efficiency. Preload adjustable upon request.

Screw bearing support units FLRBU, FLBU, PLBU or BUF (see pages 44–50).



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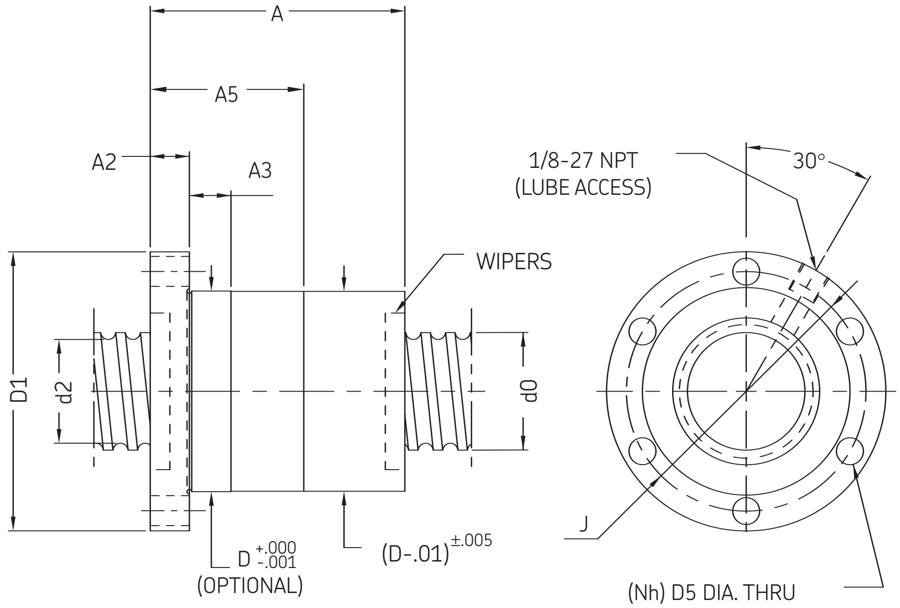
Designation		Screw diameter	Lead	Number of circuits of balls per nut	Basic load ratings dynamic	static	Preload torque	Nut stiffness
		d0	Ph		Ca	Coa	Tpr	Rn
		in	in		lbf	lbf	in.lbf	x1E6lbf/in
PGFM	2X0.75	2	0.75	1x4	24057	50350	36.09	12.53
PGFM	2X1	2	1	1x3	18375	36723	29.40	9.52
PGFM	2.25X0.25	2.25	0.25	1x4	10456	31504	18.82	12.48
PGFM	2.25X0.5	2.25	0.5	1x4	25853	57810	40.72	13.44
PGFM	2.25X0.75	2.25	0.75	1x4	25749	57631	40.55	13.61
PGFM	2.25X1	2.25	1	1x4	26599	60759	41.89	14.30
PGFM	2.5X0.25	2.5	0.25	1x4	11089	35996	22.18	13.63
PGFM	2.5X0.5	2.5	0.5	1x4	27349	65072	44.44	14.30
PGFM	2.5X0.75	2.5	0.75	1x4	28208	68325	45.84	15.17
PGFM	2.5X1	2.5	1	1x4	38815	83037	48.52	13.61
PGFM	3X0.25	3	0.25	1x4	11880	43226	28.51	15.06
PGFM	3X0.5	3	0.5	1x4	30815	83057	41.60	15.21
PGFM	3X0.75	3	0.75	1x4	43353	102706	52.02	14.82
PGFM	3X1	3	1	1x4	43216	102455	51.86	14.89
PGFM	3.5X0.5	3.5	0.5	1x4	32975	97605	51.93	16.99
PGFM	3.5X0.75	3.5	0.75	1x4	48593	128184	59.53	16.76
PGFM	3.5X1	3.5	1	1x4	62805	150171	65.94	15.84
PGFM	4X0.5	4	0.5	1x4	34886	112145	55.82	17.96
PGFM	4X0.75	4	0.75	1x4	51693	147601	62.03	17.75
PGFM	4X1	4	1	1x4	69004	180105	82.80	18.23
PGFM	5X0.5	5	0.5	1x4	38194	141214	66.84	19.81
PGFM	5X0.75	5	0.75	1x4	56974	186401	85.46	20.92
PGFM	5X1	5	1	1x4	77221	230571	96.53	20.62
PGFM	6X0.5	6	0.5	1x4	41600	173819	74.88	21.42
PGFM	6X0.75	6	0.75	1x4	61435	225174	92.15	22.48
PGFM	6X1	6	1	1x4	84043	281022	100.85	22.14

Inch series



Shaft root diameter	Locating diameter	Flange diameter	Bolt circle	Hole size	Number of holes	Nut length	Flange thickness	Locating length (optional)	Single nut length
d2	D	D1	J	D5	Nh	A	A2	A3	A5
in	in	in	in	in		in	in	in	in
1.65	3.75	5.5	4.625	0.531	6	10.125	0.875	1	4.875
1.65	3.75	5.5	4.625	0.531	6	11	1.25	1	6
2.075	3.312	5	4.187	0.531	6	4.562	0.75	0.5	2.562
1.899	4.125	5.875	5	0.531	6	7.5	0.75	0.6	4
1.899	4.125	5.875	5	0.531	6	10.125	0.875	1	4.875
1.899	4.125	5.875	5	0.531	6	13	1.25	1	7
2.325	3.625	5.375	4.5	0.531	6	4.562	0.75	0.5	2.562
2.149	4.375	6.375	5.375	0.656	6	7.5	0.75	0.6	4
2.149	4.375	6.375	5.375	0.656	6	10.125	0.875	1	4.875
2.027	5.25	7.25	6.25	0.656	6	14.5	1.25	1	7
2.825	4.125	6.125	5.125	0.656	6	4.687	0.875	0.5	2.687
2.649	4.812	6.812	5.812	0.656	6	7.625	0.875	0.6	4.125
2.527	5.75	7.75	6.75	0.656	6	11.375	0.875	1	6.125
2.527	5.75	7.75	6.75	0.656	6	14.5	1.25	1	7.5
3.149	5.375	7.375	6.375	0.656	6	7.75	1	0.6	4.25
3.022	5.875	7.875	6.875	0.656	6	11.5	1	1	6.25
2.906	6.5	8.5	7.5	0.656	6	14.75	1.25	1	7.75
3.649	5.875	7.875	6.875	0.656	6	8	1.25	0.6	4.5
3.527	6.75	8.75	7.75	0.656	6	11.75	1.25	1	6.5
3.406	7	9	8	0.656	6	14.75	1.25	1	7.75
4.649	6.75	8.75	7.75	0.656	6	8	1.25	0.6	4.5
4.527	7.75	9.75	8.75	0.656	6	11.75	1.25	1	6.875
4.406	8	10	9	0.656	6	14.75	1.25	1	7.75
5.649	7.75	9.75	8.75	0.656	6	8	1.25	0.6	4.5
5.527	8.75	10.75	9.75	0.656	6	11.75	1.25	1	6.5
5.406	9	11	10	0.656	6	14.75	1.25	1	7.75

Inch series

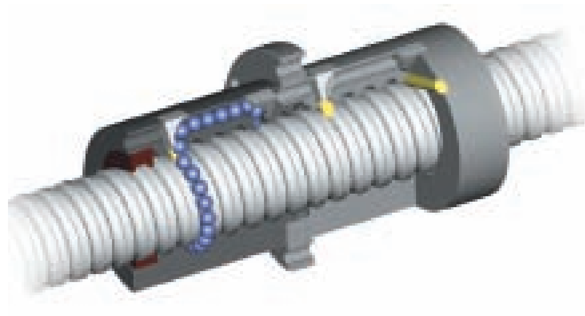
PGEM double nut preloaded center flange

Precision ground screw

Screw diameter from 0.5 to 6 inches
Lead from 0.1 to 1 inch

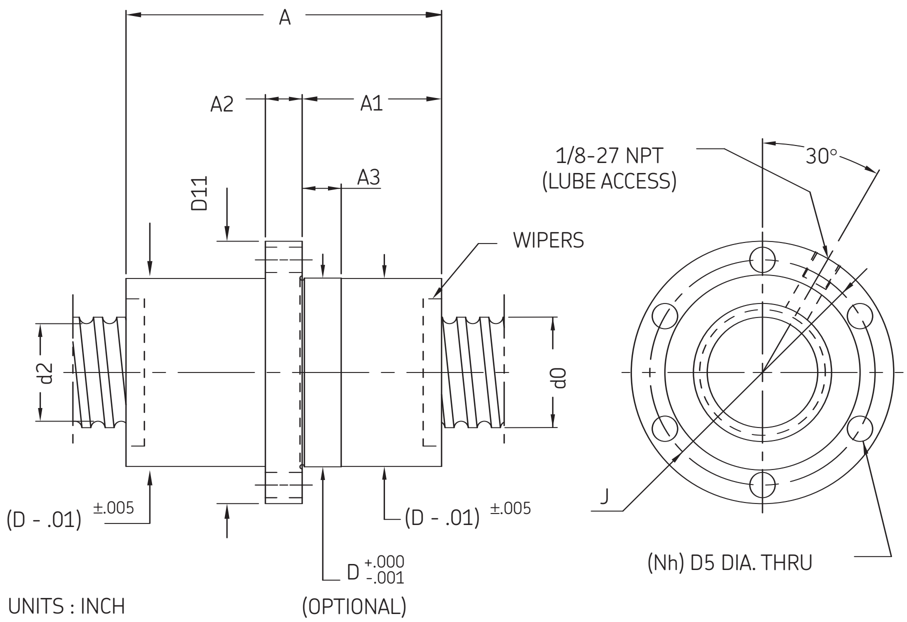
Other leads and diameters can be supplied upon request. Ball nuts as shown are with wipers supplied at each end. Assembly of an integrated flanged nut and a cylindrical pilot nut. Internal preload set for optimum rigidity & efficiency. Preload adjustable upon request.

Screw bearing support units FLRBU, FLBU, PLBU or BUF (see pages 44–50).



Designation		Screw diameter	Lead	Number of circuits of balls per nut	Basic load ratings dynamic	static	Preload torque	Nut stiffness
		d0	Ph		Ca	Coa	Tpr	Rn
		in	in		lbf	lbf	in.lbf	x1E6lbf/in
PGEM	0.5X0.1	0.5	0.1	1x4	1204	2270	0.48	3.46
PGEM	0.5X0.2	0.5	0.2	1x4	2037	3302	0.81	3.70
PGEM	0.625X0.1	0.625	0.1	1x4	1327	2867	0.66	4.07
PGEM	0.625X0.2	0.625	0.2	1x4	3213	5205	1.61	4.33
PGEM	0.625X0.25	0.625	0.25	1x4	4124	6220	2.06	4.33
PGEM	0.75X0.1	0.75	0.1	1x4	1457	3559	0.87	4.72
PGEM	0.75X0.2	0.75	0.2	1x4	3573	6416	2.14	5.08
PGEM	0.75X0.25	0.75	0.25	1x4	4804	8076	2.88	5.33
PGEM	0.875X0.2	0.875	0.2	1x4	4006	8009	2.80	6.01
PGEM	0.875X0.25	0.875	0.25	1x4	5163	9357	3.61	5.94
PGEM	1X0.1	1	0.1	1x4	1626	4752	1.30	5.75
PGEM	1X0.2	1	0.2	1x4	4262	9223	3.41	6.64
PGEM	1X0.25	1	0.25	1x4	6908	12572	5.53	6.65
PGEM	1.25X0.2	1.25	0.2	1x4	4698	11648	4.70	7.79
PGEM	1.25X0.25	1.25	0.25	1x4	6348	14366	6.35	8.13
PGEM	1.25X0.5	1.25	0.5	1x4	11147	20759	11.15	8.28
PGEM	1.5X0.2	1.5	0.2	1x4	5066	14072	6.08	8.82
PGEM	1.5X0.25	1.5	0.25	1x4	8802	20656	10.56	9.52
PGEM	1.5X0.5	1.5	0.5	1x4	20063	36024	22.57	9.61
PGEM	1.75X0.2	1.75	0.2	1x4	5474	16887	7.66	9.98
PGEM	1.75X0.25	1.75	0.25	1x4	9418	24274	13.19	10.63
PGEM	1.75X0.5	1.75	0.5	1x4	22276	43286	27.29	10.82
PGEM	1.75X0.75	1.75	0.75	1x4	22129	43065	29.04	11.11
PGEM	2X0.2	2	0.2	1x4	5757	19310	9.21	10.88
PGEM	2X0.25	2	0.25	1x4	9964	27890	15.94	11.63
PGEM	2X0.5	2	0.5	1x4	24180	50548	33.85	12.15

Inch series



Shaft root diameter	Locating diameter	Flange diameter	Bolt circle	Hole size	Number of holes	Nut length	Position of flange	Flange thickness	Locating length (optional)
d2	D	D1	J	D5	Nh	A	A1	A2	A3
in	in	in	in	in		in	in	in	in
0.441	1	1.875	1.437	0.281	3	2.174	0.869	0.437	0.5
0.412	1.25	2.125	1.687	0.281	3	3.174	1.369	0.437	0.5
0.567	1.125	2	1.562	0.281	3	2.174	0.869	0.437	0.5
0.509	1.375	2.25	1.812	0.281	3	3.5	1.532	0.437	0.5
0.509	1.375	2.25	1.812	0.281	3	4	1.782	0.437	0.5
0.692	1.25	2.25	1.75	0.344	4	2.174	0.869	0.437	0.5
0.634	1.562	2.562	2.062	0.344	4	3.5	1.532	0.437	0.5
0.604	1.625	2.625	2.125	0.344	4	4	1.782	0.437	0.5
0.76	1.687	2.687	2.187	0.344	4	3.5	1.532	0.437	0.5
0.729	1.75	2.75	2.25	0.344	4	4	1.782	0.437	0.5
0.942	1.625	2.625	2.125	0.344	4	2.174	0.837	0.5	0.5
0.883	1.812	2.812	2.312	0.344	4	3.5	1.5	0.5	0.5
0.825	2.125	3.125	2.625	0.344	4	4.125	1.812	0.5	0.5
1.133	2.062	3.062	2.562	0.344	4	3.5	1.5	0.5	0.5
1.104	2.125	3.125	2.625	0.344	4	4	1.75	0.5	0.5
1.016	2.5	3.5	3	0.344	6	7.125	3.312	0.5	0.6
1.383	2.312	3.312	2.812	0.344	6	3.7	1.538	0.625	0.5
1.325	2.562	3.562	3.062	0.344	6	4.375	1.875	0.625	0.5
1.15	3.25	4.5	3.875	0.406	6	7.25	3.312	0.625	0.6
1.633	2.625	3.875	3.25	0.406	6	3.7	1.475	0.75	0.5
1.575	2.875	4.125	3.5	0.406	6	4.375	1.812	0.75	0.5
1.4	3.5	4.75	4.125	0.406	6	7.25	3.25	0.75	0.6
1.4	3.5	4.75	4.125	0.406	6	11	5.062	0.875	1
1.883	2.937	4.187	3.562	0.406	6	3.7	1.475	0.75	0.5
1.826	3.125	4.375	3.75	0.406	6	4.375	1.812	0.75	0.5
1.65	3.75	5.5	4.625	0.531	6	7.25	3.25	0.75	0.6

(continued on next page)

Inch series

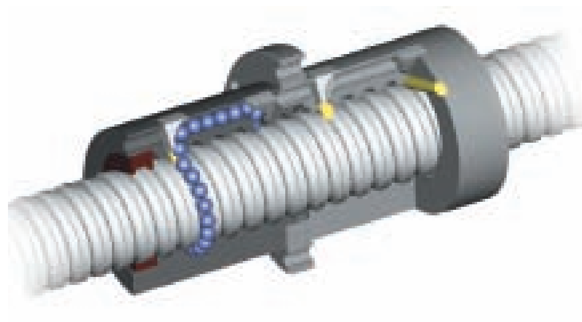
PGEM double nut preloaded center flange

Precision ground screw

Screw diameter from 0.5 to 6 inches
Lead from 0.1 to 1 inch

Other leads and diameters can be supplied upon request. Ball nuts as shown are with wipers supplied at each end. Assembly of an integrated flanged nut and a cylindrical pilot nut. Internal preload set for optimum rigidity & efficiency. Preload adjustable upon request.

Screw bearing support units FLRBU, FLBU, PLBU or BUF (see pages 44–50).



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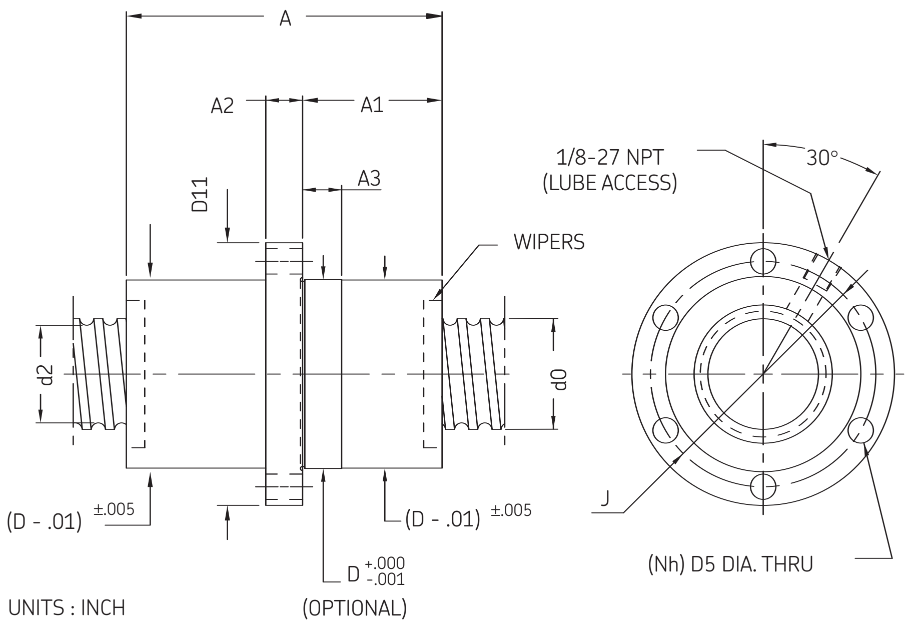
Designation		Screw diameter	Lead	Number of circuits of balls per nut	Basic load ratings dynamic	static	Preload torque	Nut stiffness
		d0	Ph		Ca	Coa	Tpr	Rn
		in	in		lbf	lbf	in.lbf	x1E6lbf/in
PGEM	2X0.5	2	0.5	1x4	24180	50548	33.85	12.15
PGEM	2X0.75	2	0.75	1x4	24057	50350	36.09	12.53
PGEM	2X1	2	1	1x3	18375	36723	29.40	9.52
PGEM	2.25X0.25	2.25	0.25	1x4	10456	31504	18.82	12.48
PGEM	2.25X0.5	2.25	0.5	1x4	25853	57810	40.72	13.44
PGEM	2.25X0.75	2.25	0.75	1x4	25749	57631	40.55	13.61
PGEM	2.25X1	2.25	1	1x4	26599	60759	41.89	14.30
PGEM	2.5X0.25	2.5	0.25	1x4	11089	35996	22.18	13.63
PGEM	2.5X0.5	2.5	0.5	1x4	27349	65072	44.44	14.30
PGEM	2.5X0.75	2.5	0.75	1x4	28208	68325	45.84	15.17
PGEM	2.5X1	2.5	1	1x4	38815	83037	48.52	13.53
PGEM	3X0.25	3	0.25	1x4	11880	43226	28.51	15.06
PGEM	3X0.5	3	0.5	1x4	30815	83057	41.60	15.21
PGEM	3X0.75	3	0.75	1x4	43353	102706	52.02	14.82
PGEM	3X1	3	1	1x4	43216	102455	51.86	14.77
PGEM	3.5X0.5	3.5	0.5	1x4	32975	97605	51.93	16.99
PGEM	3.5X0.75	3.5	0.75	1x4	48593	128184	59.53	16.76
PGEM	3.5X1	3.5	1	1x4	62805	150171	65.94	15.84
PGEM	4X0.5	4	0.5	1x4	34886	112145	55.82	17.96
PGEM	4X0.75	4	0.75	1x4	51693	147601	62.03	17.75
PGEM	4X1	4	1	1x4	69004	180105	82.80	18.23
PGEM	5X0.5	5	0.5	1x4	38194	141214	66.84	19.81
PGEM	5X0.75	5	0.75	1x4	56974	186401	85.46	20.92
PGEM	5X1	5	1	1x4	77221	230571	96.53	20.62
PGEM	6X0.5	6	0.5	1x4	41600	173819	74.88	21.42
PGEM	6X0.75	6	0.75	1x4	61435	225174	92.15	22.48
PGEM	6X1	6	1	1x4	84043	281022	100.85	22.14

Inch series



Shaft root diameter	Locating diameter	Flange diameter	Bolt circle	Hole size	Number of holes	Nut length	Position of flange	Flange thickness	Locating length (optional)
d2	D	D1	J	D5	Nh	A	A1	A2	A3
in	in	in	in	in		in	in	in	in
1.65	3.75	5.5	4.625	0.531	6	7.25	3.25	0.75	0.6
1.65	3.75	5.5	4.625	0.531	6	11	5.062	0.875	1
1.65	3.75	5.5	4.625	0.531	6	10.75	4.75	1.25	1
2.075	3.312	5	4.187	0.531	6	4.375	1.812	0.75	0.5
1.899	4.125	5.875	5	0.531	6	7.25	3.25	0.75	0.6
1.899	4.125	5.875	5	0.531	6	11	5.062	0.875	1
1.899	4.125	5.875	5	0.531	6	12.75	5.75	1.25	1
2.325	3.625	5.875	4.5	0.531	6	4.375	1.812	0.75	0.5
2.149	4.375	6.375	5.375	0.656	6	7.25	3.25	0.75	0.6
2.149	4.375	6.375	5.375	0.656	6	11	5.062	0.875	1
2.149	4.375	6.375	5.375	0.656	6	12.75	5.75	1.25	1
2.825	4.125	6.125	5.125	0.656	6	4.625	1.875	0.875	0.5
2.649	4.812	6.812	5.812	0.656	6	7.75	3.437	0.875	0.6
2.527	5.75	7.75	6.75	0.656	6	11.5	5.312	0.875	1
2.649	4.812	6.812	5.812	0.656	6	12.75	5.75	1.25	1
3.149	5.375	7.375	6.375	0.656	6	7.75	3.375	1	0.6
3.022	5.875	7.875	6.875	0.656	6	11.5	5.25	1	1
2.906	6.5	8.5	7.5	0.656	6	14.5	6.625	1.25	1
3.649	5.875	7.875	6.875	0.656	6	7.75	3.25	1.25	0.6
3.527	6.75	8.75	7.75	0.656	6	12.25	5.5	1.25	1
3.406	7	9	8	0.656	6	14.5	6.625	1.25	1
4.649	6.75	8.75	7.75	0.656	6	7.75	3.25	1.25	0.6
4.527	7.75	9.75	8.75	0.656	6	12.25	5.5	1.25	1
4.406	8	10	9	0.656	6	14.5	6.625	1.25	1
5.649	7.75	9.75	8.75	0.656	6	7.75	3.25	1.25	0.6
5.527	8.75	10.75	9.75	0.656	6	12.25	5.5	1.25	1
5.406	9	11	10	0.656	6	14.5	6.625	1.25	1

Inch series

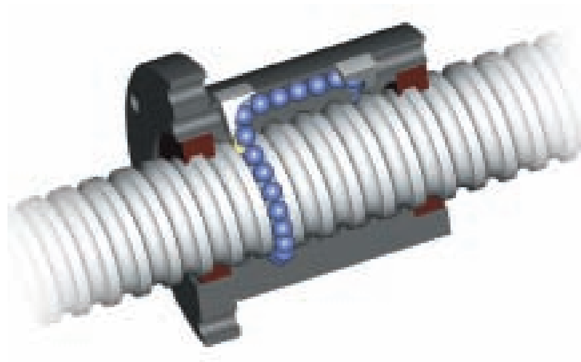
SGF single nut non-preloaded end flange

Precision ground screw

Screw diameter from 4 to 6 inches
Lead from 0.5 to 1 inch

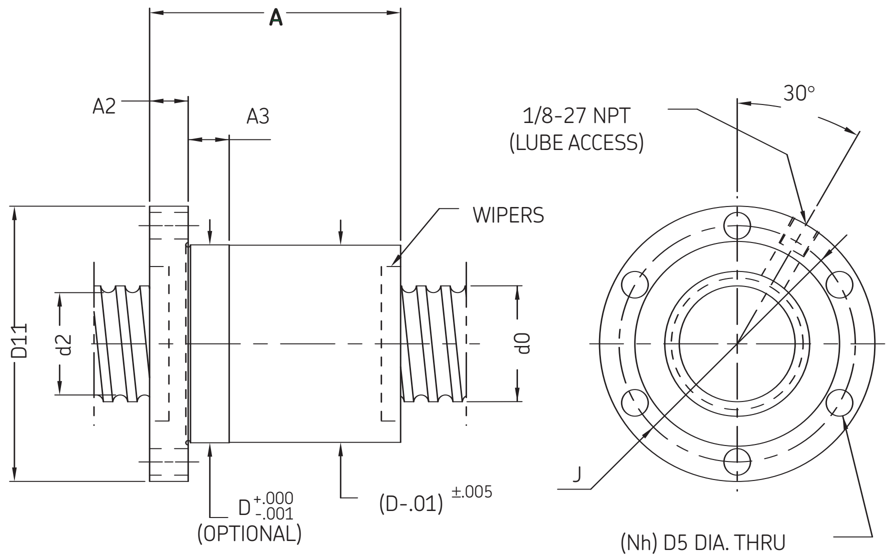
Other leads and diameters can be supplied upon request. Ball nuts as shown are with wipers supplied at each end. Compact nut with integral flange for simple mounting
Backlash adjustable upon request.

Screw bearing support units FLRBU, FLBU, PLBU or BUF (see pages 44–50).



Designation		Screw diameter	Lead	Number of circuits of balls	Basic load ratings dynamic	static	Axial play	Shaft root diameter
		d0	Ph		Ca	Coa		d2
		in	in		lbf	lbf	in	in
SGF	4X0.5	4	0.5	1x4	34886	112145	0.003	3.649
SGF	4X0.75	4	0.75	1x4	51693	147601	0.0035	3.527
SGF	4X1	4	1	1x4	69004	180105	0.004	3.406
SGF	5X0.5	5	0.5	1x4	38194	141214	0.003	4.649
SGF	5X0.75	5	0.75	1x4	56974	186401	0.0035	4.527
SGF	5X1	5	1	1x4	77221	230571	0.004	4.406
SGF	6X0.5	6	0.5	1x4	41600	173819	0.003	5.649
SGF	6X0.75	6	0.75	1x4	61435	225174	0.0035	5.527
SGF	6X1	6	1	1x4	84043	281022	0.004	5.406

Inch series



UNITS : INCH

Locating diameter	Flange diameter	Bolt circle	Hole size	Number of holes	Nut length	Flange thickness	Locating length (optional)
D	D1	J	D5	Nh	A	A2	A3
in	in	in	in		in	in	in
5.875	7.875	6.875	0.656	6	4.5	1.25	0.6
6.75	8.75	7.75	0.656	6	6.5	1.25	1
7	9	8	0.656	6	7.75	1.25	1
6.75	8.75	7.75	0.656	6	4.5	1.25	0.6
7.75	9.75	8.75	0.656	6	6.5	1.25	1
8	10	9	0.656	6	7.75	1.25	1
7.75	9.75	8.75	0.656	6	4.5	1.25	0.6
8.75	10.75	9.75	0.656	6	6.5	1.25	1
9	11	10	0.656	6	7.75	1.25	1

Inch series

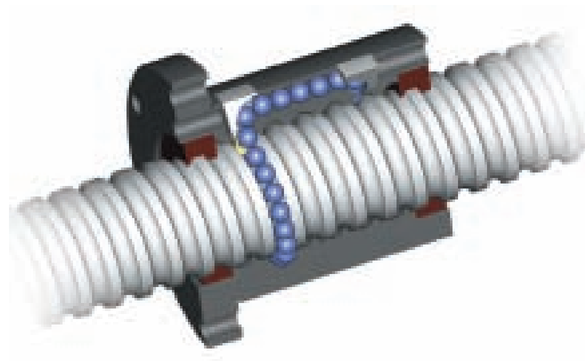
SCF single nut non-preloaded end flange-commercial range

Precision whirled screw

Screw diameter from 4 to 6 inches
Lead from 0.5 to 1 inch

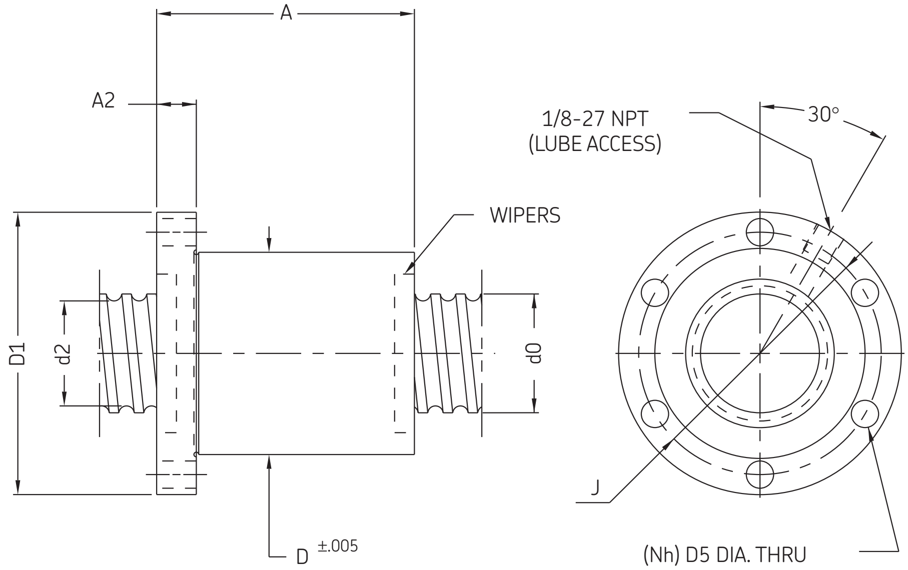
Other leads and diameters can be supplied upon request. Ball nuts as shown are with wipers supplied at each end. Compact nut with integral flange for simple mounting.
Backlash adjustable upon request.

Screw bearing support units FLRBU, FLBU, PLBU or BUF (see pages 44–50).



Designation		Screw diameter	Lead	Number of circuits of balls	Basic load ratings dynamic	static	Axial play	Shaft root diameter
		d0	Ph		Ca	Coa		d2
		in	in		lbf	lbf	in	in
SCF	0.75X0.2	0.75	0.2	1x4	3573	6416	0.0015	0.634
SCF	0.75X0.25	0.75	0.25	1x4	5734	8961	0.002	0.575
SCF	1X0.2	1	0.2	1x4	4262	9223	0.0015	0.883
SCF	1X0.25	1	0.25	1x4	6908	12572	0.002	0.825
SCF	1.25X0.2	1.25	0.2	1x4	4698	11648	0.0015	1.133
SCF	1.25X0.25	1.25	0.25	1x4	8084	17036	0.002	1.075
SCF	1.5X0.25	1.5	0.25	1x4	8802	20656	0.002	1.325
SCF	1.5X0.5	1.5	0.5	1x4	12411	25614	0.0025	1.266
SCF	1.75X0.25	1.75	0.25	1x4	9418	24274	0.002	1.575
SCF	1.75X0.5	1.75	0.5	1x4	22276	43286	0.003	1.4
SCF	1.75X0.75	1.75	0.75	1x4	22129	43065	0.003	1.4
SCF	2X0.25	2	0.25	1x4	9964	27890	0.002	1.826
SCF	2X0.5	2	0.5	1x4	24180	50548	0.003	1.65
SCF	2X0.75	2	0.75	1x4	24057	50350	0.003	1.65
SCF	2.25X0.25	2.25	0.25	1x4	10456	31504	0.002	2.075
SCF	2.25X0.5	2.25	0.5	1x4	25853	57810	0.003	1.899
SCF	2.25X0.75	2.25	0.75	1x4	25749	57631	0.003	1.899
SCF	2.25X1	2.25	1	1x4	26599	60759	0.003	1.899
SCF	2.5X0.25	2.5	0.25	1x4	11089	35996	0.002	2.325
SCF	2.5X0.5	2.5	0.5	1x4	27349	65072	0.003	2.149
SCF	2.5X0.75	2.5	0.75	1x4	28208	68325	0.003	2.149
SCF	2.5X1	2.5	1	1x4	28080	68086	0.003	2.149
SCF	3X0.5	3	0.5	1x4	30815	83057	0.003	2.649
SCF	3X0.75	3	0.75	1x4	43353	102706	0.0035	2.527
SCF	3X1	3	1	1x4	43216	102455	0.0035	2.527
SCF	3.5X0.5	3.5	0.5	1x4	32975	97605	0.003	3.149
SCF	3.5X0.75	3.5	0.75	1x4	48593	128184	0.0035	3.022
SCF	3.5X1	3.5	1	1x4	48479	127954	0.0035	3.022
SCF	4X0.5	4	0.5	1x4	34886	112145	0.003	3.649
SCF	4X0.75	4	0.75	1x4	51693	147601	0.0035	3.527
SCF	4X1	4	1	1x4	51601	147398	0.0035	3.527

Inch series



UNITS : INCH

Locating diameter	Flange diameter	Bolt circle	Hole size	Number of holes	Nut length	Flange thickness
D	D1	J	D5	Nh	A	A2
in	in	in	in		in	in
1.562	2.562	2.062	0.344	4	2	0.437
1.75	2.75	2.25	0.344	4	2.312	0.437
1.812	2.812	2.312	0.344	4	2	0.5
2.125	3.125	2.625	0.344	4	2.375	0.5
2.062	3.062	2.562	0.344	4	2	0.5
2.312	3.312	2.812	0.344	4	2.375	0.5
2.562	3.562	3.062	0.344	6	2.5	0.625
3.062	4.062	3.562	0.344	6	3.75	0.625
2.875	4.125	3.5	0.406	6	2.625	0.75
3.5	4.75	4.125	0.406	6	4	0.75
3.5	4.75	4.125	0.406	6	5.625	0.875
3.125	4.375	3.75	0.406	6	2.625	0.75
3.75	5.5	4.625	0.531	6	4	0.75
3.75	5.5	4.625	0.531	6	5.625	0.875
3.312	5	4.187	0.531	6	2.625	0.75
4.125	5.875	5	0.531	6	4	0.75
4.125	5.875	5	0.531	6	5.625	0.875
4.125	5.875	5	0.531	6	7	1.25
3.625	5.375	4.5	0.531	6	2.625	0.75
4.375	6.375	5.375	0.656	6	4	0.75
4.375	6.375	5.375	0.656	6	5.625	0.875
4.375	6.375	5.375	0.656	6	7	1.25
4.812	6.812	5.812	0.656	6	4.125	0.875
5.75	7.75	6.75	0.656	6	6.125	0.875
5.75	7.75	6.75	0.656	6	7.5	1.25
5.375	7.375	6.375	0.656	6	4.25	1
5.875	7.875	6.875	0.656	6	6.25	1
5.875	7.875	6.875	0.656	6	7.5	1.25
5.875	7.875	6.875	0.656	6	4.5	1.25
6.75	8.75	7.75	0.656	6	6.5	1.25
6.75	8.75	7.75	0.656	6	7.5	1.25

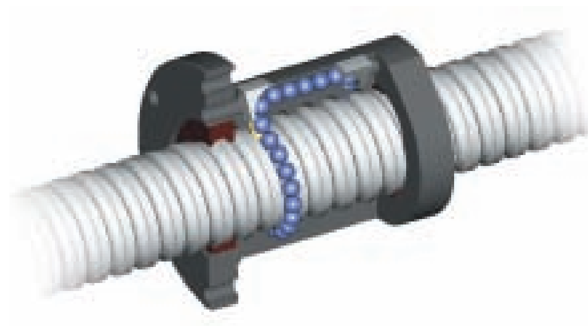
Inch series

SCC single nut non-preloaded cam shaped-commercial range

Screw shaft thread hard-whirled
Screw diameter from 1 to 4 inches
Lead from 0.3 to 1 inch

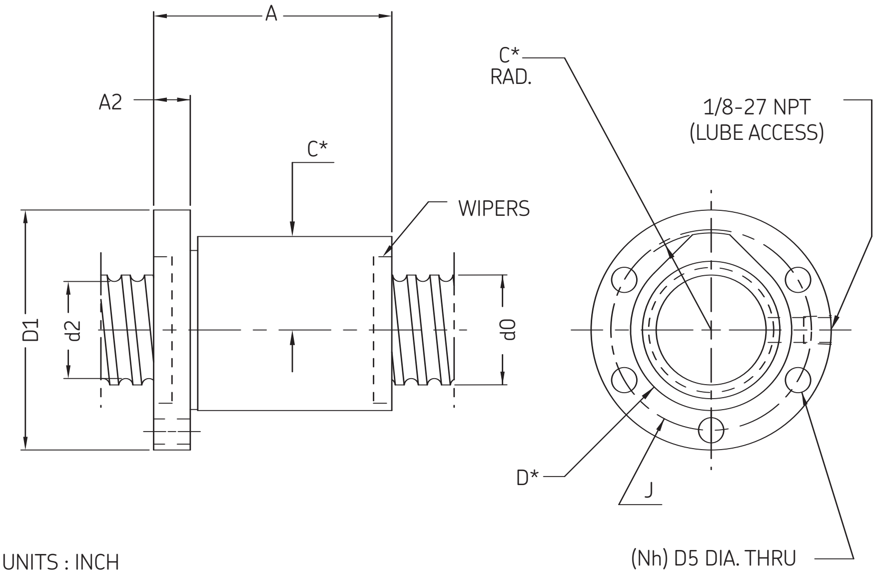
Other leads and diameters can be supplied upon request. Ball nuts as shown are with wipers supplied at each end. Compact nut with integral flange for simple mounting. Design interchangeable with any tube recirculation design. Backlash adjustable upon request.

Screw bearing support units FLRBU, FLBU, PLBU or BUF (see pages 44–50).



Designation		Screw diameter	Lead	Number of circuits of balls	Basic load ratings dynamic	static	Axial play	Shaft root diameter
		d0	Ph		Ca	Coa		d2
		in	in		lbf	lbf	in	in
SCC	1X0.25	1	0.25	1x4	5673	11222	0.0015	0.854
SCC	1.25X0.2	1.25	0.2	1x4	4698	11648	0.0015	1.133
SCC	1.5X0.25	1.5	0.25	1x4	6908	17509	0.0015	1.354
SCC	2X0.5	2	0.5	1x7	39868	90986	0.003	1.649
SCC	2X1	2	1	1x5	29198	63431	0.003	1.649
SCC	2.25X0.5	2.25	0.5	1x7	42533	103718	0.003	1.899
SCC	2.25X1	2.25	1	1x5	32465	76792	0.003	1.899
SCC	2.5X0.5	2.5	0.5	1x7	44917	116445	0.003	2.149
SCC	2.5X1	2.5	1	1x5	34247	85959	0.003	2.149
SCC	3X1	3	1	1x5	52768	129576	0.0035	2.527
SCC	4X1	4	1	1x5	62864	185783	0.0035	3.527

Inch series



UNITS : INCH

Locating diameter	Cam radius	Flange diameter	Bolt circle	Hole size	Number of holes	Nut length	Flange thickness
D	C	D1	J	D5	Nh	A	A2
in	in	in	in	in		in	in
1.625	0.968	3.25	2.75	0.281	4	2.312	0.5
1.687	1.031	3.187	2.702	0.281	4	2.062	0.5
2.062	1.218	4.375	3.5	0.406	4	2.312	0.5
3.25	1.844	5.375	4.25	0.656	5	6.375	1.531
3.25	1.844	5.375	4.25	0.656	5	8.5	1.531
3.375	2	5.375	4.375	0.656	5	6.5	1.582
3.375	2	5.375	4.375	0.656	5	8.562	1.582
4	2.125	6	5	0.656	5	6.75	1.78
4	2.125	6	5	0.656	5	8.75	1.78
4.75	2.875	7.375	6.25	0.781	7	9.375	2.02
5.875	3.375	9.75	8	1.031	7	9.375	2.02

Metric series

PGDM double nut preloaded end flange, DIN standard

Precision ground screw

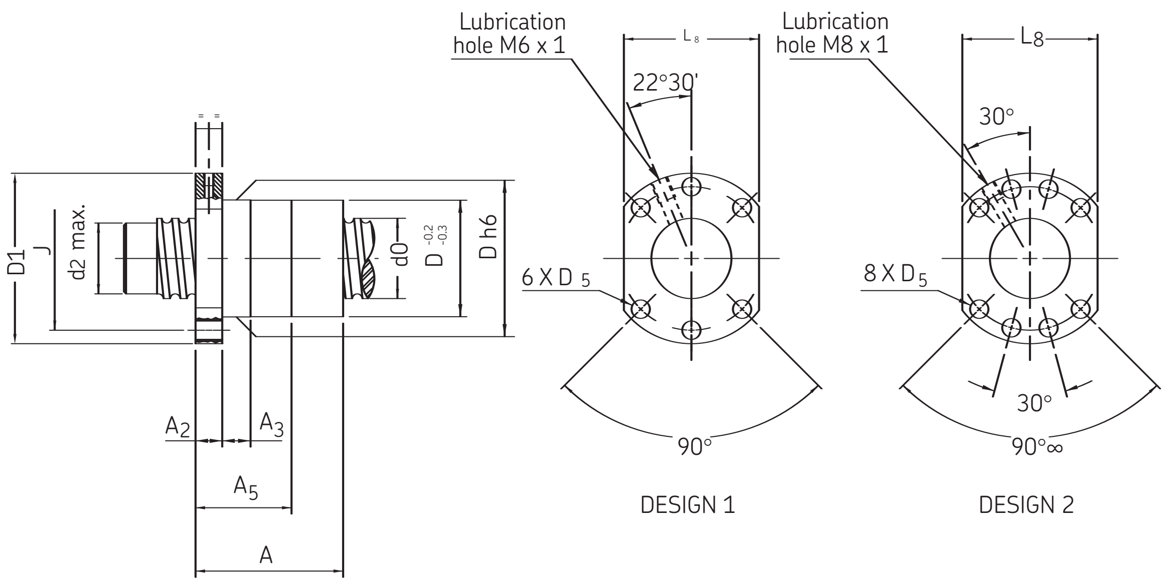
Screw diameter from 40 to 80 mm
Lead from 6 to 20 mm

Other leads and diameters can be supplied upon request. Ball nuts as shown are with wipers supplied at each end. Assembly of an integrated flanged nut and a cylindrical pilot nut. Internal preload set for optimum rigidity & efficiency Preload adjustable upon request.

Screw bearing support units FLRBU, FLBU, PLBU or BUF (see pages 44–50).

Designation	Screw diameter	Lead	Number of circuits of balls per nut	Basic load ratings dynamic	Basic load ratings static	Preload torque	Nut stiffness
	d0	Ph		Ca	Coa	Tpr	Rn
	mm	mm		kN	kN	Nm	N/µm
PGDM 40X6	40	6	1x4	31.18	81.01	1.25	1778
PGDM 40X12	40	12	1x3	51.80	101.41	2.07	1448
PGDM 40X20	40	20	1x3	45.63	95.15	1.83	1515
PGDM 50X20	50	20	1x3	59.48	134.55	2.97	1831
PGDM 63X10	63	10	1x4	72.91	207.20	4.13	2635
PGDM 63X20	63	20	1x3	94.75	216.33	4.78	2041
PGDM 80X10	80	10	1x4	80.32	264.71	5.14	2918
PGDM 80X12	80	12	1x4	95.04	298.56	5.32	2984
PGDM 80X20	80	20	1x4	198.69	485.26	7.95	2817

Metric series



Shaft root diameter	Locating diameter	Flange diameter	Bolt circle	Hole size	Number of holes	Nut length	Flange thickness	Locating length	Single nut length	Cross flat	Design
d2	D	D1	J	D5	Nh	A	A2	A3	A5	L8	
mm	mm	mm	mm	mm		mm	mm	mm	in	mm	
36.6	63	93	78	9	8	110	16	10	63	70	2
34.1	63	93	78	9	8	174	24	16	99	70	2
34.7	63	93	78	9	8	224	26	25	124	70	2
44.1	75	110	93	11	8	234	30	25	132	85	2
57.7	90	125	108	11	8	170	22	16	96	95	2
55	95	135	115	13.5	8	256	32	25	143	100	2
74.7	105	145	125	13.5	8	172	24	16	98	110	2
74.1	110	165	145	13.5	8	200	26	16	113	130	2
69.7	110	165	145	13.5	8	322	32	25	177	130	2

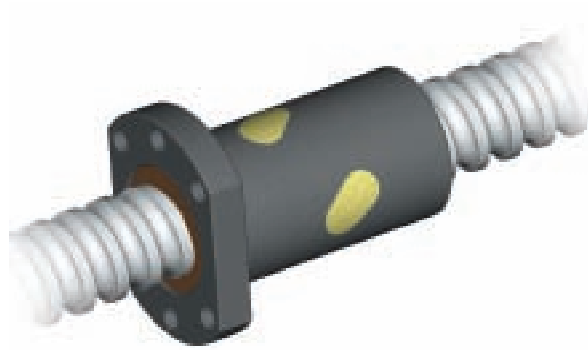
Metric series

PGD single nut preloaded end flange, DIN standard

Precision ground screw
Screw diameter from 25 to 80 mm
Lead from 5 to 20 mm

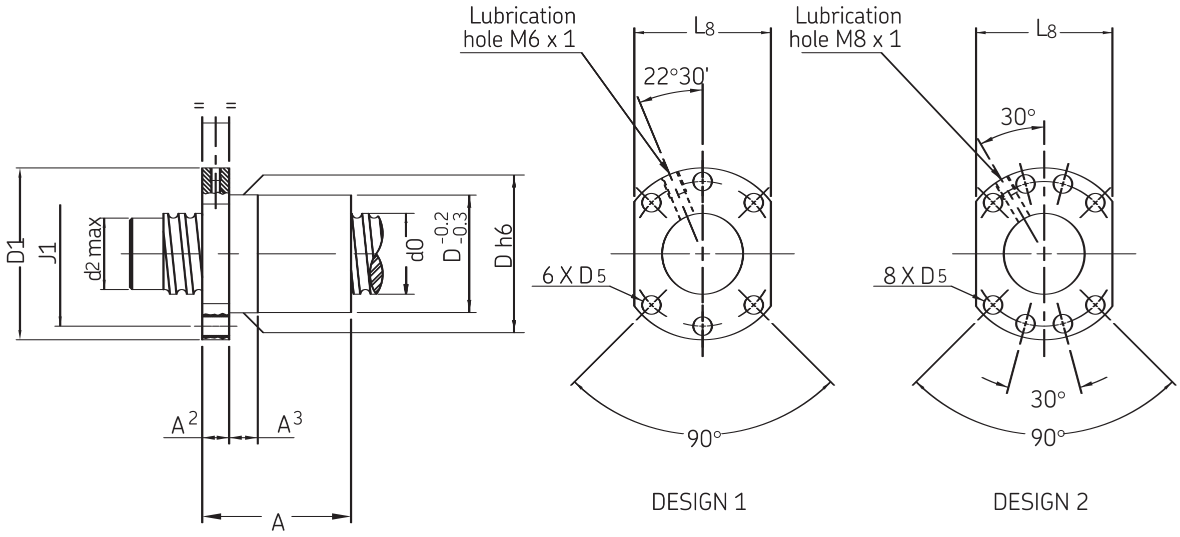
Other leads and diameters can be supplied upon request. Ball nuts as shown are with wipers supplied at each end. Compact nut with integral flange for simple mounting. Internal preload set for optimum rigidity & efficiency.
Preload adjustable upon request.

Screw bearing support units FLRBU, FLBU, PLBU or BUF (see pages 44–50).



Designation		Screw diameter	Lead	Number of circuits of balls	Basic load ratings dynamic	static	Preload torque	Nut stiffness
		d0	Ph		Ca	Coa	Tpr	Rn
		mm	mm		kN	kN	Nm	N/µm
PGD	25X5	25	5	2x3	16.12	32.40	0.41	885
PGD	25X10	25	10	2x2	17.55	31.16	0.45	620
PGD	32X5	32	5	2x4	23.45	57.65	0.76	1432
PGD	32X10	32	10	2x3	27.37	59.62	0.90	1088
PGD	40X5	40	5	2x5	30.98	90.22	1.13	2015
PGD	40X10	40	10	2x4	64.21	145.10	2.13	1691
PGD	40X12	40	12	2x3	51.80	101.41	2.07	1448
PGD	40X20	40	20	2x3	45.63	95.15	1.83	1515
PGD	50X10	50	10	2x5	84.35	224.89	3.47	2421
PGD	50X20	50	20	2x3	59.48	134.55	2.97	1831
PGD	63X10	63	10	2x5	93.06	289.56	4.79	2865
PGD	63X20	63	20	2x3	94.75	216.33	4.78	2041
PGD	80X10	80	10	2x4	80.32	264.71	5.14	2918

Metric series



Shaft root diameter	Locating diameter	Flange diameter	Bolt circle	Hole size	Number of holes	Nut length	Flange thickness	Locating length	Cross flat	Design
d2	D	D1	J	D5	Nh	A	A2	A3	L8	
mm	mm	mm	mm	mm		mm	mm	mm	mm	
21.7	40	62	51	6.6	6	62	10	10	48	1
20.5	40	62	51	6.6	6	75	10	16	48	1
28.7	50	80	65	9	6	74	12	10	62	1
26	50	80	65	9	6	102	12	16	62	1
36.7	63	93	78	9	8	88	14	10	70	2
34	63	93	78	9	8	130	14	16	70	2
34.1	63	93	78	9	8	139	24	16	70	2
34.7	63	93	78	9	8	200	26	25	70	2
44	75	110	93	11	8	155	16	16	85	2
44.1	75	110	93	11	8	200	30	25	85	2
57	90	125	108	11	8	157	18	18	95	2
55	95	135	115	13.5	8	224	32	25	100	2
74.7	105	145	125	13.5	8	150	24	16	110	2

Metric series

PND single nut preloaded end flange, DIN standard 69051

Precision rolled screw

Screw diameter from 25 to 80 mm
Lead from 6 to 20 mm

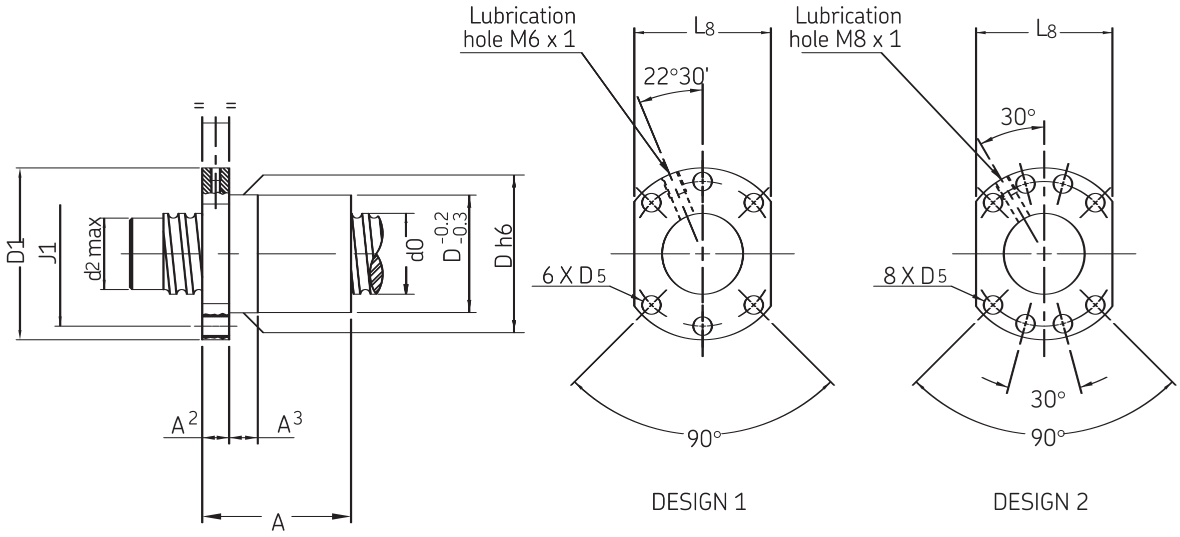
Other leads and diameters can be supplied upon request. Ball nuts as shown are with wipers supplied at each end. Assembly of an integrated flanged nut and a cylindrical pilot nut. Internal preload set for optimum rigidity & efficiency. Preload adjustable upon request.

Screw bearing support units FLRBU, FLBU, PLBU or BUF (see pages 44–50).

Precision rolled thread ball screws are available with G5 lead accuracy.

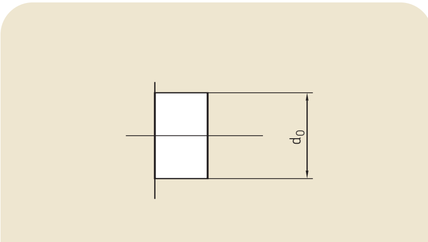
Designation		Screw diameter	Lead	Number of circuits of balls	Basic load ratings dynamic	static	Preload torque	Nut stiffness
		d0	Ph		Ca	Coa	Tpr	Rn
		mm	mm		kN	kN	Nm	N/µm
PCD	25X5	25	5	2x3	13.0	22.7	0.28	765
PCD	25X10	25	10	2x2	14.2	21.8	0.30	512
PCD	32X5	32	5	2x4	19.1	40.4	0.52	1195
PCD	32X10	32	10	2x3	22.6	41.8	0.61	907
PCD	40X5	40	5	2x5	25.4	63.2	0.71	1714
PCD	40X10	40	10	2x4	52.5	101.7	1.47	1421
PCD	50X10	50	10	2x5	70.6	157.6	2.47	2050
PCD	63X10	63	10	2x5	78.4	202.9	3.46	2449

Metric series

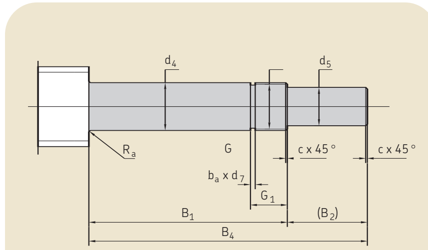


Shaft root diameter	Locating diameter	Flange diameter	Bolt circle	Hole size	Number of holes	Nut length	Flange thickness	Locating length	Cross flat	Design
d2	D	D1	J	D5	Nh	A	A2	A3	L8	
mm	mm	mm	mm	mm		mm	mm	mm	mm	
21.7	40	62	51	6.6	6	62	10	10	48	1
20.5	40	62	51	6.6	6	75	10	16	48	1
28.7	50	80	65	9	6	74	12	10	62	1
26	50	80	65	9	6	102	12	16	62	1
36.7	63	93	78	9	6	88	14	10	70	2
34	63	93	78	9	6	130	14	16	70	2
44	75	110	93	11	6	155	16	16	85	2
57	90	125	108	11	6	157	18	18	95	2

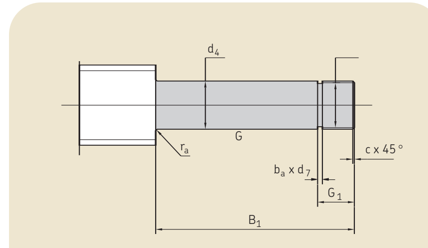
Standard end machined



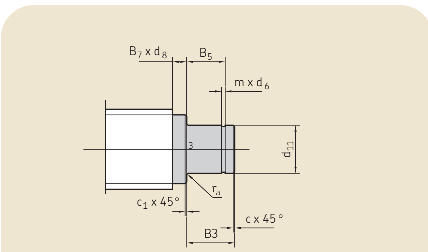
1A



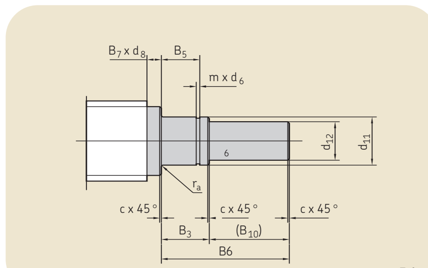
2A



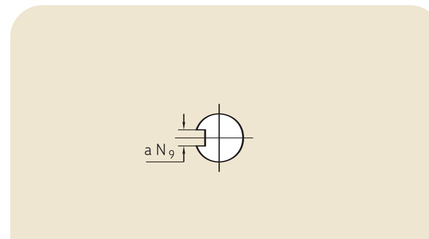
3A



4A



5A



Keyway

Standard shaft ends for ball screws have been developed to suit the SKF thrust bearings FLBU, PLBU & BUF.

These ends have been developed for screws with nominal diameters from 12mm up to 80mm.

These standard ends are the same for all screw types.

Screw size up to d0	d0	Bearing unit	d4	d5	d10	d11	d12	B1	B2	B3	B4	B5	B6	B7	B9
mm	in		mm	mm											
			h6	h7		h6	h7	js12		js12	js12	H11	js12		
12	0.5		8	6	/			38	12	10	50	7.8	22		0
16	0.625	FLBU16 BUF16	10	8	/	10	8	53	16	13	69	10	29	2	0
20	0.75	FLBU20 BUF20	12	10	/	10	8	58	17	13	75	10	29	2	0
25	1	FLBU25 BUF25	17	15	/	17	15	66	30	16	96	13	46	4.5	0
32	1.25	FLBU32 BUF32	20	17	/	17	15	69	30	16	99	13	46	5.5	0
40	1.75	FLBU40 BUF40	30	25	/	30	25	76	45	22	121	17.5	67	4.5	0
50	2	FLBU50 BUF50	35	30	/	30	25	84	55	22	139	17.5	67	4.5	0
63	2.5	FLBU63 BUF63	50	40	/	45	40	114	65	28	179	20.75	93	3	0
80	3		55	50	/	45	40	119	75	28	194	20.75	93	3	0

All dimensions in mm unless otherwise specified.

Order code	Two machined ends
AA (without length indication)	cut only
BA	1A + 2A
FA*	2A + 2A
GA*	2A + 3A
HA	2A + 4A
JA	2A + 5A
MA	3A + 5A
SA (+ length)	Ends to root diameter d_2 any possible lengths.
UA (+ length)	End manufactured to diameter d_3 under induction hardening, any possible lengths.
K	Keyway
Z	To customer's drawing

*Attention: This mounting requires the greatest precautions. Please contact us.

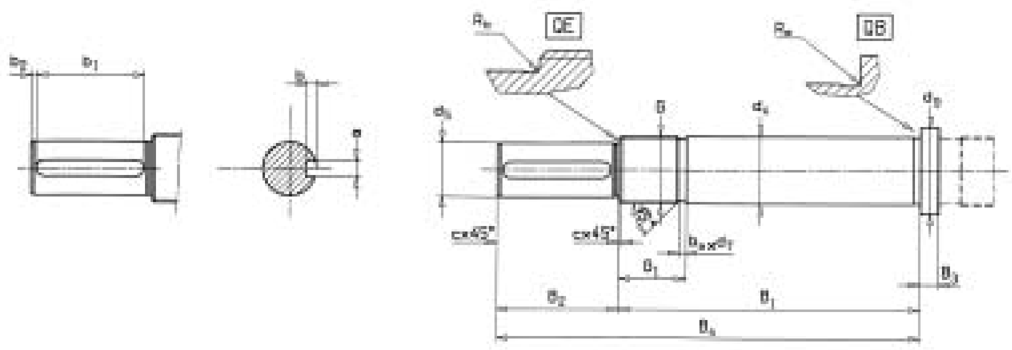
Screw size up to d0 **mm**	**d0** **in**	**Bearing unit**	**d8**	**G** **6g**	**G1**	**m** **+0.14 +0**	**d6** **h11(5)** **h12(6)**	**c**	**c1**	**ba**	**d7** **h11**	**ra**	**Keyway to a(N9)xixb** **fixed end (type 2A)**	**DIN 6885** **Free end (type 5A)**
12	0.5			M8x1	12.5	0.9	7.6	0.5		1.5	6.5	0.3	A2x2x8	A2x2x8
16	0.625	FLBU16 BUF16	12.5	M10x0.75	17	1.1	9.6	0.5	0.5	1.2	8.8	0.4	A3x3x12	A2x2x12
20	0.75	FLBU20 BUF20	14.5	M12x1	18	1.1	9.6	0.5	0.5	1.5	10.5	0.8 0.4(7)	A5x5x12	A2x2x12
25	1	FLBU25 BUF25	20	M17x1	22	1.1	16.2	0.5	0.5	1.5	15.5	0.8 0.4(7)	A2x2x25	A5x5x25
32	1.25	FLBU32 BUF32	21.7	M20x1	22	1.1	16.2	0.5	0.5	1.5	18.5	0.8 0.4(7)	A5x5x25	A5x5x25
40	1.75	FLBU40 BUF40	33.5	M30x1.5	25	1.6	28.6	1	0.5	2.3	27.8	1.2 0.8(7)	A8x7x40	A8x7x40
50	2	FLBU50 BUF50	33.5	M35x1.5	27	1.6	28.6	1	0.5	2.3	32.8	1.2 0.8(7)	A8x7x45	A8x7x40
63	2.5	FLBU60 BUF63	54	M50x1.5	32	1.85	42.5	1.5	1	2.3	47.8	1.2 0.8(7)	A12x8x50	A12x8x50
80	3		54	M55x2	32	1.85	42.5	1.5	1	3	52.1	1.6 0.8(7)	A14x9x63	A12x8x50

(5) for screws dØ 12 to 32 mm
(6) for screws d , 40 to 80 mm
(7) for ends 4A or 5A; Ø or 1 = No shoulder

3

Standard shaft ends for ball screws to suit the high performance SKF thrust bearings FLRBU.

These standard ends are the same for all screw types.



Type 2AL

Screw size up to d0	d0	Bearing unit	d4	d5	d9	B1	B2	B4	B3	G	G1
mm	in		mm	mm							
			h6	h7	h6	h12		js12	js12	js12	
16	0.625	FLRBU1	12	10	17	58	20	78	5	M12x1	17
20	0.75	FLRBU2	17	15	23	66	30	96	5	M17x1	22
25	1	FLRBU3	20	17	27	97	40	137	7	M20x1	22
32	1.25	FLRBU4	25	20	34	112	45	157	7	M25x1.5	25
40	1.75	FLRBU5	35	30	45	134	55	189	10	M35x1.5	26
50	2	FLRBU6	50	40	68	168	65	233	12	M50x1.5	31
63	2.5	FLRBU7	65	60	83	210	100	310	18	M65x2	32

Order Code	Machined end combination
BAL	2AL + 1A
FAL*	2AL + 2A
GAL*	2AL + 3A
HAL	2AL + 4A
JAL	2AL + 5A

* Attention ! This mounting requires the greatest precautions.Please contact us

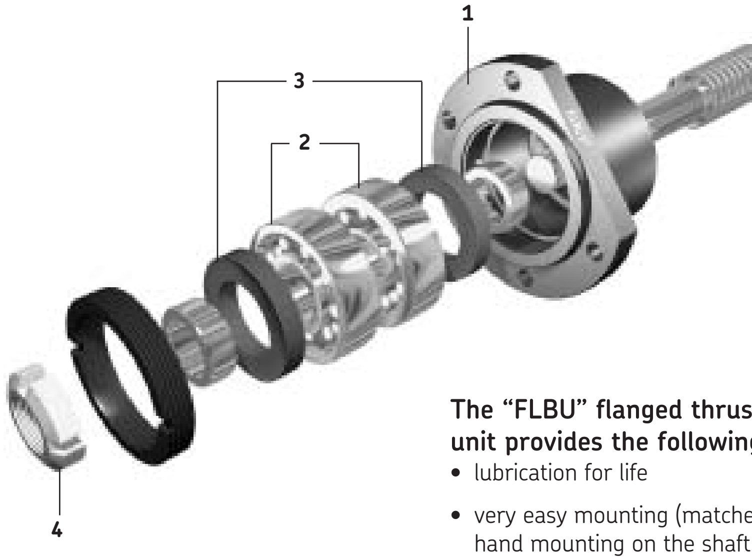
Screw size up to d0 mm	d0 in	Bearing unit	c	ba	d7 h11	Ra	Rb	a N9	b +0.1 +0	b1 +0.5 +0	b2
16	0.625	FLRBU1	0.5	1.5	10.5	0.4	0.4	3	1.8	16	1.5
20	0.75	FLRBU2	0.5	1.5	15.5	0.6	0.6	5	3	25	2
25	1	FLRBU3	0.5	1.5	18.5	0.6	0.6	5	3	35	2
32	1.25	FLRBU4	0.5	2.3	22.8	0.6	0.6	6	3.5	40	2.5
40	1.75	FLRBU5	1	2.3	32.8	0.6	0.6	8	4	45	2.5
50	2	FLRBU6	1	2.3	47.8	0.6	0.6	12	5	55	2.5
63	2.5	FLRBU7	1	3	62.2	0.8	1	18	7	90	2.5

End bearings

FLBU flanged bearing unit

Axially locating flanged housing with SKF angular contact ball bearings

(back to back arrangement)



The "FLBU" flanged bearing unit consists of:

- precision housing, made of burnished steel (1)
- two SKF preloaded angular contact ball bearings, 72 or 73 series (2)
- two garter seals (3)
- locknut, self-locking Nylstop type (4) or on demand, high precision KMT

The "FLBU" flanged thrust bearing unit provides the following benefits:

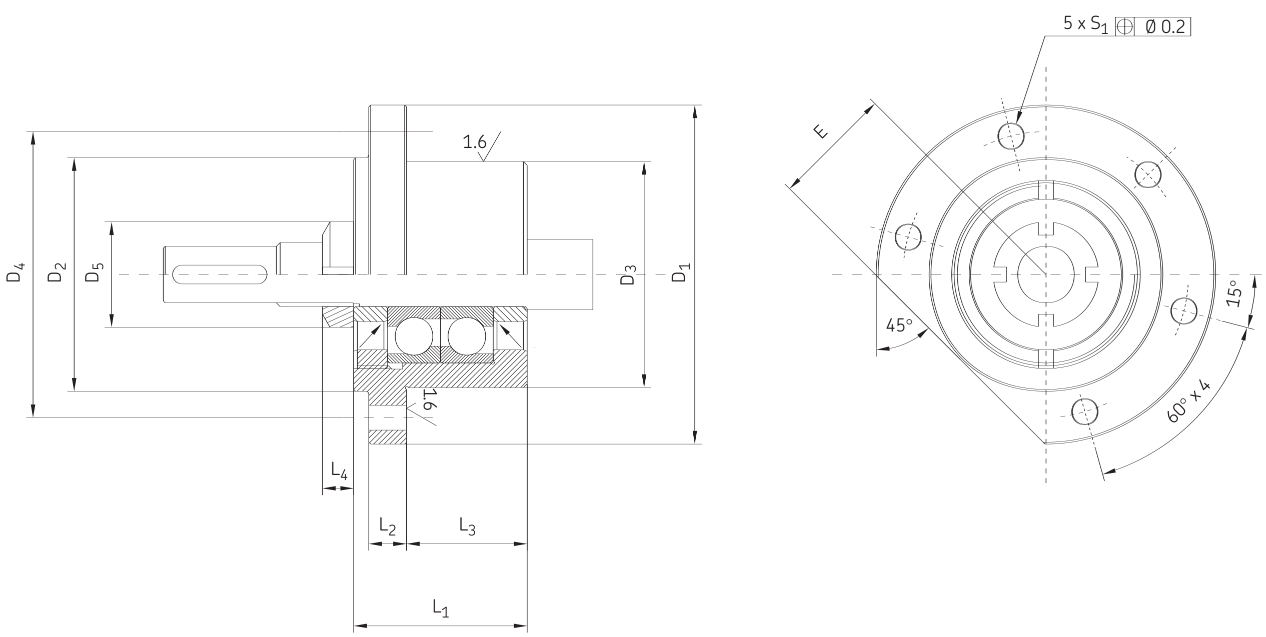
- lubrication for life
- very easy mounting (matched bearings, hand mounting on the shaft end) as well as easy disassembly with the optional high precision KMT nut.

In standard version, the "FLBU" thrust bearing unit is assembled with the flange on the lock nut side. If you require a different assembly, please indicate it when ordering.

		Angular contact ball bearing (40°)			Lock nut						
		Basic load rating (axial)		SKF Bearing designation	Self locking nut		High precision nut 4/				
Bearing journal size d	Flanged bearing unit designation	C_a (kN)	C_{oa} (kN)		Designation	Hook spanner	Designation	Hook spanner	Tightening torque (Nm)	Grub screws Size	Grub screws Max tightening torque (Nm)
10	FLBU 16 1/	12.2	12.8	7200 BECB 2/	CN 70-10	HN 1	KMT 0	HN 2/3	4	M 5	4.5
12	FLBU 20	13.3	14.7	7201 BEGA 3/	CN 70-12	HN 1	KMT 1	HN 3	8	M 5	4.5
17	FLBU 25	27.9	31.9	7303 BEGA 3/	CN 70-17	HN 3	KMT 3	HN 4	15	M 6	4.5
20	FLBU 32	24.6	31.9	7204 BEGA 3/	CN 70-20	HN 4	KMT 4	HN 5	18	M 6	8
30	FLBU 40	41.9	59.6	7206 BEGA 3/	CN 70-30	HN 6	KMT 6	HN 6	32	M 6	8
35	FLBU 50	54.5	79.8	7207 BEGA 3/	CN 70-35	HN 7	KMT 7	HN 7	40	M 6	8
50	FLBU 63 1/	128	196.1	7310 BEGA 3/	CN 70-50	HN 10	KMT 10	HN 10/11	60	M 6	8

1/ Dimensions on request
2/ No backlash elimination
3/ Light preload
4/ Optional

End bearings



Dimensions (mm)															
Bearing journal size d	**L_1**	**L_2**	**L_3**	**L_4**		**D_1**	**D_2**	**D_3**	**D_4**	**D_5**		**S_1**	**Fixing screws**	**E**
				Self locking nut	**High precision nut 1/**			**h7**		**Self locking nut**	**High precision nut 1/**	**H13**		
10	37	10	22	7	14	76	50	47	63	18	28	6.6	M6 x 30	26
12	42	10	25	7.5	14	76	50	47	63	21	30	6.6	M6 x 30	27
17	46	10	32	8.3	18	90	62	60	76	28	37	6.6	M6 x 30	32
20	49	13	32	8.3	18	90	59	60	74	32	40	9	M8 x 40	32
30	53	16	32	11	20	120	80	80	100	44	49	11	M10 x 45	44
35	59	20	32	11	22	130	89	90	110	50	54	13	M12 x 60	49
50	85	25	43.5	11.7	25	165	124	124	146	68	75	13	M12 x 60	64

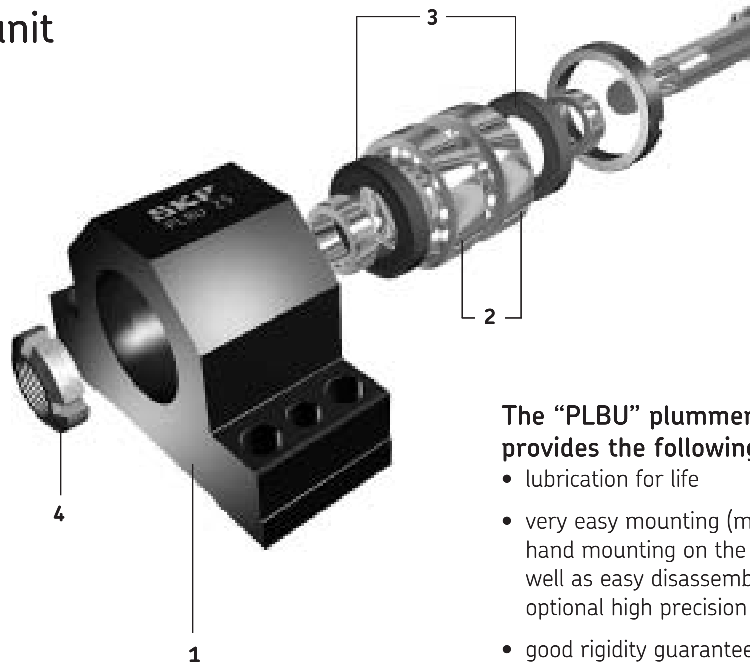
1/ Optional

End bearings

PLBU plummer bearing unit

Fixed plummer housing with SKF angular contact ball bearings

(back to back arrangement)



The "PLBU" plummer bearing unit consists of:

- precision housing, made of burnished steel, with precision reference edges on both sides, steel (1)
- two SKF preloaded angular contact ball bearings, 72 or 73 series (2)
- two garter seals (3)
- locknut, self-locking Nylstop type (4) or, on demand, high precision KMT

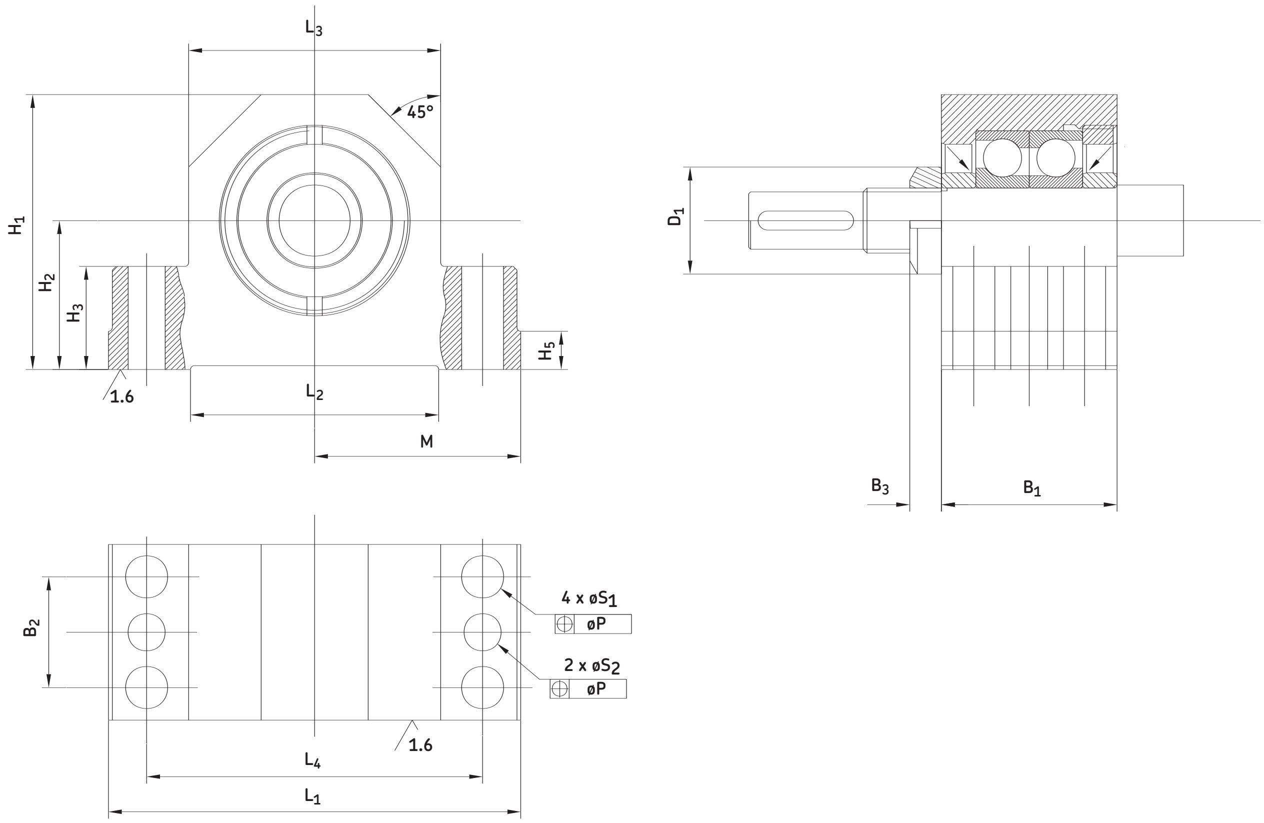
The "PLBU" plummer bearing unit provides the following benefits:

- lubrication for life
- very easy mounting (matched bearing, hand mounting on the shaft ends) as well as easy disassembly with the optional high precision KMT nut
- good rigidity guaranteed by foot mounting with dowel pins

		Angular contact ball bearing (40°)			Lock nut						
		Basic load rating (axial)		SKF Bearing designation	Self locking nut		High precision nut 4/				
Bearing journal size d	Plummer bearing unit designation (fixed)	C_a (kN)	C_{oa} (kN)		Designation	Hook spanner	Designation	Hook spanner	Tightening torque (Nm)	Grub screws Size	Grub screws Max tightening torque (Nm)
10	PLBU 16 1/	12.2	12.8	7200 BECB 2/	CN 70-10	HN 1	KMT 0	HN 2/3	4	M 5	4.5
12	PLBU 20	13.3	14.7	7201 BEGA 3/	CN 70-12	HN 1	KMT 1	HN 3	8	M 5	4.5
17	PLBU 25	27.9	31.9	7303 BEGA 3/	CN 70-17	HN 3	KMT 3	HN 4	15	M 6	4.5
20	PLBU 32	24.6	31.9	7204 BEGA 3/	CN 70-20	HN 4	KMT 4	HN 5	18	M 6	8
30	PLBU 40	41.9	59.6	7206 BEGA 3/	CN 70-30	HN 6	KMT 6	HN 6	32	M 6	8
35	PLBU 50	54.5	79.8	7207 BEGA 3/	CN 70-35	HN 7	KMT 7	HN 7	40	M 6	8
50	PLBU 63 1/	128	196.1	7310 BEGA 3/	CN 70-50	HN 10	KMT 10	HN 10/11	60	M 6	8

1/ Dimensions on request
2/ No backlash elimination
3/ Light preload
4/ Optional

End bearings



Bearing journal size d	L_1	L_2	L_3	L_4	M	B_1	B_2	B_3		H_1	H_2	H_3	H_4	H_5	S_1	P	Fixing screws	S_2	D_1		Tapered pin (hardened) or straight pin (DIN6325)
					js8			Self locking nut	High precision nut 1/		js8							H12	Self locking nut	High precision nut 1/	
10	86	52	52	68	43	37	23	7	14	58	32	22	15	8	9	0.15	M8 x 35	7.7	18	28	8 x 40
12	94	52	60	77	47	42	25	7.5	14	64	34	22	17	8	9	0.15	M8 x 35	7.7	21	30	8 x 40
17	108	65	66	88	54	46	29	8.3	18	72	39	27	19	10	11	0.2	M10 x 40	9.7	28	37	10 x 50
20	112	65	70	92	56	49	29	8.3	18	77	45	27	20	10	11	0.2	M10 x 40	9.7	32	40	10 x 50
30	126	82	80	105	63	53	32	11	20	98	58	32	23	12	13	0.2	M12 x 50	9.7	44	49	10 x 50
35	144	80	92	118	72	59	35	11	22	112	65	38	25	12	13	0.2	M12 x 55	9.7	50	54	10 x 55
50	190	110	130	160	95	85	40	11.7	25	130	65	49	35	15	13	0.2	M12 x 65	9.7	68	75	10 x 65

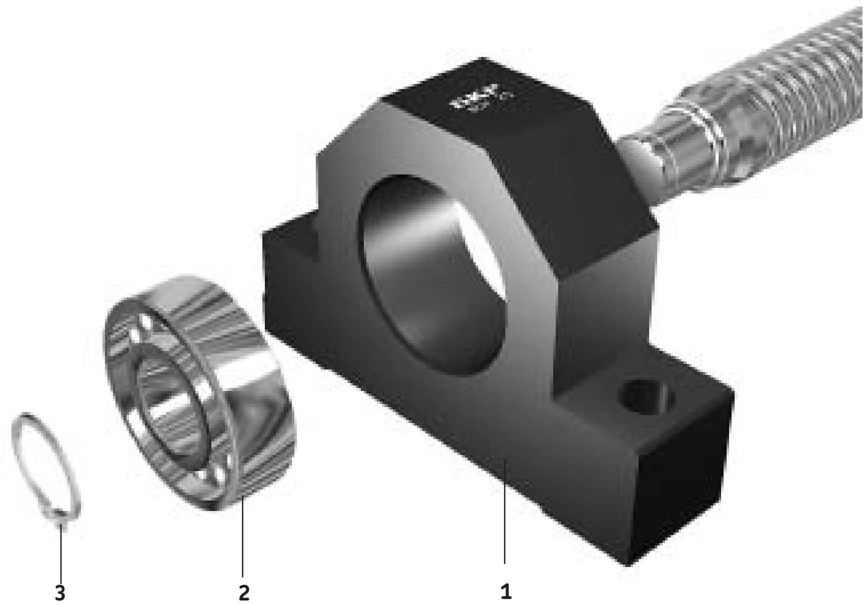
Dimensions (mm)

1/ Optional

End bearings

BUF free plummer bearing unit

Axially free plummer housing with SKF deep-groove ball bearing



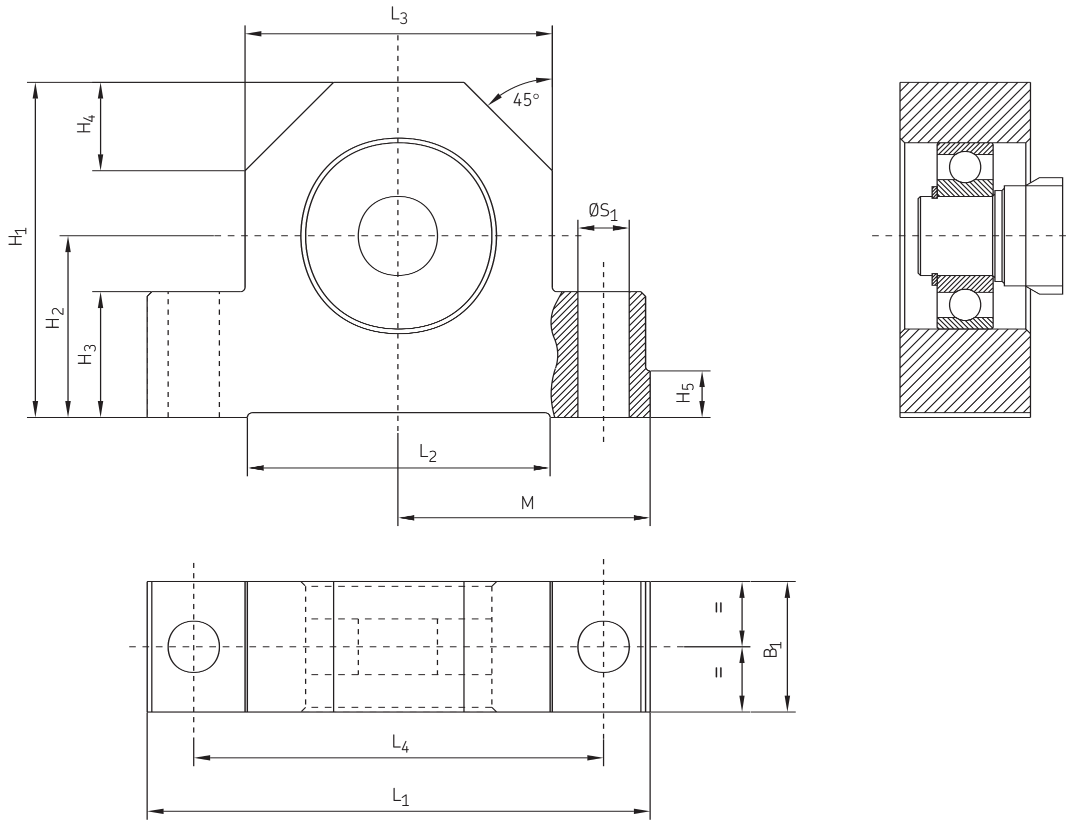
The "BUF" plummer bearing unit consists of:

- bearing housing made of burnished steel, with one reference side (1)
- grease-tight deep-groove SKF ball bearing, greased for life, type 62... 2RS1 (2)
- retaining ring (3)

		Deep-groove ball bearing						Retaining ring (DIN 471)
		Basic load rating (radial)		SKF Bearing designation	Dimensions (mm)			
Size d	Plummer bearing unit designation (free)	C (kN)	C_0 (kN)		d	D	B	
10	BUF 16 1/	5.07	2.36	6200.2RS1	10	30	9	10x1
12	BUF 20	5.07	2.36	6200.2RS1	10	30	9	10x1
17	BUF 25	9.56	4.75	6203.2RS1	17	40	12	17x1
20	BUF 32	9.56	4.75	6203.2RS1	17	40	12	17x1
30	BUF 40	19.5	11.2	6206.2RS1	30	62	16	30x1.5
35	BUF 50	19.5	11.2	6206.2RS1	30	62	16	30x1.5
50	BUF 63 1/	33.2	21.6	6209.2RS1	45	85	19	45x1.75

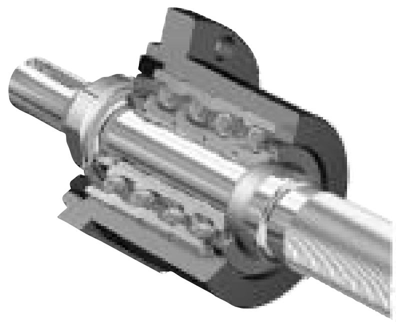
1/ Dimensions on request

End bearings

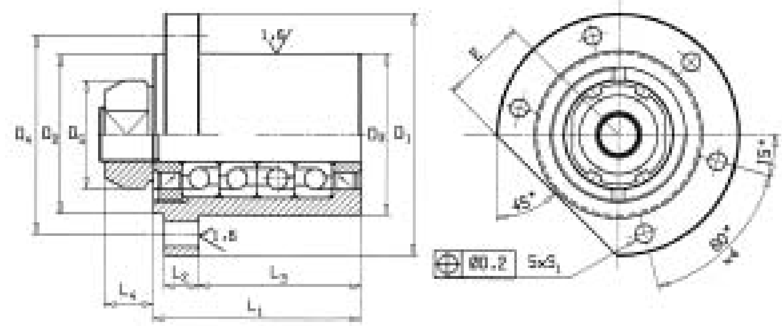


Dimensions (mm)													
Size d_0	L_1	L_2	L_3	L_4	M	B_1	H_1	H_2	H_3	H_4	H_5	S_1	Fixing screws
					js8			js8				H12	
16	86	52	52	68	43	24	58	32	22	15	8	9	M8 x 35
20	94	52	60	77	47	26	64	34	22	17	8	9	M8 x 35
25	108	65	66	88	54	28	72	39	27	19	10	11	M10 x 40
32	112	65	70	92	56	34	77	45	27	20	10	11	M10 x 40
40	126	82	80	105	63	38	98	58	32	23	12	13	M12 x 50
50	144	80	92	118	72	39	112	65	38	25	12	13	M12 x 55
63	190	110	130	160	95	38	130	65	49	35	15	13	M12 x 65

FLRBU high capacity flanged thrust bearing unit



In standard version, the “FLRBU” thrust bearing unit is assembled according to drawing page 53.
If you require a different assembly, please indicate it when ordering.



		40° angular contact ball bearing							Lock nut				
		Basic axial load rating		Number of bearings	Bearings designation	Maximum preload torque *	Axial rigidity	Tilt rigidity	High precision KMT nut				
Bearing journal d mm	Flanged bearing unit designation	C_a kN	C_{oa} kN			Nm	N/µm	Nm/mrad	Designation	Hook spanner	Tightening torque Nm	Grub screws Size	Max tightening torque, Nm
12	FLRBU1	13.3	14.7	2	7201 BEGBP	0.1	150	40	KMT 1	HN 3	10	M5	4.5
17	FLRBU2	27.9	31.9	2	7303 BEGBP	0.25	190	51	KMT 3	HN 4	15	M6	8
20	FLRBU3	40.1	63.8	4	7204 BEGBP	0.25	400	140	KMT 4	HN 5	18	M6	8
25	FLRBU4	74.2	119.2	4	7305 BEGBP	1.1	450	160	KMT 5	HN 5	25	M6	8
35	FLRBU5	109.4	188.4	4	7307 BEGBP	1.1	600	715	KMT 7	HN 7	42	M6	8
50	FLRBU6	208.8	392.3	4	7310 BEGBP	1.5	750	1000	KMT 10	HN 10	70	M6	8
65	FLRBU7	305.3	615.4	4	7313 BEGBP	2	1250	1600	KMT 13	HN 14	100	M8	18

Bearing journal d mm	Flanged bearing unit designation	L_1	L_2	L_3	L_4	D_1	D_2	D_3 h7	D_4	D_5	S_1 H13	Fixing screws	E
12	FLRBU1	42	10	25	14	76	50	47	63	30	6.6	M6 x 25	27
17	FLRBU2	46	10	32	18	90	62	60	76	37	6.6	M6 x 25	32
20	FLRBU3	77	13	60	18	90	59	60	74	40	9	M8 x 25	32
25	FLRBU4	89	16	68	20	120	80	80	100	44	11	M10 x 30	44
35	FLRBU5	110	20	82	22	140	99	100	120	54	13	M12 x 40	54
50	FLRBU6	140	25	98.5	25	171	130	130	152	75	13	M12 x 40	67
65	FLRBU7	180	30	133.5	28	225	170	170	198	95	17.5	M16 x 55	87

This range is available off the shelves. Quick delivery.
* Preload torque measured at 50rpm

SKF bearing support units at a glance

For easy selection of an SKF thrust bearing unit, refer to equivalent axial capacity ratings below (dynamic capacity rating of the bearing unit has to be compared directly to the screw one).

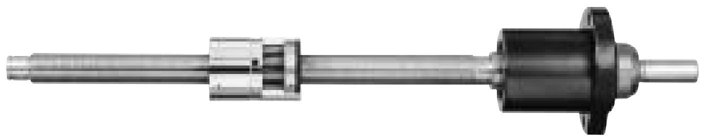
We have also some units with special design with high-precision single direction angular contact thrust ball bearings. These units have been developed especially for the support of screws in machine tool applications and incorporate 60° contact angle bearings to provide superior axial stiffness.

For other designs, diameters or capacity ratings, please contact SKF.

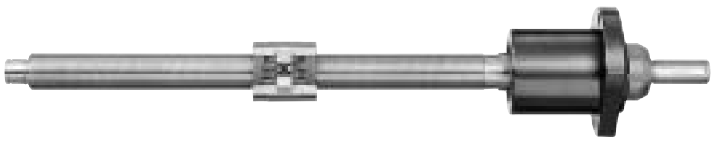
Standard bearing arrangement is back-to-back (“O”). For other arrangement, please contact us.

Thrust bearing unit	journal diameter Ca (Bearing Inner Ring dia.)		Coa Dynamic capacity rating		Static capacity rating	
	mm	in	kN	lbf	kN	lbf
FLBU16 **PLBU16**	10	0.394	12.2	2743	12.8	2878
FLBU20 **PLBU20**	12	0.472	13.3	2990	14.7	3305
FLBU25 **PLBU25**	17	0.669	27.9	6272	31.9	7171
FLBU32 **PLBU32**	20	0.787	24.6	5530	31.9	7171
FLBU40 **PLBU40**	30	1.181	41.9	9420	79.8	17940
FLBU50 **PLBU50**	35	1.378	54.5	12252	196.1	44085
FLBU63 **PLBU63**	50	1.969	128	28776	230.7	51864
FLRBU1	12	0.472	13.3	2990	14.6	3282
FLRBU2	17	0.669	27.9	6272	31.9	7171
FLRBU3	20	0.787	40.1	9015	63.8	14343
FLRBU4	25	0.984	74.2	16681	119.2	26797
FLRBU5	35	1.378	109.4	24594	188.4	42354
FLRBU6	50	1.969	208.8	46940	392.3	88193
FLRBU7	65	2.559	305	68567	615	138258

SKF roller screws – service range – quick delivery call 1-800-541-3624



Planetary roller screws - BR series



Recirculating roller screws - BV series

Optimum performance at minimum cost :

SKF TCM offers linear motion systems including roller screws and thrust bearing units in short delivery time.

1 week : without end machining
2 weeks : with end machining

Machined ends

- Premachined shafts for machining by the customer
- to customer drawing (see general rules)
- suitable for FLRBU units (see page 50)

High load capacity and no play

The load capacity of a one piece cylindrical nut and no play! Roller screw nuts are preloaded with over-size rollers

Lead precision

Available in G5 according to ISO standard

Ready for use

Roller screw and thrust bearing are delivered greased with SKF LGEP2 (temperature range -20°C / +120°C)

Break out from the limitations of ball screw performance

The 10 reasons for using roller screws

High load ratings (BR-BV)

Very high rotational speed (BR)

High acceleration and deceleration rates (BR)

Long life at high cycling rates (BR)

High reliability (BR-BV)

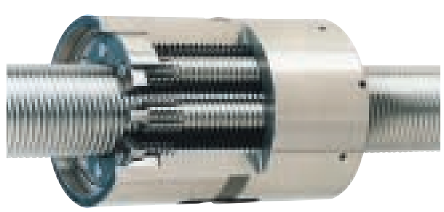
Resistance to hostile surroundings (BR)

Ability to survive shock loads (BR)

Small displacements with very good repeatability (BV)

Rotating the nut when speed becomes critical (BR)

Frequently removing the nut from the screw shaft (BR-BV)



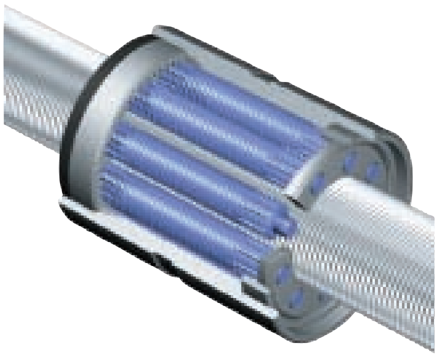
The maximum speed is defined by the product n(rpm) x d1(mm) nxd1 < 140 000

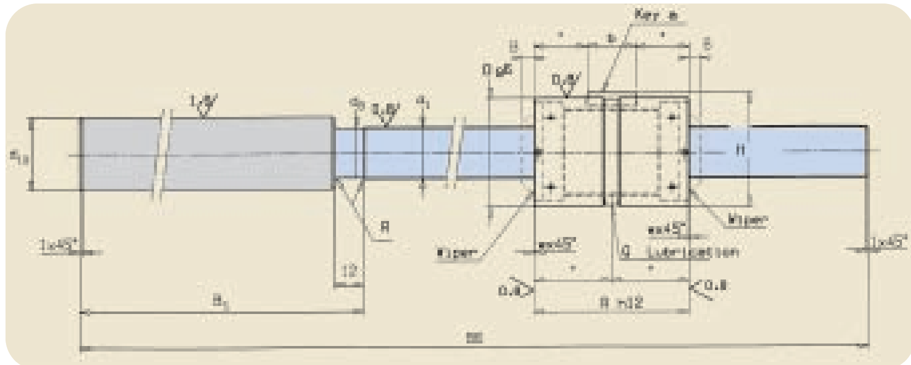
nxd1 < 20 000

General rules for the whole service range

- up to 3 pieces
- lead precision: G5 to ISO standard.
- standard nuts, standard steel (no special documents such as conformity report).
- lubrication: screw assemblies delivered with machined ends are greased with SKF LGEP2 (temperature range: -20°C/+120°C): without end machining, they are only protected with Quakers rust inhibitor
- standard machining: no spline, no hollow shaft, no radius in grinding operations. If such any requirements,please contact our Service Channel.Unless specified, tolerances will be according to class 5, ISO 3408-3 (see pages 11, 12 and 42). FLRBU thrust bearing units can be delivered for all sizes.
- screws for nuclear, military or medical applications are excluded.

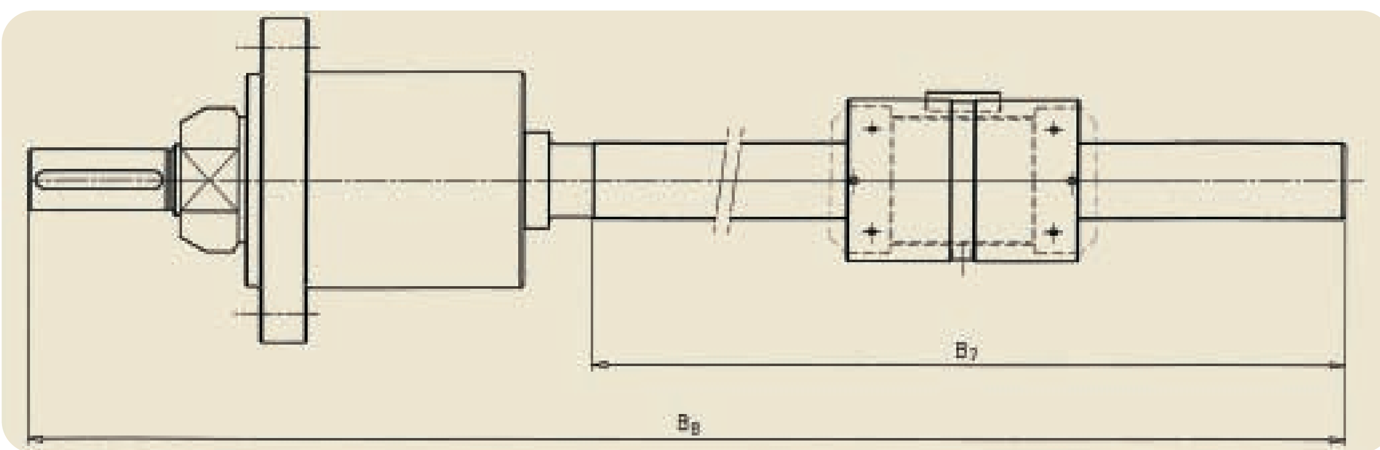
Service range – Recirculating roller screws BRC





Designation	C_a	C_{oa}	T_{pr}*	R_{nr}	d_1	d_8	d_{10}	B_5	B_6	R	D	A	w	a	b	H	Q	B
	kN	kN	Nm	N/µm														
BRC A5X5-R5	25.9	43.5	0.10	150	15.4	14.4	25	115	400	1.2	35	50	0.5	4	16	36.5	5	3
BRC 21X5-R5	50.5	81.9	0.30	200	21.4	20.4	40	178	570	1.2	45	64	0.5	5	20	47.0	5	4
BRC 30X5-R5	91.9	178.3	0.60	300	30.4	29.4	50	213	800	2.0	64	85	0.5	6	32	66.5	5	7
BRC 39X5-R5	129.2	268.9	1.10	400	39.4	38.4	70	259	1046	2.0	80	100	1.0	8	40	83.0	7	8

BRC roller screw and thrust bearing assembly



Screw designation	Thrust bearing designation	B7	B8
BRC 15X5-R5	FLRBU2	285	398
BRC 21X5-R5	FLRBU4	392	568
BRC 30X5-R5	FLRBU5	587	798
BRC 39X5-R5	FLRBU6	787	1044

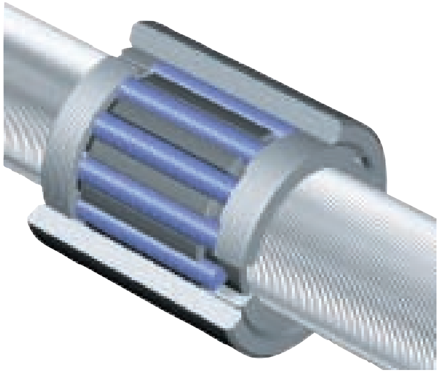
End which can be machined to customer requirements.

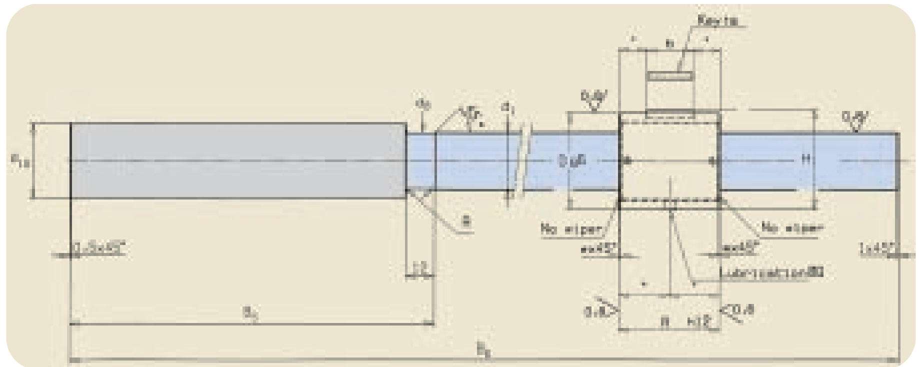
Maximum threaded length: can be cut and machined to customer requirements.

N.B.: Nut and thrust bearing unit cannot be modified. In standard version, the flange of the thrust bearing is located on the KMT side.

*Preload torque measured at 50rpm.

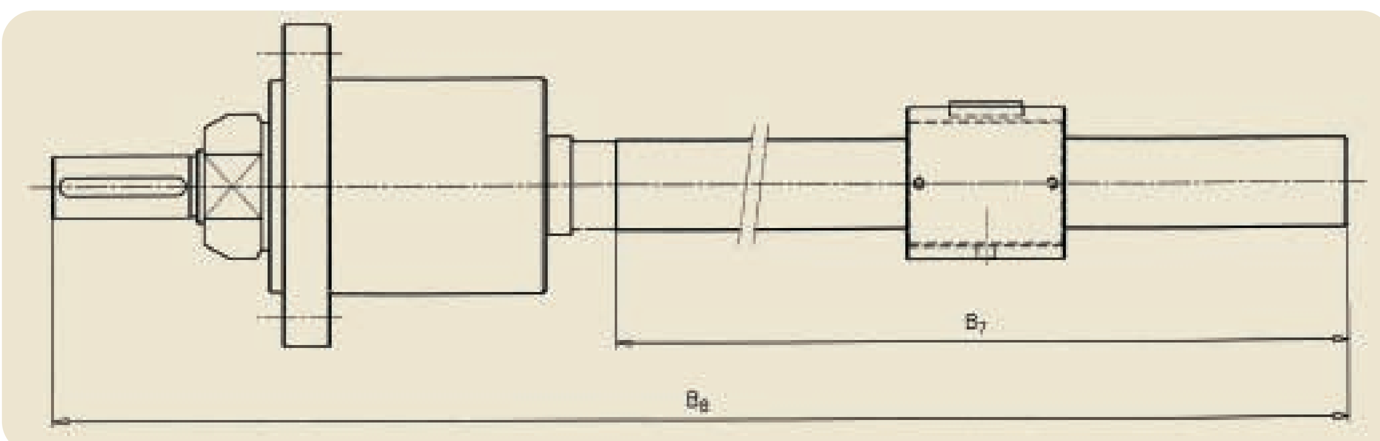
Service range – Recirculating roller screws BVC





Designation	C_a	C_{oa}	T_{pr}*	R_{nr}	d_1	d_8	d_{10}	B_5	B_6	R	D	A	w	a	b	H	Q
	kN	kN	Nm	N/µm													
BVC 20X1-R1	18.5	366	0.20	200	20	19.1	28	116	400	1.2	34	37	0.5	3	16	35.2	5
BVC 25X1-R1	32.9	68.4	0.30	250	25	24.1	33	159	500	1.2	42	44	0.5	4	20	43.5	5
BVC 32X1-R1	64.3	159.2	0.40	300	32	31.1	40	179	500	1.2	54	57	1.0	4	25	55.5	5

BVC roller screw and thrust bearing assembly



Screw designation	Thrust bearing designation	B7	B8
BVC 20X1-R1	FLRBU2	284	397
BVC 25X1-R1	FLRBU3	341	497
BVC 32X1-R1	FLRBU4	321	497

End which can be machined to customer requirements.

Maximum threaded length: can be cut and machined to customer requirements.

N.B.: Nut and thrust bearing unit cannot be modified. In standard version, the flange of the thrust bearing is located on the KMT side.

*Preload torque measured at 50rpm.

For more information on roller screws, or for any questions on the roller screws service range, call 1-800-541-3624, and ask for our full catalog.

Ball screw repair

Experience

With a combined total of more than 120 years of experience in ball screw repair and ball screw engineering department, SKF TCM has the technical expertise you've come to expect and depend on to keep your equipment running.

Our dedicated service channel will address your ball screw repair needs in the most timely manner possible.

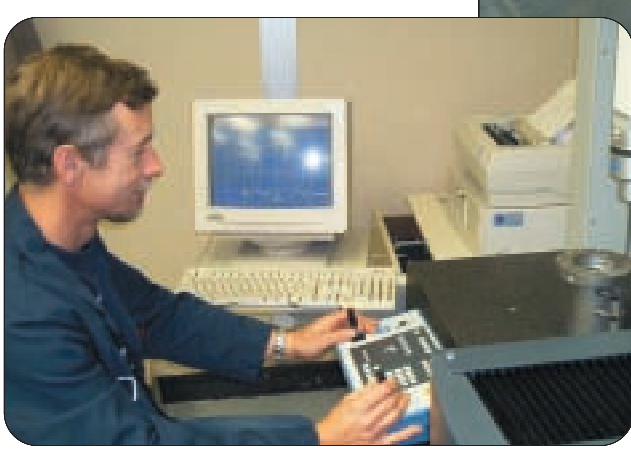
Quality

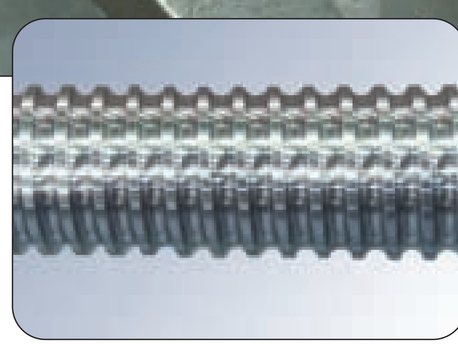
For years the name of SKF has been synonymous with quality and reliability. In our efforts to provide you with world-class products and services, all our new and repaired ball screws must pass a final inspection to provide you with the highest quality product possible.

Service

- 24 hours service available
- Free inspection and analysis
- Comprehensive failure analysis reporting
- Repair of all makes and models (inch and metric)
- Easy replacement of any model with improved performance TCM designs.
- Extensive library of over 35,000 prints
- Reverse engineering available when needed
- Extensive replacement ball nut inventory
- Plating available when required
- End journal bearing repair and machining
- Ball screw support bearings
- Emergency service / quick turn-around upon request
- On-site field service upon request

For more information, call 1-800-541-3624





Calculation formulas

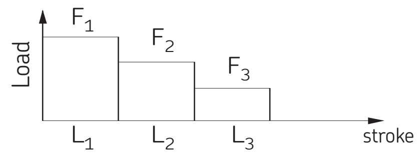
1 Dynamic load rating **(N)** and Basic life rating

$$L_{10} = \left(\frac{C_a}{F_m}\right)^3 \quad \text{or} \quad C_{req} = F_m \, (L_{10})^{1/3}_{req}$$

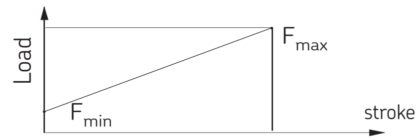
L_{10} = life (million of revolutions)
C_a = basic dynamic load rating
C_{req} = required dynamic load rating
F_m = cubic mean load [N]

2 Cubic mean load **(N)**

$$F_m = \frac{(F_1^3 \, L_1 + F_2^3 \, L_2 + F_3^3 \, L_3 + \ldots)^{1/3}}{(L_1 + L_2 + L_3 + \ldots)^{1/3}}$$



$$F_m = \frac{F_{min} + 2F_{max}}{3}$$



3 Critical speed of screw shaft **(rpm)** (no safety factor)

(a factor of 0.8 is generally recommended)

$$n_{cr} = 490 \cdot 10^5 \, \frac{f_1 \, d_2}{l^2}$$

d_2 = root diameter [mm]
l = free length, or distance between the two support bearings
f_1 = 0.9 fixed, free
3.8 fixed, supported
5.6 fixed, fixed

4 Speed limit of the mechanism

(maxi speed applied through very short periods - to be confirmed, depending on the application)

$n \times d_0$ < 80 000 to 100,000, for most of the screws.
$n \times d_0$ from 50 000 max to 80 000 max with flap-over design depending on the material and design.
For large diameters or long lead, please consult SKF.

n = revolutions per minute
d_0 = screw shaft nominal diameter

5 Buckling strength **(N)**

(with a safety factor: 3)

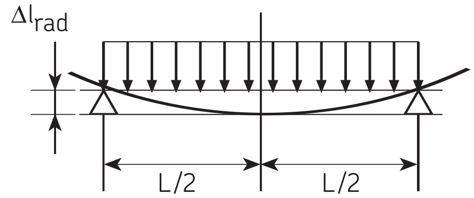
$$F_c = \frac{34\,000 \cdot f_2 \cdot d_2^4}{l^2}$$

d_2 = root diameter [mm]
l = free length, or distance between the two support bearings
f_2 = mounting correction factor
0,25 fixed, free A
1 supported, supported B
2 fixed, supported C
4 fixed, fixed D

6 Deflection of the screw shaft due to its own weight (mm)

$$\Delta l_{rad} = K_p \frac{P \cdot l^4}{E \cdot I}$$

Distributed weight P [daN/mm]



$E = 21\,000$ [daN/mm^2]

$I = \frac{\Pi}{64} d_2^4$ [mm^4]

$$K_p = \begin{cases} 1/8 & \text{in configuration A (fixed/free) } \Delta l_{rad} \text{ on the free end} \\ 5/384 & \text{in configuration B (supported/supported) } \Delta l_{rad} \text{ on the centerline} \\ 1/185 & \text{in configuration C (fixed/supported) } \Delta l_{rad} \text{ at } 0{,}42 \cdot L \text{ from the simple support} \\ 1/384 & \text{in configuration D (fixed/free) } \Delta l_{rad} \text{ on the centerline} \end{cases}$$

Intermediate supports that reduce the above deflection can be used in very long applications.

7 Rigidity

The total rigidity of a screw is:

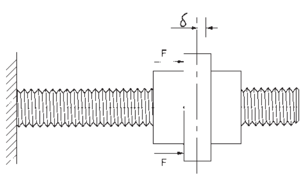
$$R_t = \frac{F}{\delta}$$

$$\frac{1}{R_t} = \frac{1}{R_s} + \frac{1}{R_n}$$

F = load
δ = deflection
R_s = screw shaft rigidity
R_n = nut rigidity

The rigidity of a screw shaft is:

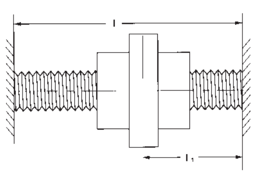
- Ball screw held rigidity at one end:



$$R_s = 165 \frac{d_2^2}{l} \quad \text{[N/µm]}$$

for standard steel

- Ball screw held rigidity at both ends:

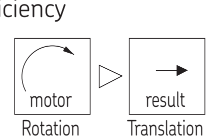


$$R_s = \frac{165\, d_2^2\, l}{l_2 (l - l_2)}$$

for standard steel

8 Theoretical efficiency

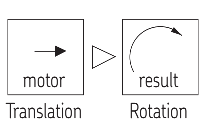
- direct (η)



$$\eta = \frac{1}{1 + \frac{K \cdot d_0}{P_h}}$$

K = 0.018
d_0 = nominal diameter of screw shaft
P_h = lead [mm]

- indirect (η')



$$\eta' = 2 - \frac{1}{\eta}$$

9 Practical efficiency (η_p)

$$\eta_p = \eta \cdot 0.9$$

The value 0.9 used is an average value between the practical efficiency of a new screw and that of a properly run in screw. It should be used for industrial applications in all normal working conditions. For extreme cases, call us.

10 Input torque in a steady state **[Nm]**

$$T = \frac{F \cdot P_h}{2000 \cdot \pi \cdot \eta_p}$$

F = maximum load of the cycle [N]

11 Power required in a steady state **[W]**

$$P = \frac{F \cdot n \cdot P_h}{60\,000 \cdot \eta_p}$$

n = revolution per minute

12 Preload torque **[Nm]**

$$T_{pr} = \frac{F_{pr} \cdot P_h}{1000 \cdot \pi}\left(\frac{1}{\eta_p} - 1\right)$$

F_{pr} = preload force between a nut and the shaft [N]

13 Restraining torque **[Nm]**

(considering system backdriving)

$$T_B = \frac{F \cdot P_h \cdot \eta'}{2000 \cdot \pi}$$

F = load [N]
For safety, we can use the theoretical indirect efficiency

14 Nominal motor torque when accelerating **[Nm]**

For a horizontal screw

$$T_t = T_f + T_{pr} + \frac{P_h\,[F + m_L \cdot \mu_f \cdot g]}{2000 \cdot \pi \cdot \eta_p} + \dot{\omega}\,\Sigma I$$

For a vertical screw

$$T_t = T_f + T_{pr} + \frac{P_h\,[F + m_L \cdot g]}{2000 \cdot \pi \cdot \eta_p} + \dot{\omega}\,\Sigma I$$

15 Nominal braking torque when decelerating **[Nm]**

For a horizontal screw

$$T'_t = T_f + T_{pr} + \frac{P_h \cdot \eta' \cdot [F + m_L \cdot \mu_f \cdot g]}{2000 \cdot \pi} + \dot{\omega}\,\Sigma I$$

For a vertical screw

$$T_t = T_f + T_{pr} + \frac{P_h \cdot \eta' \cdot [F + m_L \cdot g]}{200 \cdot \pi} + \dot{\omega}\,\Sigma I$$

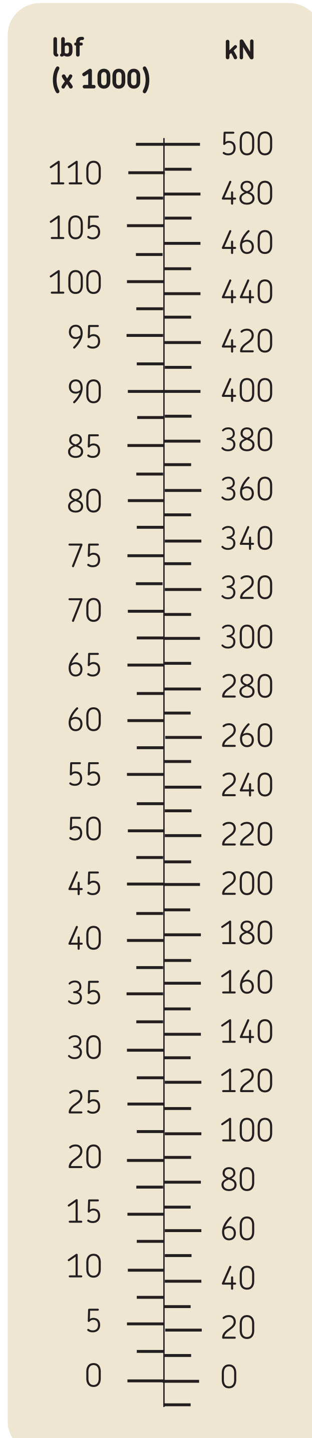
T_f = torque from friction in support bearings [Nm]
T_{pr} = preload torque [Nm]
μ_f = coefficient of friction
η_p = real direct efficiency
$\dot{\omega}$ = angular acceleration [rad/s^2]
m_L = mass of the load [kg]
g = acceleration of gravity: 9.8 [m/s^2]
$\Sigma I = I_M + I_L + I_S + I \cdot 10^{-9}$ [kg/m^2]

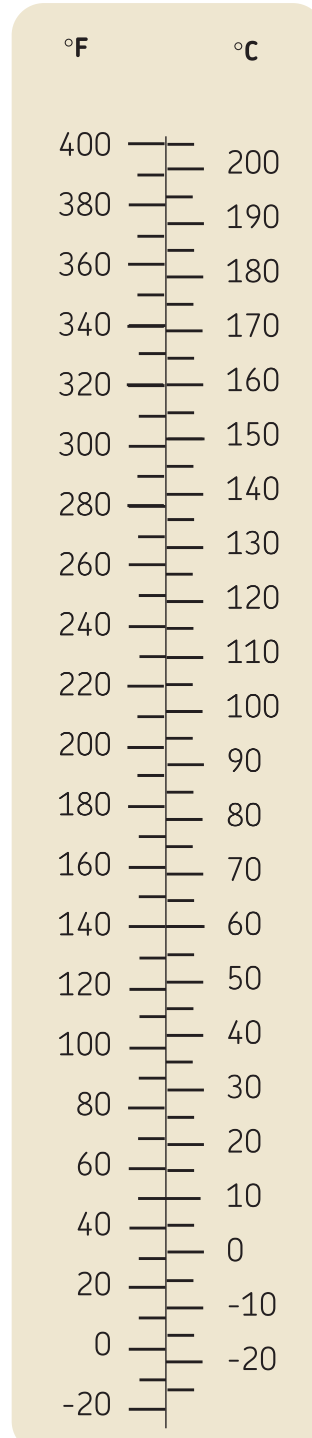
$I_L = m_L \left(\frac{P_h}{2\pi}\right)^2 10^{-6}$ [kg m^2]
η' = theoretical direct efficiency
I_M = inertia of motor [kg m^2]
I_S = inertia of screw shaft per metre [kg mm^2/m]

Note.:
For additional information, please contact SKF.

Unit conversion table

Length	1 in =	25.4 mm
	1 foot =	304.8 mm
	1 µm =	3.94×10^{-5} in
	1 mm =	0.039 in
Mass	1 kg =	2.2046 lb
Load	1 lbf =	4.448 N
	1 N =	0.2248 lbf
	1 kN =	224.81 lbf
Torque	1 Nm =	8.85 in.lbf
	1 in.lbf =	0.123 Nm
Surface	1mm^2 =	1.55 x 10-3 in^2
	1 in^2 =	645.2 mm^2
Volume	1 cm^3 =	0.061 in^3
	1 liter =	0.264 US gallon
Linear speed	1mm/s =	2.362 in/min
	1 ft/min =	5.08 mm/s
Power	1 kW =	1.341 hp
	1 kW =	737.56 ft.lbf/s
	1 hp =	745.7 W
Stiffness	1 N/µm =	0.0057×10^{-6} lbf/in
	1x10-6 lbf/in =	175 N/µm
Inertia	1 kg.m^2 =	3417 lb.in^2
	1 lb.in^2 =	292.6 kg.mm^2
Polar inertia	1 mm^4 =	2.4 x 10-6 in^4
	1 in^4 =	41.62 cm^4
Stress & Pressure	1 Mpa =	145 psi
	1 Mpa =	0.145 ksi
	1 bar =	14.5 psi
	1 ksi =	6.89 Mpa
	1 psi =	68.95 mbar
Density	1 g/cm^3 =	0.036 lb/in^3
	1 lb/in^3 =	27.68 g/cm^3
Linear weight	1 g/mm =	0.056 lb/in
	1lb/ft =	1.488 g/mm





Ball screws ordering key

PGF									WPR

Nut type:

inch series

Preloaded nut, ground type and end flange (double nut version) . . . . . PGFM
Preloaded nut, ground type and center flange (double nut version) . . . . . PGEM
Preloaded nut, ground type and end flange . . . . . PGF
Non preloaded nut, ground type and end flange . . . . . SGF
Non preloaded nut, commercial type and end flange . . . . . SCF
Preloaded nut, ground type and cam shape . . . . . PGC
Non preloaded nut, ground type and cam shape . . . . . SGC
Non preloaded nut, commercial type and cam shape . . . . . SCC

metric series

Preloaded nut, ground type with DIN std (double nut version) . . . . . PGDM
Preloaded nut, ground type with DIN std . . . . . PGD
Preloaded nut, precision rolled with DIN std . . . . . PND

Nominal diameter X Lead [mm]

Hand:
Right . . . . . R
Left (on request) L

Threaded length / Total length [mm]

Metrics . . . . . ME
Inches IN

Lead precision:
. . . . . G7, G5, G3, G1

Nut orientation:
Flange of nut towards shorter (S) or longer (L) machined end of shaft.
In case of same end machining (–)

Machined end combination (see pages 40 to 43) **(Z) if to customer's drawing**

Wipers:
With wipers . . . . . WPR
Without wipers . . . . . NOWPR

Example: PGF | 40 X 5 | R | 1300 / 1650 | ME | G5 | L | HA | WPR

Axial stiffness of the nut

Actual stiffness = theoretical stiffness x accuracy factor

Accuracy factor*	0.6	0.55	0.5	0.4
ISO accuracy classes	1	3	5	7

*Accuracy factor takes into account the effect on stiffness of dimensional errors, surface finish, nut/ball/screw shaft coupling during construction and assembly of the screw as a function of the ISO precision class

Note:
In case **of machined end Z** (to customer's drawing) please, always send a readable DWG.

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