RACO BALL SCREWS
PRECISION IS OUR PROGRAM

RACO Schwelm

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CONTENT:

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1 ABOUT US

The cornerstone for RACO´s ball screws was laid more than 50 years ago based upon RACO´s own world-wide patents for single ball return arrangements, the ball groove profile, single ball nut preloaded and the short travel ball screw assembly. Further patents set the standard for high precision ball screws and electromechanical spring brake system, which operate as safety brakes in rail based public transportation systems.

Since that time the effort for a "clean and environmental-safe solution" is our ambition and commitment. RACO Schwelm is among the leading manufactures of electromechanical linear systems.

Through the continuous development of our products the RACO products comes into many different applications. New tasks, in addition to the customers needs are measure for the innovation by RACO. This core competence was assiduously consolidated.

RACO provides high quality products for applications, where high precision linear motion is required. The complete system comes from one source, determined by the customers individual requirements and fabricated in a short period.

Modern technology and our own production facilities in addition to high skilled personal assure the outstanding quality level of our products. Based on the unique modular system for RACO actuators we are able to serve a customer´s demand, even for a great variety of executions, right from the shelve.

The company`s engineering and production services have been certified under ISO 9001 since 1994. The certification was renewed for compliance with the 2000 version. By creating a optimal workflow process RACO provides competent consultation and support for all business activities from your inquiry through the after sales service.

Fig. 1: RACO Engineering & Production Plant, Schwelm

2 QUALITY STATEMENT

Extract from the quality manual

Within the last years, comprehensive quality of all furnished work proved to be one of the most important factors for the success of a company. Quality is mostly defined as the "total of characteristics of a unit acc. to its adequacy to fulfil determined and demanded requirements".

One of the most important tasks of the management is to meet the requirements acc. to this "comprehensive product quality" by the permanent development of the Quality Management system acc. to DIN EN ISO 9001. Thus RACO was certified in 1994 for the first time.

The scale for all actions within the company with regard to quality is our customers' judgement to the degree to which our products meet the requirements, as well as the permanent comparison of the attained quality level with our goals.

We, are therefore, convinced that a permanent quality improvement which are realized in cooperation with our customers and suppliers is the best solution to provide a solid base for the future development of the company. The activity of each employee plays a decisive role and the following measures contribute to realize this objective:

- fulfilment of the customers' requirements, in particular with regard to works within the period stipulated and to reasonable prices.
- apart from general requirements linked to the products (e. g. safety instructions, standards), all points increasing the advantage to the customer have always been taken into consideration.
- increasing the sense of quality of all employees in order to raise responsibility for executed tasks and increase motivation.
- taking measures in the development stage to avoid errors, which will have a positive effect on both quality and costs.

Since the efficiency of quality-linked activities are permanently tested, it is possible to adapt the organization and the methods of the quality assurance to the latest developments and requirements. So definite aims and contents of our quality politics are:

- fulfilment of the determinated or demanded requirements of our customer.
- gain confidence by always fulfilling these requirements with respect to the customer as well as with respect to their own work

3 INTRODUCTION IN RACO BALL SCREWS

The ball screw assembly consists of screw, nut and balls. The function is to transfer the rotary motion or into a linear motion into rotary motion. This is further extension and development of slide ball screw. The important significance of development is the same as changing a bearing from rolling motion to sliding motion. Because of excellent friction function, ball screw is widely used for all kinds of industrial equipment and precision instruments.

RACO offers a wide range of ground ball screws to cover all requirements: Flanged nut with internal preload, DIN standard Double preloaded flanged nut, DIN standard Double cylindrical preloaded nut and tailor-made products. RACO offers complete screw assemblies with machined ends specify to customer drawings. Nuts are also available with axial play.

Furthermore the RACO company specializes in customized arrangements with high precision demands. The ball screws are available in different designs to cover most technical requirements. Nuts are available preloaded or with axial play. Preloaded nuts should always be used when accuracy of positioning under load is important. Even for small quantities, we provide complete assemblies with customized screw shaft, with a very short delivery time.

The RACO ball screws receive distinction with their high quality, precision and long life capabilities. There are world-wide patents for our single ball return arrangement, the ball groove profile, single ball nut preloaded and the short travel ball screw assembly. The big depth of hardness of the ball tracks (60 ± 2 HRC) allows for regrinding of worn out screws it is not necessary to have a complete new ball screw.

Based on these features we can guarantee long life time for your individual application. Especially very small or even large dimensions and length as well as telescopic or internal oil cooled screws are our most competitive business. RACO ball screws are used in many tool machines and many other applications all over the world.

3.1 Requirements and criteria for ball screws:

The manufacturing is made upon request based on your drawing or technical info and the manufacturing procedures for each RACO ball screw will be selected individually according to the preferred criteria as outlined below. Each step of manufacturing is inspected for hardness and cracks to assure our defined high quality level which is documented in accordance to the ISO 9001/Rev.2000 regulation.

- Load rating (static & dynamic)
- Max. speed (critical speed)
- Buckling
- Accuracy class (lead deviation)
- Reversibility
- Axial play (Preloading of nuts)
- Life time acc. operation conditions
- Ambient influence (Environment)
- Life cycle cost

3.2 Features of RACO Ball Screws

A strong profile

We use only high-class materials with certificate. Our ball screws and nuts are produced from high strengh steel suitable for rolling bearing applications. Spindles and nuts for the RACO ball screws are ground in air-conditioned work shop facilities. We spare no cost or efforts, since the accuracy we guarantee can only be achieved by precision grinding. The geometrically true form of our ball nuts and the spindle profiles are crucial for the considerably longer service life of our ball screws. Beyond this, our inductive hardening technique with its considerable penetration depth creates the prerequisite for each spindle to be re-ground, so that it will be reliably for a long life. This means you benefit with lower costs and shorter downtimes in the event of a breakdown.

Another feature favor of RACO ball screws: the special geometry of the profile, the option to freely choose the diameter, and the number of ball screws, depending on the required stiffness. RACO monitors the entire production process carefully, so that the requirements concerning the profile geometry can be met at any time. Moreover, the dimensional accuracy of all RACO ball screws and the quality of the material used are constantly checked and the results properly documented. In matters of quality we do not make any compromises.

The RACO nut design

The core of a RACO ball screw is the nut with its single lead ball return that has been developed by us. This design has been protected by a universal patent and ensures that the balls are returned within the ball screw nut at the shortest possible route. This gives you the benefit of a higher rated load with the smallest possible nut dimensions, meaning higher efficiency and a longer service life. RACO ball screws with a single or double nut (nut and counter nut) can be preset free from backlash, so that the correct and recurrent positioning can be ensured even if the load or direction change.

Rotating Nut Systems

Faster with less inertia! The nut rotates inside bearings and moves along the spindle which is fixed on both sides. The drive motor turns the nut, so inertia and critical speed problems associated with a long rotating shaft, are minimized. Main benefits are: easy & simple incorporation, compact solution ready to use, simplified mounting, reduced inertia and higher linear speed up to 60 m/min.

Telescopic Screws

Maximum precision for minimum space requirements! RACO provides from double up to fourfold extension systems with smooth internal override. In combination with the integrated shock absorbing system a trouble free operation is guaranteed (Fig. 2).

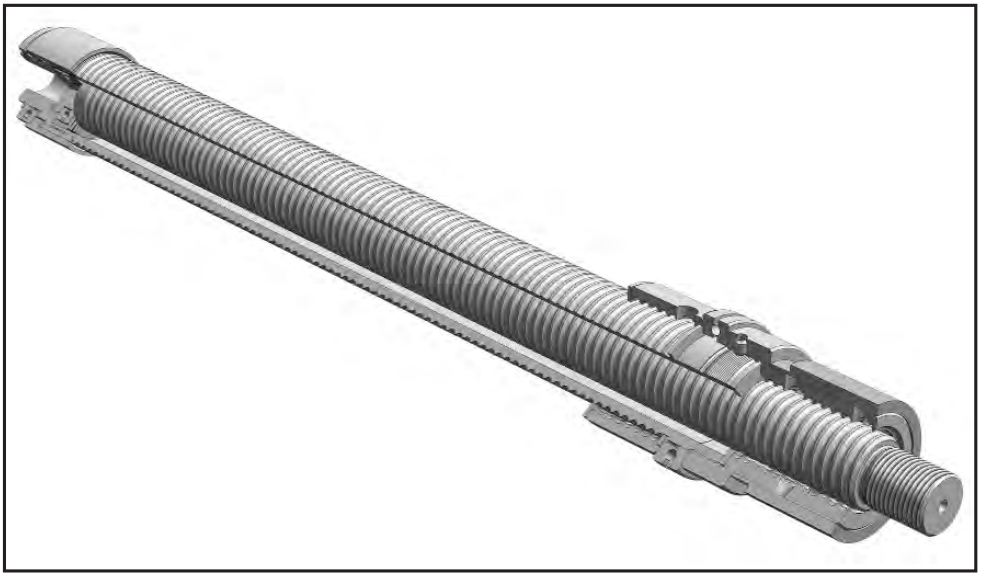


Fig. 2: Telescopic screw

Whatever you like

The range of available RACO ball screws leaves very little to be desired. Our standard program includes spindles with a diameter from 6 up to 200 mm and lengths ranging from 80 mm to 8000 mm - each of them with different profiles and in different classes of accuracy.

Smooth running, accurate positioning and high efficiency (good back driving) are the main benefits of our miniature ball screws. Nut is available with threaded end for easy mounting, with ball recirculation by integrated tube or inserts. It is typical that RACO accepts individual and special orders in line with our customers' demands: High-precision ball screws with a length of up to 14 m and with almost any profile required.

3.3 Benefits of RACO Ball Screws

It is impossible to imagine modern machine tool and plant construction nowadays without ball screws. Wherever operations require high positioning accuracy at a high switching rate, these drive elements will have to be employed. A good example are robot systems. The precision achieved by RACO ball screws is the result of our long-standing development efforts and of the extreme care we take during the manufacturing itself. These depend on following characteristics:

High Transfer Efficiency

Realized by balls with free motion transfer of force and motion between screw and nut in the ball screw assembly. This transfer replaces the traditional direct function wise between screw and nut. Therefore the minimum rolling friction takes place instead of sliding friction. The transfer efficiency of ball screw will reach more than 95%. The drive torque of transfer unit reduces to 1/3 of sliding screw. This greatly reduces the heating.

High Positioning Accuracy

Means that the ball screw has a low heat rate and small temperature increase to provide high positioning accuracy due to any operation procedure. In the machining the measures have been taken to prolong and preload so as to avoid axial clearance.

High Speed

The internal nut design has been optimized to obtain highest speeds effected by short ball return transfer rates, via straight overflow inserts.

Precise Reversibility

Ball screw has not sticky friction like sliding screw. It clears crawl which exist during transference. Ball screw can realize two transfer wise-from rotary motion to linear motion and from linear to rotary motion- and transfer momentum.

Ultra Power

The internal design has been optimized to obtain ultimate static and dynamic capacities which are much higher than the standard range. Furthermore more the load capacity is independent of lead. The maximum load should not be applied on the nut mounting bolts but on the flange.

Good Synchronization

Due to smooth running, avoidance of axial clearance and consistency of manufacture, several sets of ball screws can drive the same unit or several the same parts.

High Load Capacity

RACO-ball screws can be strained in axial direction as well and as radial direction. Even guidance characteristics can be realized without any additional support.

Resistance against worth Ambient Conditions

Wide range of temperature gradients and contamination of dirt can be tolerated without loss of precision or sign of wear.

Many Options

Rebuilds according to samples or customized design acc. to drawings are available within a short delivery time. Only our standard materials various of special materials as high alloyed, corrosion and acid resistant steel can be used.

Long Service Life

Because of strict control of shape of running track, surface hardness and material, the actual life of ball screw is much longer than sliding screw.

4 PRECISION BALL SCREWS / TECHNOLOGY

Ball screws are mechanism for changing rotary into linear motion and vice versa (Fig. 3). A ball screw assembly consists of the actual screw, the nut assembly with cross-sover for the return of the balls and the rolling balls. The balls roll in helical tracks in the screw and nut and form the only connection between them.
The force transmitted is spread over a number of balls, so that the contact stress is relatively low. The rolling friction between the ball screw and nut results in an extremely low coefficient of friction.

Fig. 3: Principle of operation of a ball screw

Features & Benefits

The advantages over screws with sliding friction are overwhelming. Precision ball screws have an efficiency of nearly 98% compared with 30% for conventional screws, with a corresponding reduction in the power of the drive required.

Even where the power consumption does not represent a crucial consideration, the larger dimensions of a motor cannot always be accommodated.

Further advantages

The service life is several times as great as that of a conventional screw. The heat generated is appreciably less, which enables higher traverse speeds to be obtained.

These factors already compensate largely for the higher cost of a ball screw, although in some cases the fact that ball screws are not irreversible, self locking drives must be taken into consideration.

With sliding friction, the phenomenon of intermittent stick-slip motion tends to occur at low sliding speeds (creep speeds), even if the screw is driven at a uniform and constant speed. This undesirable stick-slip effect does not happen with rolling friction, so that positioning can be achieved with great repetitive accuracy.

4.1 Main fields of application

The extremely high precision of the RACO ball screws makes them eminently suitable for metrology and control equipment, which is of decisive importance in the following fields of application:

- Machine tools
- Aero-space industry
- Nuclear Reactors
- Mechanical handling applications
- Medical devices
- Military equipment
- Measuring and testing equipment
- Transportation equipment
- and your individual application

4.2 Track Profile

An optimum pointed arch track profile (Fig. 4) is produced by RACO.

This profile has the greatest possible contact angle ß and good lubrication properties. Together with a ball diameter calculated to suit each application, it offers the following advantages:

- Maximum load capacity and hence long service life
- Optimum running properties
- Efficiencies up to 98%
- Optimum stiffness
- Nearly constant driving torque

The depth of induction hardening permits subsequent regrinding to larger ball diameter, so that in the event of damage a new ball screw is not necessary.

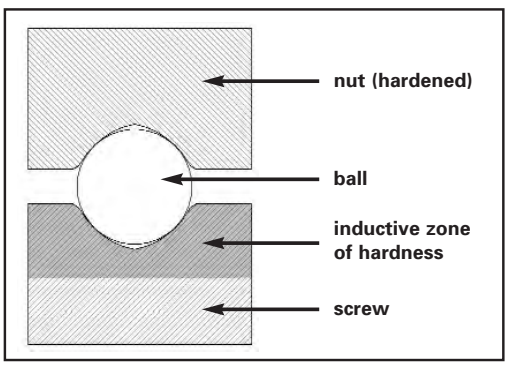


Fig. 4: RACO pointed arch track profile

4.3 Ball Return System

A crossover piece between each pair of adjacent threads returns the balls to the preceding thread for constant recirculation.

After considering external return systems, extensive research work has led us to adopt a “S shaped” and furthermore a straight crossover piece. For standard leads this straight crossover piece is covered by German Federal Patent No. 2 149 392 and other foreign patents (Fig. 4 plug type “S shaped” crossover piece).

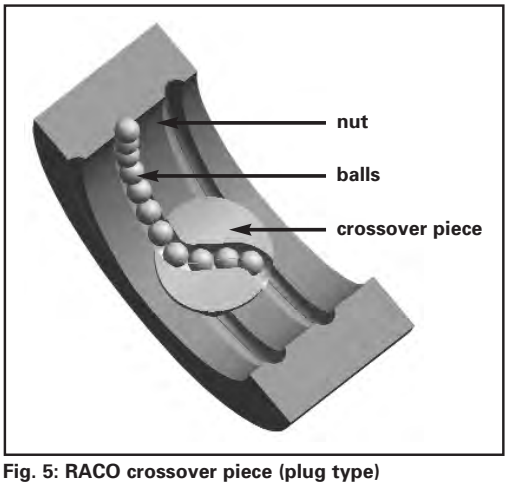


Fig. 5: RACO crossover piece (plug type)

For large lead angles, the straight key type crossover piece (German Federal patent No. 2 149 392) as shown in Fig. 6 is used.

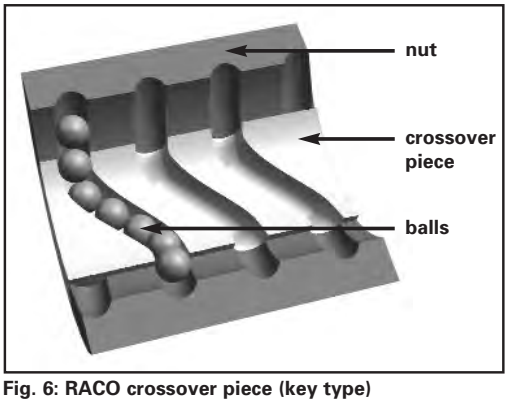


Fig. 6: RACO crossover piece (key type)

The RACO Ball Return System offers the following advantages

- Compact design with small overall dimensions
- High efficiency
- Nuts with 1 to 8 threads
- Very smooth and quiet running due to the geometric shape
- High permissible speeds of rotation
- Long service life
- Shortest possible crossover & therefore the maximum number of load carrying balls.

4.4 Axial play

Like ball bearings, ball screws with a single nut have an axial play ranging from 0.02 to 0.1 mm depending on their size. This play is constant irrespective of the load (Fig. 7).

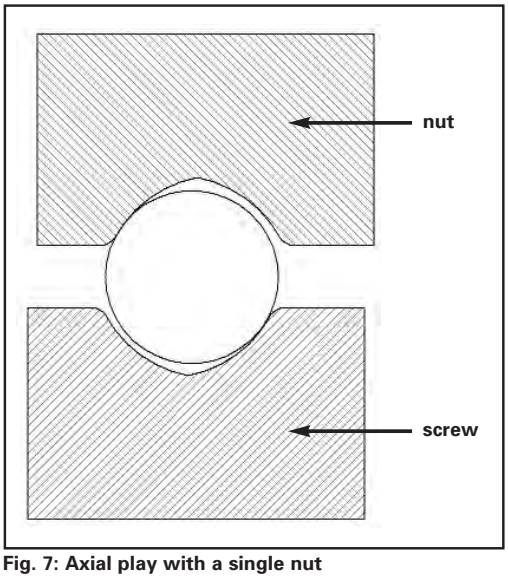


Fig. 7: Axial play with a single nut

The load produces an elastic deformation of the materials with a hysteresis characteristic, which results in an additional axial displacement (Fig. 8).

The special geometry of track and ball provides through its high grade of osculation (contact ratio of ball & shaft) a maximum load capacity in addition with an excellent smooth running characteristic.

By the selection and combination of the choosen materials we guarantee a long lasting operation period of the track profile.

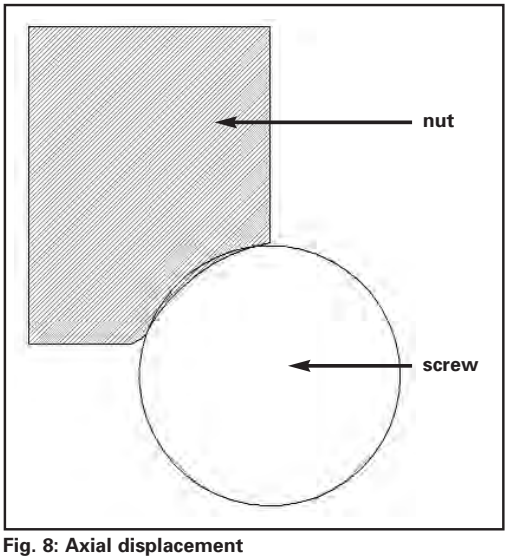


Fig. 8: Axial displacement

4.5 Preloading of Nut Assemblies

Nuts are preloaded in order to eliminate axial play and to keep the axial displacement due to the deformation of the materials as small as possible (Fig. 9).

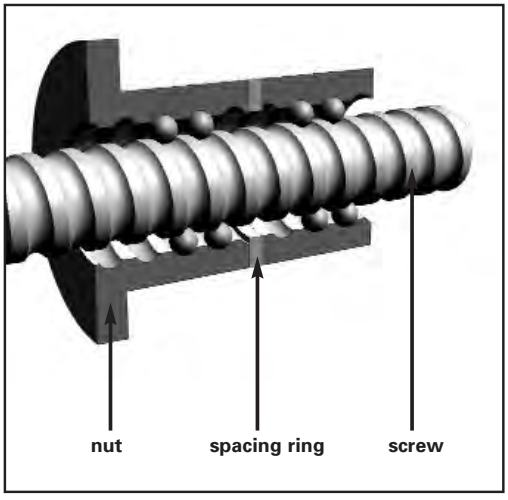


Fig. 9: Preloading of nut assembly

Two different kinds of preloads can be imposed:

O-type preload

The spacing ring forces the nuts apart and thus produces the preload. The preload is transmitted by an 0 shaped configuration. The part of the screw under preload is in tension (Fig. 10).

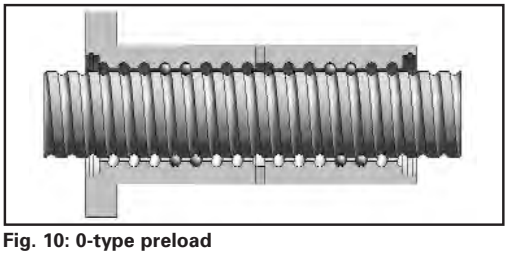


Fig. 10: 0-type preload

X-type preload:

The nuts are pressed towards each other in their housing by a ring nut to produce the preload. The spacing ring limits the amount of preload which can be applied. The preload is transmitted by an X shaped configuration. The part of the screw under preload is in compression (Fig. 11).

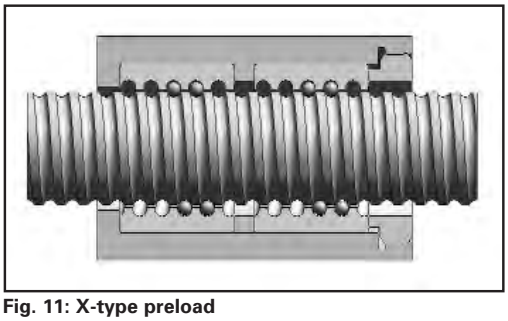


Fig. 11: X-type preload

5 STRUCTURE TYPE OF NUT ASSEMBLIES

Single plain cylindrical nut
Series A

Nut of simple design contained in housing. Prevented from rotation by key (Fig. 12).

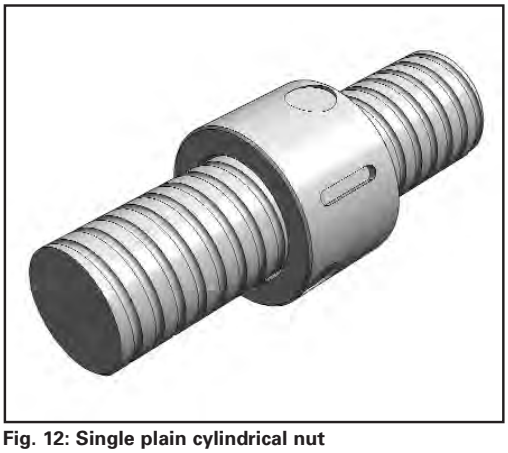


Fig. 12: Single plain cylindrical nut

Double plain cylindrical nut
Series C

The nuts are pressed towards each other in their housing by a ring nut and are thereby subjected to an X type preload. The spacing ring limits the amount of preload. Subsequent adjustment of the preload by means of the ring nut without changing of the spacing ring is only possible to a limited extent. Otherwise dismantling and modification or replacements of the spacing ring are necessary (Fig. 13).

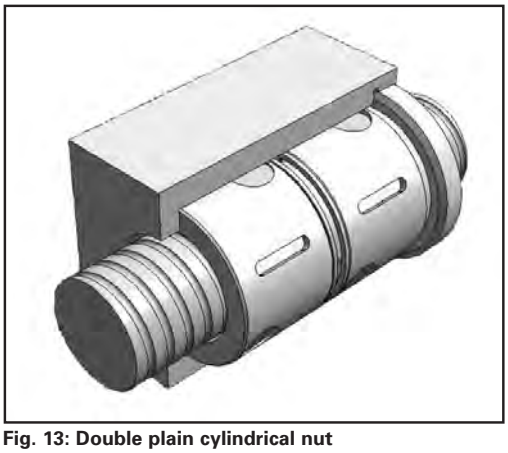


Fig. 13: Double plain cylindrical nut

Single Flange Nut
Series E

Simple installation due to attachment by a flange. No housing is necessary (Fig. 14).

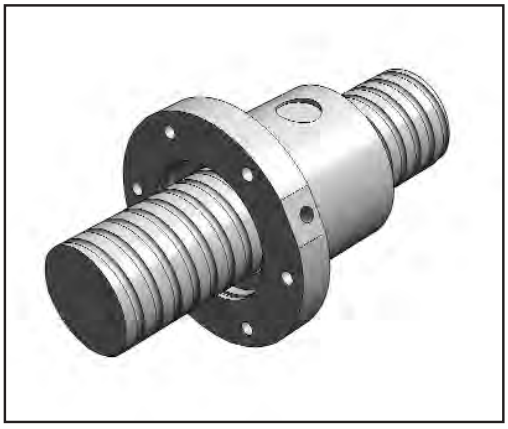


Fig. 14: Double flange nut

Back to back arrangement
Series G

The nuts are pressed towards each other when bolting the flanges to the machine, so that an X type preload is obtained. An increase or readjustment of the preload because of wear is only possible by fitting a spacing ring of reduced thickness (Fig. 15).

The nuts can be dowelled together at the required preload in our works.

The installation of the complete unit is simple.

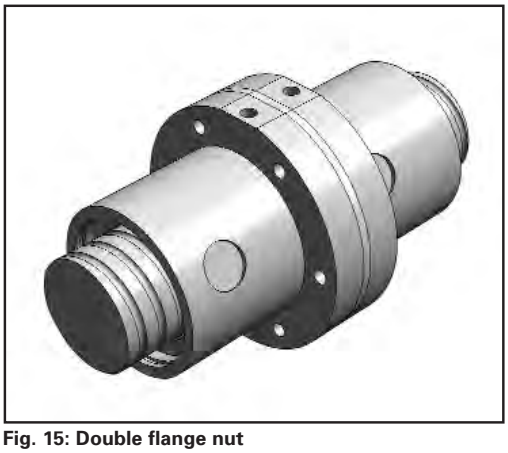


Fig. 15: Double flange nut

Double Nut with vernier adjustment
Series I

The two nuts have different numbers of external teeth. Rotation of the two nuts in the same direction through an equal number of teeth results in a differential movement which induces an 0 type preload. The nuts are located axially by the abutment in the housing (Fig. 16).

The smallest increment in preload is obtained by turning the two nuts in the same direction through one tooth each. The setting of the preload is accurate and secured positively. Adjustment to the preload can only be made by dismantling the complete unit.

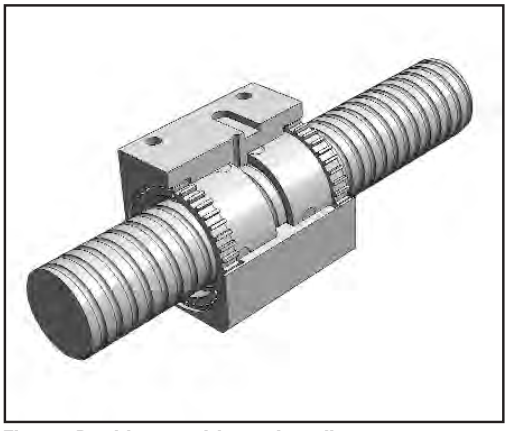


Fig. 16: Double nut with vernier adjustment

Double flanged nut with preload adjustment
(Registered design No. 7 708 184)
Series L

The 0 type preload is set by turning the nuts against each other by means adjusting screws. Axial spacing is maintained by a spacing ring. Initial setting and readjustment of the preload is very accurate, simple and possible without dismantling (Fig. 17).

The installation of the nut assembly is very simple due to the flange attachment. The assembly has a high stiffness due to the direct attachment without housing.

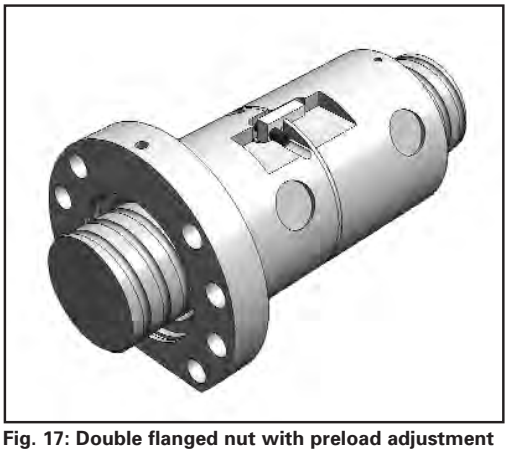


Fig. 17: Double flanged nut with preload adjustment

Flanged nut with preload adjustment
Series N

The 0 type preload is set by turning the nuts against each other by means of adjusting screws. Simple, step less and accurate initial setting and readjustment of the preload, even without dismantling (Fig. 18).

This assembly has a high stiffness due to the direct flange attachment and the compact design. Attachment by flange is easy and rapid.

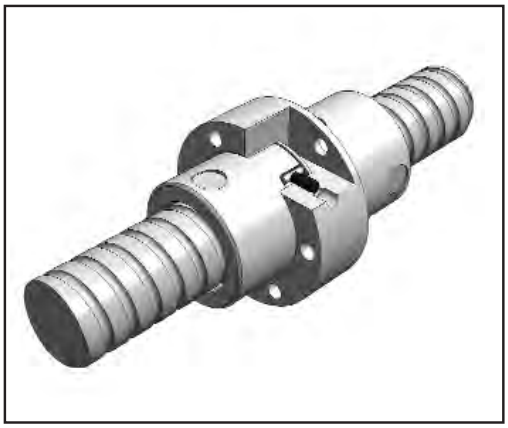


Fig. 18: Flanged nut with preload adjustment

Double flanged nut with preload adjustment
Outward facing flanges
Series Q

The 0 type preload is obtained by turning the nuts against each other by means of adjusting screws. The housing is made to the customer's drawing. Initial setting and subsequent readjustment of the preload is very accurate, simple and possible without dismantling of the nut assembly (Fig. 19).

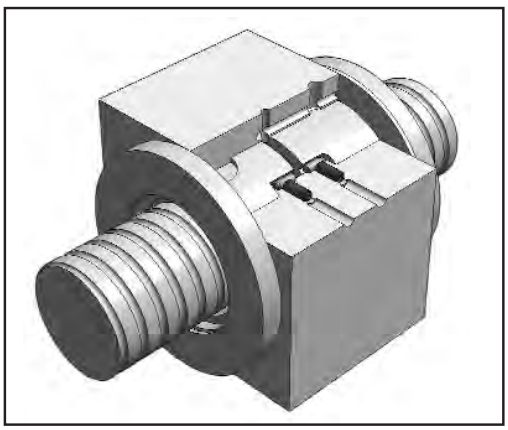


Fig. 19: Double flanged nut with preload adjustment, outward facing flanges

Single nut with zero backlash
(German Federal patent No. 3 209 086)
Series R

The newly developed geometry of the thread profile of the nut with modified lead produces the preload and ensures also uniform load distribution on the individual threads. This means high load carrying capacity and increased service (Fig. 20).

This unit required appreciably less space than preloaded double nut assemblies.

Fig. 20: Preloaded single nut with zero backlash (with and without flange)

6 PROTECTION SYSTEMS / WIPERS

As ball screws are sensitive to dirt and chips, they should invariably be protected by well fitting covers like concertina covers or telescopic springs. The nut assembly can also be equipped with wipers.

As inferred by the name, the wipers wipe off contaminants and are therefore in no way comparable to a seal. The wipers are either made of elastic material or are able to move radially, so that they fit thread profile as closely as possible. This in turn means that the wipers are subject to wear and have a limited life, so that they have to be replaced at appropriate time intervals, depending on the application and the degree of contamination.

6.1 Brush wiper

The profiled brush wiper surrounds the ball track/grove and the outer diameter of the screw (Fig. 21). This design is the long lasting solution and preferred to prevent the intake of dirt even under the worst operating conditions. Further special designs are available on request!

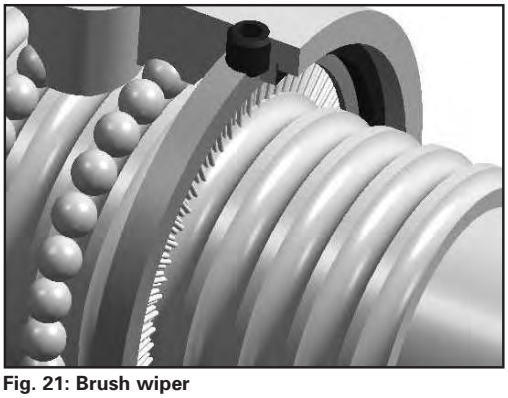


Fig. 21: Brush wiper

6.2 Felt wiper

The profiled felt ring surrounds the ball track and the outer diameter of the screw. This design is preferred where the nut is filled with grease (Fig. 22). Other special designs are available on request!

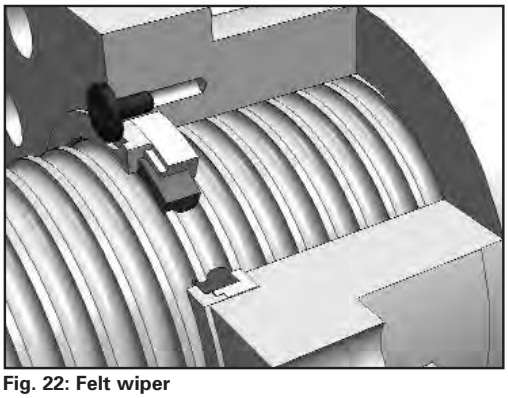


Fig. 22: Felt wiper

6.3 Plastic wiper

The spring presses the profiled nylon plunger onto the ball track. This type of design covers the major part of the application (Fig. 23).

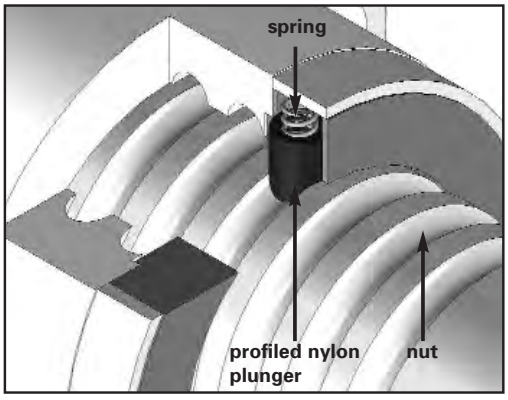


Fig. 23: Plastic wiper

7 TYPE CODE / TECHNICAL DATA

7.1 Type Code for Ball Screws

☐☐☐	-	☐☐	☐	☐	☐	☐☐	☐	☐	☐	- ☐☐☐☐ / ☐☐☐☐☐
0		1	2	3	4	5	6	7	8	9 10

Example:

☐	4	0	-	1	0	R	S	3	A	S	3	K	G	-	1	0	0	0	/	☐ 1 2 5 0

Space No.	Type designation	Key
0	Diameter	d_1 [mm]
1	Lead	P [mm]
2	Lead Orientation	R = right hand lead L = left hand lead
3	Track profile	S = pointed arch profile R = groove profile Z = special profile
4	Lead accuracy class	[0, 1, 3 , 5, 7] (<6 , 6, 12, 23, 52 micron/300 mm)
5	Type of nut	A = single plain cylindrical nut C = double plain cylindrical nut E = single flange nut G = double flange nut back-to-back arrangement I = double nut with vernier adjustment L = double flange nut with preload adjustment N = flange nut with preload adjustment Q = double flange nut with preload adjustment R = single nut with zero backlash T = short travel ball screw assembly Z = special design S = dimensions of nut deviate from RACO standard
6	Threads	Number of load carrying threads per nut
7	Wiper	B = brush wiper F = felt wiper K = plastic wiper Z = special wiper
8	Housing	G = with housing X = without housing
9	Thread length	[mm]
10	Screw overall length	[mm]

7.2 RACO standard delivery program & preferential types

d_1 \ P	2	2,5	3	4	5	6	8	10	12	16	20	24	32	40	48	0,2"	0,25"	0,4"	0,5"	1"
8	●	●	●	●																
10	●	●	●	●																
12	●	●	●	●																
16	●	●	●	●	●	●	●	●								●	●	●	●	
20	●	●	●	●	●	●	●	●	●							●	●	●	●	
22	●	●	●	●	●	●	●	●	●							●	●	●	●	
25	●	●	●	●	●	●	●	●	●	●						●	●	●	●	
30	●	●	●	●	●	●	●	●	●	●						●	●	●	●	
32	●	●	●	●	●	●	●	●	●	●	●					●	●	●	●	
37	●	●	●	●	●	●	●	●	●	●	●					●	●	●	●	
40	●	●	●	●	●	●	●	●	●	●	●	●				●	●	●	●	●
50				●	●	●	●	●	●	●	●	●	●			●	●	●	●	●
60				●	●	●	●	●	●	●	●	●	●			●	●	●	●	●
63				●	●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
70					●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
75					●	●	●	●	●	●	●	●	●	●		●	●	●	●	●
80					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
100					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
125					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
160					●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
200								●	●	●	●	●	●	●	●	●	●	●	●	●

● RACO delivery program ● RACO preferential types

Single plain cylindrical nut Series A
Double plain cylindrical nut Series C

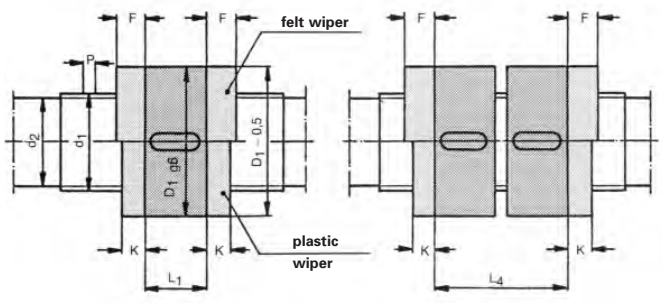
Special designs with dimensions and leads to customers' specifications can be supplied.

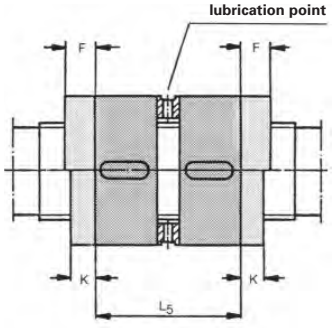
All dimensions in mm (" = lead in inches)
Housing to customer drawings can be supplied by RACO.
Tolerances not explicitly stated conform to German standard Din 7168.
Acceptance tests according to German standard DIN 69 051 part 3.

1) Where the permissible lead variation is 0.050 and 0.100 over 300 mm, d1 and d2 are subject to a tolerance of +0.4 mm.
2) The diameter of the ball screw end over which the nut is fitted must not exceed d2. If a diameter larger than d1 is required at the other spindle end, then this should be obtained by shrinking on collars and flanges to limit costs.
3) Oil holes can be incorporated on request (not standard).
4) Determination of load rating according to German standard DIN 69051 part 4 for fü ≥ 5. Please consult us if fü < 5.

f ü = S / P x I
fü = roll over ratio
S = travel [mm]
P = lead [mm]
i = number of load carrying threads in nut

C = Ci x f[N]
C_o = Coi x i [N]
C = dynamic load rating (total) [N]
C_i = dynamic load rating for i = 1 [N]
C_o = static load rating (total) [N]
C_{oi} = static load rating for i = 1 [N]
f = factor related to i





1) 2) d_1	P	1) 2) d_2	D_1 g6	K	F	i = 1 / f = 1 Slot	L_1	L_4	L_5	i = 2 / f = 1,625 Slot	L_1	L_4	L_5	i = 3 / f = 2,158 Slot	L_1	L_4	L_5	i = 4 / f = 2,639 Slot	L_1	L_4	L_5	i = 5 / f = 3,085 Slot	L_1	L_4	L_5	i = 6 / f = 3,505 Slot	L_1	L_4	L_5	4) C_i	4) C_{oi}
16	5	14,6	30	10	10	3 x 10	14	29	34	3 x 18	22	47	52																	6577	5019
20	5	16	36	10	10	6 x 10	14	29	34	6 x 18	22	47	52	6 x 20	28	58	63	6 x 28	34	69	74									8181	8740
25	5	21	40	10	10					6 x 18	22	47	52	6 x 22	28	58	63	6 x 28	34	69	74	6 x 32	38	78	83					8769	11346
	10	21	40	10	14					6 x 32	39	79	89	6 x 45	51	111	111													8439	10710
32	5	28	50	10	10					6 x 18	22	47	52	6 x 22	28	58	63	6 x 28	34	69	74	6 x 32	38	78	83					9045	13981
	10	28	50	10	14					6 x 32	39	79	89	6 x 45	51	111	111	6 x 56	65	135	135	6 x 63	71	151	151					11624	16110
40	5	36	65	10	10					6 x 18	22	47	52	6 x 22	28	58	63	6 x 28	34	69	74	6 x 32	38	78	83	6 x 36	44	89	94	10182	19174
	10	31,4	65	10	14					6 x 32	39	79	89	6 x 45	51	111	111	6 x 56	65	135	135									29318	38372
	20	36	70	10	24					6 x 40	50	110	110	6 x 63	70	150	150													12848	21620
50	5	46	75	10	10					6 x 18	22	47	52	6 x 22	28	58	63	6 x 28	34	69	74	6 x 32	38	78	83	6 x 36	44	89	94	10954	24402
	10	41,4	75	10	14					6 x 32	39	79	89	6 x 45	51	111	111	6 x 56	65	135	135	6 x 63	71	151	151	6 x 70	83	173	173	30365	47000
	20	41,4	80	10	24					6 x 40	50	110	110	6 x 63	70	150	150													30364	46999

The mentioned load ratings are related to a particular screw design.
Technical alternations reserved!

Single plain cylindrical nut Series A
Double plain cylindrical nut Series C

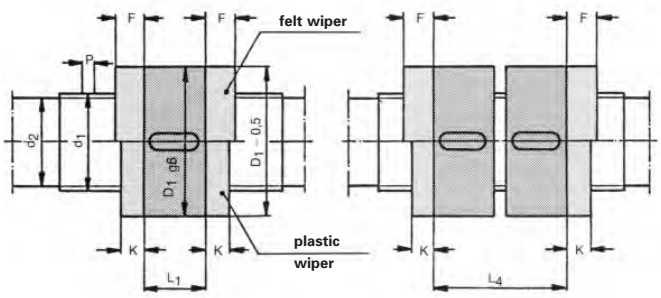
Special designs with dimensions and leads to customers' specifications can be supplied.

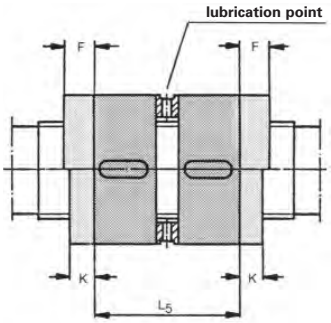
All dimensions in mm (" = lead in inches)
Housing to customer drawings can be supplied by RACO.
Tolerances not explicitly stated conform to German standard Din 7168.
Acceptance tests according to German standard DIN 69 051 part 3.

1) Where the permissible lead variation is 0.050 and 0.100 over 300 mm, d1 and d2 are subject to a tolerance of +0.4 mm.
2) The diameter of the ball screw end over which the nut is fitted must not exceed d2. If a diameter larger than d1 is required at the other spindle end, then this should be obtained by shrinking on collars and flanges to limit costs.
3) Oil holes can be incorporated on request (not standard).
4) Determination of load rating according to German standard DIN 69051 part 4 for fü ≥ 5. Please consult us if fü < 5.

f ü = S / P x I
fü = roll over ratio
S = travel [mm]
P = lead [mm]
i = number of load carrying threads in nut

C = Ci x f[N]
C_o = Coi x i [N]
C = dynamic load rating (total) [N]
C_i = dynamic load rating for i = 1 [N]
C_o = static load rating (total) [N]
C_{oi} = static load rating for i = 1 [N]
f = factor related to i





1) 2) d_1	P	1) 2) d_2	D_1 g6	K	F	i = 1 / f = 1 Slot	L_1	L_4	L_5	i = 2 / f = 1,625 Slot	L_1	L_4	L_5	i = 3 / f = 2,158 Slot	L_1	L_4	L_5	i = 4 / f = 2,639 Slot	L_1	L_4	L_5	i = 5 / f = 3,085 Slot	L_1	L_4	L_5	i = 6 / f = 3,505 Slot	L_1	L_4	L_5	4) C_i	4) C_{oi}
63	5	59	90	10	10					6 x 18	22	47	52	6 x 22	28	58	63	6 x 28	34	69	74	6 x 32	38	78	83	6 x 36	44	89	94	11602	30298
	10	54,4	90	10	14					6 x 32	39	79	89	6 x 45	51	111	111	6 x 56	65	135	135	6 x 63	71	151	151	6 x 70	83	173	173	33854	64052
	20	50,2	95	16	24					6 x 63	72	152	152	6 x 70	95	195	195	6 x 70	114	234	234									64343	89702
80	10	71,4	105	10	14					6 x 32	39	79	89	6 x 45	51	111	111	6 x 56	65	135	135	6 x 63	71	151	151	6 x 70	83	173	173	36064	81227
	20	65,1	125	20	24					6 x 70	78	158	178	6 x 70	102	222	222	6 x 100	118	238	258	6 x 100	142	302	302					92563	144782
100	10	91	125	10	14					6 x 32	39	79	89	6 x 45	51	111	111	6 x 56	65	135	135	6 x 63	71	151	151	6 x 70	83	173	173	38440	101264
	20	84,7	150	20	24					6 x 70	78	158	178	6 x 70	102	222	222	6 x 100	118	238	258	6 x 100	142	302	302	6 x 100	165	345	345	98898	184890
125	10	116,4	150	10	14					6 x 32	39	79	89	6 x 45	51	111	111	6 x 56	65	135	135	6 x 63	71	151	151	6 x 70	83	173	173	42368	132702
	20	110,1	170	20	24					6 x 70	78	158	178	6 x 70	102	222	222	6 x 100	118	238	258	6 x 100	142	302	302	6 x 100	165	345	345	105612	235119
160	10	151,4	185	10	14					6 x 32	39	79	89	6 x 45	51	111	111	6 x 56	65	135	135	6 x 63	71	151	151	6 x 70	83	173	173	45680	165672
	20	145,1	210	20	24					6 x 70	78	158	178	6 x 70	102	222	222	6 x 100	118	238	258	6 x 100	142	302	302	6 x 100	165	345	345	114100	305463
200	10	191,4	225	10	14					6 x 32	39	79	89	6 x 45	51	111	111	6 x 56	65	135	135	6 x 63	71	151	151	6 x 70	83	173	173	49628	210380
	20	185,1	250	20	24					6 x 70	78	158	178	6 x 70	102	222	222	6 x 100	118	238	258	6 x 100	142	302	302	6 x 100	165	345	345	122627	385876

The mentioned load ratings are related to a particular screw design.
Technical alternations reserved!

Single Flange Nut Series E
Back to back arrangement Series G

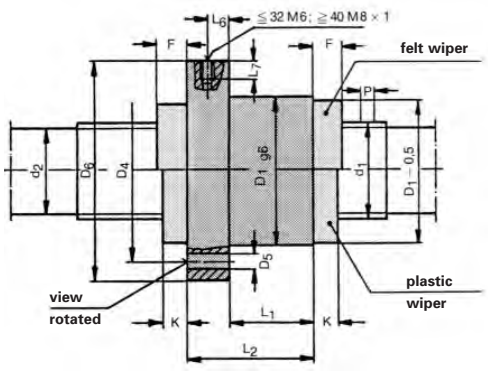
Special designs with dimensions and leads to customers' specifications can be supplied.

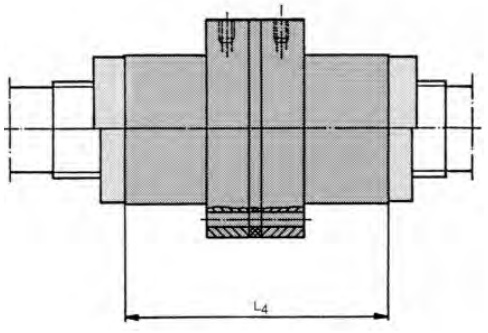
All dimensions in mm (" = lead in inches)
Housing to customer drawings can be supplied by RACO.
Tolerances not explicitly stated conform to German standard Din 7168.
Acceptance tests according to German standard DIN 69 051 part 3.

1) Where the permissible lead variation is 0.050 and 0.100 over 300 mm, d1 and d2 are subject to a tolerance of +0.4 mm.
2) The diameter of the ball screw end over which the nut is fitted must not exceed d2. If a diameter larger than d1 is required at the other spindle end, then this should be obtained by shrinking on collars and flanges to limit costs.
3) Oil holes can be incorporated on request (not standard).
4) Determination of load rating according to German standard DIN 69051 part 4 for fü ≥ 5. Please consult us if fü < 5.

f ü = S / P x I
fü = roll over ratio
S = travel [mm]
P = lead [mm]
i = number of load carrying threads in nut

C = Ci x f[N]
C_o = Coi x i [N]
C = dynamic load rating (total) [N]
C_i = dynamic load rating for i = 1 [N]
C_o = static load rating (total) [N]
C_{oi} = static load rating for i = 1 [N]
f = factor related to i





1) 2) d_1	P	1) 2) d_2	D_1 g6	D_4	D_5	D_6	K	F	3) L_6	L_7	L_8	L_9	i = 1 / f = 1 L_1	L_2	L_4	i = 2 / f = 1,625 L_1	L_2	L_4	i = 3 / f = 2,158 L_1	L_2	L_4	i = 4 / f = 2,639 L_1	L_2	L_4	i = 5 / f = 3,085 L_1	L_2	L_4	i = 6 / f = 3,505 L_1	L_2	L_4	4) C_i	4) C_{oi}
16	5	14,6	30	38	5,5	48	10	10	5	8	40	44	14	24	51	22	32	67	28	38	79	34	44	91	38	48	99	44	56	116	6577	5019
20	5	16	36	47	6,6	58	10	10	5	8	44	51	14	24	51	22	32	67	28	38	79	34	44	91							8181	8740
25	5	21	40	51	6,6	62	10	10	5	8	48	55				22	32	67	28	38	79	34	44	91	38	48	99				8769	11346
	10	21	40	51	6,6	62	10	14	5	8	48	55				39	49	101	51	61	125										8439	10710
32	5	28	50	65	9	80	10	10	6	8	62	71				22	34	72	28	40	84	34	46	96	38	50	104	44	56	116	9045	13981
	10	28	50	65	9	80	10	14	6	8	62	71				39	51	106	51	63	130	65	77	158							11624	16110
40	5	36	65	80	9	95	10	10	7	10	70	82,5				22	36	75	28	42	87	34	48	99	38	52	107	44	58	119	10182	19174
	10	31,4	65	80	9	95	10	14	7	10	70	82,5				39	53	112	51	65	136	65	79	164	71	85	176				29318	38372
	20	36	70	85	9	100	10	24	7	10	70	82,5				46	60	126													12848	21620
50	5	46	75	93	11	110	10	10	8	10	85	97,5				22	38	79	28	44	91	34	50	103	38	54	111	44	60	123	10954	24402
	10	41,4	75	93	11	110	10	14	8	10	85	97,5				39	55	116	51	67	140	65	81	168	71	87	180	83	99	204	30365	47000
	20	41,4	80	98	11	115	10	24	8	10	85	97,5				44	60	126													30365	47000

Single Flange Nut Series E
Back to back arrangement Series G

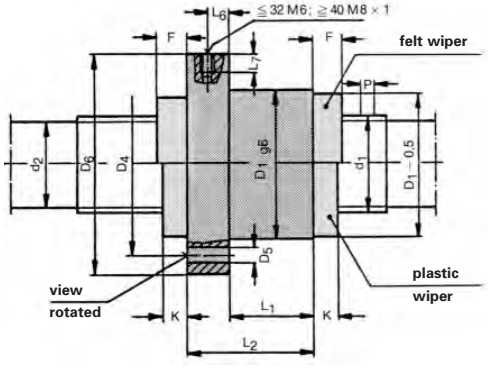
Special designs with dimensions and leads to customers' specifications can be supplied.

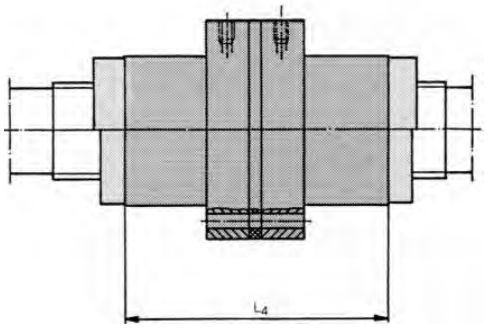
All dimensions in mm (" = lead in inches)
Housing to customer drawings can be supplied by RACO.
Tolerances not explicitly stated conform to German standard Din 7168.
Acceptance tests according to German standard DIN 69 051 part 3.

1) Where the permissible lead variation is 0.050 and 0.100 over 300 mm, d1 and d2 are subject to a tolerance of +0.4 mm.
2) The diameter of the ball screw end over which the nut is fitted must not exceed d2. If a diameter larger than d1 is required at the other spindle end, then this should be obtained by shrinking on collars and flanges to limit costs.
3) Oil holes can be incorporated on request (not standard).
4) Determination of load rating according to German standard DIN 69051 part 4 for fü ≥ 5. Please consult us if fü < 5.

f ü = S / P x I
fü = roll over ratio
S = travel [mm]
P = lead [mm]
i = number of load carrying threads in nut

C = Ci x f[N]
C_o = Coi x i [N]
C = dynamic load rating (total) [N]
C_i = dynamic load rating for i = 1 [N]
C_o = static load rating (total) [N]
C_{oi} = static load rating for i = 1 [N]
f = factor related to i





1) 2) d_1	P	1) 2) d_2	D_1 g6	D_4	D_5	D_6	K	F	3) L_6	L_7	L_8	L_9	i = 1 / f = 1 L_1	L_2	i = 2 / f = 1,625 L_1	L_2	L_4	i = 3 / f = 2,158 L_1	L_2	L_4	i = 4 / f = 2,639 L_1	L_2	L_4	i = 5 / f = 3,085 L_1	L_2	L_4	i = 6 / f = 3,505 L_1	L_2	L_4	4) C_i	4) C_{oi}
63	5	59	90	108	11	125	10	10	9	10	95	110			22	40	83	28	46	95	34	52	107	38	56	115	44	62	127	11602	30298
	10	54.4	90	108	11	125	10	14	9	10	95	110			39	57	117	51	69	141	65	83	169	71	89	181	83	101	205	33854	64052
	20	50.2	95	115	13,5	135	16	24	10	10	100	117,5			72	92	186	95	115	232	114	134	170							64343	89702
80	10	71,4	105	125	13,5	145	10	14	10	10	110	127,5			39	59	121	51	71	145	65	85	173	71	91	185	83	103	209	36064	81227
	20	65,1	125	145	13,5	165	20	24	12,5	10	130	147,5			78	103	210	102	127	258	118	143	290	142	167	338				92563	144782
100	10	91	125	145	13,5	165	10	14	11	10	130	147,5			39	61	125	51	73	149	65	87	177	71	93	199	83	105	213	38440	101264
	20	84,7	150	176	17,5	202	20	24	15	10	155	178,5			78	108	220	102	132	268	118	148	300	142	172	348	165	195	394	98898	184890
125	10	116,4	150	176	17,5	202	10	14	12,5	10	155	178,5			39	64	131	51	76	155	65	90	183	71	96	195	83	108	219	42368	132702
	20	110,1	170	196	17,5	222	20	24	15	10	175	198,5			78	108	220	102	132	268	118	148	300	142	172	348	165	195	394	105612	235119
160	10	151,4	185	212	17,5	240	10	14	15	10	190	215			39	69	141	51	81	165	65	95	193	71	101	205	83	113	229	45680	165672
	20	145,1	210	243	22	275	20	24	20	10	215	245			78	118	240	102	142	288	118	158	320	142	182	368	165	205	414	114100	305463
200	10	191,4	225	260	22	295	10	14	20	10	230	262,5			39	79	161	51	91	185	65	105	213	71	111	225	83	123	249	49628	210380
	20	185,1	250	290	26	315	20	24	22,5	10	255	285			78	123	251	102	147	299	118	163	331	142	187	379	165	210	425	122627	385876

Double Nut with vernier adjustment Series I

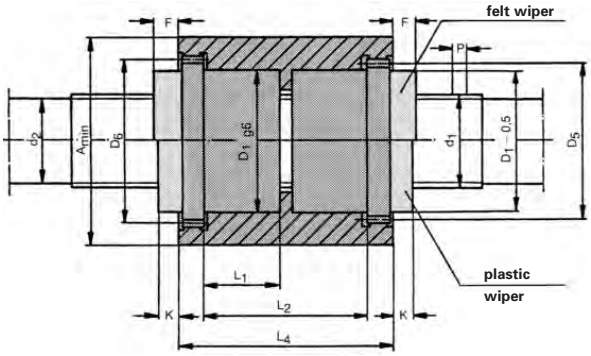
Special designs with dimensions and leads to customers' specifications can be supplied.

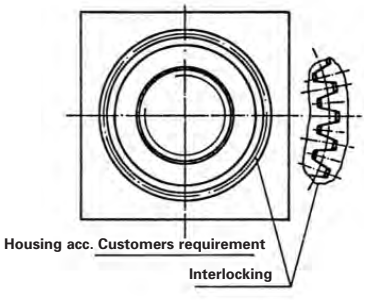
All dimensions in mm (" = lead in inches)
Housing to customer drawings can be supplied by RACO.
Tolerances not explicitly stated conform to German standard Din 7168.
Acceptance tests according to German standard DIN 69 051 part 3.

1) Where the permissible lead variation is 0.050 and 0.100 over 300 mm, d1 and d2 are subject to a tolerance of +0.4 mm.
2) The diameter of the ball screw end over which the nut is fitted must not exceed d2. If a diameter larger than d1 is required at the other spindle end, then this should be obtained by shrinking on collars and flanges to limit costs.
3) Oil holes can be incorporated on request (not standard).
4) Determination of load rating according to German standard DIN 69051 part 4 for fü ≥ 5. Please consult us if fü < 5.

f ü = S / P x I
fü = roll over ratio
S = travel [mm]
P = lead [mm]
i = number of load carrying threads in nut

C = Ci x f[N]
C_o = Coi x i [N]
C = dynamic load rating (total) [N]
C_i = dynamic load rating for i = 1 [N]
C_o = static load rating (total) [N]
C_{oi} = static load rating for i = 1 [N]
f = factor related to i





1) 2) d_1	P	1) 2) d_2	D_1 g6	D_5	D_6	K	F	A_{min}	i = 1 / f = 1			i = 2 / f = 1,625			i = 3 / f = 2,158			i = 4 / f = 2,639			i = 5 / f = 3,085			i = 6 / f = 3,505			4) C_i	4) C_{oi}
									L_1	L_2	L_4	L_1	L_2	L_4	L_1	L_2	L_4	L_1	L_2	L_4	L_1	L_2	L_4	L_1	L_2	L_4		
20	5	16	36	39	39,5	10	10	47	14	36	52	22	52	68	28	64	80										8181	8740
25	5	21	40	44	45	10	10	60	14	36	52	22	52	68	28	64	80	34	76	92	38	84	100				8769	11346
	10	21	40	44	45	10	14	60	25	58	74	39	86	102	51	110	126										8439	10710
32	5	28	47	51	52	10	10	65				22	54	74	28	66	86	34	78	98	38	86	106	44	98	118	9045	13981
	10	28	50	54	65	10	14	70				39	90	110	51	114	134	65	142	162							11624	16110
40	5	36	55	59	60	10	10	75				22	54	74	28	66	86	34	78	98	38	86	106	44	98	118	10182	19174
	10	31,4	65	69	70	10	14	85				39	90	110	51	114	134	65	142	162	71	154	174				12848	21620
	20	36	70	74	75	10	24	90				42	96	116														
50	5	46	65	69	70	10	10	85				22	56	76	28	68	88	34	80	100	38	88	108	44	100	120	10954	24402
	10	41,4	75	79	80	10	14	95				39	92	112	51	116	136	65	144	164	71	156	176	83	180	200	30365	47000
	20	41,4	80	84	85	10	24	100				42	98	118	62	138	158										30364	46999
63	5	59	80	85,5	87	10	10	105				22	56	80	28	68	92	34	80	104	38	88	112	44	100	124	11602	30298
	10	54,4	90	96	97,5	10	14	125				39	92	116	51	116	140	65	144	168	71	156	180	83	180	204	33854	64052
	20	50.2	100	105	106,5	16	24	135				72	160	184	95	206	230	114	244	268							64343	89702

Double Nut with vernier adjustment Series I

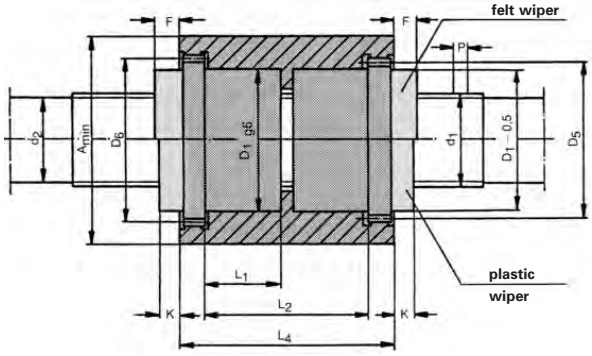
Special designs with dimensions and leads to customers' specifications can be supplied.

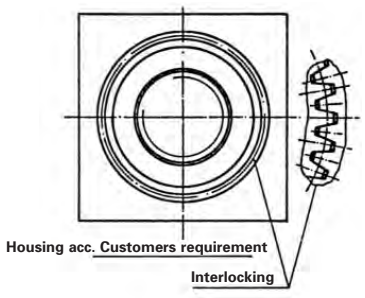
All dimensions in mm (" = lead in inches)
Housing to customer drawings can be supplied by RACO.
Tolerances not explicitly stated conform to German standard Din 7168.
Acceptance tests according to German standard DIN 69 051 part 3.

1) Where the permissible lead variation is 0.050 and 0.100 over 300 mm, d1 and d2 are subject to a tolerance of +0.4 mm.
2) The diameter of the ball screw end over which the nut is fitted must not exceed d2. If a diameter larger than d1 is required at the other spindle end, then this should be obtained by shrinking on collars and flanges to limit costs.
3) Oil holes can be incorporated on request (not standard).
4) Determination of load rating according to German standard DIN 69051 part 4 for fü ≥ 5. Please consult us if fü < 5.

f ü = S / P x I
fü = roll over ratio
S = travel [mm]
P = lead [mm]
i = number of load carrying threads in nut

C = Ci x f[N]
C_o = Coi x i [N]
C = dynamic load rating (total) [N]
C_i = dynamic load rating for i = 1 [N]
C_o = static load rating (total) [N]
C_{oi} = static load rating for i = 1 [N]
f = factor related to i





1) 2) d_1	P	1) 2) d_2	D_1 g6	D_5	D_6	K	F	A_{min}	i = 1 / f = 1 L_1	L_2	L_4	i = 2 / f = 1,625 L_1	L_2	L_4	i = 3 / f = 2,158 L_1	L_2	L_4	i = 4 / f = 2,639 L_1	L_2	L_4	i = 5 / f = 3,085 L_1	L_2	L_4	i = 6 / f = 3,505 L_1	L_2	L_4	4) C_i	4) C_{oi}
80	10	71,4	105	109,5	111	10	14	125				39	94	118	51	118	142	65	146	170	71	158	182	83	182	206	36064	81227
	20	65,1	125	130,5	132	20	24	150				78	172	196	102	220	244	118	252	276	142	300	324				92563	144782
100	10	91	125	130	132	10	14	150				39	94	118	51	118	142	65	146	170	71	158	182	83	182	206	38440	101264
	20	84,7	150	156	158	20	24	175				78	176	200	102	224	248	118	256	280	142	304	328	165	350	374	98898	184890
125	10	116,4	150	156	158	10	14	175				39	94	118	51	118	142	65	146	170	71	158	182	83	182	206	42368	132702
	20	110,1	175	180	182	20	24	200				78	176	200	102	224	248	118	256	280	142	304	328	165	350	374	105612	235119
160	10	151,4	185	190	192	10	14	210				39	94	118	51	118	142	65	146	170	71	158	182	83	182	206	45680	165672
	20	145,1	210	216	218	20	24	235				78	176	200	102	224	248	118	256	280	142	304	328	165	350	374	114100	305463
200	10	191,4	225	230	232	10	14	250				39	94	118	51	118	142	65	146	170	71	158	182	83	182	206	49628	210380
	20	185,1	250	256	258	20	24	275				78	176	200	102	224	248	118	256	280	142	304	328	165	350	374	122627	385876

Double flanged nut with preload adjustment Series L

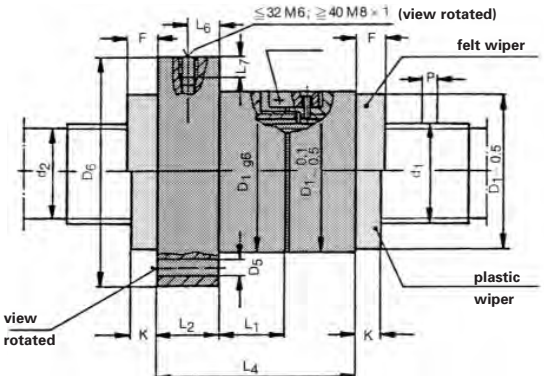
Special designs with dimensions and leads to customers' specifications can be supplied.

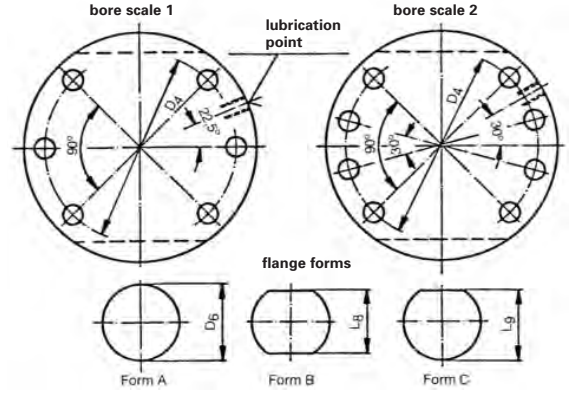
All dimensions in mm (" = lead in inches)
Housing to customer drawings can be supplied by RACO.
Tolerances not explicitly stated conform to German standard Din 7168.
Acceptance tests according to German standard DIN 69 051 part 3.

1) Where the permissible lead variation is 0.050 and 0.100 over 300 mm, d1 and d2 are subject to a tolerance of +0.4 mm.
2) The diameter of the ball screw end over which the nut is fitted must not exceed d2. If a diameter larger than d1 is required at the other spindle end, then this should be obtained by shrinking on collars and flanges to limit costs.
3) Oil holes can be incorporated on request (not standard).
4) Determination of load rating according to German standard DIN 69051 part 4 for fü ≥ 5. Please consult us if fü < 5.

f ü = S / P x I
fü = roll over ratio
S = travel [mm]
P = lead [mm]
i = number of load carrying threads in nut

C = Ci x f[N]
C_o = Coi x i [N]
C = dynamic load rating (total) [N]
C_i = dynamic load rating for i = 1 [N]
C_o = static load rating (total) [N]
C_{oi} = static load rating for i = 1 [N]
f = factor related to i





d_1 1) 2)	P	d_2 1) 2)	D_1 g6	D_4	D_5	D_6	K	F	L_6 3)	L_7	L_8	L_9	i = 1 / f = 1 L_1	L_2	L_4	i = 2 / f = 1,625 L_1	L_2	L_4	i = 3 / f = 2,158 L_1	L_2	L_4	i = 4 / f = 2,639 L_1	L_2	L_4	i = 5 / f = 3,085 L_1	L_2	L_4	i = 6 / f = 3,505 L_1	L_2	L_4	4) C_i	4) C_{oi}
20	5	16	50	65	9	80	10	10	6	8	62	71	27	12	66	35	12	82	41	12	94	47	12	106							8181	8740
25	5	21	50	65	9	80	10	10	6	8	62	71	27	12	66	35	12	82	41	12	94	47	12	106	51	12	114				8769	11346
	10	21	50	65	9	80	10	14	6	8	62	71	38	12	86	53	12	116	65	12	164	78									8439	10710
32	5	28	65	80	9	95	10	10	7	10	70	82,5				35	14	84	41	14	96	47	14	108	51	14	116	57	14	128	9045	13981
	10	28	65	80	9	95	10	14	7	10	70	82,5				53	14	118	65	14	142	78	14	168							11624	16110
40	5	36	65	80	9	95	10	10	7	10	70	82,5				35	14	84	41	14	96	47	14	108	51	14	116	57	14	128	10182	19174
	10	31,4	65	80	9	95	10	14	7	10	70	82,5				53	14	118	65	14	142	78	14	168	85	14	182				29318	38372
	20	36	70	85	9	100	10	24	7	10	70	82,5				37	14	124													12848	21620
50	5	46	75	93	11	110	10	10	8	10	85	97,5				35	16	86	41	16	98	47	16	110	51	16	118	57	16	130	10954	24402
	10	41,4	75	93	11	110	10	14	8	10	85	97,5				53	16	120	65	16	144	78	16	170	85	16	184	97	16	208	30365	47000
	20	41,4	80	98	11	115	10	24	8	10	85	97,5				35	16	124	55	16	164										30364	46999
63	5	59	90	108	11	125	10	10	9	10	95	110				35	18	88	41	18	100	47	18	112	51	18	120	57	18	132	11602	30298
	10	54,4	90	108	11	125	10	14	9	10	95	110				53	18	122	65	18	146	78	18	172	85	18	186	97	18	210	33854	64052
	20	50,2	95	115	13,5	135	16	24	10	10	100	117,5				91	20	200	111	20	235	133	20	284							64343	89702

The mentioned load ratings are related to a particular screw design.
Technical alternations reserved!

Double flanged nut with preload adjustment Series L

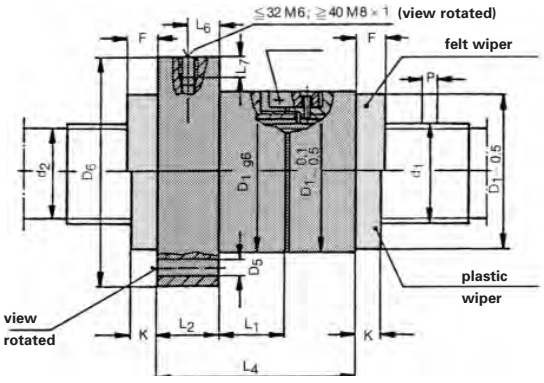
Special designs with dimensions and leads to customers' specifications can be supplied.

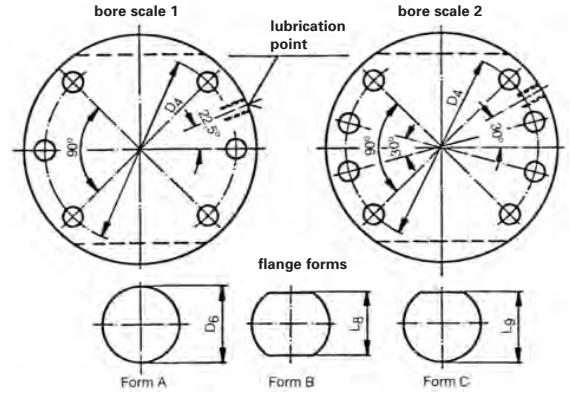
All dimensions in mm (" = lead in inches)
Housing to customer drawings can be supplied by RACO.
Tolerances not explicitly stated conform to German standard Din 7168.
Acceptance tests according to German standard DIN 69 051 part 3.

1) Where the permissible lead variation is 0.050 and 0.100 over 300 mm, d1 and d2 are subject to a tolerance of +0.4 mm.
2) The diameter of the ball screw end over which the nut is fitted must not exceed d2. If a diameter larger than d1 is required at the other spindle end, then this should be obtained by shrinking on collars and flanges to limit costs.
3) Oil holes can be incorporated on request (not standard).
4) Determination of load rating according to German standard DIN 69051 part 4 for fü ≥ 5. Please consult us if fü < 5.

f ü = S / P x I
fü = roll over ratio
S = travel [mm]
P = lead [mm]
i = number of load carrying threads in nut

C = Ci x f[N]
C_o = Coi x i [N]
C = dynamic load rating (total) [N]
C_i = dynamic load rating for i = 1 [N]
C_o = static load rating (total) [N]
C_{oi} = static load rating for i = 1 [N]
f = factor related to i





1) 2) d_1	P	1) 2) d_2	D_1, g6	D_4	D_5	D_6	K	F	3) L_6	L_7	L_8	L_9	i = 1 / f = 1 L_1	L_2	L_4	i = 2 / f = 1,625 L_1	L_2	L_4	i = 3 / f = 2,158 L_1	L_2	L_4	i = 4 / f = 2,639 L_1	L_2	L_4	i = 5 / f = 3,085 L_1	L_2	L_4	i = 6 / f = 3,505 L_1	L_2	L_4	4) C_i	4) C_{oi}
80	10	71,4	105	125	13,5	145	10	14	10	10	110	127,5				53	20	124	65	20	148	78	20	174	85	20	188	97	20	212	36064	81227
	20	65,1	125	145	13,5	165	20	24	12,5	10	130	147,5				91	25	205	115	25	253	133	25	289	155	25	233				92563	144782
100	10	91	125	145	13,5	165	10	14	11	10	130	147,5				53	22	126	65	22	150	78	22	176	85	22	190	97	22	214	38440	101264
	20	84,7	150	176	17,5	202	20	24	15	10	155	178,5				91	30	210	115	30	258	133	30	294	155	30	338	178	30	384	98898	184890
125	10	116,4	150	176	17,5	202	10	14	12,5	10	155	178,5				53	25	129	65	25	153	78	25	179	85	25	193	97	25	217	42368	132702
	20	110,1	170	196	17,5	222	20	24	15	10	175	198,5				91	30	210	115	30	258	133	30	294	155	30	338	178	30	384	105612	235119
160	10	151,4	185	212	17,5	240	10	14	15	10	190	215				53	30	134	65	30	158	78	30	184	85	30	198	97	30	222	45680	165672
	20	145,1	210	243	22	275	20	24	20	10	215	245				91	40	220	115	40	268	133	40	304	155	40	348	178	40	394	114100	305463
200	10	191,4	225	260	22	295	10	14	20	10	230	262,5				53	40	144	65	40	168	78	40	194	85	40	208	97	40	232	49628	210380
	20	185,1	250	290	26	315	20	24	22,5	10	255	285				91	45	225	115	45	273	133	45	309	155	45	353	178	45	399	122627	385876

The mentioned load ratings are related to a particular screw design.
Technical alternations reserved!

Flanged nut with preload adjustment Series N

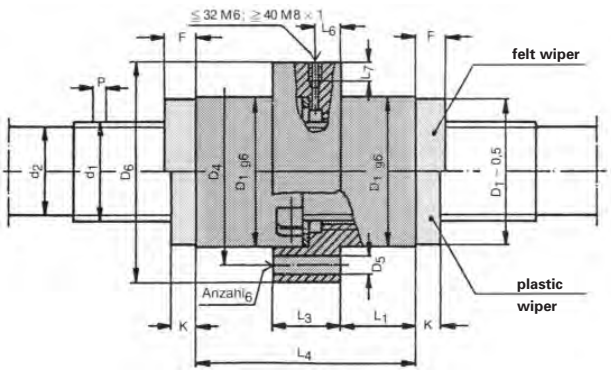
Special designs with dimensions and leads to customers' specifications can be supplied.

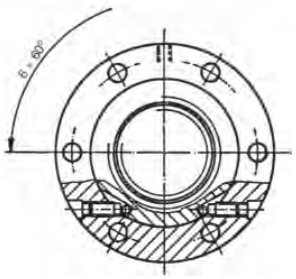
All dimensions in mm (" = lead in inches)
Housing to customer drawings can be supplied by RACO.
Tolerances not explicitly stated conform to German standard Din 7168.
Acceptance tests according to German standard DIN 69 051 part 3.

1) Where the permissible lead variation is 0.050 and 0.100 over 300 mm, d1 and d2 are subject to a tolerance of +0.4 mm.
2) The diameter of the ball screw end over which the nut is fitted must not exceed d2. If a diameter larger than d1 is required at the other spindle end, then this should be obtained by shrinking on collars and flanges to limit costs.
3) Oil holes can be incorporated on request (not standard).
4) Determination of load rating according to German standard DIN 69051 part 4 for fü ≥ 5. Please consult us if fü < 5.

f ü = S / P x I
fü = roll over ratio
S = travel [mm]
P = lead [mm]
i = number of load carrying threads in nut

C = Ci x f[N]
C_o = Coi x i [N]
C = dynamic load rating (total) [N]
C_i = dynamic load rating for i = 1 [N]
C_o = static load rating (total) [N]
C_{oi} = static load rating for i = 1 [N]
f = factor related to i





1) 2) d_1	P	1) 2) d_2	D_1 g6	D_4	D_5	D_6	K	F	3) L_6	L_7	i = 1 / f = 1 L_1	i = 1 / f = 1 L_3	i = 1 / f = 1 L_4	i = 2 / f = 1,625 L_1	i = 2 / f = 1,625 L_3	i = 2 / f = 1,625 L_4	i = 3 / f = 2,158 L_1	i = 3 / f = 2,158 L_3	i = 3 / f = 2,158 L_4	i = 4 / f = 2,639 L_1	i = 4 / f = 2,639 L_3	i = 4 / f = 2,639 L_4	i = 5 / f = 3,085 L_1	i = 5 / f = 3,085 L_3	i = 5 / f = 3,085 L_4	i = 6 / f = 3,505 L_1	i = 6 / f = 3,505 L_3	i = 6 / f = 3,505 L_4	4) C_i	4) C_{oi}
20	5	16	35	50	6,4	63	10	10	8	5	14	20	41	22	20	54	28	25	70	34	25	81	38	30	90	44	30	101	8181	8740
25	5	21	40	55	8,4	70	10	10	8	5	14	20	36	22	20	54	28	25	70	34	25	81	38	30	90	44	30	101	8769	11346
	10	21	42	58	8,4	75	10	14	8	5	25	25	61	39	25	91	51	25	113	65	30	147	71	30	158	83	30	180	8439	10710
32	5	28	47	63	8,4	80	10	10	8	6				22	25	54	28	25	70	34	25	81	38	30	90	44	30	101	9045	13981
	10	28	55	75	10,5	95	10	14	8	6				39	25	91	51	25	113	65	30	147							11624	16110
40	5	36	55	71	8,4	85	10	10	10	8				22	25	59	28	25	70	34	30	86	38	30	90	44	30	101	10182	19174
	10	31,4	65	85	10,5	105	10	14	10	8				39	25	91	51	35	123	65	30	147	71	30	158				29318	38372
	20	36	70	90	13	110	10	24	10	8				46	35	117													12848	21620
50	5	46	65	85	10,5	105	10	10	10	8				22	25	59	28	25	70	34	30	86	38	30	90	44	30	101	10954	24402
	10	41,4	75	95	13	115	10	14	10	8				39	25	91	51	35	123	65	30	147	71	30	158	83	30	180	30365	47000
	20	41,4	80	100	13	120	10	24	10	8				46	35	117	66	40	157										30364	46999
63	5	59	78	100	10,5	120	10	10	10	9				22	25	59	28	25	70	34	30	86	38	30	90	44	30	101	11602	30298
	10	54,4	90	120	17	150	10	14	10	9				39	25	91	51	35	123	65	30	147	71	40	163	83	40	185	33854	64052
	20	50,2	95	125	17	155	16	24	10	9				72	50	174	95	50	214	114	50	256							64343	89702

Flanged nut with preload adjustment Series N

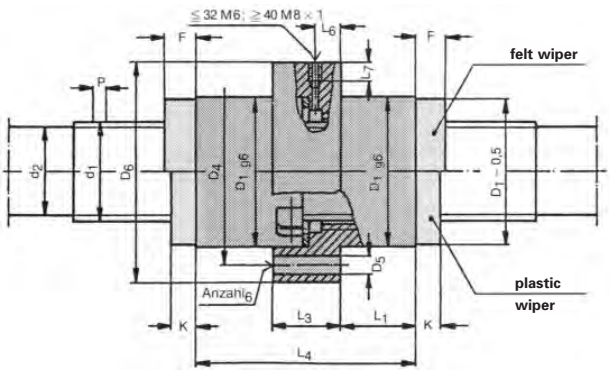
Special designs with dimensions and leads to customers' specifications can be supplied.

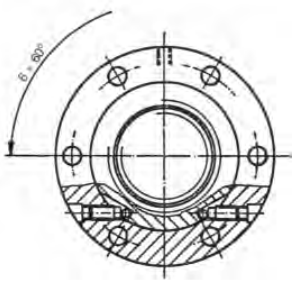
All dimensions in mm (" = lead in inches)
Housing to customer drawings can be supplied by RACO.
Tolerances not explicitly stated conform to German standard Din 7168.
Acceptance tests according to German standard DIN 69 051 part 3.

1) Where the permissible lead variation is 0.050 and 0.100 over 300 mm, d1 and d2 are subject to a tolerance of +0.4 mm.
2) The diameter of the ball screw end over which the nut is fitted must not exceed d2. If a diameter larger than d1 is required at the other spindle end, then this should be obtained by shrinking on collars and flanges to limit costs.
3) Oil holes can be incorporated on request (not standard).
4) Determination of load rating according to German standard DIN 69051 part 4 for fü ≥ 5. Please consult us if fü < 5.

f ü = S / P x I
fü = roll over ratio
S = travel [mm]
P = lead [mm]
i = number of load carrying threads in nut

C = Ci x f[N]
C_o = Coi x i [N]
C = dynamic load rating (total) [N]
C_i = dynamic load rating for i = 1 [N]
C_o = static load rating (total) [N]
C_{oi} = static load rating for i = 1 [N]
f = factor related to i





1) 2) d_1	P	1) 2) d_2	D_1 g6	D_4	D_5	D_6	K	F	3) L_6	L_7	i = 1 / f = 1 L_1	i = 1 / f = 1 L_3	i = 1 / f = 1 L_4	i = 2 / f = 1,625 L_1	i = 2 / f = 1,625 L_3	i = 2 / f = 1,625 L_4	i = 3 / f = 2,158 L_1	i = 3 / f = 2,158 L_3	i = 3 / f = 2,158 L_4	i = 4 / f = 2,639 L_1	i = 4 / f = 2,639 L_3	i = 4 / f = 2,639 L_4	i = 5 / f = 3,085 L_1	i = 5 / f = 3,085 L_3	i = 5 / f = 3,085 L_4	i = 6 / f = 3,505 L_1	i = 6 / f = 3,505 L_3	i = 6 / f = 3,505 L_4	4) C_i	4) C_{oi}
80	10	71,4	105	135	17	165	10	14	10	10				39	25	91	51	35	123	65	40	157	71	40	163	83	40	185	36064	81227
	20	65,1	130	165	21	200	20	24	10	10				78	50	180	102	50	224	118	50	260	142	50	304				92563	144782
100	10	91	130	165	21	200	10	14	10	10				39	30	91	51	35	123	65	40	157	71	40	163	83	40	185	38440	101264
	20	84,7	150	185	21	220	20	24	10	10				78	50	180	102	50	224	118	50	260	142	50	304	165	50	347	98898	184890
125	10	116,4	160	200	21	240	10	14	10	10				39	30	91	51	35	123	65	40	157	71	40	163	83	40	185	42368	132702
	20	110,1	170	210	25	250	20	24	10	10				78	50	180	102	50	224	118	50	260	142	50	304	165	50	347	105612	235119
160	10	151,4	200	240	25	280	10	14	10	10				39	30	91	51	35	123	65	40	157	71	40	163	83	40	185	45680	165672
	20	145,1	200	240	25	280	20	24	10	10				78	50	180	102	50	224	118	50	260	142	50	304	165	50	347	114100	305463
200	10	191,4	225	265	25	295	10	14	10	10				39	30	91	51	35	123	65	40	157	71	40	163	83	40	185	49628	210380
	20	185,1	250	290	25	310	20	24	10	10				78	50	180	102	50	224	118	50	260	142	50	304	165	50	347	122627	385876

Double flanged nut with preload adjustment
Outward facing flanges Series Q

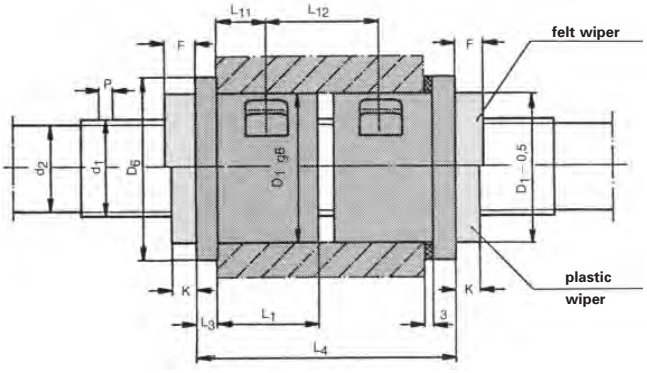
Special designs with dimensions and leads to customers' specifications can be supplied.

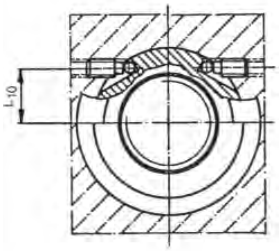
All dimensions in mm (" = lead in inches)
Housing to customer drawings can be supplied by RACO.
Tolerances not explicitly stated conform to German standard Din 7168.
Acceptance tests according to German standard DIN 69 051 part 3.

1) Where the permissible lead variation is 0.050 and 0.100 over 300 mm, d1 and d2 are subject to a tolerance of +0.4 mm.
2) The diameter of the ball screw end over which the nut is fitted must not exceed d2. If a diameter larger than d1 is required at the other spindle end, then this should be obtained by shrinking on collars and flanges to limit costs.
3) Oil holes can be incorporated on request (not standard).
4) Determination of load rating according to German standard DIN 69051 part 4 for fü ≥ 5. Please consult us if fü < 5.

f ü = S / P x I
fü = roll over ratio
S = travel [mm]
P = lead [mm]
i = number of load carrying threads in nut

C = Ci x f[N]
C_o = Coi x i [N]
C = dynamic load rating (total) [N]
C_i = dynamic load rating for i = 1 [N]
C_o = static load rating (total) [N]
C_{oi} = static load rating for i = 1 [N]
f = factor related to i





1) 2) d_1	P	1) 2) d_2	D_1 g6	D_6	L_{10}	L_{11}	K	F	i = 1 / f = 1				i = 2 / f = 1,625				i = 3 / f = 2,158				i = 4 / f = 2,639				i = 5 / f = 3,085				i = 6 / f = 3,505				4) C_i	4) C_{oi}
									L_1	L_3	L_4	L_{12}	L_1	L_3	L_4	L_{12}	L_1	L_3	L_4	L_{12}	L_1	L_3	L_4	L_{12}	L_1	L_3	L_4	L_{12}	L_1	L_3	L_4	L_{12}		
20	5	16	36	50	13	8	10	10	14	6	49	18	22	6	60	29	28	6	72	41													8181	8740
25	5	21	42	55	16	10	10	10	14	6	49	14	22	8	64	25	28	8	76	37	34	8	88	49	38	8	96	57					8769	11346
	10	21	42	55	16	16	10	14	25	6	68	21	39	8	100	49	51	8	124	73													8439	10710
32	5	28	50	60	19	10	10	10					22	8	64	25	28	8	76	37	34	8	88	49	38	8	96	57	44	8	108	69	9045	13981
	10	28	55	63	21	16	10	14					39	8	100	49	51	8	124	73	65	8	152	101	71	8	164	113					11624	16110
40	5	36	65	75	25	10	10	10					22	8	64	25	28	8	76	37	34	8	88	49	38	8	96	57	44	8	108	69	10182	19174
	10	31,4	65	75	25	16	10	14					39	8	100	49	51	8	124	73	65	8	152	101	71	8	164	113					29318	38372
	20	36	70	80	25	16	10	24					50	8	126	75																	12848	21620
50	5	46	70	85	27.5	10	10	10					22	10	68	25	28	10	80	37	34	10	92	49	38	10	100	57	44	10	112	69	10954	24402
	10	41,4	75	90	29.5	16	10	14					39	10	104	49	51	10	128	73	65	10	156	101	71	10	168	113	83	10	192	137	30365	47000
	20	41,4	80	95	29.5	20	10	24					50	10	130	67	70	10	170	107													30364	46999
63	5	59	85	100	34	10	10	10					22	10	68	25	28	10	80	37	34	10	92	49	38	10	100	57	44	10	112	69	11602	30298
	10	54,4	90	110	36	16	10	14					39	10	104	49	51	10	128	73	65	10	156	101	71	10	168	113	83	10	192	137	33854	64052
	20	50,2	95	110	38	24	16	24					72	10	174	103	95	10	220	149	114	10	258	187									64343	89702

The mentioned load ratings are related to a particular screw design.
Technical alternations reserved!

Double flanged nut with preload adjustment
Outward facing flanges Series Q

Special designs with dimensions and leads to customers' specifications can be supplied.

All dimensions in mm (" = lead in inches)
Housing to customer drawings can be supplied by RACO.
Tolerances not explicitly stated conform to German standard Din 7168.
Acceptance tests according to German standard DIN 69 051 part 3.

1) Where the permissible lead variation is 0.050 and 0.100 over 300 mm, d1 and d2 are subject to a tolerance of +0.4 mm.
2) The diameter of the ball screw end over which the nut is fitted must not exceed d2. If a diameter larger than d1 is required at the other spindle end, then this should be obtained by shrinking on collars and flanges to limit costs.
3) Oil holes can be incorporated on request (not standard).
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f ü = S / P x I
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S = travel [mm]
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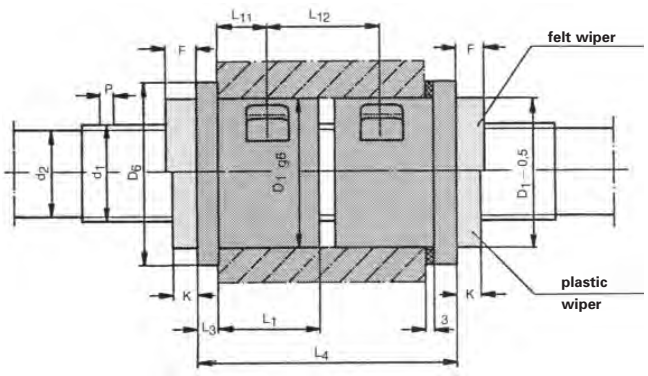

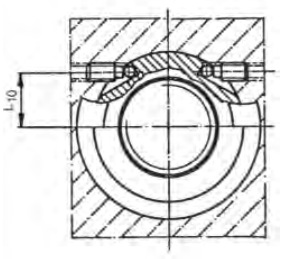

1) 2) d_1	P	1) 2) d_2	D_1 g6	D_6	L_{10}	L_{11}	K	F	i = 1 / f = 1 L_1	L_3	L_4	L_{12}	i = 2 / f = 1,625 L_1	L_3	L_4	L_{12}	i = 3 / f = 2,158 L_1	L_3	L_4	L_{12}	i = 4 / f = 2,639 L_1	L_3	L_4	L_{12}	i = 5 / f = 3,085 L_1	L_3	L_4	L_{12}	i = 6 / f = 3,505 L_1	L_3	L_4	L_{12}	4) C_i	4) C_{oi}
80	10	71,4	105	130	42,5	16	10	14					39	14	112	49	51	14	136	73	65	14	164	101	71	14	176	113	83	14	200	137	36064	81227
	20	65,1	125	150	51	24	20	24					78	14	194	115	102	14	242	163	118	14	274	195	142	14	322	243					92563	144782
100	10	91	130	155	52,5	16	10	14					39	16	116	49	51	16	140	73	65	16	168	101	71	16	180	113	83	16	204	137	38440	101264
	20	84,7	150	175	61	24	20	24					78	16	198	115	102	16	246	163	118	16	278	195	142	16	326	243	165	16	372	289	98898	184890
125	10	116,4	160	185	66	16	10	14					39	16	116	49	51	16	140	73	65	16	168	101	71	16	180	113	83	16	204	137	42368	132702
	20	110,1	170	195	70	24	20	24					78	16	198	115	102	16	646	163	118	16	278	195	142	16	326	243	165	16	372	289	105612	235119
160	10	151,4	185	215	76	16	10	14					39	20	124	49	51	20	148	73	65	20	176	101	71	20	188	113	83	20	212	137	45680	165672
	20	145,1	210	240	87	24	20	24					78	20	206	115	102	20	254	163	118	20	286	195	142	20	334	243	165	20	380	289	114100	305463
200	10	191,4	225	255	93	16	10	14					39	20	124	49	51	20	148	73	65	20	176	101	71	20	188	113	83	20	212	137	49628	210380
	20	185,1	250	280	104	24	20	24					78	20	206	115	102	20	254	163	118	20	286	195	142	20	334	243	165	20	380	289	122627	385876

8 QUALITY ASSURANCE

Everything fits together with RACO

Design and production under one roof - that's RACO. Whatever you have to move, you can be sure with RACO that ideas and products fit together. With complex sequences of motion such as multiple-level workpiece positioning, it's essential that hardware and software work together without a hitch. With our leading-edge technology and production quality, you can be sure that the processes run the way you want them to.

Our principle is giving you maximum quality

RACO means maximum quality for engineering positioning and handling operations. And there's a good reason for that. We build all of the essential components for our products ourselves. That means we can incorporate the technical aspects of the application early in the manufacturing stage of our spindles. Beyond this, our experience in the manufacture of trapezoidal and ball screw spindles guarantees a maximum of operating reliability. We check every product leaving our production site right down to the last screw.

Fig. 24: Surface measurement device

Precision components that are still robust

RACO's ball screws are real workhorses for long service lives even under the toughest conditions. Our products show their strength wherever the need is for a precision component that is still robust. Take mining, steel and rolling mills and traffic engineering for example. That's where our long-life products bring you economic benefits.

Fig. 25: Laser linear measurement equipment

9 SERVICE / MAINTENANCE

Ball screws have to be mounted so that radial or excentric loads can not appear at the screw or nut . Only axial forces should be transferred and the end positions have to be defined by switches and by mechanical barrier, to protect the nut assembly.

Dismounting and assembly of the ball screws and nuts

RACO ball screws are invariably supplied with the nut fitting. If removal of the nut is necessary, the following procedure applies:

An assembling sleeve with an outer diameter of 1.02 x d_2 and at least twice as long as the nut has to be available for receiving the nut.

This sleeve is butted up against the start of the thread and the nut including the balls are threaded onto it by rotation in the direction corresponding to the hand of the thread. The nut can then be withdrawn complete with the sleeve

Assembly takes place in the reverse sequence. During this process care has to be taken so none of the balls get into the dead zones of the thread between the crossover pieces.

NOTE: Defective balls screws and nuts and preloaded nut assemblies should be repaired in our works!

Installation

Prior to fitting, the ball screw and nut should be cleaned with a cleaning agent, e. g. white spirit, if it is necessary. The cleaning agents used must not attack the wiper materials such as nylon and felt. As a rule, the removal of the corrosion inhibitor is not necessary.

The ball screws and nuts are protected from corrosion in our shop and require lubrication (oil or grease) before operation. As ball screws and nuts are sensitive to dirt and chips, they invariably must be protected by tightly fitting covers, such as concertina covers or telescopic springs.

To achieve the desired service life, the balls screws must be fitted without alignment error between the screw bearings, the nut mounting and the slideways. Where the housing for the double cylindrical nuts is supplied by the customer, the permissible axial run-out of the nut locating face relative to the locating bore in the housing must not exceed 0.005 mm.

NOTE: Never dismount the guiding inserts!
Never put additional balls as substitution for lost balls in the nut assembly!
Assembly of nut with new balls should be carried out by specialists!

Max. permissible speed of rotation

The maximum permissible speed of rotation depends on the speed of the balls in the nut assembly and the centrifugal forces generated by them. A rough guideline for medium sized diameter is

$n \times d_1 =$ 110 000

n = speed of rotation (rpm)

d_1 = screw dia. (mm)

This does not take into consideration other factors such as ball diameter, lead, operating, conditions and the critical speed of rotation of the screw. Please consult us for applications within the critical range.

Permissible operating temperature

The standard ball screws can be used at temperatures ranging from -30 + 110°C without taking the dimensional changes due the temperature into consideration. Please consult us for applications outsides these limits.

Lubrication

Lubricants have the task of reducing friction and, together with the wipers and covers, of protecting the ball screws from wear and corrosion. The choice of lubricants and the type of lubrication should suit the speed of rotation, the load and the operating temperature. Similar considerations as for the lubrication of rolling bearings apply.

Due to the axial movement between screw and nut, however, and the imperfect sealing, the loss of lubricant is greater than with ordinary rolling bearings. Therefore, a single charge of grease usually is not adequate for the entire life of the ball screw. Graphite and molybdenum disulphide additives should be avoided if possible.

A few rough guidelines are given below. The choice of lubricant and the lubrication system for the entire machine must be taken into account in individual cases.

Oil lubrication

One of the effects of severe fluctuations in the operating temperature is a change in the length of the screw, which is detrimental, to the positioning accuracy. In such cases, oil rather than grease lubrication can be used to provide an additional means of heat dissipation.

For recirculating systems we recommend mineral oils with additives for improving the resistance to aging and the corrosion protection, such as CL oils to German standard DIN 51517 part 2.

In the case of heavy duty and/or low speeds of rotation these oils should also have extreme pressure additives to reduce wear, such as CLP oils to German specification DIN 51517 part 3.

In the case of oil bath lubrication, the balls should be immersed completely in oil when in their lowest position. In recirculating systems the flow of oil should range from approx. 5 to 15 cc7h per thread (= number of ball tracks in nut), depending on the size of the screw and the amount of heat to be dissipated.

The recommended viscosities are listed in Fig. 25. The higher viscosities apply to the larger sizes of ball screws.

n x d rpm x nominal diameter (mm)	Viscosity (c St/40°C)	Viscosity grade German standard DIN 51 519
up to 1000	400-1100	ISO VG 460 ISO VG 680 ISO VG 1000
100-10000	150-350	ISO VG 150 ISO VG 220 ISO VG 320
10000-40000	35-110	ISO VG 46 ISO VG 68 ISO VG 100
40000-110000	17-50	ISO VG 46 ISO VG 32 ISO VG 22

Fig. 25: Viscosity recommendations

Grease lubrication

Grease lubrication has the advantage over a costly central lubrication system need not be fitted and that as a rule replenishment is only required after every 500 hours of operation.

We recommend greases based on mineral oils with additives for improved resistance to aging and corrosion protection and conforming to German standard DIN 51 825 part 1.

n x d rpm x nominal diameter (mm)	Grade of grease as per German standard DIN 51 825 part 1
up to 1000	K3K
100-10000	K2K
10000-40000	K2K
40000-110000	K1K

Fig. 26: Recommend greases

For extremely heavy duty, greases with additives for increasing the load carrying capacity and reducing wear, such as KP grease to German standard DIN 51 825 part 3, can be used.

The amount of grease should be such that the cavities are only approximately half filled. Greases based on different soaps must not be mixed together.

Storage

Ball screws are high precision machine parts and are sensitive to all kinds of damage and dirt. Storage prior to installation must ensure that bending of the screw and corrosion cannot occur.

Our ball screws and nuts are treated with a corrosion inhibitor prior to dispatch, so that under proper indoor storage conditions they are protected for approx. 5 years.

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certified acc. ISO 9001

NOTE:
For your convenience please find the engineering data sheet, which may assists you by collecting all relevant items for your particular ball screw enquiry! If you have further questions our engineering team will be prepared to support you.