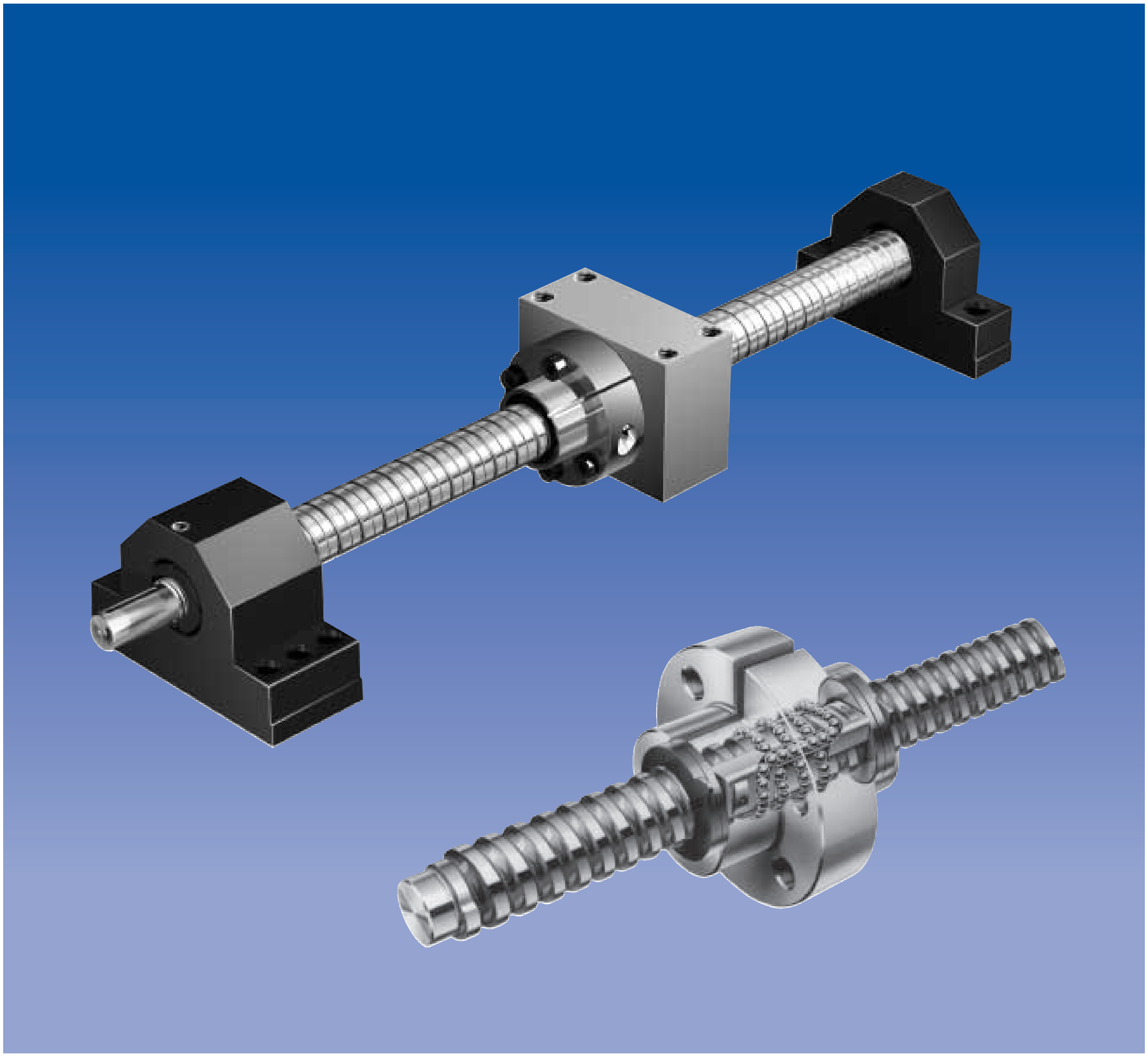


Precision Ball Screw Assemblies
End Bearings And Housings

RA 83 301/07.99

Linear Bushings and Shafts	Linear Bushings Linear Sets Shafts Shaft Support Rails, Shaft Support Blocks
	Ball Transfer Units
	Other Engineering Components
Profiled Rail Systems	Cam Roller Guides
	Ball Rail® Systems
	Roller Rail™ Systems
Screw Drives	**Precision Ball Screw Assemblies** **End Bearings and Housings**
Linear Motion Systems	Linear Motion Slides
	Linear Modules Robotic Erector Systems, Connectors and Mounting Accessories
	Compact Slides
	Ball Rail® Tables
	Components for Customized Positioning Systems
	Controllers Electrical Accessories, Fittings

Deutsche Star GmbH
D-97419 Schweinfurt

CERTIFIED DIN ISO 9001 DQS QUALITY SYSTEM

REG.-NR. 1617 - 01

CERTIFIED EQNet QUALITY SYSTEM

STAR

STAR – Precision Ball Screw Assemblies Product Overview

For nearly 20 years, Precision Ball Screw Assemblies have been a core product group within the STAR range.
The related standards (DIN 69 051 and ISO 3408), though relatively young by comparison, are fully supported by STAR: for every STAR nut with flange in this catalog you will find a corresponding design with DIN mounting dimensions.

STAR ball screws provide technical designers with diverse solutions for positioning and transport tasks. Moreover, affordable system design is made easy with

- **precision-rolled screws**
- **preloaded single nuts**
- **adjustable-preload single nuts (patented)**

Affordable precision-rolled screws replace ground-thread screws in a wide range of application areas.

Preloaded single nuts with optimized ball size selection or patented adjustable-preload single nuts are much more cost efficient than conventional double-nut systems.

Single STAR nut units and off-the-shelf precision-rolled screws guarantee short delivery periods for complete ball screw assemblies.

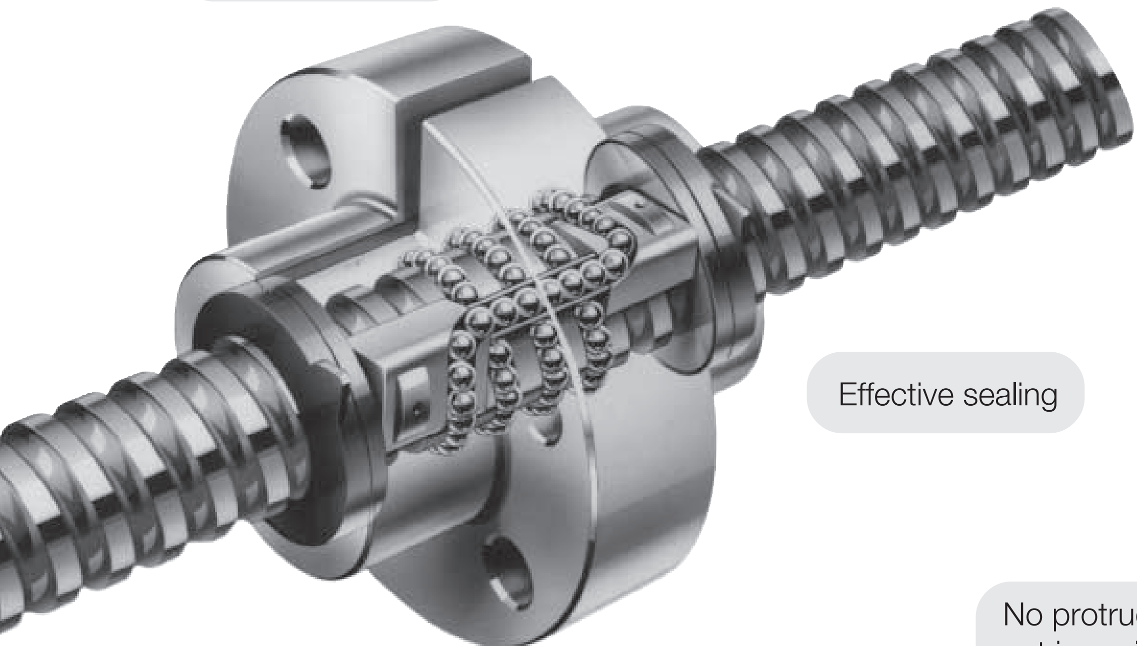
Available from stock

STAR offers the following product range:

- **complete ball screw assemblies**
  ground-thread or precision-rolled screws combined with any of the available single or double nuts, with end machining
- **precision-rolled screws, optional length, with soft-annealed ends**
  for end machining by customer
- **single nuts supplied on mounting arbor**
  All single nuts in the version with backlash can be easily mounted by the customer. In addition, the adjustable-preload single nut allows the customer to perform preload adjustment in-house.

Particularly smooth motion due to the tangential lift-off of the balls from the raceway within a single, fully enclosed ball circuit in the nut

short nut length



Effective sealing

No protruding parts, nut is easily mounted

High load-carrying capacity due to large number of re-circulating balls

Smooth outer shell, consistently smooth operation due to internal ball recirculation system

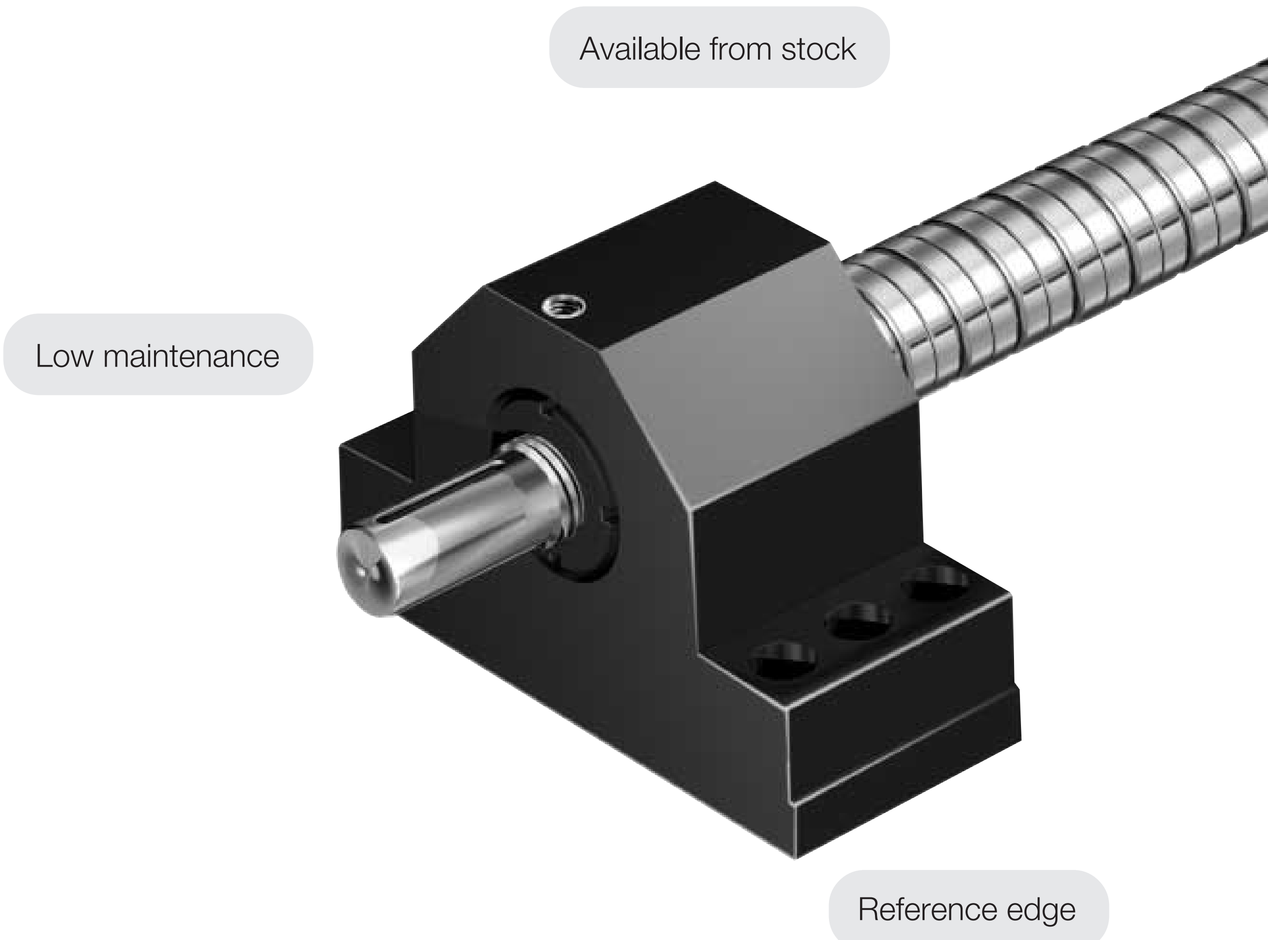
STAR – Precision Ball Screw Assemblies
Product Overview

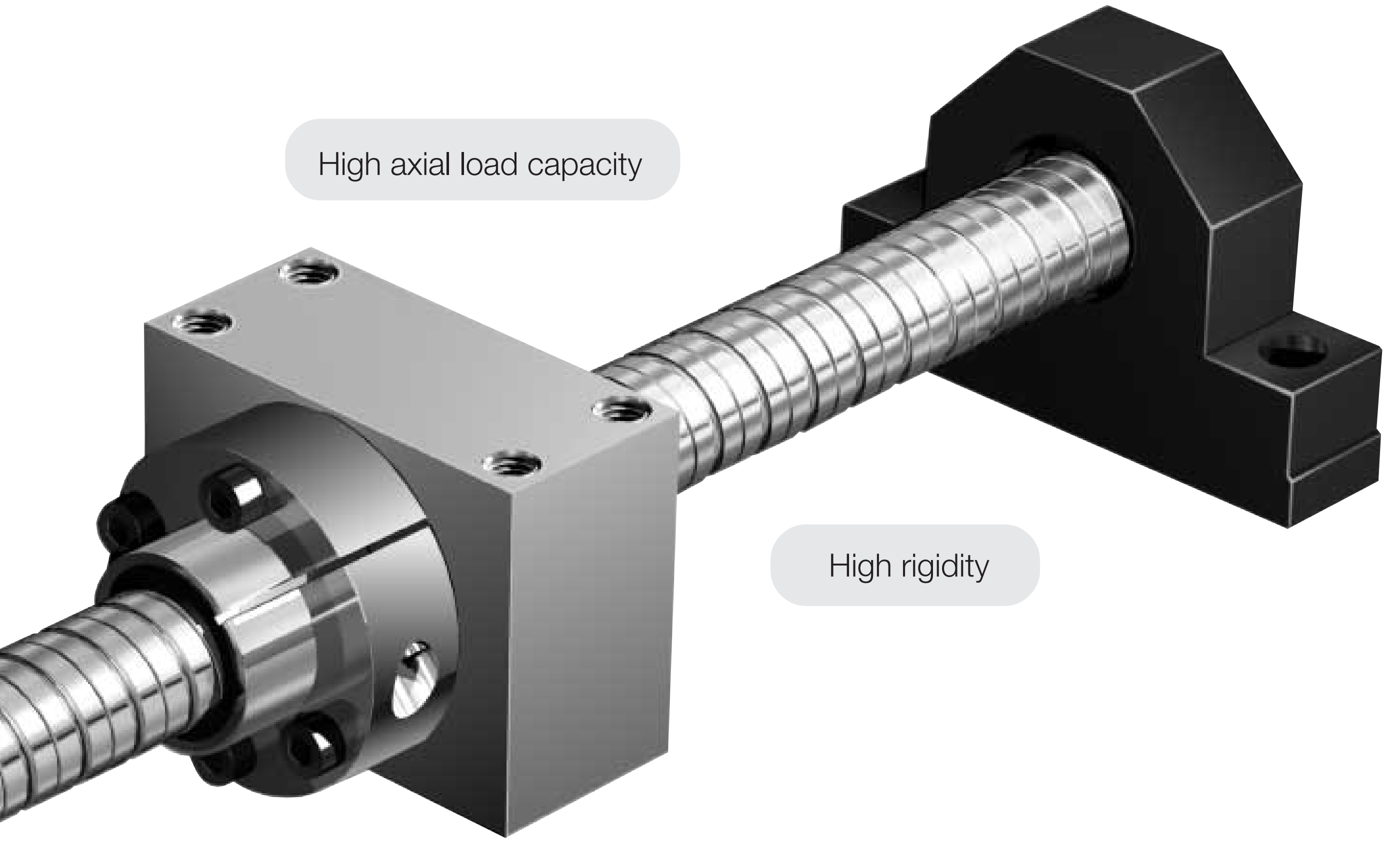
The complete linear motion drive system:
STAR Precision Ball Screw Assemblies with end bearings and housings.

STAR Precision Ball Screw Assemblies are available with fixed and floating bearings.

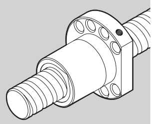
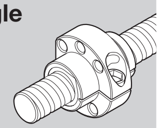
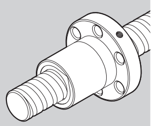
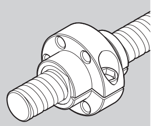
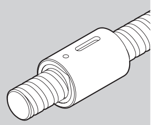
STAR also offers robust pillow block units designed for all types of applications.
- Easy installation due to the variety of fixture options and reference edges
- Use of premachined pin holes provides increased mounting accuracy

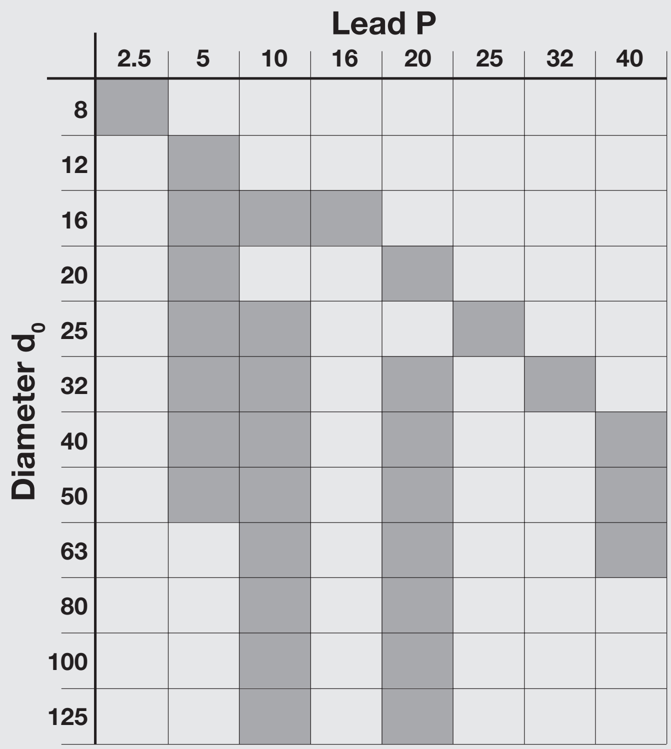
Housings for various flanged nuts complete the ready-to-mount STAR product range.



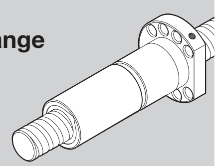
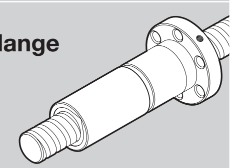

High axial load capacity
High rigidity
Low friction

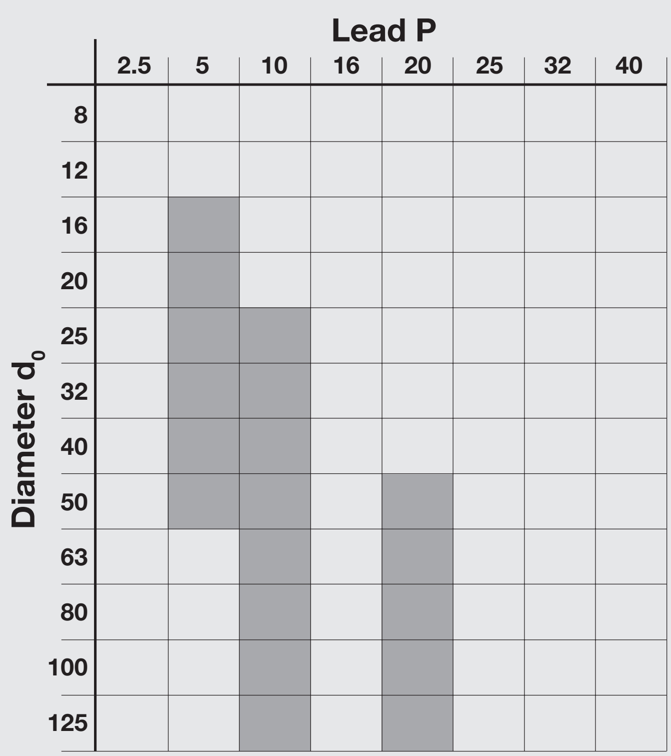
STAR – Precision Ball Screw Assemblies
Product Overview

Nuts for precision-rolled and ground-thread screws	Page
Single nut with flange DIN 69051, Part 5 FEM-E-C 	30
Adjustable-preload single nut DIN 69051, Part 5 SEM-E-C 	32
Single nut with flange FEM-E-S 	34
Adjustable-preload single nut SEM-E-S 	36
Cylindrical single nut ZEM-E-S, ZEM-E-A 	38



Other versions available upon request to suit special requirements (e.g. other standards).

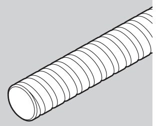
Double nut with flange DIN 69051, Part 5 FDM-E-C 	40
Double nut with flange FDM-E-S 	42



Other versions available upon request to suit special requirements (e.g. other standards).

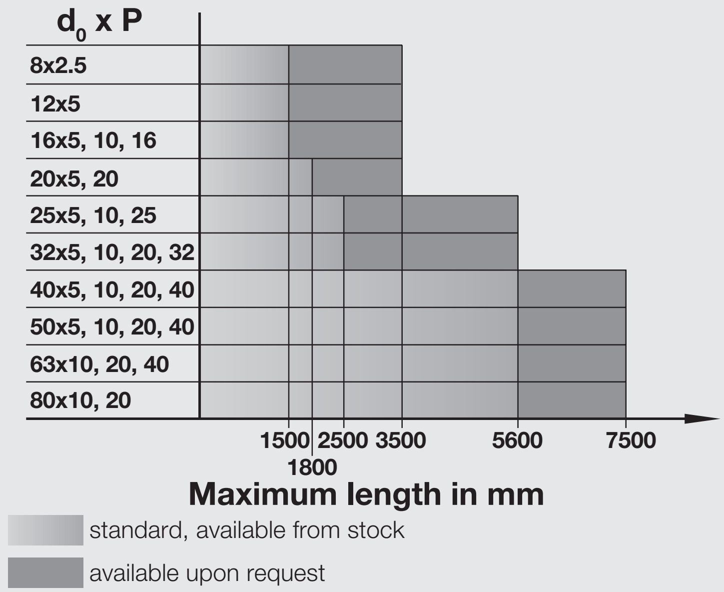
Precision Screws	Page

Precision-rolled screw (available from stock) — 44

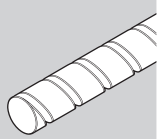


Tolerance grades T5, T7, T9, (P5)

Acceptance conditions — 14

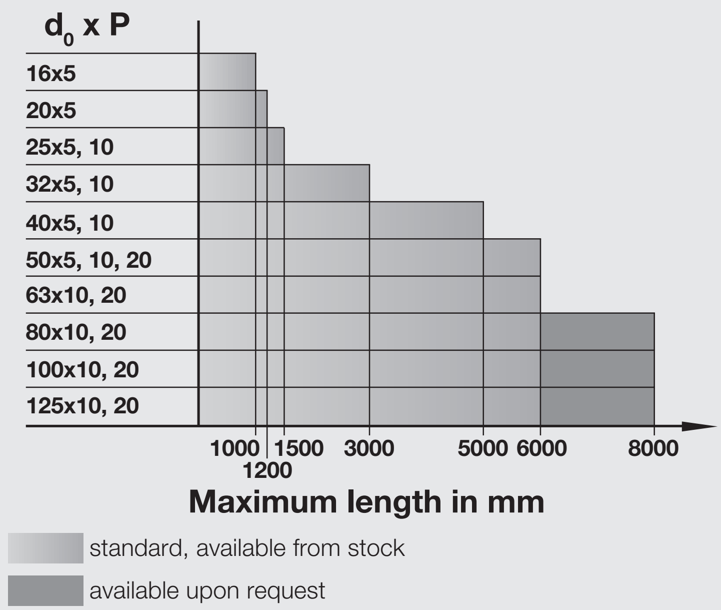


Ground-thread screws (made to order)

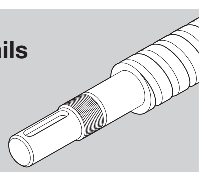


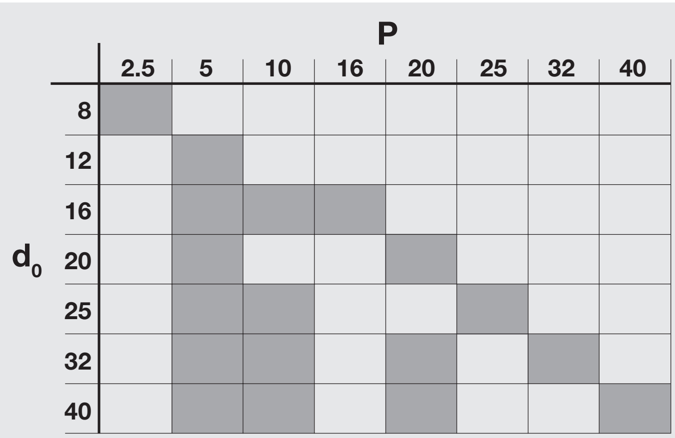
Tolerance grades T1, T3, T5 P1, P3, P5

Acceptance conditions — 14

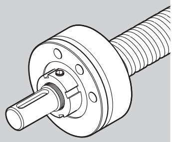
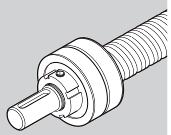
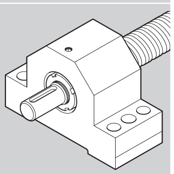
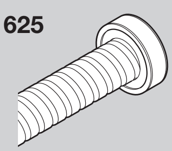
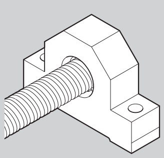


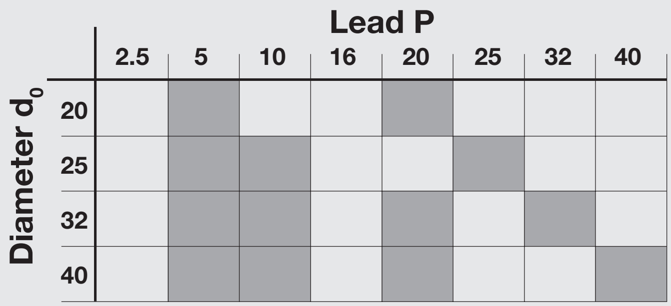
End machining details — 46

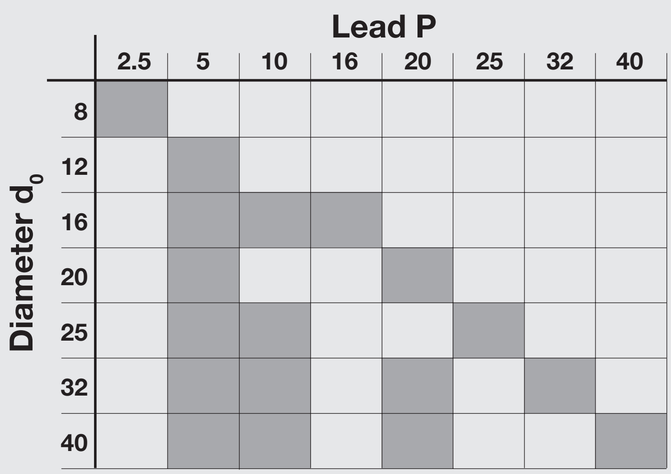


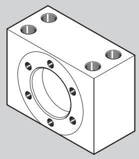
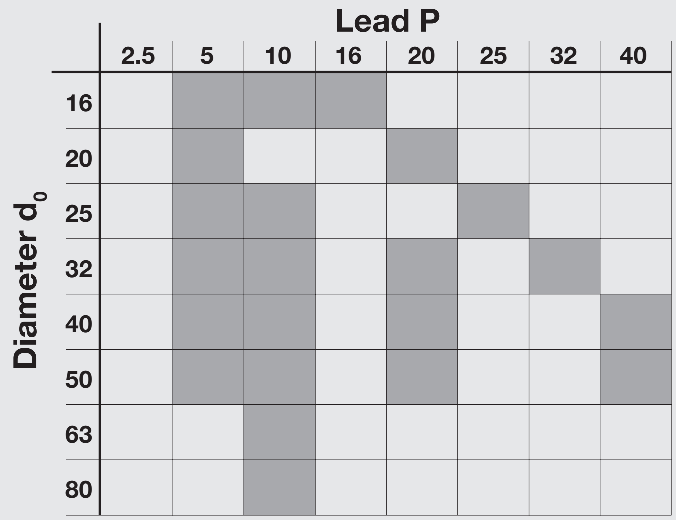


STAR – Precision Ball Screw Assemblies
Product Overview

End bearings and Housings	Page
Fixed bearing ZKLF 	54
Fixed bearing ZKLN 	56
Pillow block unit - fixed bearing ZKLN 	58
Floating bearing DIN 625 	60
Pillow block unit - floating bearing DIN 625 	62





Housings for flanged nuts	Page	
Nut housings 	64	

STAR – Precision Ball Screw Assemblies
General

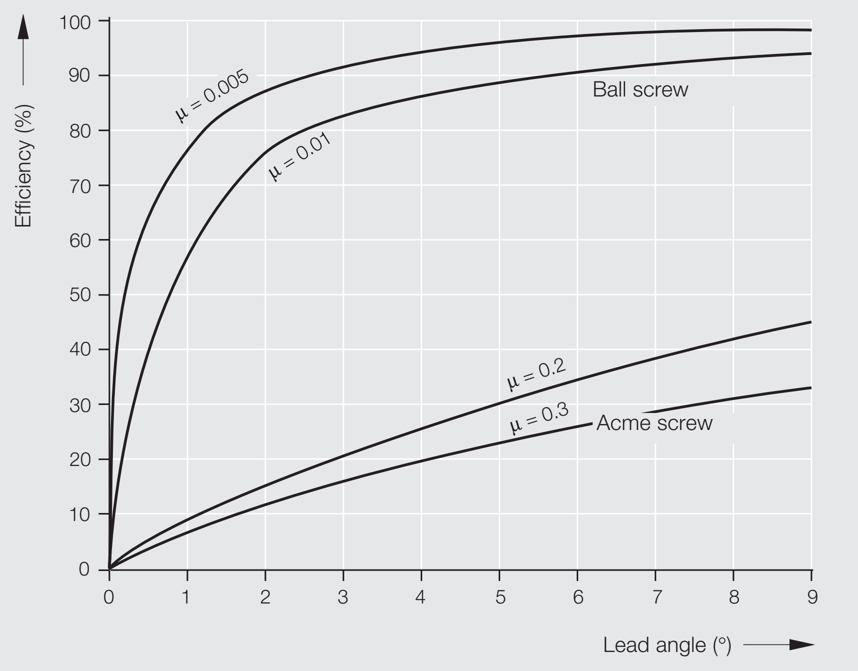
DIN 69 051 Part 1 defines a ball screw as follows:

An assembly comprising a ball screw shaft and ball nut, which is capable of converting rotary motion to linear motion and vice versa. The rolling elements of the assembly are balls.

Advantages over the Acme screw drive

- The mechanical efficiency of an Acme screw drive is a maximum of 50%, whereas a ball screw can reach a mechanical efficiency of up to 98%
- higher life expectancy due to negligible wear during operation
- less drive power required
- no stick-slip effect
- more precise positioning
- higher travel speed
- less heat-up

Due to their high mechanical efficiency, ball screws in principle are not self-locking and can backdrive.



Fields of application

Ball screw assemblies have been successfully implemented worldwide in the following areas:

Machine tool engineering

General mechanical engineering
- paper-processing machines
- packaging machines
- printing machines
- plastics processing machines
- handling machines (robots)
- drawing machines
- lifting units (e.g. car jacks)
- valve actuators

Steel industry
- smelting plants
- slab lifting plants

Automobile industry
- steering gears

Reactor technology
- refueling machines
- control rod drive mechanisms

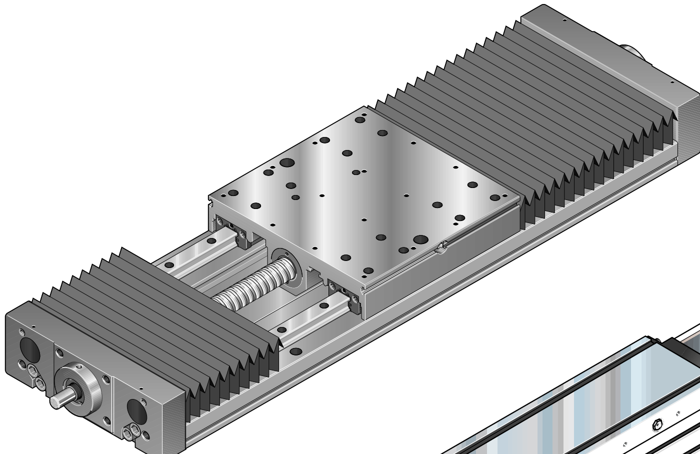
Aircraft industry
- aircraft landing flaps
- airport technology
- telescopic hoist spindles for loading equipment

Medical engineering
- X-ray apparatus
- radiotherapy devices
- hospital beds

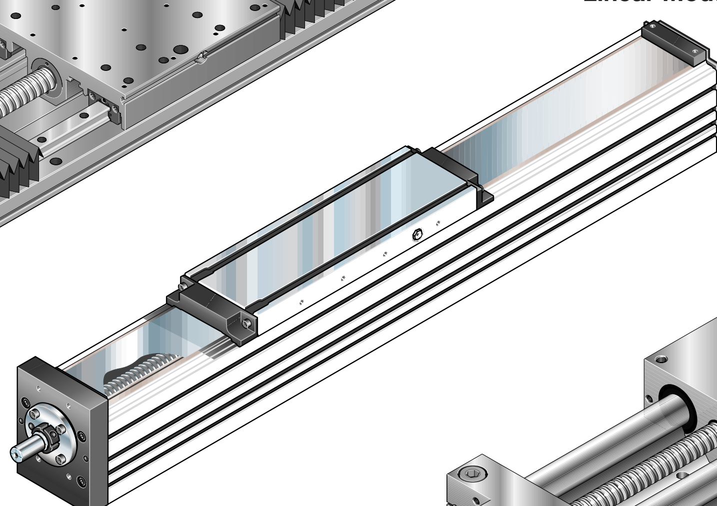
Semaphore technology
- signal arm movements

In STAR linear motion systems

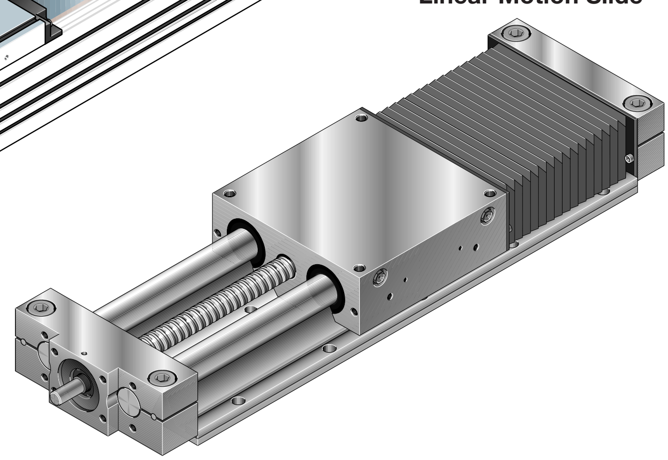
Ball Rail Table



Linear Module



Linear Motion Slide



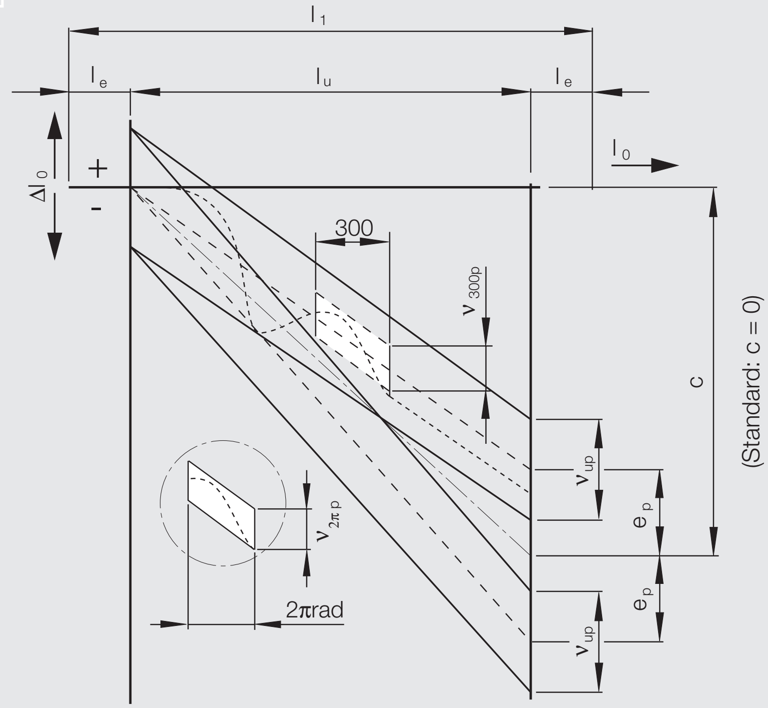
STAR – Precision Ball Screw Assemblies
Acceptance Conditions and Tolerance Grades

Permissible travel deviation

in accordance with DIN 69051, Part 3 and ISO 3408-3

Many values are significantly more accurate than those defined in DIN 69051, Part 3 and ISO 3408-3

P Ball screw with ground-thread or rolled precision screw



l_u		P e_p (μm) Tolerance grade			P ν_{up} (μm) Tolerance grade		
>	≤	1	3	5	1	3	5
	315	6	12	23	6	12	23
315	**400**	7	13	25	6	12	25
400	**500**	8	15	27	7	13	26
500	**630**	9	16	30	7	14	29
630	**800**	10	18	35	8	16	31
800	**1000**	11	21	40	9	17	35
1000	**1250**	13	24	46	10	19	39
1250	**1600**	15	29	54	11	22	44
1600	**2000**	18	35	65	13	25	51
2000	**2500**	22	41	77	15	29	59
2500	**3150**	26	50	93	17	34	69
3150	**4000**	32	62	115	21	41	82
4000	**5000**	-	76	140	-	49	99
5000	**6300**	-	-	170	-	-	119

For STAR Precision Ball Screw Assemblies the following values apply in all cases for P and T

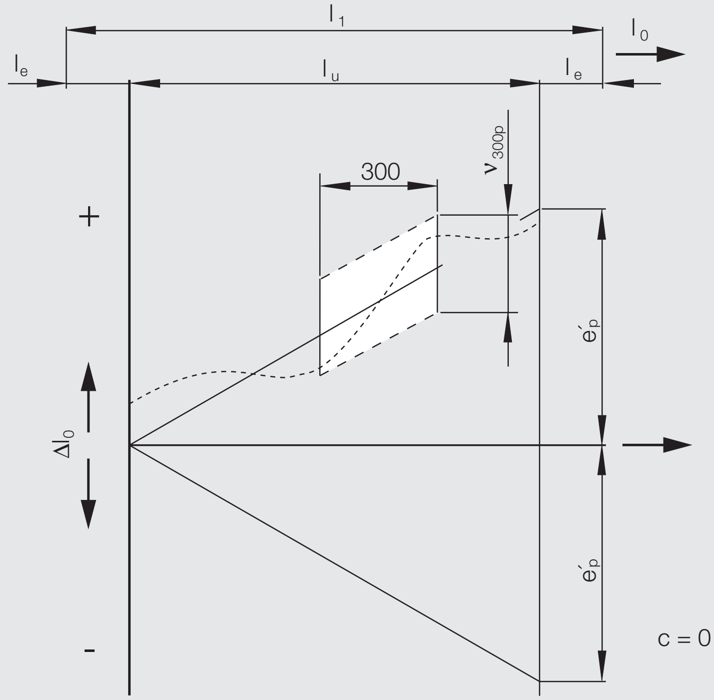
ν_{300p} (μm) Tolerance grade				
1	3	5	7	9
6	12	23	52	130

$\nu_{2\pi p}$ (μm) Tolerance grade				
1	3	5	7	9
4	6	8	10	10

Symbol definitions (excerpt):

l_0	=	nominal travel
l_1	=	thread length
Δl_0	=	travel deviation
l_u	=	useful travel
l_e	=	excess travel
c	=	travel compensation for useful travel, defined by user (standard: c = 0)
e'_p	=	tolerance for actual mean travel deviation
ν_{up}	=	permissible travel variation within useful travel l_u
ν_{300p}	=	permissible travel deviation within 300 mm travel
$\nu_{2\pi p}$	=	permissible travel variation within 1 revolution

T Ball screw with ground-thread or rolled precision screw



Subindices:

0	=	nominal
p	=	permissible
a	=	actual

T	e'_p (µm) Tolerance grade			
1	**3**	**5**	**7**	**9**

$$e'_p = \frac{l_u}{300} \cdot \nu_{300p}$$

Star supplies T-type ball screws with more accurate values than those defined in DIN 69051 Part 3 and ISO 3408-3 (tolerance reduced by half).

Minimum number of measurements within 300 mm (measuring interval) and permissible excess travel

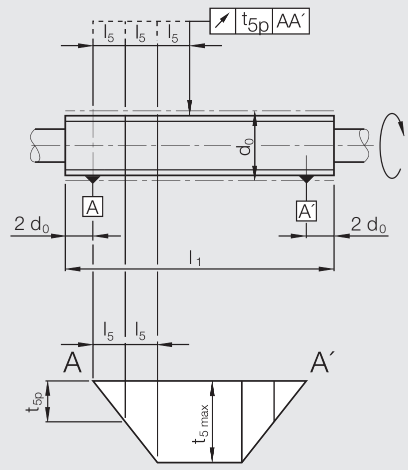
Lead P	Min. no. of measurements for tolerance grades					Excess travel l_{emax} (mm)
	1	3	5	7	9	
2.5	30	20	10	5	5	10
5	15	10	6	3	3	20
10	10	5	3	1	1	40
16	8	5	3	1	1	50
20	5	5	3	1	1	60
25	4	4	3	1	1	70
32	3	3	2	1	1	80
40	-	2	1	1	1	100

STAR – Precision Ball Screw Assemblies
Acceptance Conditions and Tolerance Grades

Run-outs and location deviations

based on DIN 69051, Part 3 and ISO 3408-3

Radial run-out t_5 of the outer diameter of the ball screw shaft over the length l_5 used to determine the straightness in relation to AA´



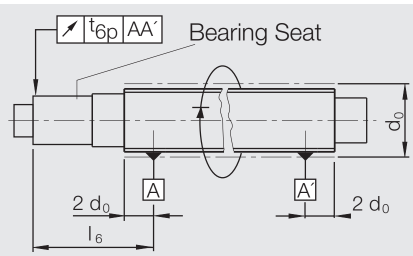
d_0 above	d_0 up to	l_5	t_{5p} in µm for l_5 for tolerance grade 1	3	5	7; 9
6	12	80				
12	25	160				
25	50	315	20	25	32	40
50	100	630				
100	200	1250				

l_1/d_0 above	l_1/d_0 up to	t_{5max} in µm for $l_1 \geq 4l_5$ tolerance grade 1	3	5	7; 9
	40	40	50	64	80
40	60	60	75	96	120
60	80	100	125	160	200
80	100	160	200	256	320

Radial run-out t_6 of the bearing diameter in relation to AA´ for $l_6 \leq l$

Where $l_6 > l$, then

$$t_{6a} \leq t_{6p} \cdot \frac{l_6}{l}$$

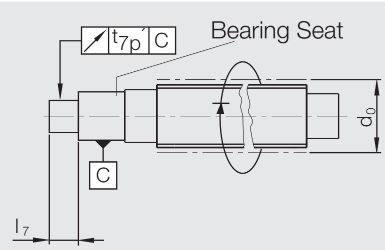


Nominal diameter d_0 above	up to	Ref. length l	t_{6p} in µm for $l_6 \leq l$ tolerance grade 1	3	5; 7; 9
6	20	80	10	12	20
20	50	125	12	16	25
50	125	200	16	20	25
125	200	315	-	25	25

Coaxial deviation t_7' of the journal diameter of the ball screw shaft in relation to the bearing diameter for $l_7 \leq l$

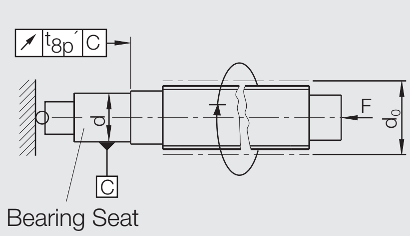
Where $l_7 > l$, then

$$t_{7a} \leq t_{7p}' \cdot \frac{l_7}{l}$$



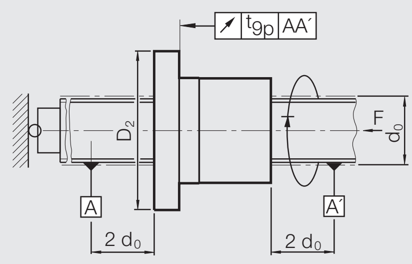
Nominal diameter d_0 above	up to	Ref. length l	t_{7p}' in µm for $l_7 \leq l$ for tolerance grade 1	3	5; 7; 9
6	20	80	5	5	6
20	50	125	5	5	6
50	125	200	6	6	7
125	200	315	-	8	12

Axial runout t_8' of the shaft (bearing) face of the ball screw shaft in relation to the bearing diameter



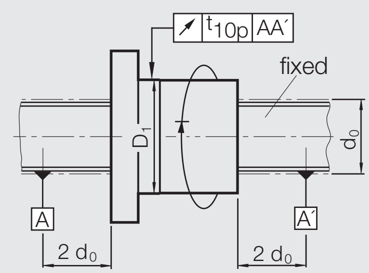
Nominal diameter d_0 above	up to	t_{8p}' in µm for tolerance grade 1	3	5; 7; 9
6	63	3	4	5
63	125	4	5	6
125	200	-	6	8

Axial runout t_9 of the ball nut location face in relation to A and A´ (for preloaded ball nuts only)



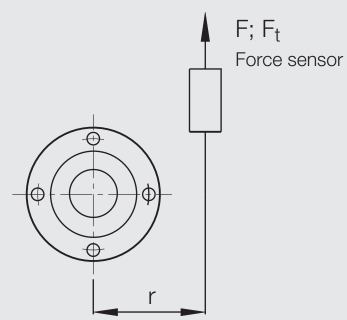
Flange diameter D_2		t_{9p} in µm for tolerance grade		
above	up to	1	3	5; 7; 9
16	**32**	10	12	16
32	**63**	12	16	20
63	**125**	16	20	25
125	**250**	20	25	32
250	**500**	-	32	40

Radial runout t_{10} of the outer diameter D1 of the ball nut in relation to A and A´ (for preloaded and rotating ball nuts only) (fix screw against rotation)



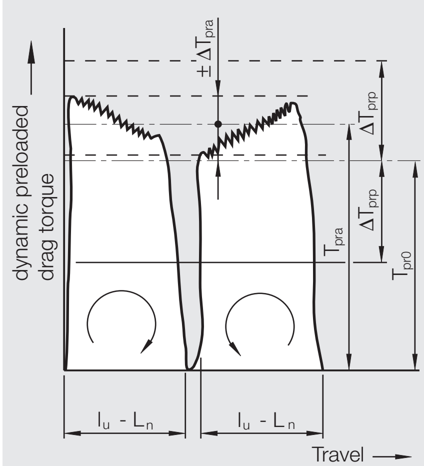
Outer diameter D_1		t_{10p} in µm for tolerance grade		
über	bis	1	3	5; 7; 9
16	**32**	10	12	16
32	**63**	12	16	20
63	**125**	16	20	25
125	**250**	20	25	32
250	**500**	-	32	40

Permissible deviation ΔT_{prp} for the dynamic preload drag torque T_{pr0} (for preloaded ball nuts only).



without seals $T_{pr} = F \cdot r$

with seals $T_t = F_t \cdot r$



$l_u - L_n$ = useful travel minus length of ball nut

T_{pr0} (Nm)		for $l_u/d_0 \leq 40$ and $l_u \leq 4000$ mm ΔT_{prp} in % of T_{pr0} for tolerance grade			
above	up to	1	3	5	7; 9
0.2	**0.4**	35	40	50	-
0.4	**0.6**	25	40	40	-
0.6	**1.0**	25	30	35	40
1.0	**2.5**	20	25	30	35
2.5	**6.3**	15	20	25	30
6.3	**10.0**	-	15	20	30

T_{pr0} (Nm)		for $l_u/d_0 \leq 60$ and $l_u \leq 4000$ mm ΔT_{prp} in % of T_{pr0} for tolerance grade			
above	up to	1	3	5	7; 9
0.2	**0.4**	40	50	60	-
0.4	**0.6**	33	40	45	-
0.6	**1.0**	30	35	40	45
1.0	**2.5**	25	30	35	40
2.5	**6.3**	20	25	30	35
6.3	**10.0**	-	20	25	35

T_{pr0} (Nm)		for $l_u/d_0 > 60$ or $l_u > 4000$ mm ΔT_{prp} in % of T_{pr0} for tolerance grade			
above	up to	1	3	5	7; 9
	0.6	not yet determined			
0.6	**1.0**	-	40	45	50
1.0	**2.5**	-	35	40	45
2.5	**6.3**	-	30	35	40
6.3	**10.0**	-	25	30	35

STAR – Precision Ball Screw Assemblies
Design Notes

Selection Criteria

The following factors should be considered in the selection of the ball screw required for a given application:

- degree of accuracy required (lead deviation)
- permissible clearance or desired preload
- in-service load conditions
- service life
- critical speed
- buckling load
- rigidity

The following points should be taken into consideration when selecting a ball screw assembly that is to be both cost-efficient and optimally designed:

- the lead is a decisive factor for the load-carrying capacity (depending on the maximum possible ball diameter) and the drive moment;
- the calculation of the service life should be based on average loads and average speeds, not on maximum values;
- in order for us to provide you with a customized solution, installation drawings or sketches of the nut and screw environment should be enclosed with your inquiry;
- no special bearings are required for ball screws; bearings used for conventional screws are suitable. At least one bearing must be able to take up axial thrust forces. Where high rigidity is required, we recommend the use of combined radial and thrust bearings;
- the end machining will be done according to customer specifications. The diameter of the bearing seats should correspond to the recommended dimensions for end bearings. **A drawing should be enclosed with the inquiry.** Star standard end machining options with the matching bearings are also available.
- radial and eccentric forces relative to the screw must be avoided as they have a negative effect on the life and proper function of the ball screw.

Inquiry / Order Form

In order to help us find the ball screw that best suits your application, please complete the inquiry/order form at the back of this catalog.

Please mark any questions that you are unable to answer as well as those values that you would like us to define.

STAR Screw
Nominal diameter .... d_0 =__________ mm
Lead ☐ right-hand ☐ left-hand .... P =__________ mm

STAR Nut
☐ FEM-E-C ☐ ZEM-E-A ☐ SEM-E-C ☐ FDM-E-C
☐ FEM-E-S ☐ ZEM-E-S ☐ SEM-E-S ☐ FDM-E-S
☐ with backlash ☐ with preload
Part number [1|5| |] - [ ] - [| | |]

Mounting direction of nut:
Mounting ø D_1 (or in the case of ZEM-E-A/S, lube port) facing drive end ☐
facing non-drive end ☐

STAR Screw
Tolerance grade (see Page 14/15)
P1 ☐ P3 ☐ P5 ☐

T1 ☐	≙ ν_{300p}	= 6µm
T3 ☐	≙ ν_{300p}	= 12µm
T5 ☐	≙ ν_{300p}	= 23µm
T7 ☐	≙ ν_{300p}	= 52µm
T9 ☐	≙ ν_{300p}	= 130µm

Total length .... L =_______ mm
Threaded length .... L_1 =_______ mm
Machining of screw ends .... ends not machined ☐
(Read bearing recommendations carefully!) ends annealed L_{G1} / L_{G2} ______ / _____ mm ☐
to customer specs(drawing required) ☐
to STAR specs (page 46/47) ☐
Type of drive end................................. for fixed bearing ☐ for floating bearing ☐
Type of non-drive end.......................... for fixed bearing ☐ for floating bearing ☐

STAR End bearings .... Part no./Drive end [1|5|9|] - [ ] - [| | |]
.... Part no./Non-drive end [1|5|9|] - [ ] - [| | |]

STAR Housing for flanged nut .... Part no. [1|5|0|6] - [ ] - [| | |]

Material, Hardness

Our standard ball screw assemblies are made of high-quality, heat-treatable steel, carbon chrome alloy steels or case-hardened steels. The screw and nut raceways have a minimum Rockwell hardness of HRC 58. Ball screw assemblies made of corrosion-resistant steel (DIN 17230, EN 10088) are also available upon request. Unless otherwise specified, the screw ends are not hardened.

Sealing

Ball screws are precision assemblies that require protection against contamination. Flat protective covers and bellows type dust boots are particularly suitable for this purpose. As there are many applications in which these methods do not provide sufficient protection, we have developed a wiper-type seal which, due to the extremely low friction between the lip edges and the screw, ensures an optimal sealing effect without noticeably reducing the high efficiency of the assembly. We have therefore included these seals as standard features of our ball screw assemblies. At the request of the customer, these seals can also be omitted.

Permissible Operating Temperatures

Ball screws are suitable for continuous operation at temperatures of -20° to +100°C

Load-Carrying Capacities and Service Life

In accordance with DIN 69 051 Part 4 and ISO 3408 - 4 (P5).

Basic static load rating C_0

The static load rating is an axial, concentrically acting force that induces a permanent deformation of 0.0001 x the ball diameter between the ball and the ball raceway.

Basic dynamic load rating C

The dynamic load rating is an axial, concentrically acting force of constant magnitude and direction under which a representative sample of identical ball screws can achieve a nominal life of one million revolutions.

Service Life

The nominal life is expressed by the number of revolutions (or number of operating hours at constant speed) that will be attained or exceeded by 90% of a representative sample of identical ball screws before the first signs of material fatigue become evident. The nominal life is designated as L or L_h, depending on whether it is specified in revolutions or hours.

Critical Speed and Buckling Load

The critical speed and buckling load can be checked using the corresponding charts. For precise calculations see formula (12)

CharacteristicSpeed $d_0 \cdot n$

STAR ball screws can be operated at very high speeds due to their internal ball recirculation system. The recommended limit is:

$d_0 \cdot n \leq 100\,000$

d_0 = nominal diameter (mm)
n = speed (rpm)

Acceleration

$25 m/sec^2$ maxim. m

Design Calculations

Upon request, we can perform all calculations to your specifications. (See Design Calculation Form)

Average Speed and Average Load

Where speed and load fluctuate, the service life must be calculated using the averages $\mathbf{F_m}$ and $\mathbf{n_m}$.

- where the speed fluctuates, the average speed $\mathbf{n_m}$ is calculated as follows:

$$n_m = \frac{q_1}{100} \cdot n_1 + \frac{q_2}{100} \cdot n_2 + ... + \frac{q_n}{100} \cdot n_n \quad (1)$$

n_m = average speed (rpm)
q = discrete time step (%)

- where the load fluctuates and the speed is constant, the average load $\mathbf{F_m}$ is calculated as follows:

$$F_m = \sqrt[3]{F_1^3 \cdot \frac{q_1}{100} + F_2^3 \cdot \frac{q_2}{100} + ... + F_n^3 \cdot \frac{q_n}{100}} \quad (2)$$

F_m = average load (N)
q = discrete time step (%)

- where both the load and the speed fluctuate, the average load $\mathbf{F_m}$ is calculated as follows:

$$F_m = \sqrt[3]{F_1^3 \cdot \frac{n_1}{n_m} \cdot \frac{q_1}{100} + F_2^3 \cdot \frac{n_2}{n_m} \cdot \frac{q_2}{100} + ... + F_n^3 \cdot \frac{n_n}{n_m} \cdot \frac{q_n}{100}} \quad (3)$$

F_m = average load (N)
q = discrete time step (%)
n_m = average speed (rpm)

Nominal Life

L (service life in revolutions)

$$L = \left(\frac{C}{F_m}\right)^3 \cdot 10^6 \quad (4) \quad \Rightarrow C = F_m \cdot \sqrt[3]{\frac{L}{10^6}} \quad (5) \quad \Rightarrow F_m \cdot \frac{C}{\sqrt[3]{\frac{L}{10^6}}} \quad (6)$$

L = service life (revolutions)
F_m = average load (N)
C = dynamic load rating (N)

L_h (service life in hours)

$$L_h = \frac{L}{n_m \cdot 60} \quad (7)$$

L_h = service life (h)
L = service life (revolutions)
n_m = average speed (rpm)

$$\text{Machine service life} = L_h \cdot \frac{\text{Machine operating hours}}{\text{Ball screw operating hours}} \quad (8)$$

Drive Torque and Drive Power

Drive torque M_{ta}
for conversion of rotary motion into linear motion:

$$M_{ta} = \frac{F \cdot P}{2000 \cdot \pi \cdot \eta} \quad (9)$$

Transmitted torque M_{te}
or conversion of linear motion into rotary motion:

$$M_{te} = \frac{F \cdot P \cdot \eta'}{2000 \cdot \pi} \quad (10)$$

M_{ta} = drive torque (Nm)
M_{te} = transmitted torque (Nm)
F = operating load (N)
P = lead (mm)
η = mech. efficiency (approx. 0.9)
η´ = mech. efficiency (approx. 0.8)

The dynamic drag torque must be taken into account for preloaded nuts.

Drive power P_a

$$P_a = \frac{M_{ta} \cdot n}{9550} \quad (11)$$

P_a = drive power (kW)
M_{ta} = drive torque (Nm)
n = speed (rpm)

Calculation Example

Service life

Proposed ball screw: 63 x 10

Operating conditions

F_1 =	50 000 N	at	n_1	= 10 rpm	for q_1	=	6%	of the duty cycle
F_2 =	25 000 N	at	n_2	= 30 rpm	for q_2	=	22%	of the duty cycle
F_3 =	8 000 N	at	n_3	= 100 rpm	for q_3	=	47%	of the duty cycle
F_4 =	2 000 N	at	n_4	= 1 000 rpm	for q_4	=	25%	of the duty cycle
							100%	

The service life of the machine should be 40,000 operating hours with the ball screw operating 60% of the time.

Calculation procedure

Average speed $\mathbf{n_m}$

$$n_m = \frac{6}{100} \cdot 10 + \frac{22}{100} \cdot 30 + \frac{47}{100} \cdot 100 + \frac{25}{100} \cdot 1000 \quad (1)$$

$n_m = 304$ rpm

Average load $\mathbf{F_m}$ for variable load and variable speed

$$F_m = \sqrt[3]{50000^3 \cdot \frac{10}{304} \cdot \frac{6}{100} + 25000^3 \cdot \frac{30}{304} \cdot \frac{22}{100} + 8000^3 \cdot \frac{100}{304} \cdot \frac{47}{100} + 2000^3 \cdot \frac{1000}{304} \cdot \frac{25}{100}} \quad (3)$$

$F_m = 8\,757$ N

Required service life **L** (revolutions)

The life L can be calculated by transposing the formulas (7) and (8) as follows:

$$L = L_h \cdot n_m \cdot 60$$

$$L_h = \text{Machine operating hours} \cdot \frac{\text{Ball screw operating hours}}{\text{Machine operating hours}}$$

$$L_h = 40\,000 \cdot \frac{60}{100} = 24\,000\text{h}$$

$$L = 24\,000 \cdot 304 \cdot 60$$

$$L = 437\,760\,000 \text{ revolutions}$$

Basic dynamic load rating **C**

$$C = 8\,757 \cdot \sqrt[3]{\frac{437\,760\,000}{10^6}} \quad (5)$$

$C \approx 66\,492$ N

Result and selection

The ball screw can now be selected from the Dimension Tables:
e.g. ball screw, size 63 x 10 R x 6-6, with preloaded single nut with flange, basic dynamic load rating C = 88 800 N, part no. 1512-6-4003.

Cross check

Life **L** of the selected ball screw in revolutions

$$L = \left(\frac{88\,800}{8757}\right)^3 \cdot 10^6 \quad (4)$$

$L \approx 1042 \cdot 10^6$ revolutions

Life $\mathbf{L_h}$ in hours

$$L_h = \frac{1042 \cdot 10^6}{304 \cdot 60} \quad (7)$$

$L_h \approx 57\,167$ hours

The life of the selected ball screw assembly is thus greater than the required service life of 24,000 hours (including operating hours). A smaller ball screw could therefore be selected.

Critical Speed

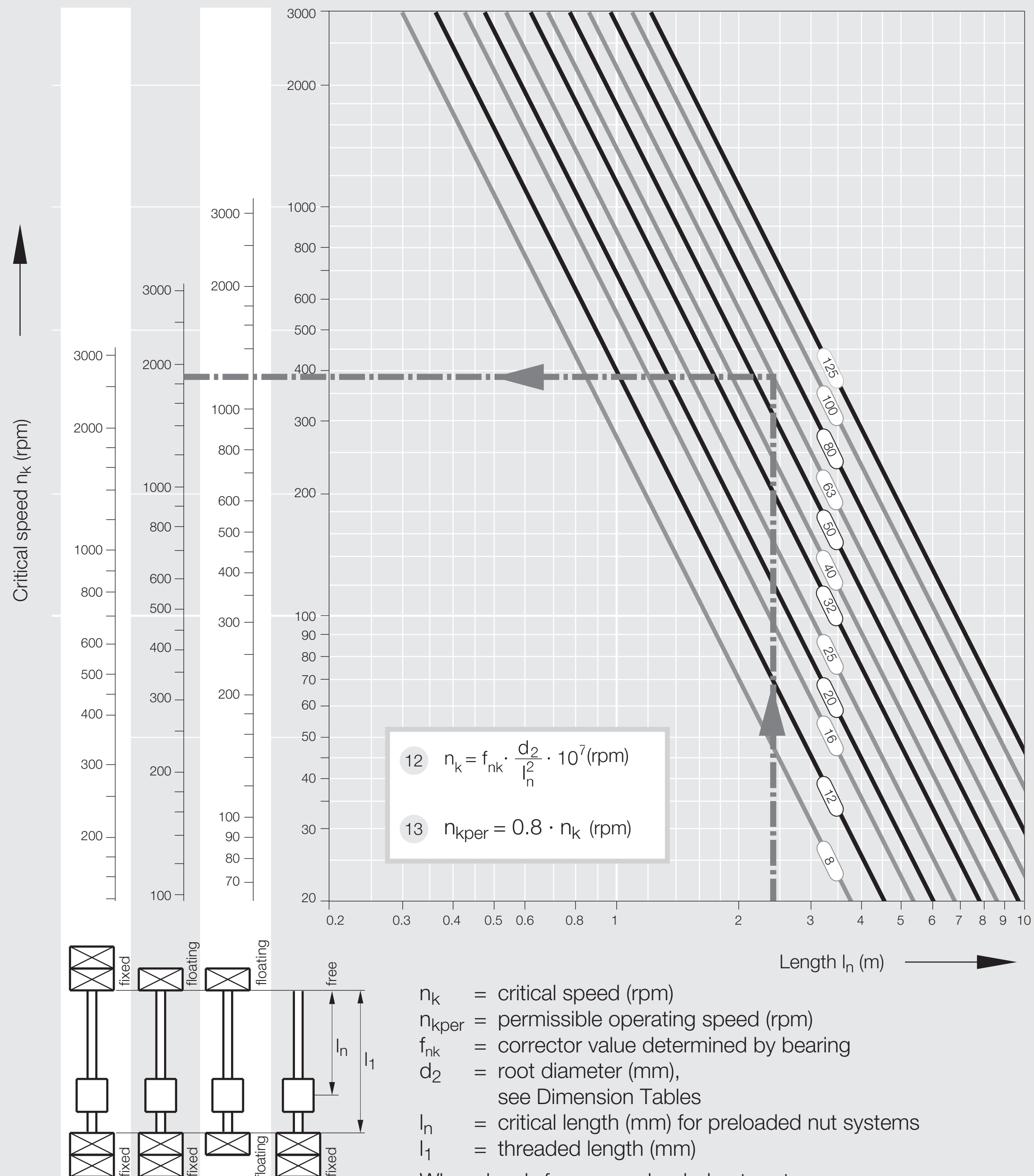
The critical speed depends on the diameter of the screw, the type of end fixity and the free length l_n. No allowance may be made for guidance by a nut without preload. The operating speed should not reach more than 80% of the critical speed. The characteristic speed is to be taken into account: (see Page 19)

Example:

Screw diameter = 63 mm
Length l_n = 2.4 m
End fixity type II (fixed - supported)

According to the graph, the critical speed is 1850 rpm.
The permissible operating speed is thus 1850 rpm x 0.8 = 1480 rpm.

The maximum operating speed in our calculation example of n_4 = 1000 rpm is therefore below the permissible operating speed.



(12) $n_k = f_{nk} \cdot \frac{d_2}{l_n^2} \cdot 10^7$ (rpm)

(13) $n_{kper} = 0.8 \cdot n_k$ (rpm)

End fixity	I	II	III	IV
f_{nk} value	27.4	18.9	12.1	4.3

n_k = critical speed (rpm)
n_{kper} = permissible operating speed (rpm)
f_{nk} = corrector value determined by bearing
d_2 = root diameter (mm), see Dimension Tables
l_n = critical length (mm) for preloaded nut systems
l_1 = threaded length (mm)
Where $l_n = l_1$ for non-preloaded nut systems

Permissible axial load on screw (buckling load)

The permissible axial load on the screw depends on the diameter of the screw, the type of end fixity and the effective free (unsupported) length l_k.
A safety factor of $\gamma \geq 2$ should be taken into consideration when determining the permissible axial load.

Example:

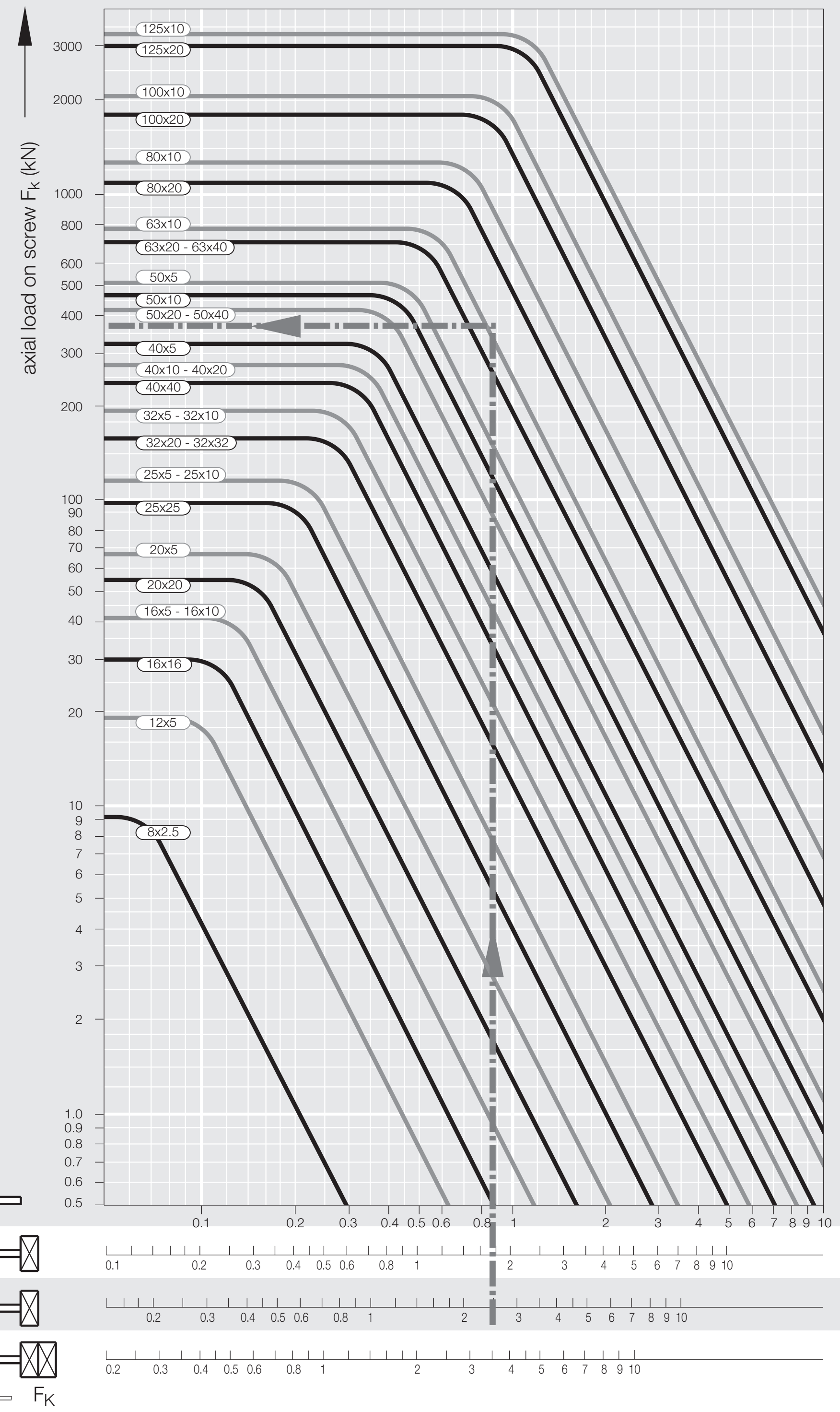
Screw diameter	= 63 mm
lead	= 10 mm
length l_k	= 2.4 m
End fixity type II	(fixed - supported)

According to the graph, the theoretically permissible axial load is 360 kN.
A permissible axial load on the screw of 360 kN : 2 = 180 kN is achieved when applying the safety factor 2. This therefore lies above the maximum operating load of F_1 = 50 kN used in our calculation example.

(14) $$F_k = f_{Fk} \cdot \frac{d_2^4}{l_k^2} \cdot 10^4 \quad (N)$$

(15) $$F_{kperl} = \frac{F_k}{2} \quad (N)$$

F_k = theoretically permissible axial load on screw
F_{kper} = permissible axial load during operation
f_{Fk} = corrector value determined by bearing
d_2 = root diameter (mm), see Dimension Tables
l_k = unsupported threaded length (mm)



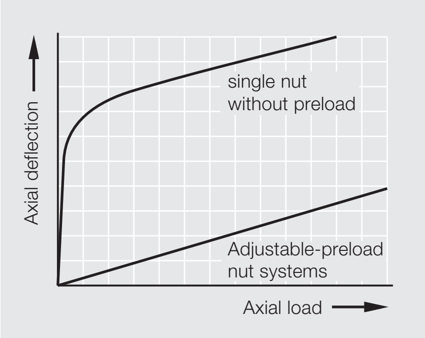
f_{Fk} value	End fixity (as on Page 22)
2.6	IV
10.2	III
20.4	II
40.6	I

l_k F_K

Nut System Preload

In addition to single nuts with reduced backlash, STAR supplies preloaded or adjustable-preload nut systems.

The graph illustrates that preloaded nut systems have a significantly lower spring deflection than a single nut without preload.



Double nut

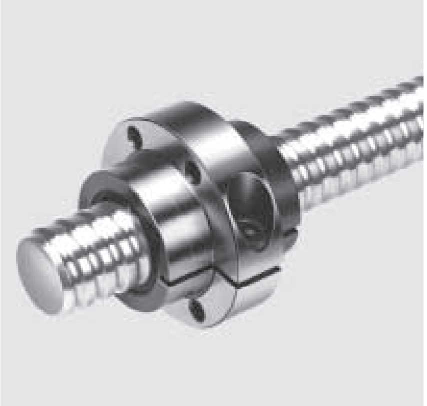
Tensioning two nuts against each other eliminates the inherent backlash of the ball screw, increases rigidity and thus improves positioning accuracy.

As excessive preload can cause a reduction in service life, we recommend that it not be more than $^1/_3$ of the average operating load. If the customer does not specify a certain preload, we will preload the nut system with approx. 10% of the basic dynamic load rating.

Adjustable-preload single nut

The adjustable-preload single nut allows cost-efficient design techniques to be implemented in a large number of applications. The radial clearance and preload are adjusted radially via a slot approx. 0.1 mm wide (see also: Mounting Instructions).

The maximum preload is approx. 5% of the basic dynamic load rating. The dynamic drag torque corresponds to that of a double-nut system with a preload of approx. 13% of the basic dynamic load rating.



Preloaded single nut

Single nuts can be preloaded with approx. 5% of the basic dynamic load rating by means of optimized ball size selection.

The rigidity of these three types of STAR nut systems is approximately the same, as the adjustable-preload single nut and the preloaded single nut have a much more compact design, and are thus only half as long as a double-nut system (please also note the information given under "Overall Rigidity").

Overall Rigidity

The rigidity of a ball screw is also influenced by all adjoining parts such as bearings, housing bores, nut housings etc.

Overall axial rigidity R_{tot} of the ball screw

R = axial rigidity (N/µm)

R_{aL} = see Dimension Tables / End Bearings and Housings

The overall axial rigidity is comprised of the component rigidity of the bearing $\mathbf{R_{aL}}$, the screw $\mathbf{R_S}$ and the nut unit $\mathbf{R_{nu}}$ and is calculated according to the following formula:

$$\frac{1}{R_{tot}} = \frac{1}{R_{aL}} + \frac{1}{R_S} + \frac{1}{R_{nu}} \qquad (16)$$

Please note that in most cases the rigidity $\mathbf{R_S}$ of the screw will be significantly lower than the rigidity $\mathbf{R_{nu}}$ of the nut unit. In an assembly with a diameter of 40 x 10, for example, the rigidity $\mathbf{R_{nu}}$ of the nut unit is 2 to 3 times higher than the rigidity $\mathbf{R_S}$ of a screw with a length of 500 mm.

Rigidity of the bearing R_{aL}

The rigidity of the bearings corresponds to the values found in the bearing manufacturer's catalog. The rigidity of our bearing assemblies can be found in the tables.

Rigidity of the screw R_S

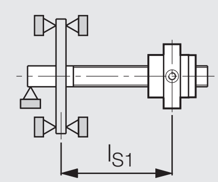
The rigidity of the screw depends on the type of bearing used.

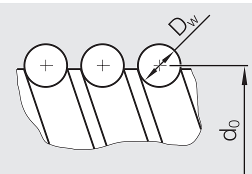
1. Ball screw shaft is fixed at one end.

   l_{S1} = distance between bearing and nut

$$R_{S1} = 165 \cdot \frac{(d_0 - 0{,}71 \cdot D_W)^2}{l_{S1}} \quad (\text{N}/\mu\text{m}) \qquad (17)$$

See Dimension Tables for rigidity values.





d_0 = nominal diameter (mm)
D_W = ball diameter (mm)

2. Ball screw shaft is fixed at both ends.

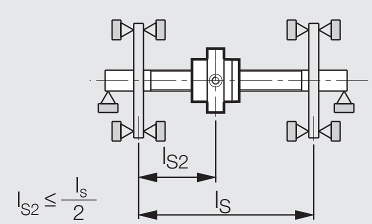
   l_S = distance between bearing and bearing
   l_{S2} = distance between bearing and nut

$$R_{S2} = 165 \cdot \frac{(d_0 - 0{,}71 \cdot D_W)^2}{l_{S2}} \cdot \frac{l_S}{l_S - l_{S2}} \quad (\text{N}/\mu\text{m}) \qquad (18)$$

The lowest screw rigidity occurs at the center of the screw ($l_{S2} = l_S/2$),

and thus equals:

$$R_{S2min} = 660 \cdot \frac{d_2^2}{l_S} \quad (\text{N}/\mu\text{m}) \qquad (19)$$



Rigidity in the area of the nut unit R_{nu}

The rigidity in the area of the nut unit is calculated according to DIN 69051 (P1).

See Dimension Tables for rigidity values.

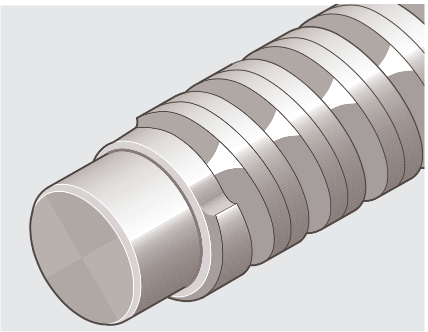
Nut Mounting

- **adjustable-preload single nut**
- **double nut**

These models are supplied with pre-mounted nut units. The nut unit and screw may not be disassembled. Please consult us first, should this become necessary for any reason.

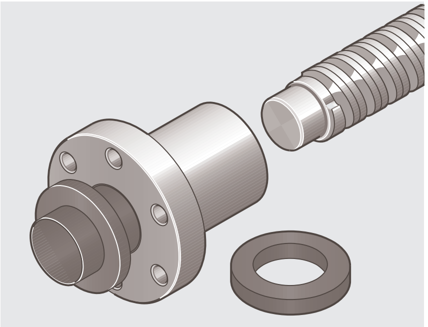
- **single nut with reduced backlash**
- **adjustable preload single nut**

The nut unit may only be mounted using a mounting arbor. The outer diameter of the arbor should be approx. 0.1 mm smaller than the root diameter of the screw. In most cases, the transport arbor on which the nuts are delivered may be used to mount the nut. The end of the screw thread must be chamfered in order to prevent damage to the seal and the internal components of the nut unit.



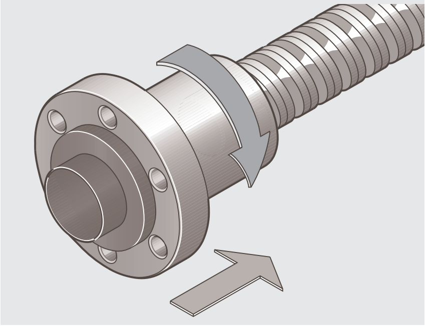
The nut is to be mounted as follows:

Remove the rubber ring from one end of the mounting arbor.



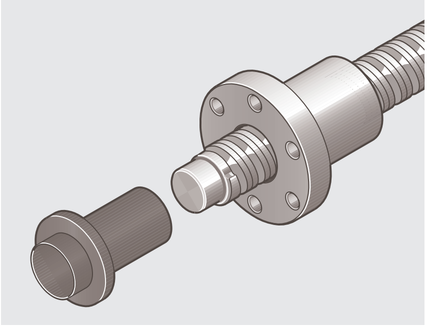
Push the mounting arbor with nut until it engages with the end of the thread. The arbor must make contact without axial clearance.

Carefully turn the nut unit onto the thread, applying only light axial pressure.



Do not remove the mounting arbor until the entire nut unit is seated on the screw thread.

Proceed in the reverse order when removing the nut from the screw. Take particular care not to damage the nut, screw or internal components, as this could result in the premature failure of the ball screw assembly.



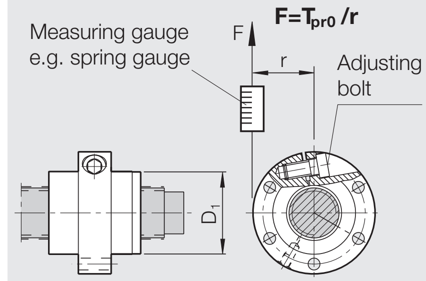
Mounting instructions are supplied as standard along with every unit.

Setting the radial clearance or preload of adjustable-preload single nuts

Using the adjusting bolt, reduce the clearance of the nut mounted on the screw until the corresponding dynamic drag torque $\mathbf{T_{pr0}}$ specified in the table has been attained (ball screw lightly oiled).

Check this torque along the entire length of the thread; if the torque exceeds the value specified in the table at any point along the thread, adjust accordingly.

Once the torque has been properly adjusted, the centering diameter D_1 must correspond to the values specified in the table. Cover the head of the bolt with a protective cap.



$\mathbf{T_{pr0}}$ = dynamic preload drag torque F_V = 0.05 C (5% of the dyn. load rating), measured without seals. See “Acceptance Conditions and Tolerance Grades” for permissible deviations.

$\mathbf{T_{RD}}$ = dynamic drag torque of the 2 seals

$\mathbf{T_{ta}}$ = overall dynamic drag torque

$\mathbf{T_{ta}} = \mathbf{T_{pr0}} + \mathbf{T_{RD}}$

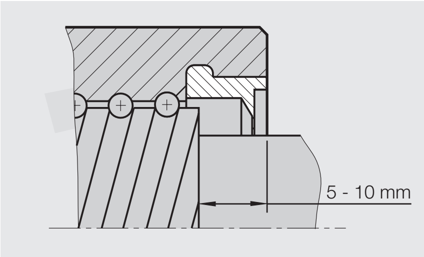
See Page 17 for tolerances.

Size d_0 x P x Dw - i	T_{pr0} (Nm)	T_{RD} approx. (Nm)	Centering ø D_1 after adjustment (mm) SEM-E-C max.	 min.	 SEM-E-S max.	 min.
8 x 2.5R x 1.588 - 3	0.01	0.015			15.978	15.953
12 x 5R x 2.5 - 3	0.04	0.03			23.975	23.940
16 x 5R x 3 - 4	0.10	0.08	27.975	27.940	27.975	27.940
16 x 10R x 3 - 3	0.08	0.08	27.975	27.940	27.975	27.940
16 x 16R x 3 - 2	0.05	0.08	27.978	27.950	32.973	32.945
16 x 16R x 3 - 3	0.08	0.08	27.978	27.950	32.973	32.945
20 x 5R x 3 - 4	0.15	0.10	35.970	35.935	32.970	32.935
20 x 20R x 3.5 - 2	0.09	0.12	35.973	35.945	37.973	37.945
20 x 20R x 3.5 - 3	0.14	0.12	35.973	35.945	37.973	37.945
25 x 5R x 3 - 4	0.21	0.12	39.970	39.935	37.970	37.935
25 x 10R x 3 - 4	0.21	0.15	39.970	39.935	37.970	37.935
25 x 25R x 3.5 - 2	0.13	0.20	39.973	39.945	47.973	47.945
25 x 25R x 3.5 - 3	0.19	0.20	39.973	39.945	47.973	47.945
32 x 5R x 3.5 - 4	0.36	0.25	49.970	49.935	47.970	47.935
32 x 10R x 3.969 - 5	0.53	0.25	49.970	49.935	47.970	47.935
32 x 20R x 3.969 - 2	0.22	0.25	49.973	49.945	55.969	55.941
32 x 20R x 3.969 - 3	0.33	0.25	49.973	49.945	55.969	55.941
32 x 32R x 3.969 - 2	0.22	0.25	49.973	49.945	55.969	55.941
32 x 32R x 3.969 - 3	0.32	0.25	49.973	49.945	55.969	55.941
40 x 5R x 3.5 - 5	0.61	0.40	62.966	62.931	55.966	55.931
40 x 10R x 6 - 4	1.04	0.40	62.966	62.931	62.966	62.931
40 x 20R x 6 - 3	0.79	0.40	62.969	62.941	62.969	62.941
40 x 40R x 6 - 2	0.53	0.40	62.969	62.941	71.969	71.941
40 x 40R x 6 - 3	0.77	0.40	62.969	62.941	71.969	71.941
50 x 5R x 3.5 - 5	0.83	0.50	74.966	74.931	67.966	67.931
50 x 10R x 6 - 6	2.07	0.60	74.966	74.931	71.966	71.931
50 x 20R x 6.5 - 3	1.25	0.60	74.969	74.941	84.964	84.936
50 x 20R x 6.5 - 5	1.97	0.60	74.969	74.941	84.964	84.936
50 x 40R x 6.5 - 2	0.83	0.60	74.969	74.941	84.964	84.936
50 x 40R x 6.5 - 3	1.21	0.60	74.969	74.941	84.964	84.936
63 x 10R x 6 - 6	2.91	0.70	89.961	89.926	84.961	84.926
63 x 20R x 6.5 - 3	1.74	1.20	94.964	94.936	94.964	94.936
63 x 20R x 6.5 - 5	2.75	1.20	94.964	94.936	94.964	94.936
63 x 40R x 6.5 - 2	1.21	1.20	94.964	94.936	94.964	94.936
63 x 40R x 6.5 - 3	1.75	1.20	94.964	94.936	94.964	94.936
80 x 10R x 6.5 - 6	4.51	1.40	104.961	104.926	104.961	104.926
80 x 20R x 9 - 6	7.11	2.20	124.959	124.931	124.959	124.931
80 x 20R x 12.7 - 6	10.93	2.20	124.959	124.931	124.959	124.931

STAR – Precision Ball Screw Assemblies
Mounting and Lubrication Instructions

Inserting the wiper-type seal

Position the nut on the screw as illustrated in the diagram. Insert the wiper so that its projection is in the recess and press it in until it snaps into the groove. While turning the nut on the screw, watch the wiper lip carefully and straighten it if necessary by applying pressure to the end surface. Ensure that the lip is not damaged.

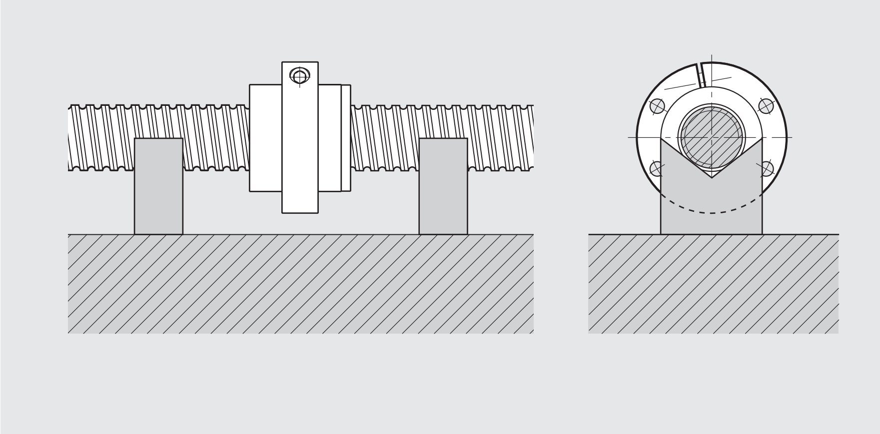


Be careful not to run the nut past the end of the screw thread.

Storage

Ball screw assemblies are high-quality systems that must be treated with due care. In order to prevent damage and contamination, the elements should not be removed from the protective wrapping until immediately before installation.

Once they have been removed from the packaging, they must be set down on V-shaped cradles.



Installation in the Machine

It is not normally necessary to remove the preservative coating before installation.

- If the ball screw is contaminated it must first be cleaned (see “Cleaning”) and reoiled.
- Push the nut unit into the mounting bore, taking care to avoid any impacts or misalignment.
- Tighten the mounting bolts using a torque wrench if necessary. See table for the tightening torque that corresponds to the bolt strength class.

Bolt diameter (mm)	Tightening torque (Nm) strength class to DIN ISO 898:		
	8.8	10.9	12.9
M 3	1.3	1.8	2.1
M 4	2.7	3.8	4.6
M 6	9.5	13	16
M 8	23	32	39
M 10	46	64	77
M 12	80	110	135
M 16	195	275	330

Tolerances

Observe the correct tolerances when installing the nut (see “Nut Housings”).

Lubrication

Before the ball screw is put into operation, a lubricant must be applied to the nut via the lube hole.

The standard lubrication practices that apply to antifriction bearings also apply to ball screws. Either oil or grease may be used as a lubricant.
Lubricant loss is, however, greater than that of antifriction bearings due to the axial motion between the screw and the nut. **In most cases, the initial supply of grease will not last for the entire service life of the assembly.** Graphite and MoS_2 additives must not be used.

Oil lubrication

The influence of the temperature on the performance of the ball screw is very significant, as thermal expansion interferes with the positioning accuracy of the assembly. One of the advantages of oil lubrication is the minimized heat build-up of the ball screw, particularly at high speeds. As a rule, commercially available petroleum base oils used for antifriction bearings are suitable. The necessary viscosity depends on the speed, temperature and load conditions of the respective application (see DIN 51501, 51517, 51519 and GfT Worksheet 3).

Grease lubrication

The advantage of grease lubrication is that the ball screw can run for 500 to 1000 hours on one supply of grease. As a result, a lubricating system is not required in many cases.
The amount of grease used should fill the pockets to approximately half of their capacity. All commercially available antifriction-bearing lubricating greases may be used. Do not mix different varieties together. Ball screws subjected to normal loads should be lubricated with a KP2K antifriction bearing lubricating grease as specified in DIN 51825. Read the lubricant manufacturer specifications carefully!

Cleaning

Various cleaning agents can be used to degrease and wash the assembly:

- aqueous cleaning agents
- organic cleaning agents

Do not use trichloroethylene!

⚠ Immediately after cleaning, thoroughly dry all parts, then apply a preservative coating or anti-corrosion oil.

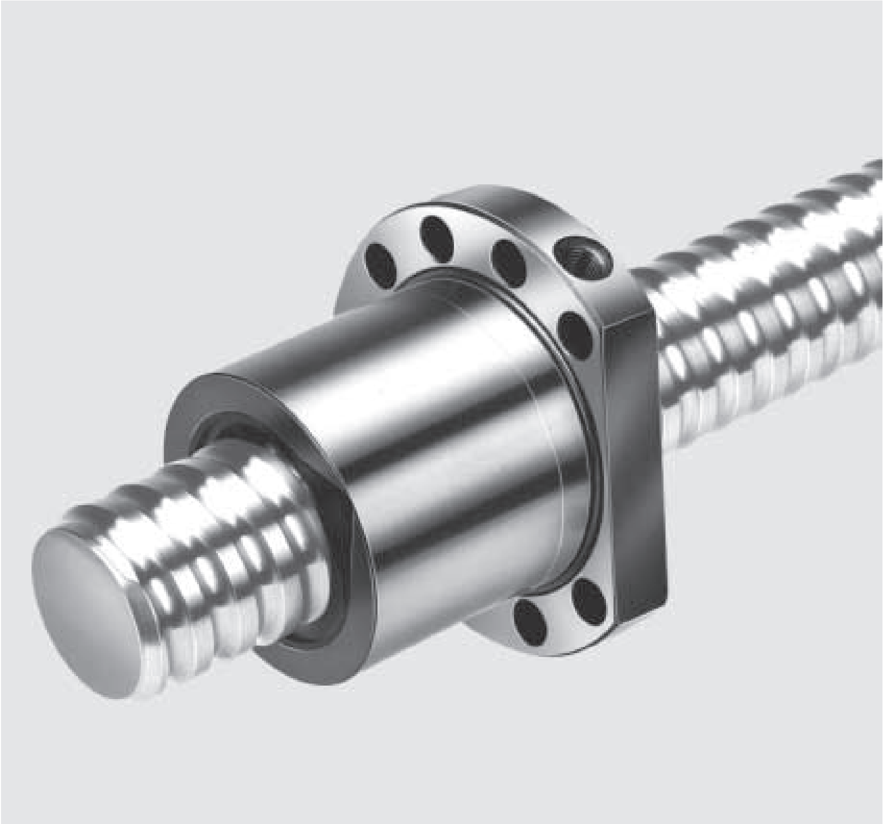
In all cases, take care to observe the appropriate legal regulations (environmental protection, health and safety at work, etc.) as well as the specifications for the cleaning agent (e.g. handling).

STAR – Precision Ball Screw Assemblies
Single Nut with Flange FEM-E-C

Mounting dimensions to DIN 69 051, Part 5

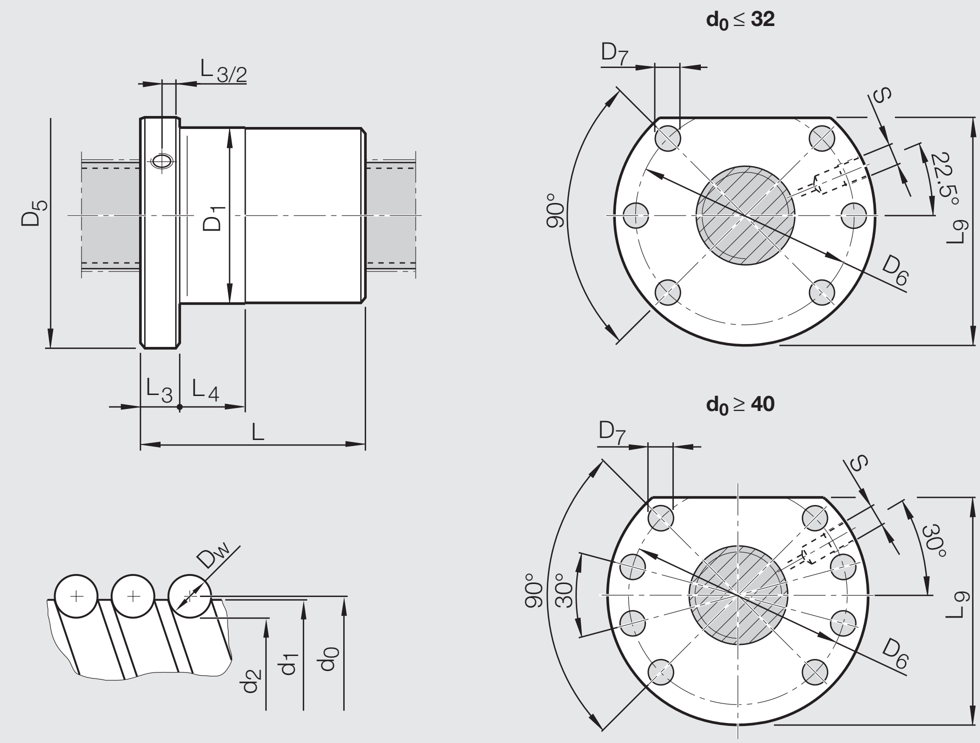
Flange type C

Nut version:
with reduced backlash or preloaded by means of optimized ball size selection



d_0 = nominal diameter
P = Lead
(R = right-hand thread,
L = left-hand thread)
D_W = ball diameter
i = number of ball track turns

Size	Part number	Load ratings		Rigidity		Mass moment of inertia of screw
		dyn.	stat.	Nut	Screw	
d_0 x P x D_w - i		C (N)	C_0 (N)	R_{nu} (N/µm)	R_{S1} (N/µm/m)	J_S (kgcm²/m)
16 x 5 R x 3-4	1502-0-1085	12300	16100	350	32	0.29
16 x 10 R x 3-3	1502-0-4065	9600	12300	280	32	0.29
16 x 16 R x 3-3	1502-0-6065	9200	11900	260	32	0.29
20 x 5 R x 3-4	1502-1-1065	14300	21600	440	53	0.79
20 x 20 R x 3.5-3	1502-1-7065	13300	18800	340	52	0.74
25 x 5 R x 3-4	1502-2-1065	15900	27200	510	86	2.11
25 x 10 R x 3-4	1502-2-4065	15800	27000	540	86	2.33
25 x 25 R x 3.5-3	1502-2-8065	14600	23200	404	84	2.04
32 x 5 R x 3.5-4	1502-3-1065	21500	40000	610	144	5.67
32 x 10 R x 3.969-5	1502-3-4086	31700	58200	834	141	6.14
32 x 20 R x 3.969-3	1502-3-7065	19600	33600	500	141	6.14
32 x 32 R x 3.969-3	1502-3-9065	19400	34000	500	141	5.89
40 x 5 R x 3.5-5	1502-4-1066	29100	64300	880	232	14.90
40 x 10 R x 6-4	1502-4-4065	50000	86300	840	211	12.57
40 x 20 R x 6-3	1502-4-7065	37800	62800	640	211	12.57
40 x 40 R x 6-3	1502-4-9065	36900	62200	620	211	12.57
50 x 5 R x 3.5-5	1502-5-1066	32100	81500	1010	373	38.52
50 x 10 R x 6-6	1502-5-4066	79700	166500	1450	345	33.66
50 x 20 R x 6.5-5	1502-5-7086	75700	149600	1300	340	32.15
50 x 40 R x 6.5-3	1502-5-9065	46500	85900	770	340	32.15
63 x 10 R x 6-6	1502-6-4066	88800	214200	1690	569	91.51
63 x 20 R x 6.5-5	1502-6-7086	83900	190300	1550	563	88.28
63 x 40 R x 6.5-3	1502-6-9065	53300	114000	960	563	88.28
80 x 10 R x 6.5-6	1502-7-4066	108400	291700	1950	938	246.00
80 x 20 R x 12.7-6	1502-7-7066	262700	534200	2320	832	193.20
80 x 20 R x 9-6	1502-7-7086	170900	403900	2330	894	237.20
100 x 10 R x 6.5-6	1502-8-4066	119500	371900	2200	1501	631.80
100 x 20 R x 12.7-6	1502-8-7066	295100	686400	2760	1366	521.90
125 x 10 R x 6.5-6	1502-9-4066	130600	468700	2390	2391	1606.00
125 x 20 R x 12.7-6	1502-9-7066	326500	870400	3180	2220	1380.00



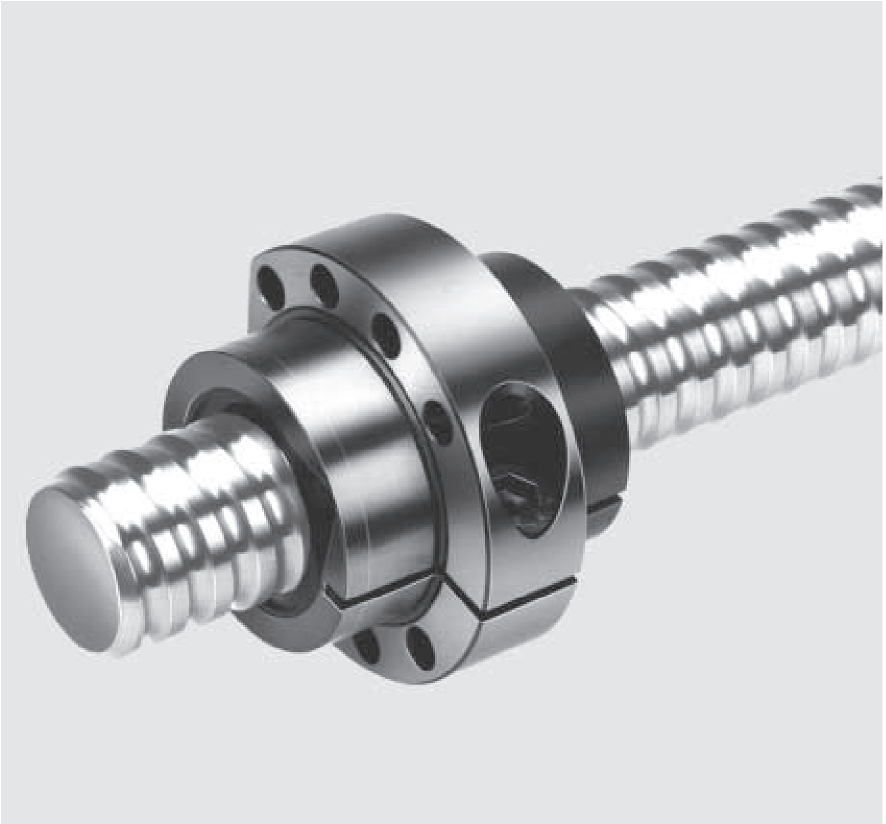
First angle projection

Dimensions (mm)												Max. backlash	Weight	
					Holes								Screw	Nut
d_1	d_2	D_1 g6	D_5	D_6	n (number)	D_7	L	L_3	L_4	L_9	S	(mm)	(kg/m)	(kg)
15.0	12.9	28	48	38	6	5.5	35	12	10	44	M6	0.04	1.26	0.18
15.0	12.9	28	48	38	6	5.5	45	12	18	44	M6	0.04	1.26	0.21
15.0	12.9	28	48	38	6	5.5	61	12	20	44	M6	0.04	1.27	0.26
19.0	16.9	36	58	47	6	6.5	45	12	10	51	M6	0.04	2.06	0.33
19.3	16.7	36	58	47	6	6.5	77	12	25	51	M6	0.04	1.98	0.49
24.0	21.9	40	62	51	6	6.5	45	12	10	55	M6	0.04	3.33	0.36
24.0	21.9	40	62	51	6	6.5	64	12	16	55	M6	0.04	3.44	0.47
24.0	21.4	40	62	51	6	6.5	95	12	30	55	M6	0.04	3.16	0.63
31.0	28.4	50	80	65	6	9	48	13	10	71	M6	0.04	5.50	0.62
31.0	27.9	50	80	65	6	9	77	13	16	71	M6	0.04	5.71	0.84
31.0	27.9	50	80	65	6	9	84	13	25	71	M6	0.04	5.33	0.90
31.0	27.9	50	80	65	6	9	120	13	40	71	M6	0.04	5.49	1.21
39.0	36.4	63	93	78	8	9	54	15	10	81.5	M8x1	0.04	8.84	1.03
38.0	33.8	63	93	78	8	9	70	15	16	81.5	M8x1	0.07	8.21	1.19
38.0	33.8	63	93	78	8	9	88	15	25	81.5	M8x1	0.07	8.21	1.44
38.0	33.8	63	93	78	8	9	142	15	45	81.5	M8x1	0.07	8.21	2.16
49.0	46.4	75	110	93	8	11	54	15	10	97.5	M8x1	0.04	14.20	1.39
48.0	43.8	75	110	93	8	11	90	18	16	97.5	M8x1	0.07	13.40	2.14
48.0	43.3	75	110	93	8	11	132	18	25	97.5	M8x1	0.07	12.70	2.73
48.0	43.3	75	110	93	8	11	149	18	45	97.5	M8x1	0.07	12.70	3.04
61.0	56.8	90	125	108	8	11	90	22	16	110	M8x1	0.07	21.80	2.56
61.0	56.3	95	135	115	8	13.5	132	22	25	117.5	M8x1	0.07	21.00	4.51
61.0	56.3	95	135	115	8	13.5	149	22	45	117.5	M8x1	0.07	21.00	5.04
78.0	73.3	105	145	125	8	13.5	95	22	16	127.5	M8x1	0.07	35.70	3.4
76.0	67.0	125	165	145	8	13.5	170	25	25	147.5	M8x1	0.12	32.40	10.2
77.0	70.8	125	165	145	8	13.5	160	25	25	147.5	M8x1	0.09	32.40	9.95
98.0	93.4	125	165	145	8	13.5	95	25	16	147.5	M8x1	0.06	56.90	4.4
96.0	87.1	150	202	176	8	17.5	170	30	25	178.5	M8x1	0.11	52.70	14.3
123.0	118.0	150	202	176	8	17.5	95	25	16	178.5	M8x1	0.06	90.40	5.65
121.0	112.0	170	222	196	8	17.5	170	40	25	198.5	M8x1	0.11	85.10	16.1

STAR – Precision Ball Screw Assemblies Adjustable-Preload Single Nut SEM-E-C

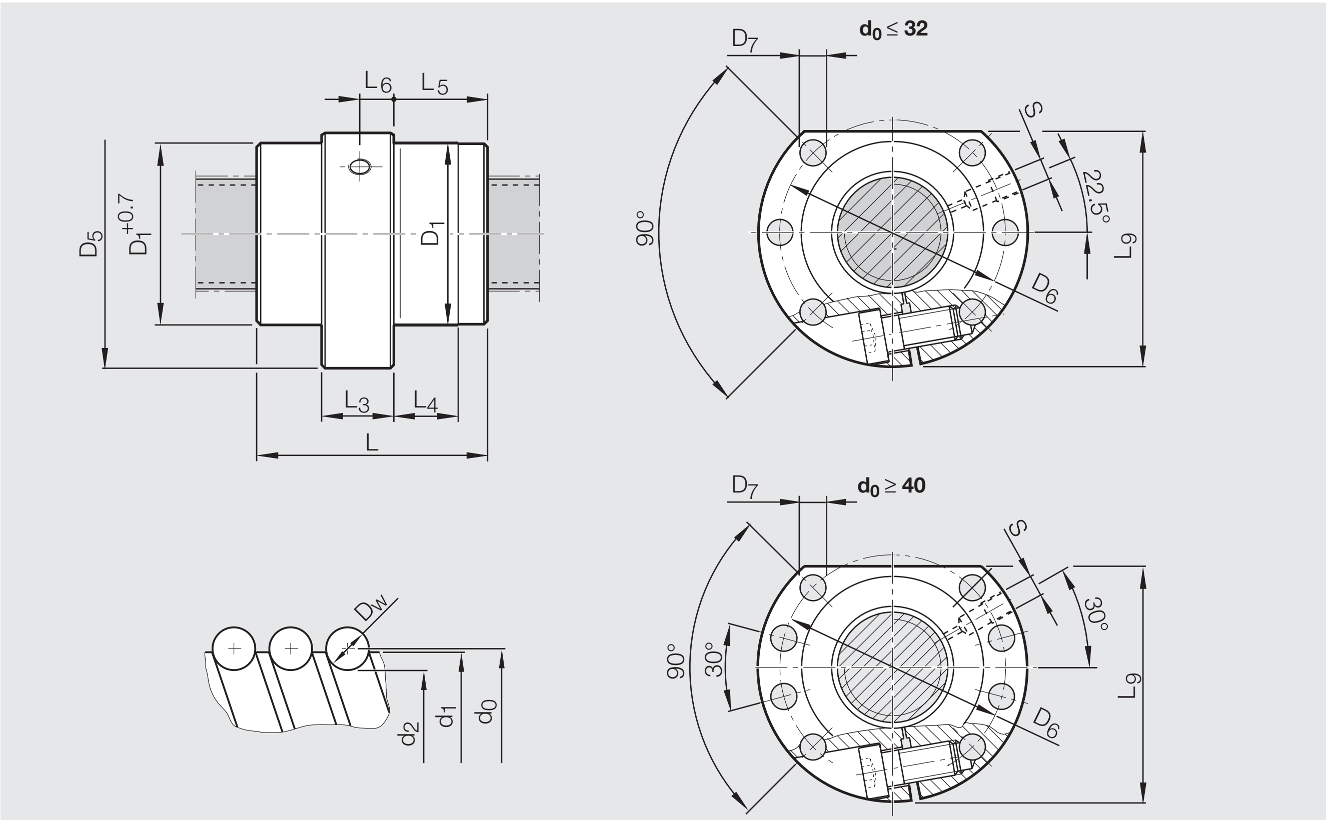
Mounting dimensions to DIN 69 051, Part 5

Flange type C



d_0 = nominal diameter
P = Lead
(R = right-hand thread,
L = left-hand thread)
D_W = ball diameter
i = number of ball track turns

Size	Part number	Load ratings		Rigidity		Mass moment of inertia of screw
		dyn.	stat.	Nut	Screw	
d_0 x P x D_w - i		C (N)	C_0 (N)	R_{nu} (N/μm)	R_{S1} (N/μm/m)	J_S (kgcm²/m)
16 x 5 R x 3-4	1512-0-1075	12300	16100	350	32	0.29
16 x 10 R x 3-3	1512-0-4055	9600	12300	280	32	0.29
16 x 16 R x 3-3	1512-0-6055	9200	11900	260	32	0.33
20 x 5 R x 3-4	1512-1-1055	14300	21600	440	53	0.79
20 x 20 R x 3.5-3	1512-1-7055	13300	18800	340	52	0.74
25 x 5 R x 3-4	1512-2-1055	15900	27200	510	86	2.11
25 x 10 R x 3-4	1512-2-4055	15800	27000	540	86	2.33
25 x 25 R x 3.5-3	1512-2-8055	14600	23200	404	84	2.04
32 x 5 R x 3.5-4	1512-3-1055	21500	40000	610	144	5.67
32 x 10 R x 3.969-5	1512-3-4075	31700	58200	834	141	6.14
32 x 20 R x 3.969-3	1512-3-7055	19600	33600	500	141	6.14
32 x 32 R x 3.969-3	1512-3-9055	19400	34000	500	141	5.59
40 x 5 R x 3.5-5	1512-4-1055	29100	64300	880	232	14.90
40 x 10 R x 6-4	1512-4-4055	50000	86300	840	211	12.57
40 x 20 R x 6-3	1512-4-7055	37800	62800	640	211	12.57
40 x 40 R x 6-3	1512-4-9055	36900	62200	620	211	12.57
50 x 5 R x 3.5-5	1512-5-1055	32100	81500	1010	373	38.52
50 x 10 R x 6-6	1512-5-4055	79700	166500	1450	345	33.66
50 x 20 R x 6.5-5	1512-5-7076	75700	149600	1300	340	32.15
50 x 40 R x 6.5-3	1512-5-9055	46500	85900	770	340	32.15
63 x 10 R x 6-6	1512-6-4055	88800	214200	1690	569	91.51
63 x 20 R x 6.5-5	1512-6-7076	83900	190300	1550	563	88.28
63 x 40 R x 6.5-3	1512-6-9055	53300	114000	960	563	88.28
80 x 10 R x 6.5-6	1512-7-4055	108400	291700	1950	938	246.00
80 x 20 R x 9-6	1512-7-7075	170900	403900	2330	894	237.20
80 x 20 R x 12.7- 6	1512-7-7055	262700	534200	2320	832	193.20



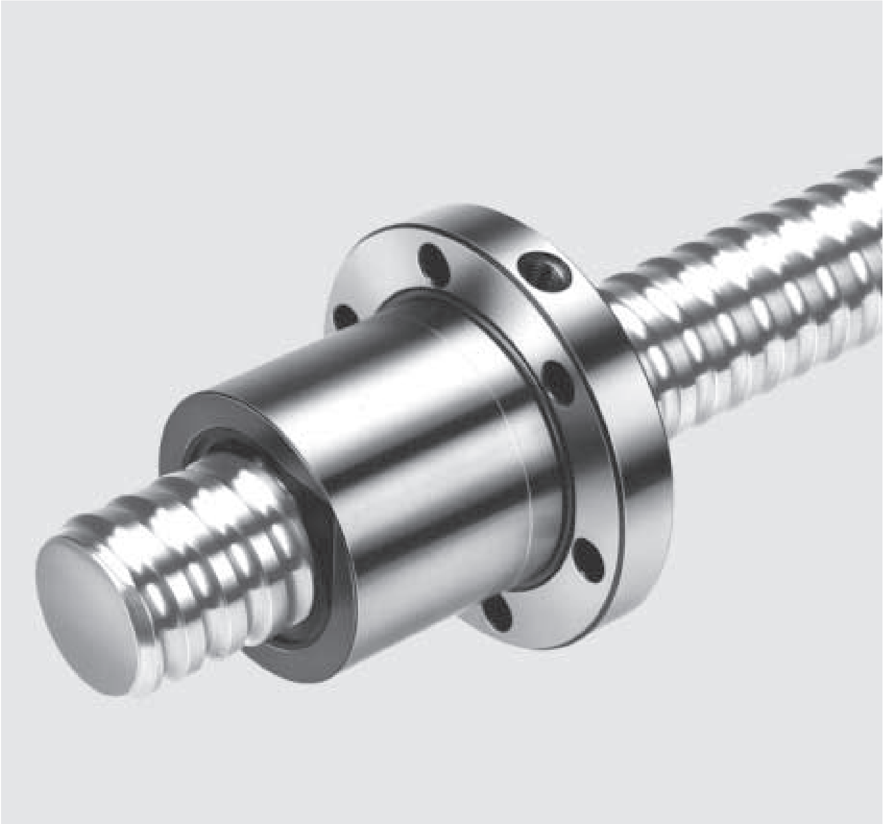
First angle projection

d₁	d₂	D₁ f9	D₅	D₆	Holes n (number)	Holes D₇	L	L₃	L₄	L₅	L₆	L₉	S	Weight Screw (kg/m)	Weight Nut (kg)
15	12.9	28	48	38	6	5.5	35	15	10	10	7.1	44	M6	1.26	0.19
15	12.9	28	48	38	6	5.5	45	15	15	15	11	44	M6	1.26	0.22
15	12.9	28	48	38	6	5.5	61	15	20	23	10	44	M6	1.27	0.29
19	16.9	36	58	47	6	6.5	45	15	10	15	7.1	51	M6	2.06	0.35
19.3	16.7	36	58	47	6	6.5	77	20	25	28.5	12.5	51	M6	1.98	0.56
24	21.9	40	62	51	6	6.5	45	20	10	12.5	9.6	55	M6	3.33	0.43
24	21.9	40	62	51	6	6.5	64	20	16	22	10	55	M6	3.44	0.54
24	21.4	40	62	51	6	6.5	95	25	30	35	14	55	M6	3.16	0.77
31	28.4	50	80	65	6	9	48	20	10	14	9.5	71	M6	5.50	0.74
31	27.9	50	80	65	6	9	77	20	16	28.5	12.5	71	M6	5.71	0.97
31	27.9	50	80	65	6	9	84	20	25	32	12.5	71	M6	5.33	1.04
31	27.9	50	80	65	6	9	120	20	40	50	12.5	71	M6	5.49	1.34
39	36.4	63	93	78	8	9	54	25	10	14.5	12	81.5	M8x1	8.84	1.25
38	33.8	63	93	78	8	9	70	25	16	22.5	11.8	81.5	M8x1	8.21	1.39
38	33.8	63	93	78	8	9	88	25	25	31.5	16	81.5	M8x1	8.21	1.55
38	33.8	63	93	78	8	9	142	40	45	51	25	81.5	M8x1	8.21	2.69
49	46.4	75	110	93	8	11	54	25	10	14.5	12	97.5	M8x1	14.20	1.67
48	43.8	75	110	93	8	11	90	30	16	30	14.1	97.5	M8x1	13.40	2.46
48	43.3	75	110	93	8	11	132	30	25	51	20	97.5	M8x1	12.70	3.08
48	43.3	75	110	93	8	11	149	30	45	59.5	18	97.5	M8x1	12.70	3.39
61	56.8	90	125	108	8	11	90	30	16	30	14	110	M8x1	21.80	2.83
61	56.3	95	135	115	8	13.5	132	30	25	51	20	117.5	M8x1	21.00	4.86
61	56.3	95	135	115	8	13.5	149	30	45	59.5	18	117.5	M8x1	21.00	5.36
78	73.3	105	145	125	8	13.5	95	30	16	32.5	14	127.5	M8x1	5.70	3.73
77	70.8	125	165	145	8	13.5	160	50	25	55	23.5	147.5	M8x1	32.40	10.88
76	67.0	125	165	145	8	13.5	170	50	25	60	23.7	147.5	M8x1	32.40	13.50

Dimensions (mm)

STAR – Precision Ball Screw Assemblies
Single Nut with Flange FEM-E-S

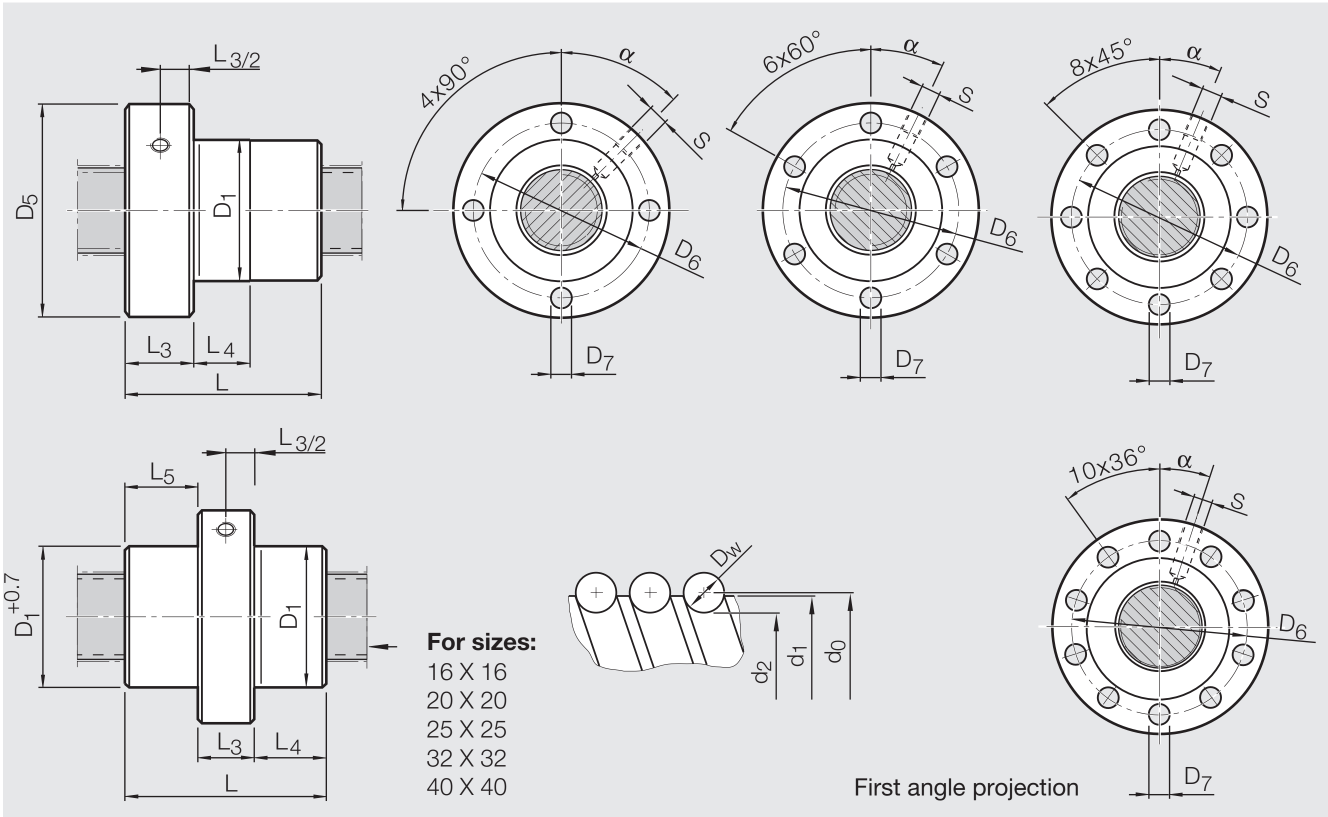
STAR Mounting dimensions



Nut version:
with reduced backlash or preloaded by means of optimized ball size selection

d_0 = nominal diameter
P = Lead
(R = right-hand thread,
L = left-hand thread)
D_W = ball diameter
i = number of ball track turns

Size	Part number	Load ratings		Rigidity		Mass moment of inertia of screw
		dyn.	stat.	Nut	Screw	
d_0 x P x D_w - i		C (N)	C_0 (N)	R_{nu} (N/µm)	R_{S1} (N/µm/m)	J_S (kgcm²/m)
8 x 2.5 R x 1.588-3	1532-2-3003	2900	3100	140	8	0.02
12 x 5 R x 2.5-3	1532-4-6013	6500	7500	210	17	0.09
16 x 5 R x 3-4	1512-0-1013	12300	16100	350	32	0.29
16 x 10 R x 3-3	1512-0-4003	9600	12300	280	32	0.29
16 x 16 R x 3-2	1512-0-6013	6200	7600	171	32	0.33
20 x 5 R x 3-4	1512-1-1003	14300	21600	440	53	0.79
20 x 20 R x 3.5-2	1512-1-7013	9100	12100	220	52	0.74
25 x 5 R x 3-4	1512-2-1003	15900	27200	510	86	2.11
25 x 10 R x 3-4	1512-2-4003	15800	27000	540	86	2.33
25 x 25 R x 3.5-2	1512-2-8013	10100	15000	260	84	2.04
32 x 5 R x 3.5-4	1512-3-1003	21500	40000	610	144	5.67
32 x 10 R x 3.969-5	1512-3-4013	31700	58200	834	141	6.14
32 x 20 R x 3.969-2	1512-3-7013	13500	21700	330	141	6.14
32 x 32 R x 3.969-2	1512-3-9013	13300	22000	330	141	5.59
40 x 5 R x 3.5-5	1512-4-1003	29100	64300	880	232	14.90
40 x 10 R x 6-4	1512-4-4003	50000	86300	840	211	12.57
40 x 20 R x 6-3	1512-4-7003	37800	62800	640	211	12.57
40 x 40 R x 6 -2	1512-4-9013	25400	40300	410	211	12.57
50 x 5 R x 3.5-5	1512-5-1003	32100	81500	1010	373	38.52
50 x 10 R x 6-6	1512-5-4003	79700	166500	1450	345	33.66
50 x 20 R x 6.5-3	1512-5-7013	47900	87000	780	340	32.15
50 x 40 R x 6.5-2	1512-5-9013	32000	55700	510	340	32.15
63 x 10 R x 6-6	1512-6-4003	88800	214200	1690	569	91.51
63 x 20 R x 6.5-3	1512-6-7013	53200	112100	930	563	88.28
63 x 40 R x 6.5-2	1512-6-9013	36900	74300	640	563	88.28
80 x 10 R x 6.5-6	1512-7-4003	108400	291700	1950	938	246.00
80 x 20 R x 12.7-6	1512-7-7003	262700	534200	2320	832	193.20
80 x 20 R x 9-6	1512-7-7013	170900	403900	2330	894	237.20
100 x 10 R x 6.5-6	1502-8-4002	119500	371900	2200	1501	631.80
100 x 20 R x 12.7-6	1502-8-7002	295100	686400	2760	1366	521.90
125 x 10 R x 6.5-6	1502-9-4002	130600	468700	2390	2391	1606.00
125 x 20 R x 12.7-6	1502-9-7002	326500	870400	3180	2220	1380.00

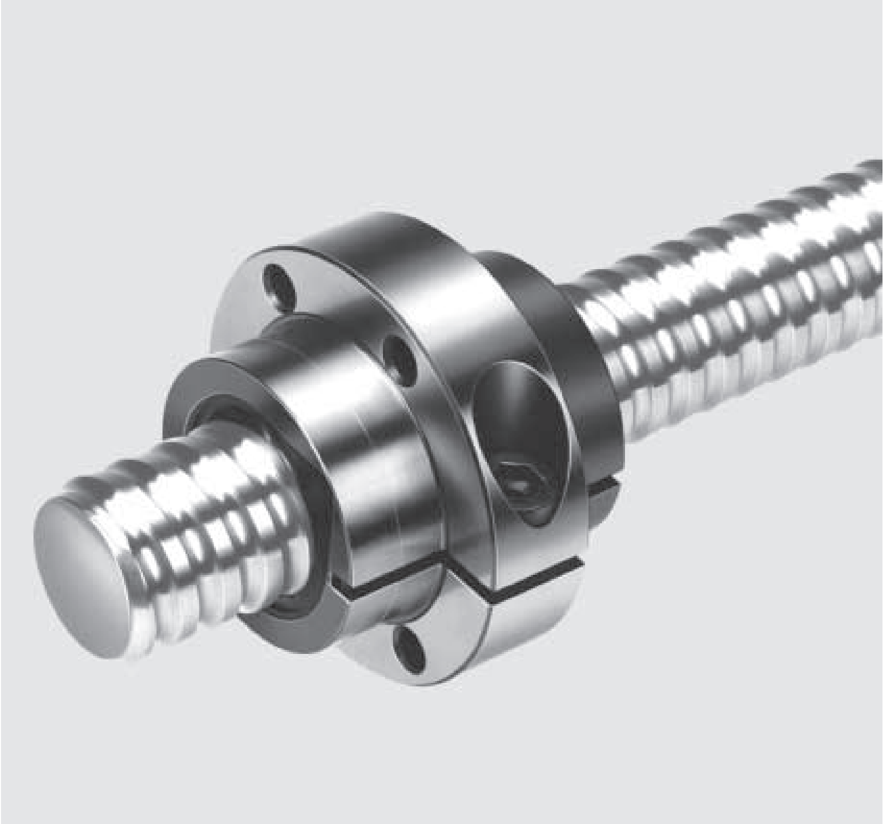


Dimensions (mm)												Angle α	Max. backlash	Weight Screw	Weight Nut
					Holes										
d_1	d_2	D_1 g6	D_5	D_6	n (number)	D_7	L	L_3	L_4	L_5	S	(°)	(mm)	(kg/m)	(kg)
7.5	6.3	16	30	23	6	3.4	16	8	8	-	3.9	30	0.02	0.32	0.05
11.2	9.4	24	40	32	6	4.5	28	12	10	-	M6	30	0.03	0.70	0.12
15.0	12.9	28	53	40	4	6.6	35	12	10	-	M6	45	0.04	1.26	0.23
15.0	12.9	28	53	40	4	6.6	45	12	16	-	M6	45	0.04	1.26	0.25
15.0	12.9	33	58	45	6	6.6	45	15	15	15	M6	30	0.04	1.27	0.39
19.0	16.9	33	58	45	6	6.6	45	12	10	-	M6	30	0.04	2.06	0.30
19.3	16.7	38	63	50	6	6.6	57	20	18.5	18.5	M6	30	0.04	1.98	0.60
24.0	21.9	38	63	50	6	6.6	45	12	10	-	M6	30	0.04	3.33	0.35
24.0	21.9	38	63	50	6	6.6	64	12	16	-	M6	30	0.04	3.44	0.44
24.0	21.4	48	73	60	6	6.6	70	25	22.5	22.5	M6	42	0.04	3.16	1.09
31.0	28.4	48	73	60	6	6.6	48	13	10	-	M6	30	0.04	5.50	0.54
31.0	27.9	48	73	60	6	6.6	77	13	16	-	M6	30	0.04	5.71	0.72
31.0	27.9	56	80	68	6	6.6	64	15	25	-	M6	30	0.04	5.33	1.02
31.0	27.9	56	80	68	6	6.6	88	20	34	34	M6	30	0.04	5.49	1.3
39.0	36.4	56	80	68	6	6.6	54	15	10	-	M8x1	30	0.04	8.84	0.71
38.0	33.8	63	95	78	6	9	70	15	16	-	M8x1	30	0.07	8.21	1.29
38.0	33.8	63	95	78	6	9	88	15	25	-	M8x1	30	0.07	8.21	1.54
38.0	33.8	72	110	90	6	11	102	40	31	31	M8x1	41	0.07	8.21	3.59
49.0	46.4	68	98	82	6	9	54	15	10	-	M8x1	30	0.04	14.20	1.02
48.0	43.8	72	110	90	6	11	90	18	16	-	M8x1	30	0.07	13.40	2.02
48.0	43.3	85	125	105	6	11	92	22	25	-	M8x1	30	0.07	12.70	3.40
48.0	43.3	85	125	105	6	11	109	22	45	-	M8x1	30	0.07	12.70	3.87
61.0	56.8	85	125	105	6	11	90	22	16	-	M8x1	30	0.07	21.80	2.62
61.0	56.3	95	140	118	6	14	92	22	25	-	M8x1	30	0.07	21.00	3.71
61.0	56.3	95	140	118	6	14	109	22	45	-	M8x1	30	0.07	21.00	4.21
78.0	73.3	105	150	125	6	14	95	22	16	-	M8x1	30	0.07	35.70	3.78
76.0	67.0	125	180	152	8	18	170	25	25	-	M8x1	22.5	0.12	32.40	11.00
77.0	70.8	125	180	152	8	18	160	25	25	-	M8x1	22.5	0.09	32.40	10.80
98.0	93.4	125	180	152	8	18	95	25	16	-	M8x1	22.5	0.06	56.90	5.46
96.0	87.1	145	200	172	8	18	170	30	25	-	M8x1	22.5	0.11	56.90	14.50
123.0	118.0	150	210	180	8	18	95	30	16	-	M8x1	22.5	0.06	90.40	7.49
121.0	112.0	170	230	200	10	18	170	40	25	-	M8x1	18	0.11	85.10	19.00

STAR – Precision Ball Screw Assemblies
Adjustable-Preload Single Nut SEM-E-S

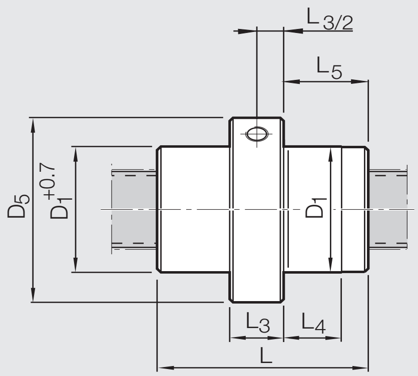
STAR Mounting dimensions

Also available with left-hand thread in some versions

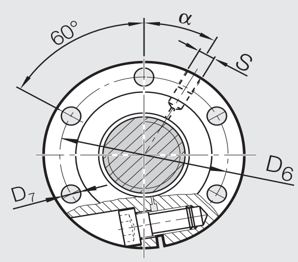


d_0 = nominal diameter
P = Lead
(R = right-hand thread,
L = left-hand thread)
D_W = ball diameter
i = number of ball track turns

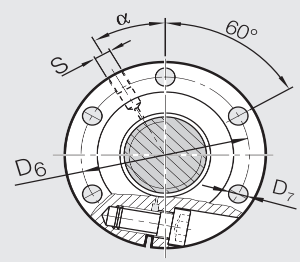
Size	Part number	Load rating		Rigidity		Mass moment of inertia of screw
		dyn.	stat.	Nut	Screw	
d_0 x P x D_w - i		C (N)	C_0 (N)	R_{nu} (N/µm)	R_{S1} (N/µm/m)	J_S (kgcm²/m)
8 x 2.5 R x 1.588-3	1532-2-3004	2900	3100	140	8	0.02
12 x 5 R x 2.5-3	1532-4-6014	6500	7500	210	17	0.09
16 x 5 R x 3-4	1512-0-1014	12300	16100	350	32	0.29
16 x 10 R x 3-3	1512-0-4004	9600	12300	280	32	0.29
16 x 16 R x 3-2	1512-0-6014	6200	7600	171	32	0.33
20 x 5 R x 3-4	1512-1-1004	14300	21600	440	53	0.79
20 x 20 R x 3.5-2	1512-1-7014	9100	12100	220	52	0.74
25 x 5 R x 3-4	1512-2-1004	15900	27200	510	86	2.11
25 x 10 R x 3-4	1512-2-4004	15800	27000	540	86	2.33
25 x 25 R x 3.5-2	1512-2-8014	10100	15000	260	84	2.04
32 x 5 R x 3.5-4	1512-3-1004	21500	40000	610	144	5.67
32 x 5 L x 3.5-4	1552-3-1004	21500	40000	610	144	5.67
32 x 10 R x 3.969-5	1512-3-4014	31700	58200	834	141	6.14
32 x 20 R x 3.969-2	1512-3-7014	13500	21700	330	141	6.14
32 x 32 R x 3.969-2	1512-3-9014	13300	22000	330	141	5.89
40 x 5 R x 3.5-5	1512-4-1004	29100	64300	880	232	14.90
40 x 5 L x 3.5-5	1552-4-1004	29100	64300	880	232	14.90
40 x 10 R x 6-4	1512-4-4004	50000	86300	840	211	12.57
40 x 10 L x 6-4	1552-4-4004	50000	86300	840	211	12.57
40 x 20 R x 6-3	1512-4-7004	37800	62800	640	211	12.57
40 x 40 R x 6-2	1512-4-9014	25400	40300	410	211	12.57
50 x 5 R x 3.5-5	1512-5-1004	32100	81500	1010	373	38.52
50 x 10 R x 6-6	1512-5-4004	79700	166500	1450	345	33.66
50 x 20 R x 6.5-3	1512-5-7014	47900	87000	780	340	32.15
50 x 40 R x 6.5-2	1512-5-9014	32000	55700	510	340	32.15
63 x 10 R x 6-6	1512-6-4004	88800	214200	1690	569	91.51
63 x 20 R x 6.5-3	1512-6-7014	53200	112100	930	563	88.28
63 x 40 R x 6.5-2	1512-6-9014	36900	74300	640	563	88.28
80 x 10 R x 6.5-6	1512-7-4004	108400	291700	1950	938	246.00
80 x 20 R x 9-6	1512-7-7014	170900	403900	2330	894	237.20
80 x 20 R x 12.7-6	1512-7-7004	262700	534200	2320	832	193.20



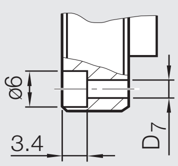
right-hand thread

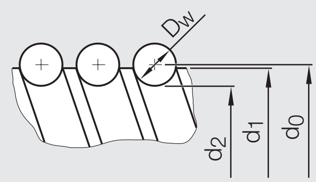


left-hand thread



Version for 8 x 2.5





First angle projection

Dimensions (mm)												Angle α	Weight	
					Holes								Screw	Nut
d_1	d_2	D_1 f9	D_5	D_6	n (number)	D_7	L	L_3	L_4	L_5	S	(°)	(kg/m)	(kg)
7.5	6.2	16	30	23	5	3.4	16	13	3	3	3.9	90	0.32	0.06
11.2	9.4	24	40	32	5	4.5	28	12	8	8	M6	35	0.70	0.11
15	12.9	28	53	40	5	6.6	35	15	10	10	M6	37	1.26	0.23
15	12.9	28	53	40	5	6.6	45	15	15	15	M6	270	1.26	0.25
15	12.9	33	58	45	5	6.6	45	15	15	15	M6	40	1.27	0.42
19	16.9	33	58	45	5	6.6	45	15	10	15	M6	34	2.06	0.33
19.3	16.7	38	63	50	5	6.6	57	20	18.5	18.5	M6	30	1.98	0.63
24	21.9	38	63	50	5	6.6	45	20	10	12.5	M6	30	3.33	0.44
24	21.9	38	63	50	5	6.6	64	20	16	22	M6	30	3.44	0.52
24	21.4	48	73	60	5	6.6	70	25	22.5	22.5	M6	42	3.16	1.13
31	28.4	48	73	60	5	6.6	48	20	10	14	M6	31	5.50	0.63
31	28.4	48	73	60	5	6.6	48	20	16	14	M6	31	5.50	0.63
31	27.9	48	73	60	5	6.6	77	20	28.5	28.5	M6	282	5.71	0.87
31	27.9	56	80	68	5	6.6	64	20	22	22	M6	30	5.33	1.13
31	27.9	56	80	68	5	6.6	88	20	34	34	M6	30	5.49	1.44
39	36.4	56	80	68	5	6.6	54	20	10	17	M8x1	25	8.84	0.87
39	36.4	56	80	68	5	6.6	54	20	10	17	M8x1	25	8.84	0.87
38	33.8	63	95	78	5	9.0	70	25	16	22.5	M8x1	33	8.21	1.52
38	33.8	63	95	78	5	9.0	70	25	16	22.5	M8x1	33	8.21	1.52
38	33.8	63	95	78	5	9.0	88	25	25	31.5	M8x1	270	8.21	1.77
38	33.8	72	110	90	5	11.0	102	40	31	31	M8x1	41	8.21	3.77
49	46.4	68	98	82	5	9.0	54	25	10	14.5	M8x1	23	14.20	1.23
48	43.8	72	110	90	5	11.0	90	30	16	30	M8x1	29	13.40	2.44
48	43.3	85	125	105	5	11.0	92	30	25	31	M8x1	270	12.70	3.94
48	43.3	85	125	105	5	11.0	109	30	39.5	39.5	M8x1	30	12.70	4.42
61	56.8	85	125	105	5	11.0	90	30	16	30	M8x1	25	21.80	2.94
61	56.3	95	140	118	5	14.0	92	30	25	31	M8x1	260	21.00	4.44
61	56.3	95	140	118	5	14.0	109	30	39.5	39.5	M8x1	20	21.00	4.94
78	73.3	105	150	125	5	14.0	95	30	16	32.5	M8x1	23	35.70	4.19
77	70.8	125	180	152	5	18.0	160	50	25	55	M8x1	30	32.40	13.79
76	67.0	125	180	152	5	18.0	170	50	25	60	M8x1	30	32.40	13.30

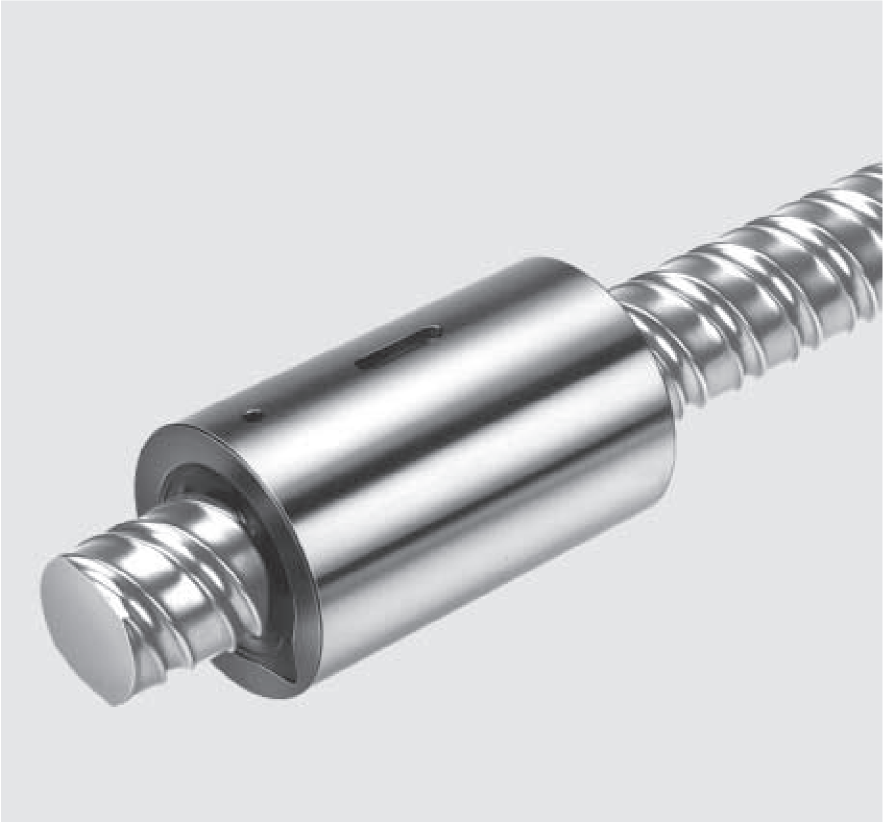
STAR – Precision Ball Screw Assemblies Cylindrical Single Nut ZEM-E-S and ZEM-E-A*)

STAR Mounting dimensions

In some cases, the outer diameter has been based on the centering diameter to DIN 69 051.

Nut version:

with reduced backlash or preloaded by means of optimized ball size selection



d_0 = nominal diameter

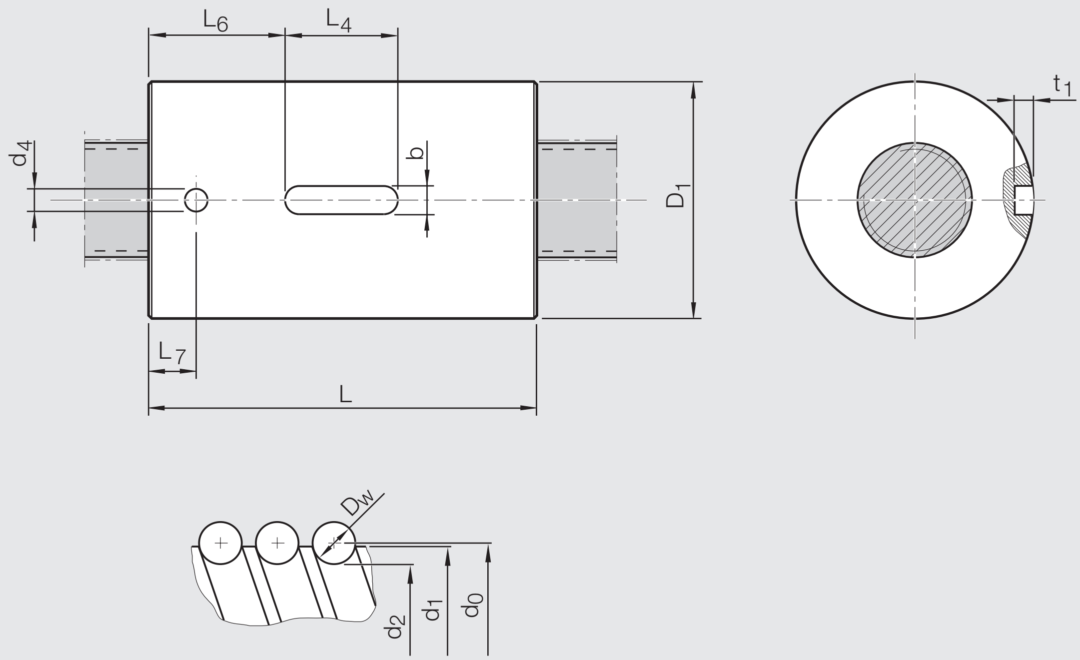
P = Lead (R = right-hand thread, L = left-hand thread)

D_W = ball diameter

i = number of ball track turns

Size	Part number	Load ratings dyn.	Load ratings stat.	Rigidity Nut	Rigidity Screw	Mass moment of inertia of screw
d_0 x P x D_w - i		C (N)	C_0 (N)	R_{nu} (N/µm)	R_{S1} (N/µm/m)	J_S ($kgcm^2$/m)
8 x 2.5 R x 1.588-3	1532-2-3002	2900	3100	140	8	0.02
12 x 5 R x 2.5-3	1532-4-6012	6500	7500	210	17	0.09
16 x 5 R x 3-4	1512-0-1012	12300	16100	350	32	0.29
16 x 10 R x 3-3	1512-0-4002	9600	12300	280	32	0.29
16 x 16 R x 3-2	1512-0-6012	6200	7600	171	32	0.33
20 x 5 R x 3-4	1512-1-1002	14300	21600	440	53	0.79
20 x 20 R x 3.5-2	1512-1-7012	9100	12100	220	52	0.74
25 x 5 R x 3-4	1512-2-1002	15900	27200	510	86	2.11
25 x 10 R x 3-4	1512-2-4002	15800	27000	540	86	2.33
25 x 25 R x 3.5-2	1512-2-8012	10100	15000	260	84	2.04
25 x 25 R x 3.5-3*)	1512-2-8052	14100	22300	375	84	2.04
32 x 5 R x 3.5-4	1512-3-1002	21500	40000	610	144	5.67
32 x 10 R x 3.969-5	1512-3-4012	31700	58200	834	141	6.14
32 x 20 R x 3.969-2	1512-3-7012	13500	21700	330	141	6.14
32 x 20 R x 3.969-3*)	1512-3-7052	19200	32800	475	141	6.14
32 x 32 R x 3.969-2	1512-3-9012	13300	22000	330	141	5.89
32 x 32 R x 3.969-3*)	1512-3-9052	19000	33100	470	141	5.89
40 x 5 R x 3.5-5	1512-4-1002	29100	64300	880	232	14.90
40 x 10 R x 6-4	1512-4-4002	50000	86300	840	211	12.57
40 x 20 R x 6-3	1512-4-7002	37800	62800	640	211	12.57
40 x 40 R x 6-2	1512-4-9012	25400	40300	410	211	12.57
40 x 40 R x 6-3*)	1512-4-9052	37100	62500	585	211	12.57
50 x 5 R x 3.5-5	1512-5-1002	32100	81500	1010	373	38.52
50 X 10 R X 6-6	1512-5-4002	79700	166500	1450	345	33.66
50 x 20 R x 6.5-3	1512-5-7012	47900	87000	780	340	32.15
63 x 10 R x 6-6	1512-6-4002	88800	214200	1690	569	91.51

*) Outer diameter corresponds to DIN 69 051, Part 5, model code ZEM-E-A



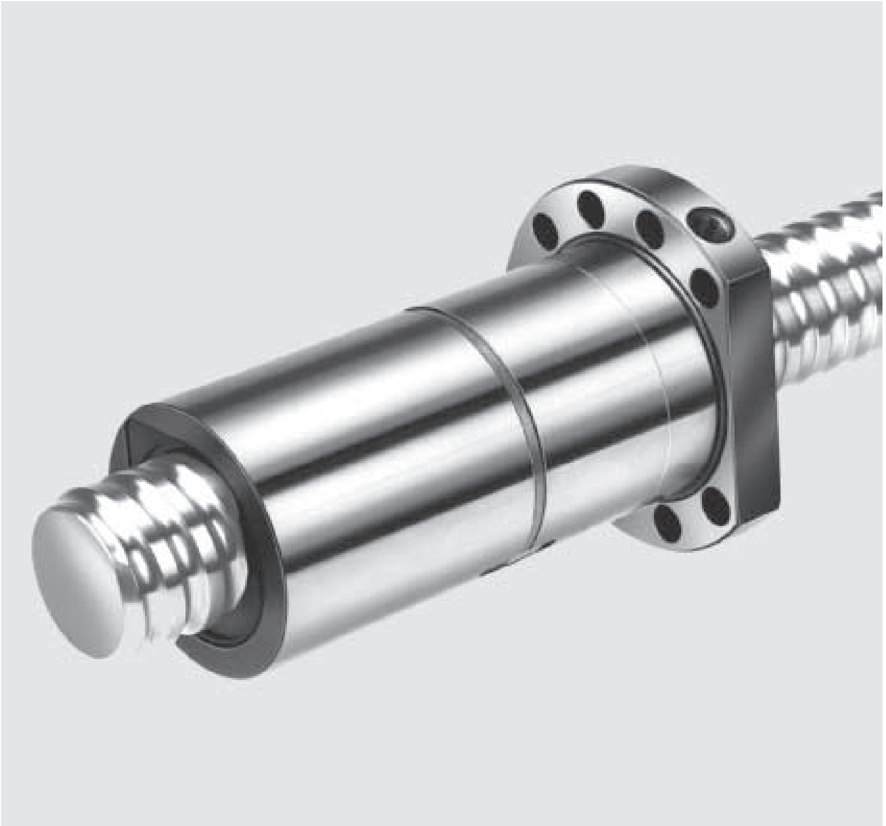
First angle projection

Dimensions (mm)										Max. backlash	Weight	
											Screw	Nut
d_1	d_2	D_1 g6	L ±0.1	L_4 +0.2	L_6	L_7	d_4	b P9	t_1 +0.1	(mm)	(kg/m)	(kg)
7.5	6.3	16	16	6	5	3.5	2	3	1.8	0.02	0.32	0.02
11.2	9.4	24	28	12	10	7	4	5	3	0.03	0.70	0.06
15.0	12.9	28	35	12	14.5	9.5	4	5	3	0.04	1.26	0.09
15.0	12.9	28	45	16	14.5	9.5	4	5	3	0.04	1.26	0.12
15.0	12.9	33	45	16	14.5	9.5	4	5	3	0.04	1.27	0.20
19.0	16.9	33	45	16	14.5	9.5	4	5	3	0.04	2.06	0.16
19.3	16.7	38	64	20	22	9.5	4	5	3	0.04	1.98	0.34
24.0	21.9	38	45	16	14.5	9.5	4	5	3	0.04	3.33	0.19
24.0	21.9	38	64	20	22	9.5	4	5	3	0.04	3.44	0.28
24.0	21.4	48	80	20	30	10.5	4	5	3	0.04	3.16	0.73
24.0	21.4	40	95	20	37.5	10.5	4	5	3	0.04	3.29	0.50
31.0	28.4	48	48	20	14	9.5	4	5	3	0.04	5.50	0.32
31.0	27.9	48	77	20	28.5	9.5	4	5	3	0.04	5.71	0.50
31.0	27.9	56	64	20	22	9.5	4	5	3	0.04	5.33	0.74
31.0	27.9	50	84	20	32	9.5	4	5	3	0.04	5.63	0.66
31.0	27.9	56	88	20	34	9.5	4	5	3	0.04	5.49	1.03
31.0	27.9	50	120	20	50	9.5	4	5	3	0.04	5.56	0.97
39.0	36.4	56	54	20	17	9.5	4	5	3	0.04	8.84	0.44
38.0	33.8	63	70	20	25	14	4	5	3	0.07	8.21	0.88
38.0	33.8	63	88	20	34	14	4	5	3	0.07	8.21	1.13
38.0	33.8	72	113	20	46.5	14	4	5	3	0.07	8.21	2.23
38.0	33.8	63	142	20	61	14	4	5	3	0.07	8.21	1.85
49.0	46.4	68	54	20	17	9.5	4	5	3	0.04	14.20	0.62
48.0	43.8	72	90	20	35	14	5	5	3.0	0.07	13.40	1.34
48.0	43.3	85	92	32	30	14	5	6	3.5	0.07	12.70	2.39
61.0	56.8	85	90	32	29	14	5	5	3.5	0.07	21.80	1.59

STAR – Precision Ball Screw Assemblies
Double Nut with Flange FDM-E-C

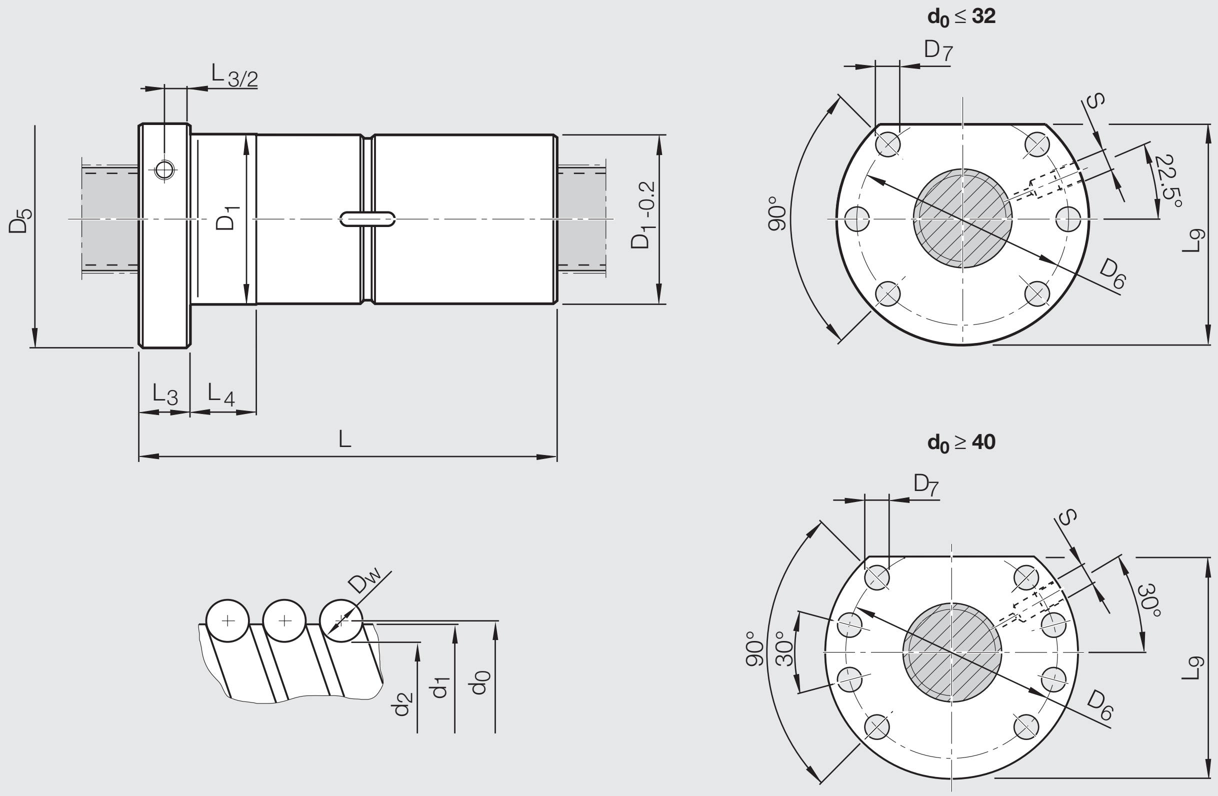
Mounting dimensions to DIN 69 051, Part 5

Flange type C



d_0 = nominal diameter
P = Lead
(R = right-hand thread,
L = left-hand thread)
D_W = ball diameter
i = number of ball track turns

Size	Part number	Load ratings dyn.	stat.	Rigidity Nut	Screw	Mass moment of inertia of screw
d_0 x P x D_w - i		C (N)	C_0 (N)	R_{nu} (N/µm)	R_{S1} (N/µm/m)	J_S (kgcm²/m)
16 x 5 R x 3-4	1502-0-1075	12300	16100	350	32	0.29
20 x 5 R x 3-4	1502-1-1055	14300	21600	440	53	0.79
25 x 5 R x 3-4	1502-2-1055	15900	27200	510	86	2.11
25 x 10 R x 3-4	1502-2-4055	15800	27000	540	86	2.33
32 x 5 R x 3.5-4	1502-3-1055	21500	40000	610	144	5.67
32 x 10 R x 3.969-5	1502-3-4076	31700	58200	834	141	6.14
40 x 5 R x 3.5-5	1502-4-1056	29100	64300	880	232	14.90
40 x 10 R x 6-4	1502-4-4055	50000	86300	840	211	12.57
40 x 10 R x 6-6	1502-4-4056	72100	132200	1250	211	12.57
50 x 5 R x 3.5-5	1502-5-1056	32100	81500	1010	373	38.52
50 x 10 R x 6-4	1502-5-4055	55400	109500	960	345	33.66
50 x 10 R x 6-6	1502-5-4056	79700	166500	1450	345	33.66
50 x 20 R x 6.5-5	1502-5-7076	75700	149600	1300	340	32.15
63 x 10 R x 6-4	1502-6-4055	61700	140400	1130	569	91.51
63 x 10 R x 6-6	1502-6-4056	88800	214200	1690	569	91.51
63 x 20 R x 6.5-5	1502-6-7076	83900	190300	1550	563	88.28
80 x 10 R x 6.5-6	1502-7-4056	108400	291700	1950	938	246.00
80 x 20 R x 9-6	1502-7-7076	170900	403900	2330	894	237.20
80 x 20 R x 12.7-6	1502-7-7056	262700	534200	2320	832	193.20
100 x 10 R x 6.5-6	1502-8-4056	119500	371900	2200	1501	631.80
100 x 20 R x 12.7-6	1502-8-7056	295100	686400	2760	1366	521.90
125 x 10 R x 6.5-6	1502-9-4056	130600	468700	2390	2391	1606.00
125 x 20 R x 12.7-6	1502-9-7056	326500	870400	3180	2220	1380.00

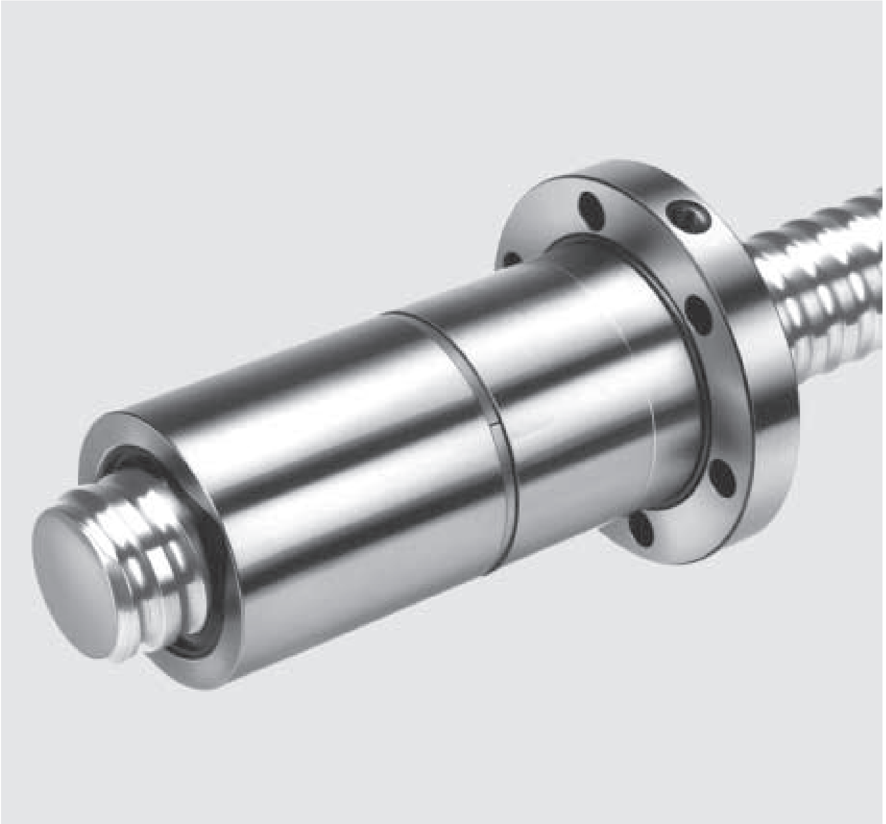


First angle projection

Dimensions (mm)												Weight	
					Holes							Screw	Nut
d_1	d_2	D_1 g6	D_5	D_6	n (number)	D_7	L	L_3	L_4	L_9	S	(kg/m)	(kg)
15.0	12.9	28	48	38	6	5.5	72	12	10	44	M6	1.25	0.29
19.0	16.9	36	58	47	6	6.5	82	12	10	51	M6	2.05	0.53
24.0	21.9	40	62	51	6	6.5	82	12	10	55	M6	3.33	0.57
24.0	21.9	40	62	51	6	6.5	120	12	16	55	M6	3.44	0.77
31.0	28.4	50	80	65	6	9	88	13	10	71	M6	5.50	0.96
31.0	27.9	50	80	65	6	9	144	13	16	71	M6	5.71	1.34
39.0	36.4	63	93	78	8	9	100	15	10	81.5	M8x1	8.84	1.68
38.0	33.8	63	93	78	8	9	140	15	16	81.5	M8x1	8.21	2.15
38.0	33.8	63	93	78	8	9	180	15	16	81.5	M8x1	8.21	2.73
49.0	46.4	75	110	93	8	11	100	15	10	97.5	M8x1	14.12	2.25
48.0	43.8	75	110	93	8	11	140	18	16	97.5	M8x1	13.32	2.97
48.0	43.8	75	110	93	8	11	180	18	16	97.5	M8x1	13.32	3.73
48.0	43.3	75	110	93	8	11	255	18	25	97.5	M8x1	13.12	4.93
61.0	56.8	90	125	108	8	11	140	22	16	110	M8x1	21.80	4.00
61.0	56.8	90	125	108	8	11	180	22	16	110	M8x1	21.80	4.45
61.0	56.3	95	135	115	8	13.5	255	22	25	117.5	M8x1	21.55	8.21
78.0	73.3	105	145	125	8	13.5	190	22	16	127.5	M8x1	35.72	5.93
77.0	70.8	125	165	145	8	13.5	320	25	25	147.5	M8x1	34.95	17.77
76.0	67.0	125	165	145	8	13.5	340	25	25	147.5	M8x1	32.42	19.40
98.0	93.4	125	165	145	8	13.5	190	25	16	147.5	M8x1	56.95	7.35
96.0	87.1	150	202	176	8	17.5	340	30	25	178.5	M8x1	52.74	24.60
123.0	118.0	150	202	176	8	17.5	190	25	16	178.5	M8x1	90.42	9.38
121.0	112.0	170	222	196	8	17.5	340	40	25	198.5	M8x1	85.07	29.70

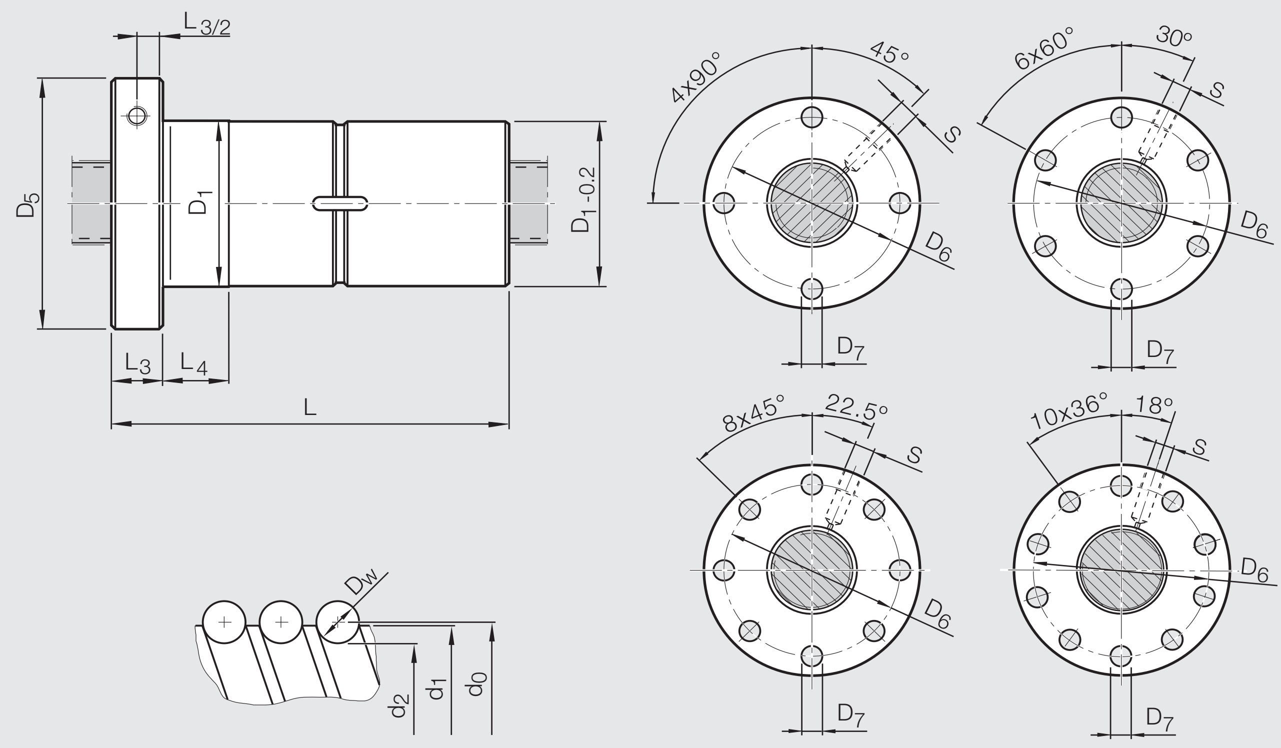
STAR – Precision Ball Screw Assemblies
Double Nut with Flange FDM-E-S

STAR Mounting dimensions



d_0 = nominal diameter
P = Lead
(R = right-hand thread,
L = left-hand thread)
D_W = ball diameter
i = number of ball track turns

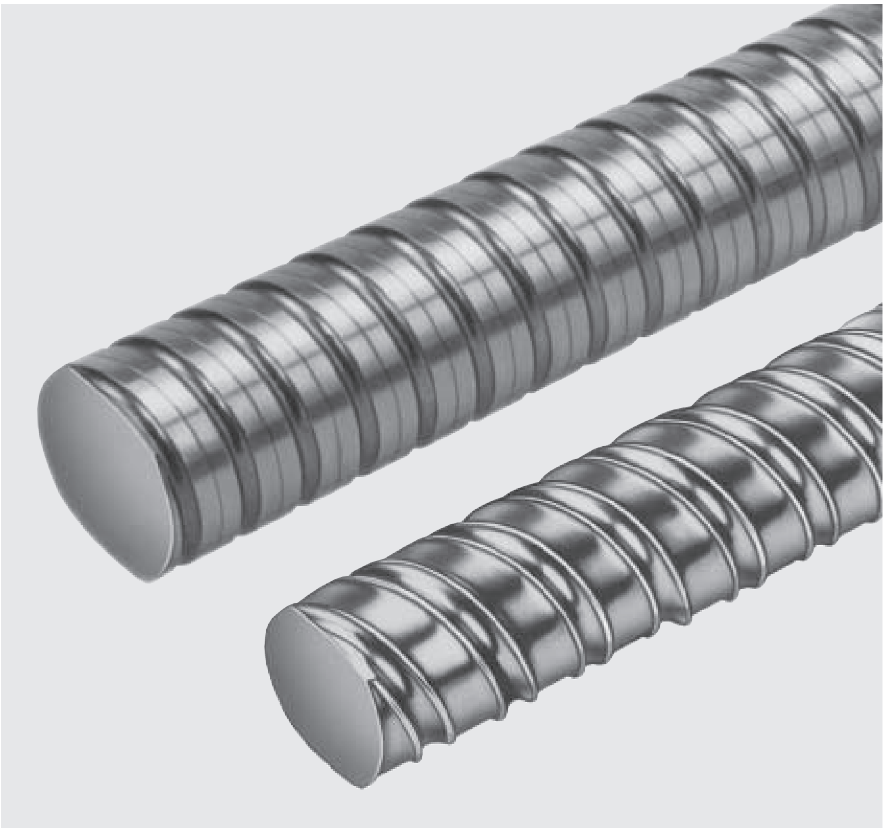
Size	Part number	Load ratings dyn.	Load ratings stat.	Rigidity Nut	Rigidity Screw	Mass moment of inertia of screw
d_0 x P x D_w - i		C (N)	C_0 (N)	R_{nu} (N/µm)	R_{S1} (N/µm/m)	J_S (kgcm²/m)
16 x 5 R x 3-4	1502-0-1033	12300	16100	350	32	0.29
20 x 5 R x 3-4	1502-1-1023	14300	21600	440	53	0.79
25 x 5 R x 3-4	1502-2-1023	15900	27200	510	86	2.11
25 x 10 R x 3-4	1502-2-4023	15800	27000	540	86	2.33
32 x 5 R x 3.5-4	1502-3-1023	21500	40000	610	144	5.67
32 x 10 R x 3.969-5	1502-3-4033	31700	58200	834	141	6.14
40 x 5 R x 3.5-5	1502-4-1023	29100	64300	880	232	14.90
40 x 10 R x 6-4	1502-4-4023	50000	86300	840	211	12.57
40 x 10 R x 6-6	1502-4-4024	72100	132200	1250	211	12.57
50 x 5 R x 3.5-5	1502-5-1023	32100	81500	1010	373	38.52
50 x 10 R x 6-4	1502-5-4023	55400	109500	960	345	33.66
50 x 10 R x 6-6	1502-5-4024	79700	166500	1450	345	33.66
50 x 20 R x 6.5-5	1502-5-7034	75700	149600	1300	340	32.15
63 x 10 R x 6-4	1502-6-4023	61700	140400	1130	569	91.51
63 x 10 R x 6-6	1502-6-4024	88800	214200	1690	569	91.51
63 x 20 R x 6.5-5	1502-6-7034	83900	190300	1550	563	88.28
80 x 10 R x 6.5-6	1502-7-4024	108400	291700	1950	938	246.00
80 x 20 R x 9-4	1502-7-7033	118600	264200	1550	894	237.20
80 x 20 R x 9-6	1502-7-7034	170900	403900	2330	894	237.20
80 x 20 R x 12.7-6	1502-7-7024	262700	534200	2320	832	193.20
100 x 10 R x 6.5-6	1502-8-4024	119500	371900	2200	1501	631.80
100 x 20 R x 12.7-6	1502-8-7024	295100	686400	2760	1366	521.90
125 x 10 R x 6.5-6	1502-9-4024	130600	468700	2390	2391	1606.00
125 x 20 R x 12.7-6	1502-9-7024	326500	870400	3180	2220	1380.00



First angle projection

Dimensions (mm)											Weight	
					Holes						Screw	Nut
d_1	d_2	D_1 g6	D_5	D_6	n (number)	D_7	L	L_3	L_4	S	(kg/m)	(kg)
15.0	12.9	28	53	40	4	6.6	72	12	10	M6	1.26	0.33
19.0	16.9	33	58	45	6	6.6	82	12	10	M6	2.06	0.45
24.0	21.9	38	63	50	6	6.6	82	12	10	M6	3.33	0.53
24.0	21.9	38	63	50	6	6.6	120	12	16	M6	3.44	0.70
31.0	28.4	48	73	60	6	6.6	88	13	10	M6	5.50	0.84
31.0	27.9	48	73	60	6	6.6	146	13	16	M6	5.71	1.22
39.0	36.4	56	80	68	6	6.6	100	15	10	M8x1	8.84	1.13
38.0	33.8	63	95	78	6	9	140	15	16	M8x1	8.21	2.25
38.0	33.8	63	95	78	6	9	180	15	16	M8x1	8.21	2.83
49.0	46.4	68	98	82	6	9	100	15	10	M8x1	14.20	1.60
48.0	43.8	72	110	90	6	11	140	18	16	M8x1	13.40	2.74
48.0	43.8	72	110	90	6	11	180	18	16	M8x1	13.40	3.39
48.0	43.3	85	125	105	6	11	255	22	25	M8x1	12.70	6.71
61.0	56.8	85	125	105	6	11	140	22	16	M8x1	21.80	3.53
61.0	56.8	85	125	105	6	11	180	22	16	M8x1	21.80	4.32
61.0	56.3	95	140	118	6	14	255	22	25	M8x1	21.00	8.65
78.0	73.3	105	150	125	6	14	190	22	16	M8x1	35.70	6.35
77.0	70.8	125	180	152	8	18	240	25	25	M8x1	32.40	14.80
77.0	70.8	125	180	152	8	18	320	25	25	M8x1	32.40	18.60
76.0	67.0	125	180	152	8	18	340	25	25	M8x1	32.40	20.20
98.0	93.4	125	180	152	8	18	190	25	16	M8x1	56.90	8.19
96.0	87.1	145	200	172	8	18	340	30	25	M8x1	52.70	24.50
123.0	118.0	150	210	180	8	18	190	30	16	M8x1	90.40	10.80
121.0	112.0	170	230	200	10	18	340	40	25	M8x1	85.10	31.00

STAR – Precision Ball Screw Assemblies
Precision-Rolled Screws



The Star precision-rolled screw presents an affordable alternative to the conventional ground-thread screw.

A particular advantage is the possibility of stocking various sizes and tolerance grades, as the rolled screws can be manufactured in advance independently of any customer order. This ensures supply at short notice and at an attractive price.

Star supplies precision-rolled screws with ends machined to specifications and the nuts ready-mounted. Alternatively, they can be supplied without end machining or with annealed ends. In these cases, the nuts are supplied separately on a mounting arbor.
(see also “End Machining Details” and “Mounting and Lubrication Instructions”)

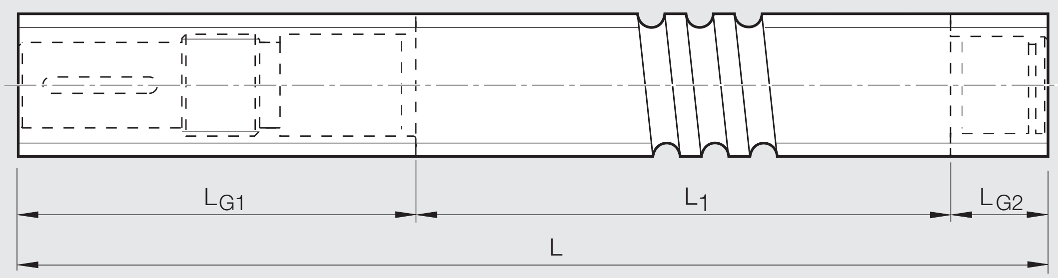
If the screw ends are to be machined by the customer, the most suitable solution is to use the screw with a single nut with backlash or with Star’s patented adjustable-preload single nut.

If Star is to supply screws with ready-machined ends, it is also possible to use a single nut preloaded by optimum ball size selection or a double nut.

Precision-rolled Star screws comply with the acceptance conditions and tolerance grades defined for T type screws according to DIN 69 051, Part 3, or ISO 3408-3.

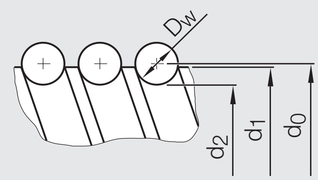
Star screws attain considerably better values than those required by the DIN standard; the permissible actual travel deviation being halved in the precision-rolled screw. In addition, the very linear lead characteristic of the precision-rolled screw greatly facilitates travel compensation in machine control systems.

For particularly demanding applications, customers may, upon request, receive a test report recording the total lead deviation. This allows type T5 screws to be classified according to tolerance grade P5.
(see “Acceptance Conditions and Tolerance Grades”)



Please state lengths in the "Inquiry / Order Form"

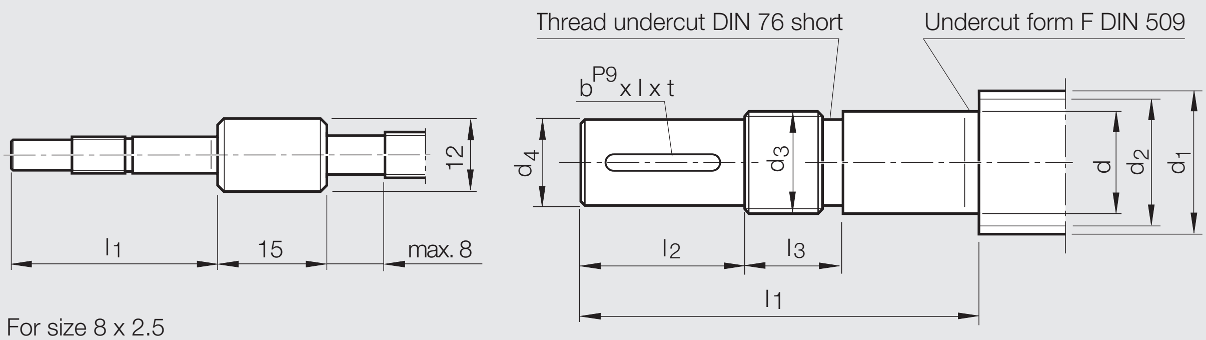
L = overall length
L_1 = threaded length
L_{G1}/L_{G2} = length of soft-annealed screw ends



Size	Part number								Maximum length	
d_0 x P x D_w	Tolerance grade T5	Tolerance grade T7	Tolerance grade T9	d1 (mm)	d2 (mm)	Rigidity R_{S1} (N/µm/m)	Weight (kg/m)	Mass moment of inertia J_S (kgcm²/m)	standard (mm)	on request (mm)
8 x 2.5 R x 1.588	1531-2-3500	1531-2-3700	1531-2-3900	7.5	6.3	8	0.31	0.02		
12 x 5 R x 2.5	1531-4-6500	1531-4-6700	1531-4-6900	11.2	9.4	17	0.70	0.09		
16 x 5 R x 3	1511-0-1500	1511-0-1700	1511-0-1900	15	12.9	32	1.25	0.29	1500	
16 x 10 R x 3	1511-0-4500	1511-0-4700	1511-0-4900	15	12.9	32	1.25	0.29		3500
16 x 16 R x 3	1511-0-6510	1511-0-6710	1511-0-6910	15	12.9	32	1.30	0.33		
20 x 5 R x 3	1511-1-1500	1511-1-1700	1511-1-1900	19	16.9	53	2.05	0.79	1800	
20 x 20 R x 3.5	1511-1-7510	1511-1-7710	1511-1-7910	19.3	16.7	52	2.04	0.74		
25 x 5 R x 3	1511-2-1500	1511-2-1700	1511-2-1900	24	21.9	86	3.33	2.11		
25 x 10 R x 3	1511-2-4500	1511-2-4700	1511-2-4900	24	21.9	86	3.44	2.33		
25 x 25 R x 3.5	1511-2-8510	1511-2-8710	1511-2-8910	24	21.4	84	3.29	2.04		
32 x 5 R x 3.5	1511-3-1500	1511-3-1700	1511-3-1900	31	28.4	144	5.50	5.67		
32 x 5 L x 3.5	1551-3-1500	1551-3-1700	1551-3-1900	31	28.4	144	5.50	5.67		
32 x 10 R x 3.969	1511-3-4510	1511-3-4710	1511-3-4910	31	27.9	141	5.63	6.14	2500	5600
32 x 20 R x 3.969	1511-3-7510	1511-3-7710	1511-3-7910	31	27.9	141	5.63	6.14		
32 x 32 R x 3.969	1511-3-9510	1511-3-9710	1511-3-9910	31	27.9	141	5.56	5.89		
40 x 5 R x 3.5	1511-4-1500	1511-4-1700	1511-4-1900	39	36.4	232	8.84	14.90		
40 x 5 L x 3.5	1551-4-1500	1551-4-1700	1551-4-1900	39	36.4	232	8.84	14.90		
40 x 10 R x 6	1511-4-4500	1511-4-4700	1511-4-4900	38	33.8	211	8.21	12.57		
40 x 10 L x 6	1551-4-4500	1551-4-4700	1551-4-4900	38	33.8	211	8.21	12.57		
40 x 20 R x 6	1511-4-7500	1511-4-7700	1511-4-7900	38	33.8	211	8.21	12.57		
40 x 40 R x 6	1511-4-9510	1511-4-9710	1511-4-9910	38	33.8	211	8.21	12.57		
50 x 5 R x 3.5	1511-5-1500	1511-5-1700	1511-5-1900	49	46.4	373	14.12	38.52		
50 x 10 R x 6	1511-5-4500	1511-5-4700	1511-5-4900	48	43.8	345	13.32	33.66		
50 x 20 R x 6.5	1511-5-7510	1511-5-7710	1511-5-7910	48	43.3	340	13.12	32.15	5600	7500
50 x 40 R x 6.5	1511-5-9510	1511-5-9710	1511-5-9910	48	43.3	340	13.12	32.15		
63 x 10 R x 6	1511-6-4500	1511-6-4700	1511-6-4900	61	56.8	569	21.80	91.51		
63 x 20 R x 6.5	1511-6-7510	1511-6-7710	1511-6-7910	61	56.3	563	21.55	88.28		
63 x 40 R x 6.5	1511-6-9510	1511-6-9710	1511-6-9910	61	56.3	563	21.55	88.28		
80 x 10 R x 6.5	1511-7-4500	1511-7-4700	1511-7-4900	78	73.3	936	35.72	246.0		
80 x 20 R x 9	1511-7-7510	1511-7-7710	1511-7-7910	77	70.8	894	34.95	237.2		

STAR – Precision Ball Screw Assemblies
End Machining Details

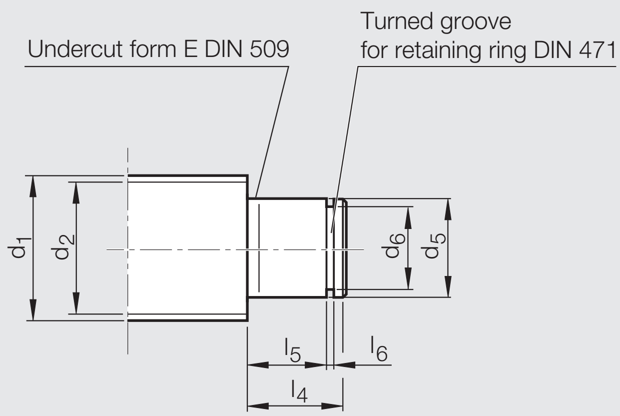
Fixed bearing end: angular contact thrust bearing ZKLN or ZKLF



For size 8 x 2.5
Screw-shaft end friction welded
or pressed sleeve for bearing face

Size	Dimensions (mm)								Keyway to DIN 6885	Fixed bearing		
										Angular contact thrust bearing with slotted nut		Pillow block unit complete
d_0 x P	d h5	d_1	d_2	d_3	d_4 h7	l_1	l_2	l_3	b^{P9} x l x t	ZKLN Part no.	ZKLF Part no.	Part no.
8 x 2.5	6	7.5	6.3	M6x0.5	5	40	16	10	-	1590-1-0600	-	1591-1-0600
12 x 5	6	11.2	9.4	M6x0.5	5	40	16	10	-	1590-1-0600	-	1591-1-0620
16 x 5	10	15	12.9	M10x1	8	50	20	12	2 x 14 x 1.2	1590-1-1000	-	1591-1-1020
16 x 10	10	15	12.9	M10x1	8	50	20	12	2 x 14 x 1.2	1590-1-1000	-	1591-1-1020
16 x 16	10	15	12.4	M10x1	8	50	20	12	2 x 14 x 1.2	1590-1-1000	-	1591-1-1020
20 x 5	12	19	16.9	M12x1	10	60	25	12	3 x 20 x 1.8	1590-1-1200	1590-0-1200	1591-1-1220
20 x 20	12	19.3	16.7	M12x1	10	60	25	12	3 x 20 x 1.8	1590-1-1200	1590-0-1200	1591-1-1220
25 x 5	17	24	21.9	M17x1	15	67	30	14	5 x 25 x 3	1590-1-1700	1590-0-1700	1591-1-1720
25 x 10	17	24	21.9	M17x1	15	67	30	14	5 x 25 x 3	1590-1-1700	1590-0-1700	1591-1-1720
25 x 25	17	24	21.4	M17x1	15	67	30	14	5 x 25 x 3	1590-1-1700	1590-0-1700	1591-1-1720
32 x 5	20	31	28.4	M20x1	15	80	40	14	5 x 28 x 3	1590-1-2000	1590-0-2000	1591-1-2020
32 x 10	20	31	27.9	M20x1	15	80	40	14	5 x 28 x 3	1590-1-2000	1590-0-2000	1591-1-2020
32 x 20	20	31	27.9	M20x1	15	80	40	14	5 x 28 x 3	1590-1-2000	1590-0-2000	1591-1-2020
32 x 32	20	31	27.9	M20x1	15	80	40	14	5 x 28 x 3	1590-1-2000	1590-0-2000	1591-1-2020
40 x 5	30	39	36.4	M30x1.5	25	93	50	18	8 x 36 x 4	1590-1-3000	1590-0-3000	1591-1-3020
40 x 10	25	38	33.8	M25x1.5	20	130	50	26	6 x 36 x 3.5	1590-2-2500	1590-3-2500	1591-2-2500
40 x 20	25	38	33.8	M25x1.5	20	130	50	26	6 x 36 x 3.5	1590-2-2500	1590-3-2500	1591-2-2500
40 x 40	25	38	33.8	M25x1.5	20	130	50	26	6 x 36 x 3.5	1590-2-2500	1590-3-2500	1591-2-2500
										Details on page 56	**Details on page 54**	

Floating bearing end: deep-groove bearing to DIN 625



Size	Dimensions (mm)								Floating bearing	
									Deep-groove bearing with retaining ring Part no.	Pillow block unit complete Part no.
d_0 x P	d_1	d_2	d_5 j6	d_6 h11	d_6 h12	l_4	l_5	l_6 H13		
8 x 2.5	7.5	6.3	5	4.8		7	5	0.7	1590-6-0500	1591-6-0500
12 x 5	11.2	9.4	6	5.7		8	6	0.8	1590-6-0600	1591-6-0620
16 x 5	15	12.9	10	9.6		12	9	1.1	1590-6-1000	1591-6-1020
16 x 10	15	12.9	10	9.6		12	9	1.1	1590-6-1000	1591-6-1020
16 x 16	15	12.4	10	9.6		12	9	1.1	1590-6-1000	1591-6-1020
20 x 5	19	16.9	12	11.5		13	10	1.1	1590-6-1200	1591-6-1220
20 x 20	19.3	16.7	12	11.5		13	10	1.1	1590-6-1200	1591-6-1220
25 x 5	24	21.9	17	16.2		15	12	1.1	1590-6-1700	1591-6-1720
25 x 10	24	21.9	17	16.2		15	12	1.1	1590-6-1700	1591-6-1720
25 x 25	24	21.4	17	16.2		15	12	1.1	1590-6-1700	1591-6-1720
32 x 5	31	28.4	20	19		18	14	1.3	1590-6-2000	1591-6-2020
32 x 10	31	27.9	20	19		18	14	1.3	1590-6-2000	1591-6-2020
32 x 20	31	27.9	20	19		18	14	1.3	1590-6-2000	1591-6-2020
32 x 32	31	27.9	20	19		18	14	1.3	1590-6-2000	1591-6-2020
40 x 5	39	36.4	30		28.6	20	16	1.6	1590-6-3000	1591-6-3020
40 x 10	38	33.8	30		28.6	20	16	1.6	1590-6-3000	1591-6-3010
40 x 20	38	33.8	30		28.6	20	16	1.6	1590-6-3000	1591-6-3010
40 x 40	38	33.8	30		28.6	20	16	1.6	1590-6-3000	1591-6-3010
									Details on page 60	**Details on page 62**

STAR – Precision Ball Screw Assemblies End Bearings, Design Calculations

Star supplies complete drive systems including the required end bearings. Design calculations for these are performed according to the formulas usually applied in the antifriction bearing industry.

Resulting and equivalent bearing loads

The angular contact thrust ball bearings are preloaded. The chart shows the resulting axial bearing load F_a as a function of preload and axial operating load F_{aB}. If the system is primarily subject to axial operating loads, then $F = F_a$.

$\alpha = 60°$	X	Y
$\frac{F_a}{F_r} \leq 2.17$	1.9	0.55
$\frac{F_a}{F_r} > 2.17$	0.92	1

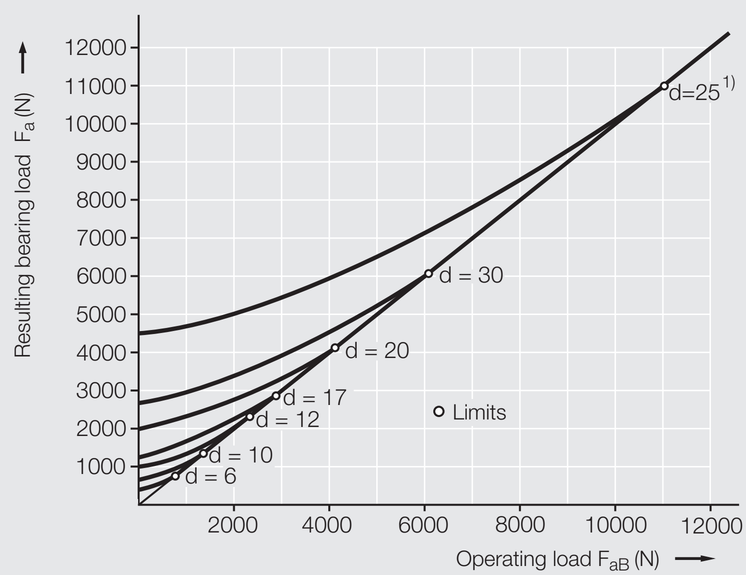
If the radial operating forces are not insignificant, the equivalent bearing loads are calculated according to formula (20).

Bearings for ball screw assemblies are also able to accommodate tilting moments. As a rule, the moments that usually occur due to the weight and drive motion of the screw do not need to be incorporated in the calculation of the equivalent bearing load.

$$F = X \cdot F_r + Y \cdot F_a \quad (20)$$

F_r = radial bearing load (N)
F_a = resulting axial bearing load (N)
F = equivalent bearing load (N)

Internal preload limit and resulting bearing load



1) ZKL-...2AP

Average speed and average bearing load

If the bearing is subject to varying axial loads over time, the average axial bearing load can be calculated using formula (21).
If the speed varies, apply formula (22).
In these formulas, the q_i values represent the discrete time steps in %.
If the radial load F_{rm} varies, calculate the average radial load in the same manner.

$$F_{am} = \sqrt[3]{F_1^3 \cdot \frac{n_1}{n_m} \cdot \frac{q_1}{100} + F_2^3 \cdot \frac{n_2}{n_m} \cdot \frac{q_2}{100} + ... + F_n^3 \cdot \frac{n_n}{n_m} \cdot \frac{q_n}{100}} \quad (21)$$

$$n_m = \frac{q_1}{100} \cdot n_1 + \frac{q_2}{100} \cdot n_2 + ... + \frac{q_n}{100} \cdot n_n \quad (22)$$

(21) F_{am} = resulting average axial load (N)
q = time fraction (%)
(22) n_m = average speed (rpm)

Service life and load safety factor

Nominal life

The nominal life is calculated as follows:

$$L = \left(\frac{C}{F}\right)^3 \quad (23)$$

$$L_h = \frac{16666}{n} \left(\frac{C}{F}\right)^3 \quad (24)$$

L = nominal life in millions of revolutions (10^6 revolutions)
L_h = nominal life in operating hours (h)
C = dynamic bearing load rating (N)
n = average speed (rpm)
F = equivalent bearing load (N)

Static load safety factor

$$S_0 = \frac{C_0}{F_0} \quad (25)$$

S_0 = static load safety factor (-)
C_0 = static load rating (N)
F_0 = maximum static load (N)

The static load safety factor of machine tools should not be lower than 4.

Friction

The bearing friction torque M_{RL} is primarily dependent on the bearing preload. The influence of the operating load F_{aB} is insignificant as long as it does not exceed the limits at which the bearings have zero clearance.
The bearing friction torque M_{RL} specified in the Dimension Tables applies to the preload generated by means of the slotted nut tightening torque M_A. The preloaded bearing has the rigidity R_{aL}. The bearing preload is selected so as to allow it to remain effective even at high operating loads and ensure that the bearing has zero clearance.

The bearing friction torque M_{RL} is measured at a speed of n = 5 rpm. The friction power loss N_{RL} of the bearing can be calculated using the formula (26).

The various operating speeds n_i must be incorporated in the heat balance as a function of their time fractions q_i.

$$N_{RL} = \frac{M_{RL} \cdot n}{9{,}55} \quad (26)$$

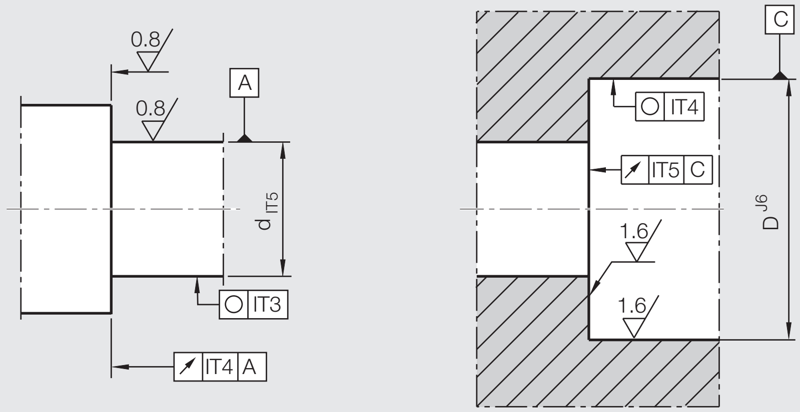
N_{RL} = friction power (W)
n = speed (rpm)
M_{RL} = bearing friction torque (Nm)

STAR – Precision Ball Screw Assemblies
End Bearings, Design Notes

Bearing Design

For customer-machined screw ends, please observe the design notes given for screw ends and housings.

See “End Machining Details” for Star screw end designs.



Screw end

Housing

Accuracy

Series	Bore D^{J6} (mm)	Axial run-out	Radial clearance (µm)	Tolerance (µm) Bore	Outer diameter ≤ 50	Outer diameter > 50	Width
ZKLN... .2RS PE ZKLF... .2RS PE	≤ 10	P5 to DIN 620	preloaded	+3 -5	-10		-250
	> 10	P5 to DIN 620	preloaded	-10	-11	-13	-250
ZKLN... .2RS 2AP ZKLF... .2RS 2AP	≤ 25	2	preloaded	-5		-10	-500
	> 25	2.5					

Lubrication

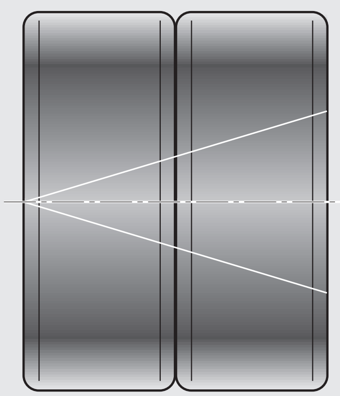
Bearings for ball screw assemblies are lubricated with grease for a lifetime of reliable service. It should be noted, however, that grease lubrication does not facilitate the dissipation of heat in the bearings. The bearing temperature should therefore not exceed 50°C, particularly in machine tool applications. Angular contact thrust ball bearings series ZKLN, ZKLF are lubricated for life with grease KPE2K to DIN 51825.
This eliminates all drawbacks associated with in-service lubrication such as over-greasing or the use of an unsuitable type of grease.

Mounting

Angular contact thrust ball bearings and deep-groove ball bearings

When mounting angular contact thrust ball bearings Series ZKLN and ZKLF, ensure that the mounting forces are only exerted on the bearing rings.
Never apply mounting forces via the antifriction bearing elements or the seal rings!
The two sections of the inner raceway may not be separated during assembly or disassembly for any reason.
Tighten mounting screws for screw-down or flange-mounted bearings in crosswise sequence.
The mounting screws may only be subject to tension amounting to a maximum of 70% of their yielding point.
The screw-down (ZKLF) bearings have a groove on the cylindrical surface of the outer raceway for disassembly. The individual bearings of the bearing pair series ZKLN...2AP and ZKLF...2AP are marked on the cylindrical surfaces of the outer raceways (see diagram).

The markings reveal the bearing sequence. The sealing rings should face outward after proper assembly.



Outer raceway markings for paired bearings

Slotted nut

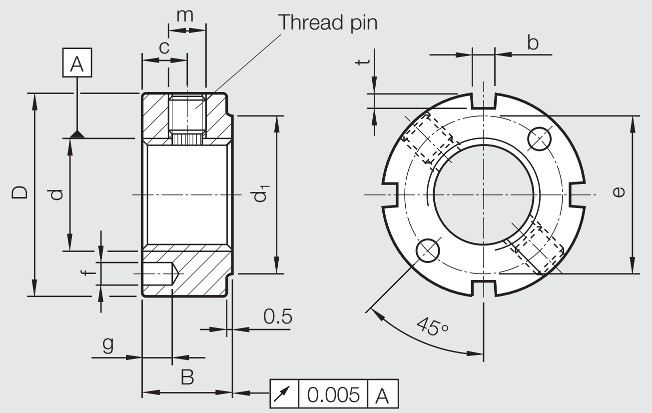
The bearings are preloaded by tightening the nuts ZM.
In order to prevent settling phenomena, we recommend first tightening the slotted nut by 2 times the tightening torque M_A and then easing the load. Only then should the slotted nut be retightened to the specified tightening torque M_A.
The two counter set screws are then alternately tightened using a hexagon socket wrench.
The components are disassembled in the reverse order, i.e., the counter set screws are to be removed before the slotted nut.

The slotted nuts can be reused several times when properly assembled and disassembled by competent personnel.
The inner raceways of the bearings are dimensioned in such a way as to achieve a defined bearing preload sufficient for most applications when the slotted nut is tightened (M_A in accordance with Dimension Table).

STAR – Precision Ball Screw Assemblies
End Bearings, Mounting

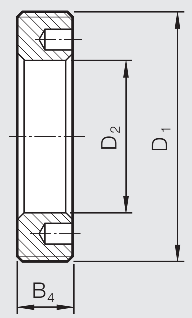
Slotted Nut and Housing Nut for Fixed Bearing

Slotted nut



First angle projection

Housing nut



M_A = tightening torque for slotted nut

F_{aB} = axial fracture load for slotted nut

M_{AG} = tightening torque for set screw

Size	Designa-tion	Slotted nut Dimensions (mm)															Housing nut Dimensions (mm)		
d_0 x P		d	D	B	d_1	c	m	b	t	e	f	g	M_A (Nm)	F_{aB} (kN)	Weight (g)	M_{AG} (Nm)	D_1	D_2	B_4
8 x 2.5	ZM 06	M6 x 0.5	16	8	12	4	M4	3	2	11	2.5	3.5	2.0	17	10	2 - 2.5	M26 x 1.5	16.5	8
12 x 5	ZM 06	M6 x 0.5	16	8	12	4	M4	3	2	11	2.5	3.5	2.0	17	10	2 - 2.5	M26 x 1.5	16.5	8
16 x 5	ZM 10	M10 x 1	18	8	14	4	M4	3	2	14	2.5	3.5	6.0	31	10	2 - 2.5	M36 x 1.5	22	8
16 x 10	ZM 10	M10 x 1	18	8	14	4	M4	3	2	14	2.5	3.5	6.0	31	10	2 - 2.5	M36 x 1.5	22	8
16 x 16	ZM 10	M10 x 1	18	8	14	4	M4	3	2	14	2.5	3.5	6.0	31	10	2 - 2.5	M36 x 1.5	22	8
20 x 5	ZM 12	M12 x 1	22	8	18	4	M4	3	2	17	2.5	3.5	8.0	38	15	2 - 2.5	M45 x 1.5	28	8
20 x 20	ZM 12	M12 x 1	22	8	18	4	M4	3	2	17	2.5	3.5	8.0	38	15	2 - 2.5	M45 x 1.5	28	8
25 x 5	ZM 17	M17 x 1	28	10	23	5	M5	4	2	22.5	3	4	15.0	57	28	4 - 5	M50 x 1.5	31	10
25 x 10	ZM 17	M17 x 1	28	10	23	5	M5	4	2	22.5	3	4	15.0	57	28	4 - 5	M50 x 1.5	31	10
25 x 25	ZM 17	M17 x 1	28	10	23	5	M5	4	2	22.5	3	4	15.0	57	28	4 - 5	M50 x 1.5	31	10
32 x 5	ZM 20	M20 x 1	32	10	27	5	M5	4	2	26	3	4	18.0	69	35	4 - 5	M55 x 1.5	36	10
32 x 10	ZM 20	M20 x 1	32	10	27	5	M5	4	2	26	3	4	18.0	69	35	4 - 5	M55 x 1.5	36	10
32 x 20	ZM 20	M20 x 1	32	10	27	5	M5	4	2	26	3	4	18.0	69	35	4 - 5	M55 x 1.5	36	10
32 x 32	ZM 20	M20 x 1	32	10	27	5	M5	4	2	26	3	4	18.0	69	35	4 - 5	M55 x 1.5	36	10
40 x 5	ZM 30	M30 x 1.5	45	12	40	6	M6	5	2	37.5	4	5	32.0	112	75	8 - 10	M65 x 1.5	47	12
40 x 10	ZMA 25/45	M25 x 1.5	45	20	40	10	M6	5	2	35	4	5	25.0	211	160	8 - 10	M62 x 1.5	43	10
40 x 20	ZMA 25/45	M25 x 1.5	45	20	40	10	M6	5	2	35	4	5	25.0	211	160	8 - 10	M62 x 1.5	43	10
40 x 40	ZMA 25/45	M25 x 1.5	45	20	40	10	M6	5	2	35	4	5	25.0	211	160	8 - 10	M62 x 1.5	43	10

Mounting the Housing

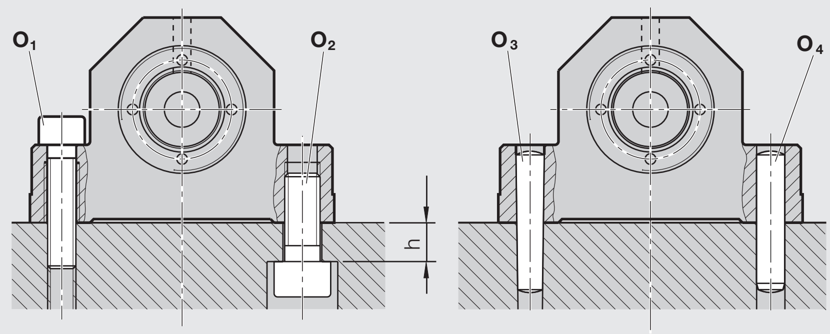
Tighten the pillow block mounting screws in crosswise sequence.

See table for tightening torque.

The housing nut fixes the entire bearing unit in the housing.

Use screws and pins to fix the bearing housing in place.

⚠ Take care to align the screw, nut assembly, bearings and guideway precisely with one another.



Mounting screws **Locating pins**

Size d_0 x P	h (mm)	O_1 DIN 912	O_2 DIN 912 (hardened)	O_3 Tapered pin O_4 Straight pin (DIN 6325)
8 x 2.5	8	M5 x 20	M6 x 16	4 x 20
12 x 5	8	M5 x 20	M6 x 16	4 x 20
16 x 5	11	M8 x 35	M10 x 25	8 x 40
16 x 10	11	M8 x 35	M10 x 25	8 x 40
16 x 16	11	M8 x 35	M10 x 25	8 x 40
20 x 5	11	M8 x 35	M10 x 25	8 x 40
20 x 20	11	M8 x 35	M10 x 25	8 x 40
25 x 5	14	M10 x 40	M12 x 30	10 x 50
25 x 10	14	M10 x 40	M12 x 30	10 x 50
25 x 25	14	M10 x 40	M12 x 30	10 x 50
32 x 5	14	M10 x 40	M12 x 30	10 x 50
32 x 10	14	M10 x 40	M12 x 30	10 x 50
32 x 20	14	M10 x 40	M12 x 30	10 x 50
32 x 32	14	M10 x 40	M12 x 30	10 x 50
40 x 5	16	M12 x 50	M14 x 35	10 x 50
40 x 10	16	M12 x 50	M14 x 35	10 x 50
40 x 20	16	M12 x 50	M14 x 35	10 x 50
40 x 40	16	M12 x 50	M14 x 35	10 x 50

	Strength class for O_1; O_2	M5	M6	M8	M10	M12	M14
Nm	**8.8**	5.5	9.5	23	46	80	125
	12.9	9.5	16	39	77	135	215

STAR – Precision Ball Screw Assemblies
End Bearings, Fixed Bearing ZKLF

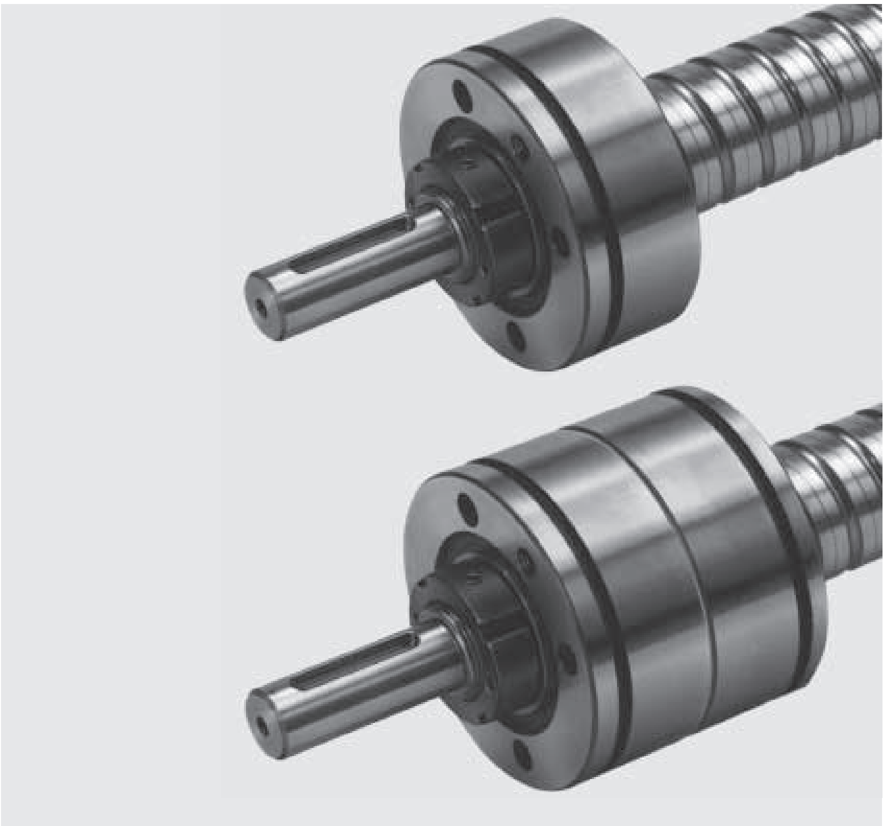
Fixed bearing with angular contact thrust ball bearing

Double-thrust, screw-down, Series ZKLF... .2RS PE

Double-thrust, screw-down, paired
Series ZKLF... .2RS2AP

The fixed bearing consists of:
- angular contact thrust ball bearing ZKLF
- slotted nut ZM...

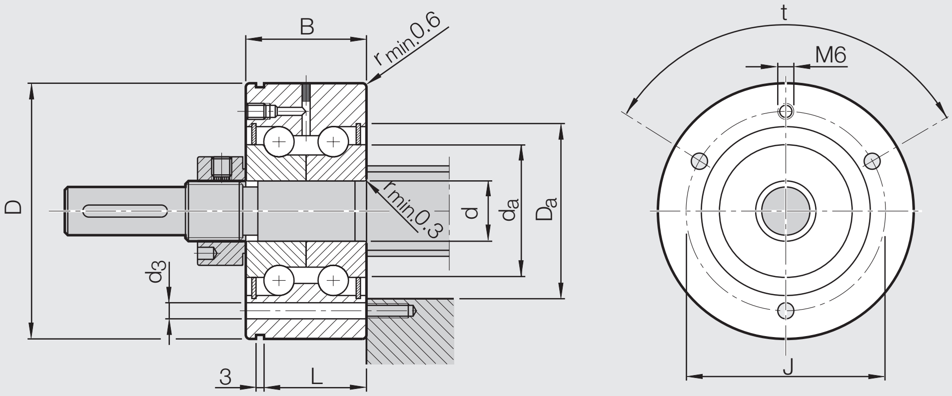
60° contact angle, preloaded, sealed and lubricated for life.



Size d_0 x P	Angular contact thrust bearing incl. slotted nut Part no.	 Designation	Slotted nut Designa-tion	Load ratings dyn. C (N)	 stat. C_0 (N)	Bearing friction torque with sealing disc M_{RL} (Nm)	Rigidity (axial) R_{aL} (N/µm)	Rigidity against tilting R_{kL} (Nm/mrad)
20 x 5	1590-0-1200	ZKLF 1255.2RS PE	ZM 12	17000	24700	0.16	375	50
20 x 20	**1590-0-1200**	ZKLF 1255.2RS PE	ZM 12	17000	24700	0.16	375	50
25 x 5	1590-0-1700	ZKLF 1762.2RS PE	ZM 17	18800	31000	0.24	450	80
25 x 10	1590-0-1700	ZKLF 1762.2RS PE	ZM 17	18800	31000	0.24	450	80
25 x 25	1590-0-1700	ZKLF 1762.2RS PE	ZM 17	18800	31000	0.24	450	80
32 x 5	1590-0-2000	ZKLF 2068.2RS PE	ZM 20	26000	47000	0.30	650	140
32 x 10	1590-0-2000	ZKLF 2068.2RS PE	ZM 20	26000	47000	0.30	650	140
32 x 20	1590-0-2000	ZKLF 2068.2RS PE	ZM 20	26000	47000	0.30	650	140
32 x 32	1590-0-2000	ZKLF 2068.2RS PE	ZM 20	26000	47000	0.30	650	140
40 x 5	1590-0-3000	ZKLF 3080.2RS PE	ZM 30	29000	64000	0.50	850	300
40 x 10	**1590-3-2500**	**ZKLF 2575.2RS2AP**	**ZMA 25/45**	**45000**	**110000**	**0.60**	**1300**	**450**
40 x 20	**1590-3-2500**	**ZKLF 2575.2RS2AP**	**ZMA 25/45**	**45000**	**110000**	**0.60**	**1300**	**450**
40 x 40	**1590-3-2500**	**ZKLF 2575.2RS2AP**	**ZMA 25/45**	**45000**	**110000**	**0.60**	**1300**	**450**

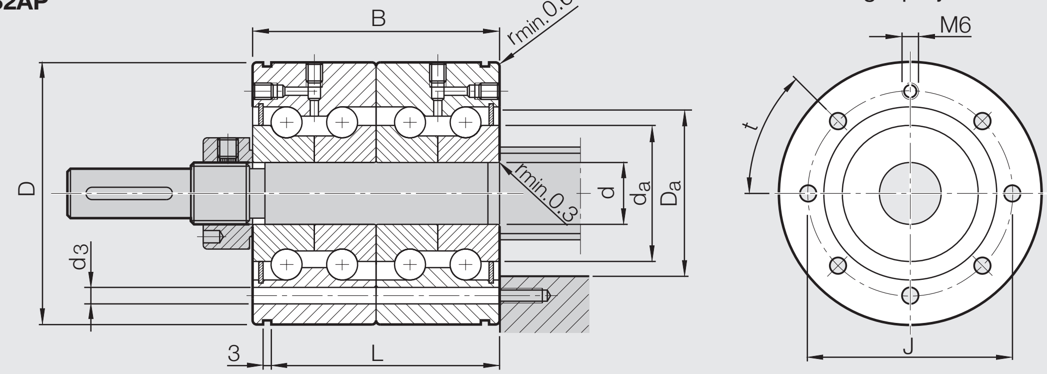
Details on page 52

ZKLF... .2RS PE



ZKLF... .2RS2AP

First angle projections



Dimensions (mm)												Weight complete
				Location shoulders					Holes			
d	D -0.010	B -0.013	J -0.25	D_a min.	D_a max.	d_a min.	d_a max.	L	n (number)	d_3	t (°)	(kg)
12	55	25	42	30	33	16	29	17	3	6.5	120	0.385
12	55	25	42	30	33	16	29	17	3	6.5	120	
17	62	25	48	34	37	23	33	17	3	6.5	120	
17	62	25	48	34	37	23	33	17	3	6.5	120	0.478
17	62	25	48	34	37	23	33	17	3	6.5	120	
20	68	28	53	40	43	25	39	19	4	6.5	90	
20	68	28	53	40	43	25	39	19	4	6.5	90	0.645
20	68	28	53	40	43	25	39	19	4	6.5	90	
20	68	28	53	40	43	25	39	19	4	6.5	90	
30	80	28	63	50	53	40	49	19	6	6.5	60	0.855
25	75	56	58	45	48	32	44	47	8	6.5	45	1.6
25	75	56	58	45	48	32	44	47	8	6.5	45	1.6
25	75	56	58	45	48	32	44	47	8	6.5	45	1.6

End Bearings, Fixed Bearing ZKLN

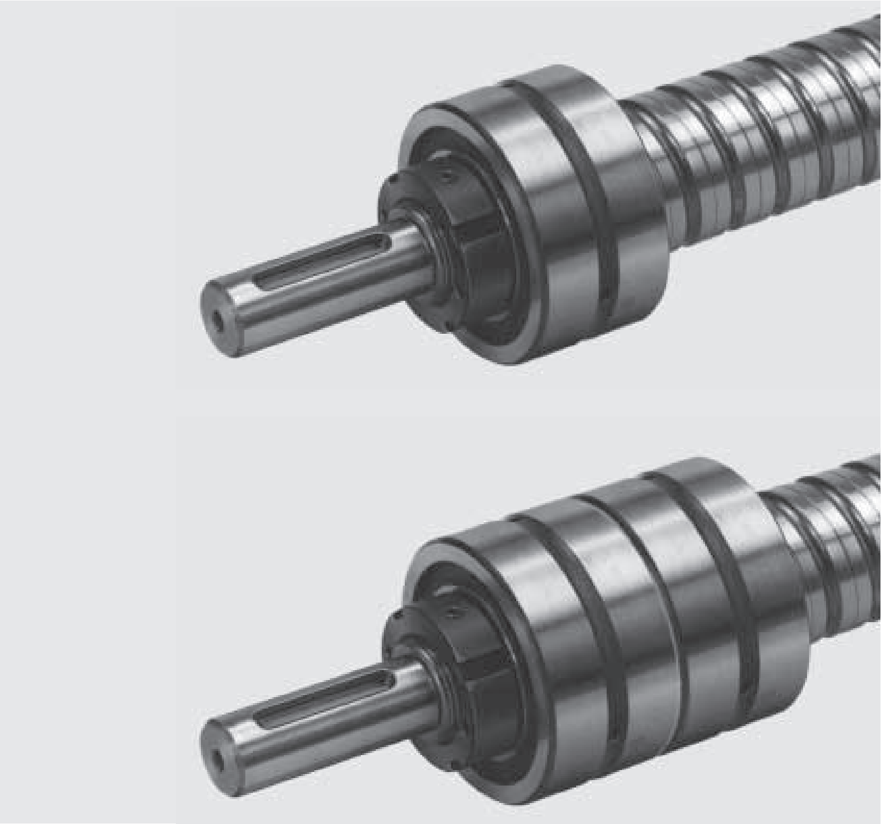
Fixed bearing with angular contact thrust ball bearing

Double-thrust,
Series ZKLN... .2RS PE

Double-thrust, paired,
Series ZKLN... .2RS2AP

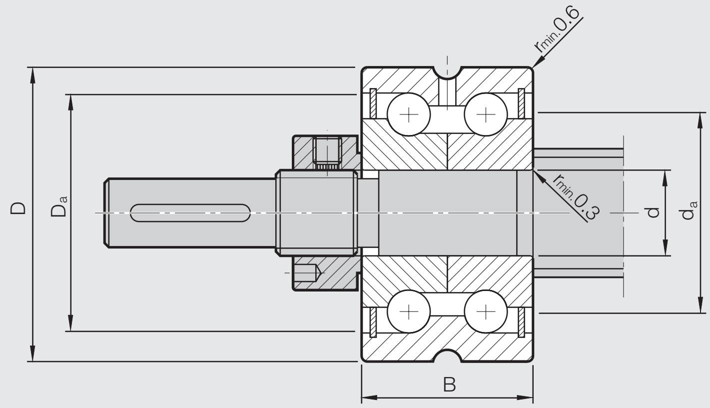
The fixed bearing consists of:
- angular contact thrust ball bearing ZKLN
- slotted nut ZM...

60° contact angle, preloaded, sealed and lubricated for life.

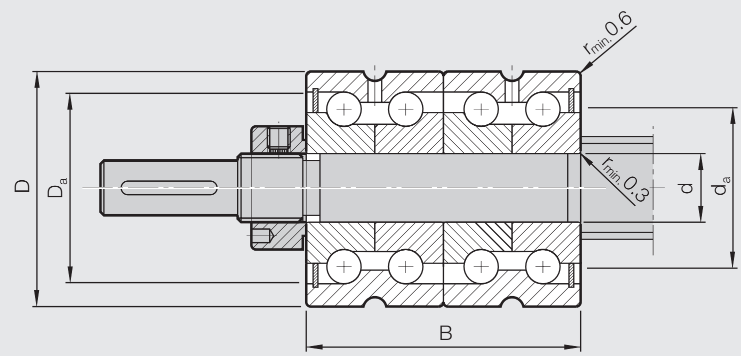


Size d_0 x P	Angular contact thrust bearing incl. slotted nut Part no.	Designation	Slotted nut Designa-tion	Load ratings dyn. C (N)	stat. C_0 (N)	Bearing friction torque with sealing disc M_{RL} (Nm)	Rigidity axial R_{aL} (N/µm)	Rigidity against tilting R_{kL} (Nm/mrad)
8 x 2.5	1590-1-0600	ZKLN 0624.2RS PE	ZM 06	6900	8500	0.04	200	8
12 x 5	1590-1-0600	ZKLN 0624.2RS PE	ZM 06	6900	8500	0.04	200	8
16 x 5	1590-1-1000	ZKLN 1034.2RS PE	ZM 10	13400	18800	0.12	325	25
16 x 10	1590-1-1000	ZKLN 1034.2RS PE	ZM 10	13400	18800	0.12	325	25
16 x 16	1590-1-1000	ZKLN 1034.2RS PE	ZM 10	13400	18800	0.12	325	25
20 x 5	1590-1-1200	ZKLN 1242.2RS PE	ZM 12	17000	24700	0.16	375	50
20 x 20	1590-1-1200	ZKLN 1242.2RS PE	ZM 12	17000	24700	0.16	375	50
25 x 5	1590-1-1700	ZKLN 1747.2RS PE	ZM 17	18800	31000	0.24	450	80
25 x 10	1590-1-1700	ZKLN 1747.2RS PE	ZM 17	18800	31000	0.24	450	80
25 x 25	1590-1-1700	ZKLN 1747.2RS PE	ZM 17	18800	31000	0.24	450	80
32 x 5	1590-1-2000	ZKLN 2052.2RS PE	ZM 20	26000	47000	0.30	650	140
32 x 10	1590-1-2000	ZKLN 2052.2RS PE	ZM 20	26000	47000	0.30	650	140
32 x 20	1590-1-2000	ZKLN 2052.2RS PE	ZM 20	26000	47000	0.30	650	140
32 x 32	1590-1-2000	ZKLN 2052.2RS PE	ZM 20	26000	47000	0.30	650	140
40 x 5	1590-1-3000	ZKLN 3062.2RS PE	ZM 30	29000	64000	0.50	850	300
40 x 10	**1590-2-2500**	**ZKLN 2557.2RS2AP**	**ZMA 25/45**	**45000**	**110000**	**0.60**	**1300**	**450**
40 x 20	**1590-2-2500**	**ZKLN 2557.2RS2AP**	**ZMA 25/45**	**45000**	**110000**	**0.60**	**1300**	**450**
40 x 40	**1590-2-2500**	**ZKLN 2557.2RS2AP**	**ZMA 25/45**	**45000**	**110000**	**0.60**	**1300**	**450**
			Details on page 52					

ZKLN... .2RS PE



ZKLN... .2RS2AP



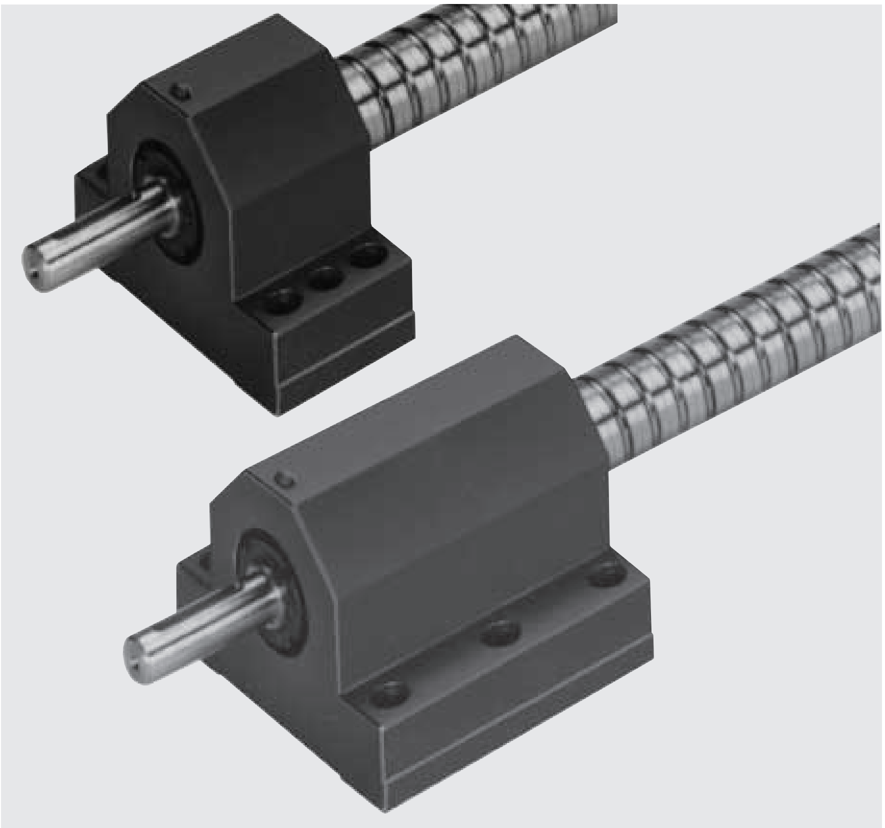
Dimensions (mm)												Weight
d			D			B		Location shoulders D_a		d_a		complete
+ 0,003 - 0,005	-0.010	-0.005	-0.010	-0.011	-0.013	-0.25	-0.5	min.	max.	min.	max.	(kg)
6			24			15		16	19	9	15	0.04
6			24			15		16	19	9	15	0.04
10			34			20		25	28	14	24	
10			34			20		25	28	14	24	0.11
10			34			20		25	28	14	24	
	12			42		25		30	33	16	29	
	12	25	57	42		25	56	30 / 45	33 / 48	16 / 32	29 / 44	0.84
	17			47		25		34	37	23	33	
	17			47		25		34	37	23	33	0.248
	17			47		25		34	37	23	33	
	20				52	28		40	43	25	39	
	20				52	28		40	43	25	39	0.215
	20				52	28		40	43	25	39	
	20				52	28		40	43	25	39	
	30				62	28		50	53	40	49	0.465
		25	57				56	45	48	32	44	0.84
		25	57				56	45	48	32	44	0.84

Pillow block unit - fixed bearing with angular contact thrust ball bearing

ZKLN....2RSPE
ZKLN....2RS2AP

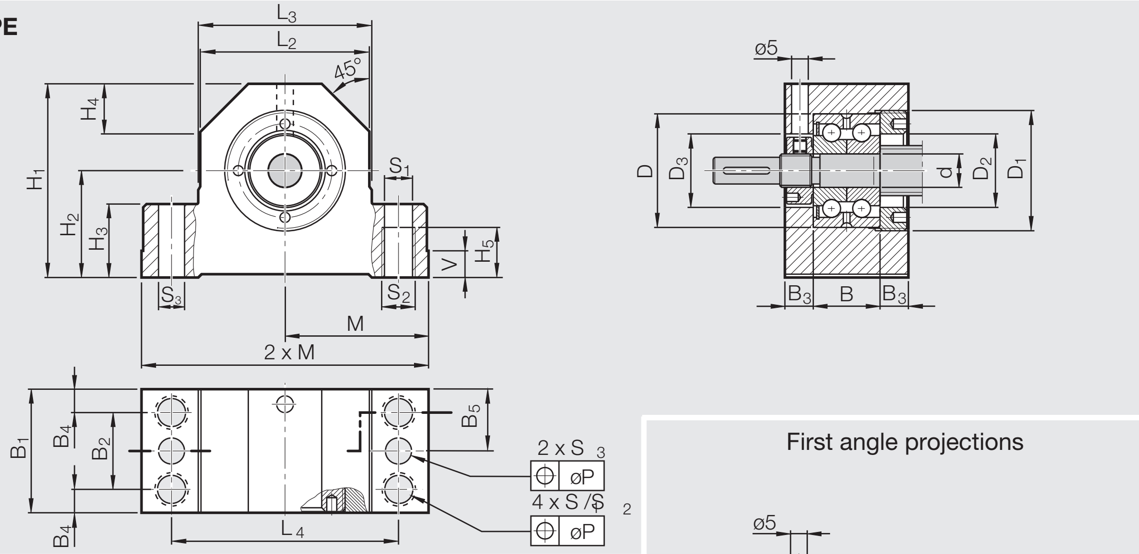
The pillow block unit consists of:
- precision pillow block housing with reference edges on both sides
- angular contact thrust ball bearing ZKLN...
- slotted nut with two set screws
- housing nut with set screw

Slotted nut is enclosed separately.

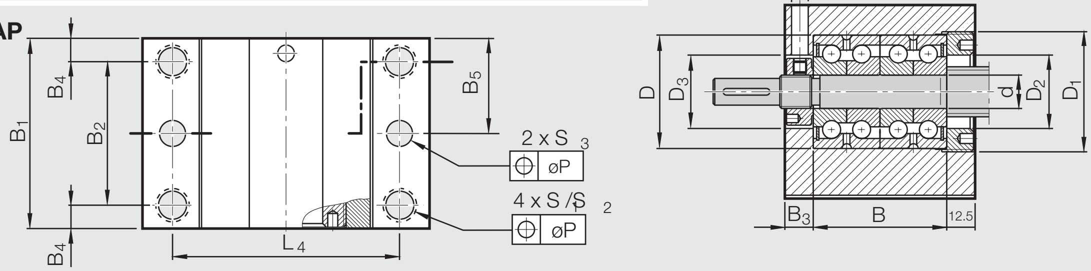


Size	Pillow block unit Part no.	Angular contact thrust bearing Load ratings (axial)		Dimensions (mm)			Designation	Slotted nut		Weight complete
		dyn.	stat.					M_A	Designation	
d_0 x P	complete	C (N)	C_0 (N)	d	D	B		(Nm)		(kg)
8 x 2.5	1591-1-0600	6900	8500	6	24	15	ZKLN 0624.2RS PE	2.0	ZM 06	0.38
12 x 5	1591-1-0620	6000	8500	6	24	15	ZKLN 0624.2RS PE	2.0	ZM 06	0.38
16 x 5	1591-1-1020	13400	18800	10	34	20	ZKLN 1034.2RS PE	6.0	ZM 10	0.87
16 x 10	1591-1-1020	13400	18800	10	34	20	ZKLN 1034.2RS PE	6.0	ZM 10	0.87
16 x 16	1591-1-1020	13400	18800	10	34	20	ZKLN 1034.2RS PE	6.0	ZM 10	0.87
20 x 5	1591-1-1220	17000	24700	12	42	25	ZKLN 1242.2RS PE	8.0	ZM 12	1.12
20 x 20	1591-1-1220	17000	24700	12	42	25	ZKLN 1242.2RS PE	8.0	ZM 12	1.12
25 x 5	1591-1-1720	18800	31000	17	47	25	ZKLN 1747.2RS PE	15.0	ZM 17	1.65
25 x 10	1591-1-1720	18800	31000	17	47	25	ZKLN 1747.2RS PE	15.0	ZM 17	1.65
25 x 25	1591-1-1720	18800	31000	17	47	25	ZKLN 1747.2RS PE	15.0	ZM 17	1.65
32 x 5	1591-1-2020	26000	47000	20	52	28	ZKLN 2052.2RS PE	18.0	ZM 20	1.93
32 x 10	1591-1-2020	26000	47000	20	52	28	ZKLN 2052.2RS PE	18.0	ZM 20	1.93
32 x 20	1591-1-2020	26000	47000	20	52	28	ZKLN 2052.2RS PE	18.0	ZM 20	1.93
32 x 32	1591-1-2020	26000	47000	20	52	28	ZKLN 2052.2RS PE	18.0	ZM 20	1.93
40 x 5	1591-1-3020	29000	64000	30	62	28	ZKLN 3062.2RS PE	32.0	ZM 30	2.64
40 x 10	1591-2-2500	45000	110000	25	57	56	ZKLN 2557.2RS2AP	25.0	ZMA 25/45	5.13
40 x 20	1591-2-2500	45000	110000	25	57	56	ZKLN 2557.2RS2AP	25.0	ZMA 25/45	5.13
40 x 40	1591-2-2500	45000	110000	25	57	56	ZKLN 2557.2RS2AP	25.0	ZMA 25/45	5.13
									Details on page 52	

ZKLN… .2RS PE



ZKLN... .2RS2AP



Dimensions (mm)

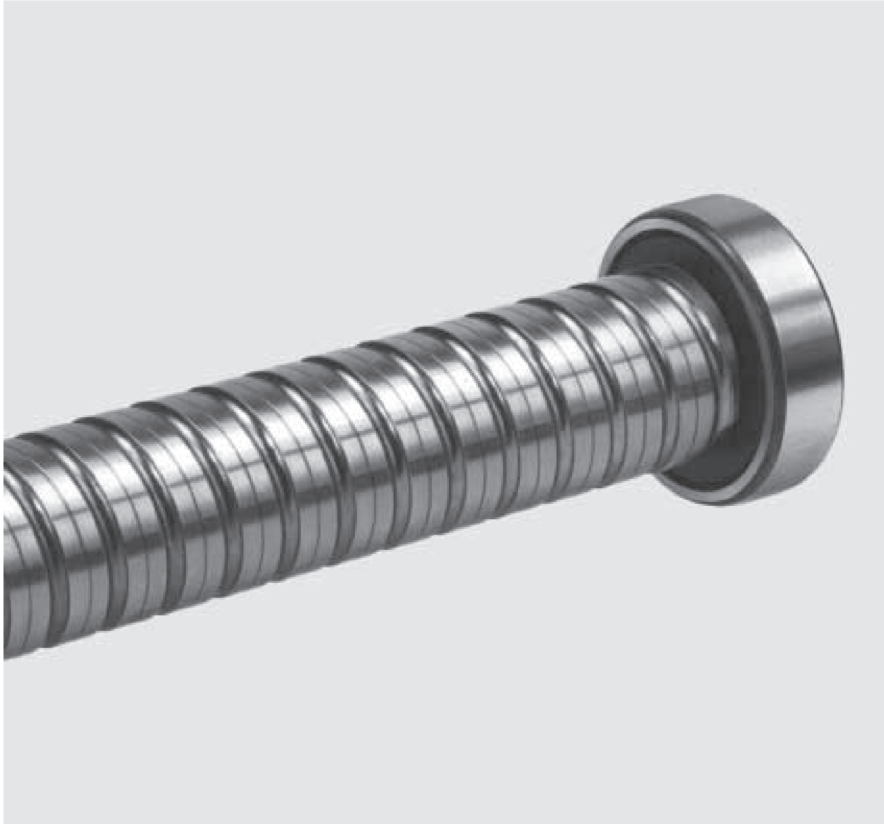
M js7	L_2	L_3	L_4	H_1	H_2 ±0.02	H_3	H_4	H_5	B_1	B_2	B_3	B_4	B_5	V	S_1 H12	S_2	S_3	D_1	D_2	D_3	P
31	-	38	50	34	18	13	8	9	32	16	8.5	8	16	6	5.3	M6	3.7	M26 x 1.5	16.5	18	0.1
31	36	38	50	41	22	13	10	9	32	16	8.5	8	16	6	5.3	M6	3.7	M26 x 1.5	16.5	18	0.1
43	50	52	68	58	32	22	14	15	37	23	8.5	7	18.5	8	8.4	M10	7.7	M36 x 1.5	22	22	0.15
43	50	52	68	58	32	22	14	15	37	23	8.5	7	18.5	8	8.4	M10	7.7	M36 x 1.5	22	22	0.15
43	50	52	68	58	32	22	14	15	37	23	8.5	7	18.5	8	8.4	M10	7.7	M36 x 1.5	22	22	0.15
47	58	60	77	64	34	22	16	15	42	25	8.5	8.5	21	8	8.4	M10	7.7	M45 x 1.5	28	26	0.15
47	58	60	77	64	34	22	16	15	42	25	8.5	8.5	21	8	8.4	M10	7.7	M45 x 1.5	28	26	0.15
54	64	66	88	72	39	27	18	18	46	29	10.5	8.5	23	10	10.5	M12	9.7	M50 x 1.5	31	32	0.2
54	64	66	88	72	39	27	18	18	46	29	10.5	8.5	23	10	10.5	M12	9.7	M50 x 1.5	31	32	0.2
54	64	66	88	72	39	27	18	18	46	29	10.5	8.5	23	10	10.5	M12	9.7	M50 x 1.5	31	32	0.2
56	68	70	92	77	42	27	19	18	49	29	10.5	10.0	24.5	10	10.5	M12	9.7	M55 x 1.5	36	36	0.2
56	68	70	92	77	42	27	19	18	49	29	10.5	10.0	24.5	10	10.5	M12	9.7	M55 x 1.5	36	36	0.2
56	68	70	92	77	42	27	19	18	49	29	10.5	10.0	24.5	10	10.5	M12	9.7	M55 x 1.5	36	36	0.2
56	68	70	92	77	42	27	19	18	49	29	10.5	10.0	24.5	10	10.5	M12	9.7	M55 x 1.5	36	36	0.2
63	78	80	105	90	50	32	22	21	53	32	12.5	10.5	26.5	12	12.6	M14	9.7	M65 x 1.5	48	48	0.2
63	82	80	105	98	58	32	23	21	89	62	20.5	13.5	44.5	12	12.6	M14	9.7	M62 x 1.5	43	48	0.2
63	82	80	105	98	58	32	23	21	89	62	20.5	13.5	44.5	12	12.6	M14	9.7	M62 x 1.5	43	48	0.2
63	82	80	105	98	58	32	23	21	89	62	20.5	13.5	44.5	12	12.6	M14	9.7	M62 x 1.5	43	48	0.2

End Bearings, Floating Bearing DIN 625

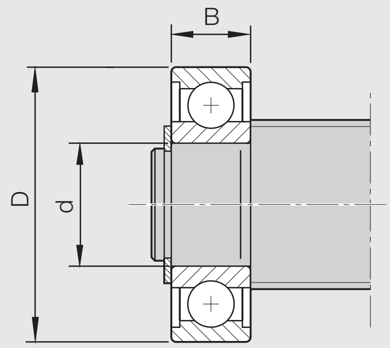
Floating bearing with deep-groove ball bearing

The floating bearing consists of:

- deep-groove ball bearing DIN 625....2RS
- retaining ring DIN 471



Size d_0 x P	Deep-groove ball bearing to DIN 625 Part no. with retaining ring	Load ratings dyn. C (N)	 stat. C_0 (N)	Designation DIN 625-...	Retaining ring Designation DIN 471
8 x 2.5	1590-6-0500	1900	590	625.2RS	5 x 0.6
12 x 5	1590-6-0600	2450	900	626.2RS	6 x 0.7
16 x 5	1590-6-1000	6000	2240	6200.2RS	10 x 1
16 x 10	1590-6-1000	6000	2240	6200.2RS	10 x 1
16 x 16	1590-6-1000	6000	2240	6200.2RS	10 x 1
20 x 5	1590-6-1200	6950	2650	6201.2RS	12 x 1
20 x 20	1590-6-1200	6950	2650	6201.2RS	12 x 1
25 x 5	1590-6-1700	9500	4150	6203.2RS	17 x 1
25 x 10	1590-6-1700	9500	4150	6203.2RS	17 x 1
25 x 25	1590-6-1700	9500	4150	6203.2RS	17 x 1
32 x 5	1590-6-2000	12700	5700	6204.2RS	20 x 1.2
32 x 10	1590-6-2000	12700	5700	6204.2RS	20 x 1.2
32 x 20	1590-6-2000	12700	5700	6204.2RS	20 x 1.2
32 x 32	1590-6-2000	12700	5700	6204.2RS	20 x 1.2
40 x 5	1590-6-3000	19300	9800	6206.2RS	30 x 1.5
40 x 10	1590-6-3000	19300	9800	6206.2RS	30 x 1.5
40 x 20	1590-6-3000	19300	9800	6206.2RS	30 x 1.5
40 x 40	1590-6-3000	19300	9800	6206.2RS	30 x 1.5



Dimensions (mm)			Weight complete
d	D	B	(kg)
5	16	5	0.005
6	19	6	0.008
10	30	9	
10	30	9	0.03
10	30	9	
12	32	10	0,035
12	32	10	
17	40	12	
17	40	12	0.064
17	40	12	
20	47	14	
20	47	14	0,106
20	47	14	
20	47	14	
30	62	16	
30	62	16	0,195
30	62	16	
30	62	16	

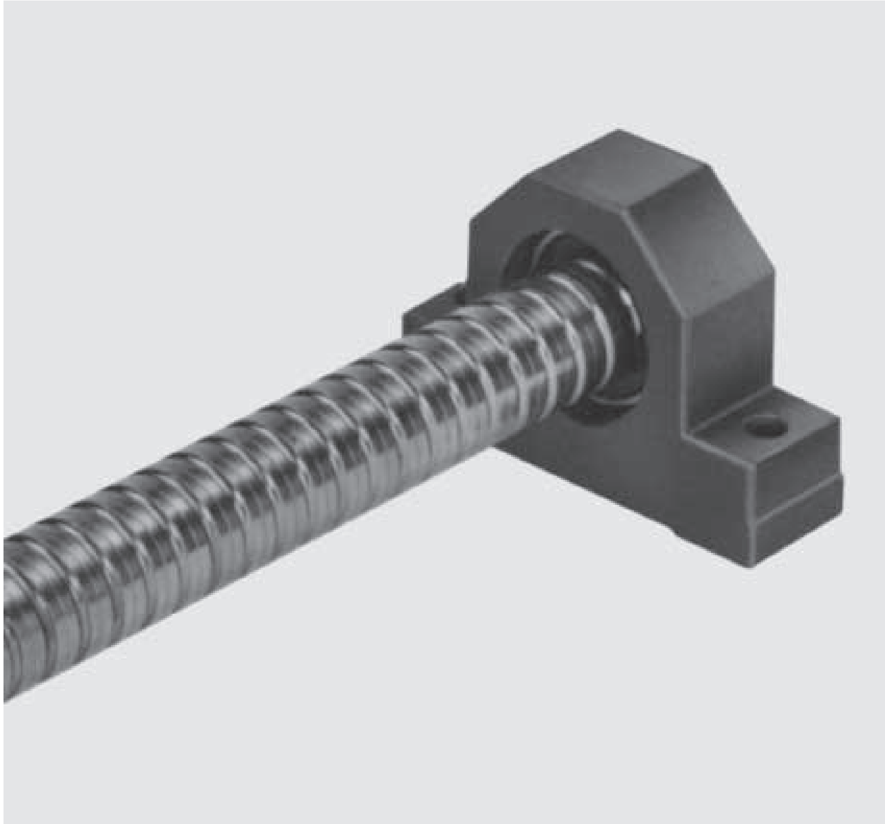
Pillow block unit - floating bearing with deep-groove ball bearing DIN 625

The pillow block unit consists of:

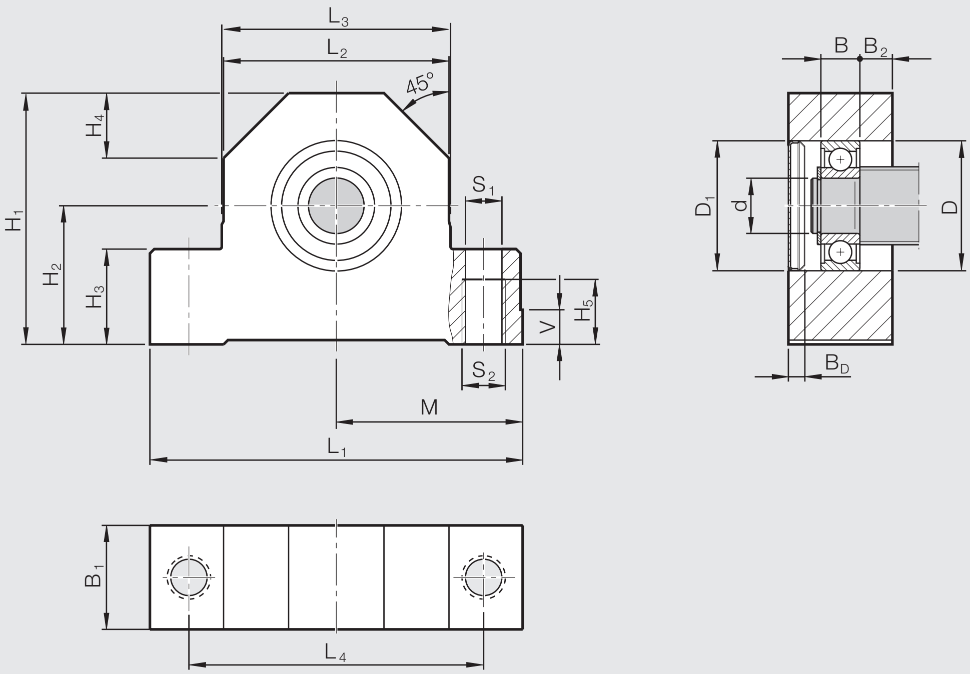
- precision pillow block housing with reference edge on one side
- deep-groove ball bearing

  DIN 625....2RS
- retaining ring DIN 471
- cover

All parts are enclosed separately



Size	Pillow block unit	Deep-groove ball bearing to DIN 625						Retaining ring	Weight
		Load ratings		Dimensions (mm)			Designation	Designation	complete
d_0 x P	Part no.	dyn. C (N)	stat. C_0 (N)	d	D	B	DIN 625-...	DIN 471	(kg)
8 x 2.5	1591-6-0500	1900	590	5	16	5	625.2RS	5 x 0.6	0.14
12 x 5	1591-6-0620	2450	900	6	19	6	626.2RS	6 x 0.7	0.18
16 x 5	1591-6-1020	6000	2240	10	30	9	6200.2RS	10 x 1	0.54
16 x 10	1591-6-1020	6000	2240	10	30	9	6200.2RS	10 x 1	0.54
16 x 16	1591-6-1020	6000	2240	10	30	9	6200.2RS	10 x 1	0.54
20 x 5	1591-6-1220	6950	2650	12	32	10	6201.2RS	12 x 1	0.73
20 x 20	1591-6-1220	6950	2650	12	32	10	6201.2RS	12 x 1	0.73
25 x 5	1591-6-1720	9500	4150	17	40	12	6203.2RS	17 x 1	0.96
25 x 10	1591-6-1720	9500	4150	17	40	12	6203.2RS	17 x 1	0.96
25 x 25	1591-6-1720	9500	4150	17	40	12	6203.2RS	17 x 1	0.96
32 x 5	1591-6-2020	12700	5700	20	47	14	6204.2RS	20 x 1.2	1.24
32 x 10	1591-6-2020	12700	5700	20	47	14	6204.2RS	20 x 1.2	1.24
32 x 20	1591-6-2020	12700	5700	20	47	14	6204.2RS	20 x 1.2	1.24
32 x 32	1591-6-2020	12700	5700	20	47	14	6204.2RS	20 x 1.2	1.24
40 x 5	1591-6-3020	19300	9800	30	62	16	6206.2RS	30 x 1.5	1.66
40 x 10	1591-6-3010	19300	9800	30	62	16	6206.2RS	30 x 1.5	1.82
40 x 20	1591-6-3010	19300	9800	30	62	16	6206.2RS	30 x 1.5	1.82
40 x 40	1591-6-3010	19300	9800	30	62	16	6206.2RS	30 x 1.5	1.82



First angle projection

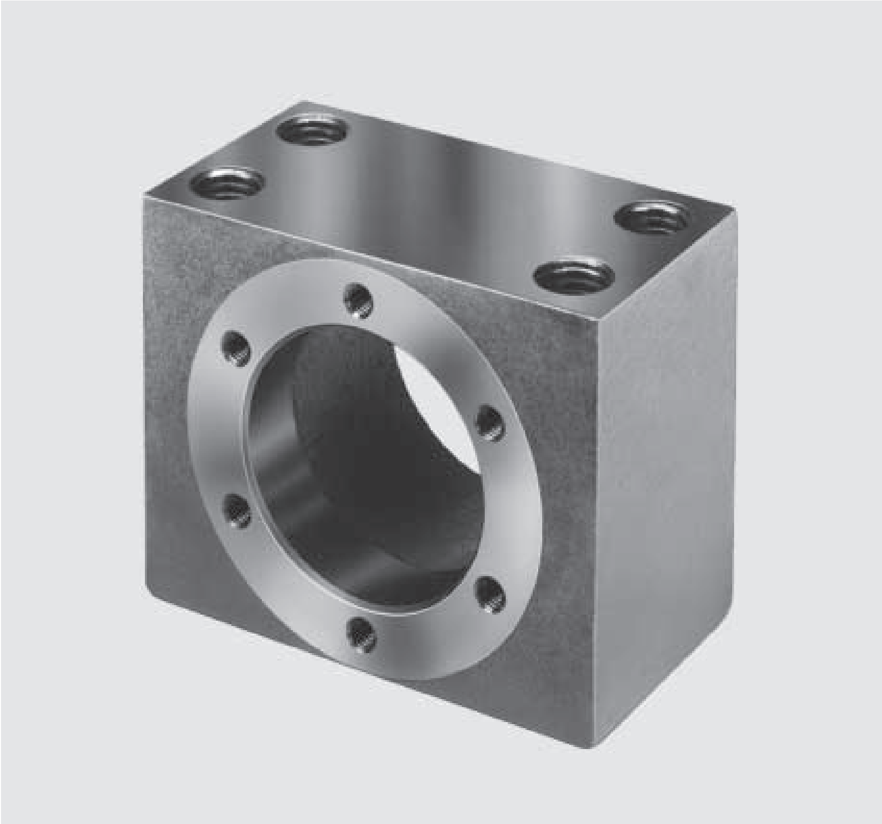
Pillow block housing Dimensions (mm)																Cover
L_1	L_2	L_3	L_4	H_1	H_2 ±0.02	H_3	H_4	H_5	B_1	B_2	M js7	V	S_1	S_2 H12	D_1 J6	B_D
62	-	38	50	34	18	13	11	9	13	4	31	6	5.3	M6	16	2.6
62	36	38	50	41	22	13	11	9	15	4.5	31	6	5.3	M6	19	2.6
86	50	52	68	58	32	22	15	15	24	7.5	43	8	8.4	M10	30	3.8
86	50	52	68	58	32	22	15	15	24	7.5	43	8	8.4	M10	30	3.8
86	50	52	68	58	32	22	15	15	24	7.5	43	8	8.4	M10	30	3.8
94	58	60	77	64	34	22	17	15	26	8	47	8	8.4	M10	32	3.8
94	58	60	77	64	34	22	17	15	26	8	47	8	8.4	M10	32	3.8
108	64	66	88	72	39	27	19	18	28	8	54	10	10.5	M12	40	3.7
108	64	66	88	72	39	27	19	18	28	8	54	10	10.5	M12	40	3.7
108	64	66	88	72	39	27	19	18	28	8	54	10	10.5	M12	40	3.7
112	68	70	92	77	42	27	20	18	34	10	56	10	10.5	M12	47	4.8
112	68	70	92	77	42	27	20	18	34	10	56	10	10.5	M12	47	4.8
112	68	70	92	77	42	27	20	18	34	10	56	10	10.5	M12	47	4.8
112	68	70	92	77	42	27	20	18	34	10	56	10	10.5	M12	47	4.8
126	78	80	105	90	50	32	23	21	38	11	63	12	12.6	M14	62	4.5
126	-	80	105	98	58	32	23	21	38	11	63	12	12.6	M14	62	4.5
126	-	80	105	98	58	32	23	21	38	11	63	12	12.6	M14	62	4.5
126	-	80	105	98	58	32	23	21	38	11	63	12	12.6	M14	62	4.5

STAR – Precision Ball Screw Assemblies
Nut Housings for FEM-E-S and SEM-E-S

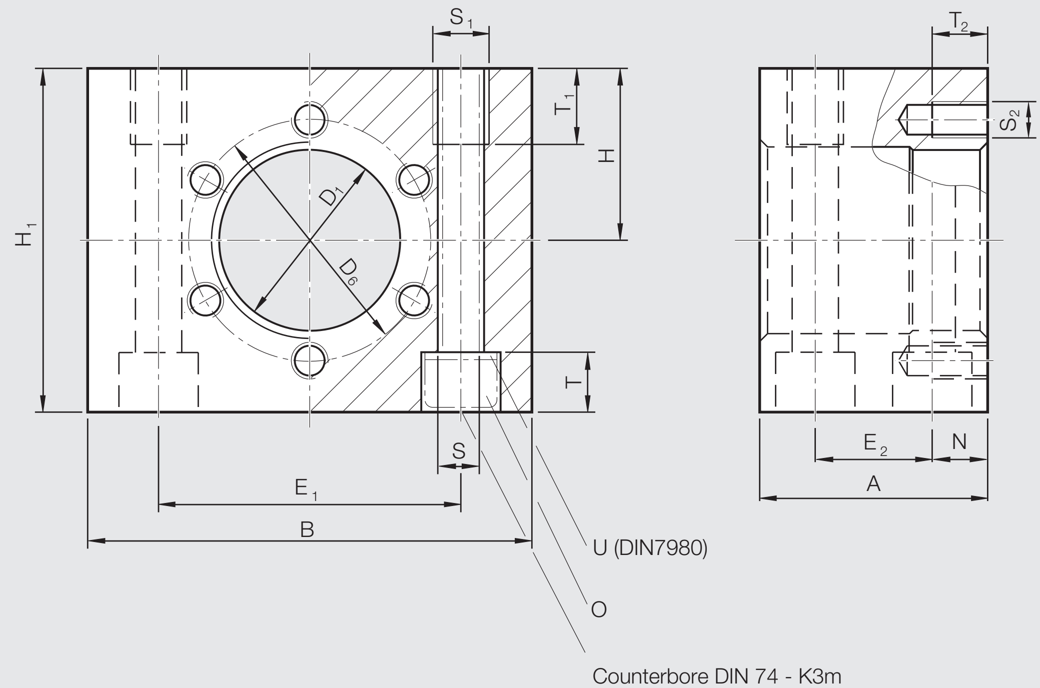
For ball screw assemblies with flanged nuts and adjustable-preload single nuts
(not suitable for DIN versions)

In addition to bolting, the housings should be locked in place by positive means (e.g. two pins with a diameter equal to that of the bolt).
We recommend using bolts with a strength class of 8.8. See “Mounting” for tightening torques.

Material:
Spheroidal graphite cast iron



Size d_0 x P	Part no.	Weight (kg)	
16 x 5	1506-0-0010	0.85	
16 x 10	1506-0-0010	0.85	
16 x 16	1506-1-0010	1.05	
20 x 5	1506-1-0010	1.05	
20 x 20	1506-2-0010	1.25	
25 x 5	1506-2-0010	1.25	
25 x 10	1506-2-0010	1.25	
25 x 25	1506-3-0010	1.8	
32 x 5	1506-3-0010	1.8	
32 x 10	1506-3-0010	1.8	
32 x 20	1506-4-0010	2.5	
32 x 32	1506-4-0010	2.5	
40 x 5	1506-4-0010	2.5	
40 x 10	1506-4-0011	3.7	
40 x 20	1506-4-0011	3.7	
40 x 40	1506-5-0011	6.3	
50 x 5	1506-5-0010	4.1	
50 x 10	1506-5-0011	6.3	
50 x 20	1506-6-0010	7.3	
50 x 40	1506-6-0010	7.3	
63 x 10	1506-6-0010	7.3	
80 x 10	1506-7-0010	9.4	



First angle projection

Dimensions (mm)															Hex socket cap. screw DIN 912	Lock washer
D_1 H8	D_6	A[1)]	B[1)]	H js7	H_1[1)]	E_1	E_2	N	S	T	S_1	T_1	S_2	T_2	O	U
28	40	40	70	28	55	52±0.1	20±0.1	10	8.4	11	M10	15	4/6 x M6	10	M8 x 55	8
28	40	40	70	28	55	52±0.1	20±0.1	10	8.4	11	M10	15	4/6 x M6	10	M8 x 55	8
33	45	40	75	32	62	56±0.1	20±0.1	10	8.4	11	M10	15	6 x M6	10	M8 x 65	8
33	45	40	75	32	62	56±0.1	20±0.1	10	8.4	11	M10	15	6 x M6	10	M8 x 65	8
38	50	40	85	34	65	63±0.1	20±0.1	10	8.4	11	M10	15	6 x M6	10	M8 x 65	8
38	50	40	85	34	65	63±0.1	20±0.1	10	8.4	11	M10	15	6 x M6	10	M8 x 65	8
38	50	40	85	34	65	63±0.1	20±0.1	10	8.4	11	M10	15	6 x M6	10	M8 x 65	8
48	60	50	95	38	74.5	72±0.1	26±0.1	12	10.5	13.5	M12	15	6 x M6	10	M10 x 80	10
48	60	50	95	38	74.5	72±0.1	26±0.1	12	10.5	13.5	M12	15	6 x M6	10	M10 x 80	10
48	60	50	95	38	74.5	72±0.1	26±0.1	12	10.5	13.5	M12	15	6 x M6	10	M10 x 80	10
56	68	60	105	42	82	82±0.1	30±0.1	15	13	18	M16	20	6 x M6	12	M12 x 80	12
56	68	60	105	42	82	82±0.1	30±0.1	15	13	18	M16	20	6 x M6	12	M12 x 80	12
56	68	60	105	42	82	82±0.1	30±0.1	15	13	18	M16	20	6 x M6	12	M12 x 80	12
63	78	65	120	50	98	93±0.1	35±0.1	15	15	18.5	M18	25	6 x M8	14	M14 x 100	14
63	78	65	120	50	98	93±0.1	35±0.1	15	15	18.5	M18	25	6 x M8	14	M14 x 100	14
72	90	80	140	58	113	108±0.15	46±0.15	17	17	21	M20	30	6 x M10	18	M16 x 120	16
68	82	65	130	52	101	100±0.15	35±0.15	15	15	18.5	M18	30	6 x M8	14	M14 x 100	14
72	90	80	140	58	113	108±0.15	46±0.15	17	17	21	M20	30	6 x M10	18	M16 x 120	16
85	105	80	150	65	128	121±0.15	46±0.15	17	17	21	M20	30	6 x M10	18	M16 x 130	16
85	105	80	150	65	128	121±0.15	46±0.15	17	17	21	M20	30	6 x M10	18	M16 x 130	16
85	105	80	150	65	128	121±0.15	46±0.15	17	17	21	M20	30	6 x M10	18	M16 x 130	16
105	125	80	170	78	153	140±0.2	46±0.15	17	17	21	M20	30	6 x M12	20	M16 x 160	16

1) Tolerances to DIN 1685-GTB 16

STAR – Precision Ball Screw Assemblies
Design Calculation Form

Star Linear Systems

14001 South Lakes Drive
Charlotte, NC 28273

Telephone 704-583-4338
Telefax 704-583-0523

Design Calculation Form

Application: New design ☐ Revised design ☐

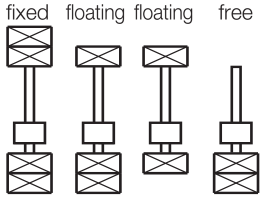
Operating conditions

Loads	[N]	Speeds	[rpm]	Operating time	[%]
F_1	=	at n_1	=	for q_1	=
F_2	=	at n_2	=	for q_2	=
F_3	=	at n_3	=	for q_3	=
F_4	=	at n_4	=	for q_4	=
F_5	=	at n_5	=	for q_5	=
F_6	=	at n_6	=	for q_6	=
Average load		Average speed		Total operating time	
F_m	=	nm	=	Q	= 100%

Maximum static load: N

Required service life ________________ Operating hours or ______________________________ x 10^6 ball screw revolutions

Screw end fixity



Selected:

Total stroke length:

Installation conditions (enclose drawings/sketches if possible!) Drawing enclosed ☐

Type of lubrication
Operating temperature: °C - min/max. / °C
Exceptional operating conditions:

Sender

Company: ____ **Name:** ____

Address: ____ **Department:** ____

____ **Telephone:** ____

____ **Telefax:** ____

Inquiry / Order Form

Star Linear Systems

14001 South Lakes Drive
Charlotte, NC 28273

Telephone 704-583-4338
Telefax 704-583-0523

STAR Screw

Nominal diameter .... d_0 = ________ mm
Lead ☐ right-hand ☐ left-hand .... P = ________ mm

STAR Nut

☐ FEM-E-C	☐ ZEM-E-A	☐ SEM-E-C	☐ FDM-E-C
☐ FEM-E-S	☐ ZEM-E-S	☐ SEM-E-S	☐ FDM-E-S
☐ with backlash	☐ with preload	Part number 1 5 ☐☐ - ☐ - ☐☐☐☐	

Mounting direction of nut:

Mounting ø D_1 (or in the case of ZEM-E-A/S, lube port) facing drive end ☐
facing non-drive end ☐

STAR Screw

Tolerance grade
(see Page 14/15)

P1 ☐	T1 ☐	≙ $v_{300\,p}$	=	6 µm
P3 ☐	T3 ☐	≙ $v_{300\,p}$	=	12 µm
P5 ☐	T5 ☐	≙ $v_{300\,p}$	=	23 µm
	T7 ☐	≙ $v_{300\,p}$	=	52 µm
	T9 ☐	≙ $v_{300\,p}$	=	130 µm

Total length .... L = ________ mm
Threaded length .... L_1 = ________ mm

Machining of screw ends .... ends not machined ☐
(Read bearing recommendations carefully!)
ends annealed L_{G1} / L_{G2} ______ / ______ mm ☐
to customer specs (drawing required) ☐
to STAR specs (page 46/47) ☐

Type of drive end.................................. for fixed bearing ☐ for floating bearing ☐
Type of non-drive end............................ for fixed bearing ☐ for floating bearing ☐

STAR End bearings
.... Part no./ Drive end 1 5 9 ☐ - ☐ - ☐☐☐☐
.... Part no./ Non-drive end 1 5 9 ☐ - ☐ - ☐☐☐☐

STAR Housings for flanged nut ....Part no. 1 5 0 6 - ☐ - ☐☐☐☐

Quantity **Order for:____ units, _____ per month, ______ per year,_____ per order, or __________________**

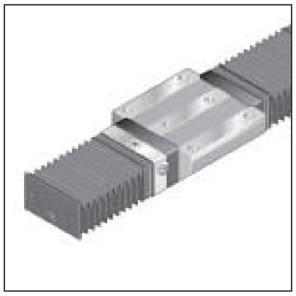
Comments:

Sender

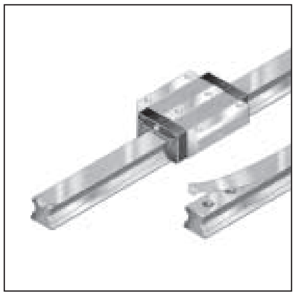
Company: ______________________ **Name:** ______________________
Address: ______________________ **Department:** ______________________
______________________ **Telephone:** ______________________
______________________ **Telefax:** ______________________

Star Products

Rexroth Star offers a complete line of linear motion products...

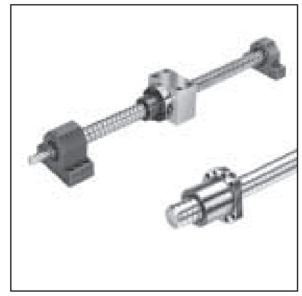


Ball Rail® Systems
RA 82 201



Roller Rails™
RA 82 301

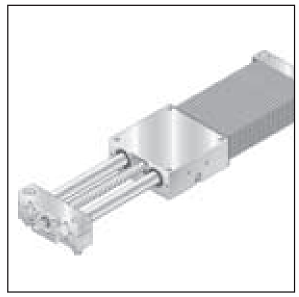
Linear Bushings
RA 99 004



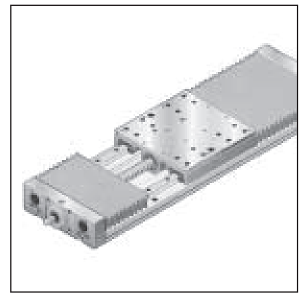
Precision Ball Screw Assemblies
RA 83 301

Linear Modules
RA 82 401

Compact Modules
RA 82 600

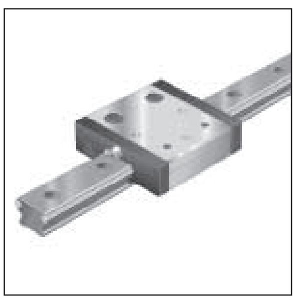


Linear Motion Slides
RA 83 300

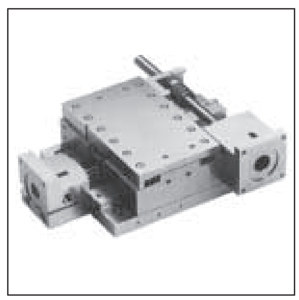


Ball Rail® Tables
RA 82 510

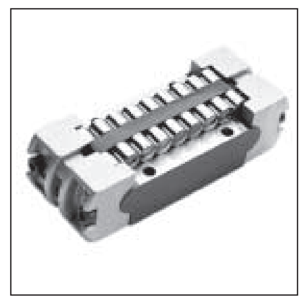
Super Structure™
RA 82 800



Cam Roller Guide
RA 82 100

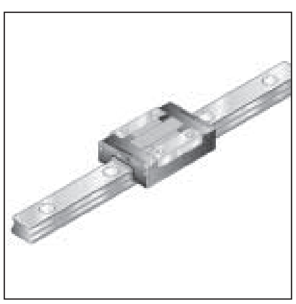


Special Systems
RA 99 003

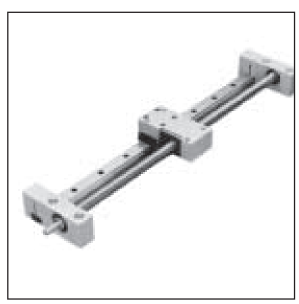


Tychoway® Linear Roller Bearings
RA 99 001

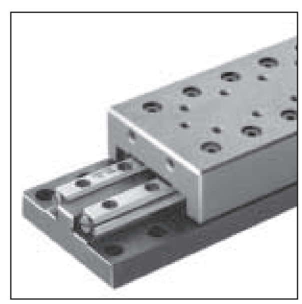
Ball Transfers
RA 82 910



Tychoway® Miniature Ball Rail
RA 99 004



Mini Compact Slides
RA 99 007



Tychoway® Linear Roller Slides
RA 99 000

July 1999

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