kammerer

Ball Screws
Trapezoidal Screws

Precision Screw Techology

More than 50 years of Kammerer

For your information

The technical specifications of the products represented in this catalog are for informational purposes only. They are just a part of all possible manufacturing options with regard to dimensions, profiles, forms and material qualities.

Please contact us!

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ZERTIFIKAT

ISO 9001:2000

DEKRA Certification

bescheinigt hiermit, dass das Unternehmen

kammerer

Kammerer Gewindetechnik GmbH

Bereiche:

Entwicklung, Herstellung und Vertrieb von Gewindetrieben

Standort:

In der Hausmatte 3 * D-78132 Hornberg-Niederwasser

IAF

Registrierungsurkunde

EMAS

GEPRÜFTES UMWELTMANAGEMENT

Kammerer
Gewindetechnik GmbH
In der Hausmatte 3
78132 Hornberg-Niederwasser

Register- Nr.: DE-126-00072

Eintragung am 26. November 2007

IHK

Freiburg, den 27. November 2007

All data, measures and details in this catalog are non-binding. Modifications and improvements reserved.

Issue 8/2011

Contents

What we manufacture

Ball screws

Sliding threaded screws

Rolled shafts

also in big volumes

for the automotive industry

Planetary roller screws

Worms and worm shafts

Subassemblies

The most modern measurement technology

- Modern inspection machines developed especially for the measurement of ball and trapezoidal thread spindles ensure consistent quality of each ball and trapezoidal screw that leaves the factory
- Measurement technology available especially for verifying profile accuracy
- Measurement precision, form and position tolerances are ensured by the controlling and documentation during the production process
- Measurement reports concerning pitch accuracy torque and rigidity can be produced upon request

Technical consultation

- All calculations related to our products are provided by our experienced technicians to support you in your special application, in order to assist you in making the optimal screw selection.

Ball screws

- In rolled, finely peeled and ground design
- Pitch precision IT 1, IT 3, IT 5, IT 7, IT 10
- Spindle length up to 7000 mm depending on production technology selected, by request even longer
- Spindle threading righthanded and lefthanded even on the same spindle
- Every custom pitch available according to customer request
- Large scale manufacturing also possible for the automobile industry, for example

New ball deflection system with optimized friction

- Own ball deflection system with optimized friction in the ball thread nuts guarantees greater smoothness of running even at high speeds and higher service life as a result
- Dimensions according to DIN 69051 enable replacement even after several years
- Individual nuts, cylindrical and with flange, as well as backlash-free nut combinations (pre-tensioning according to customer requirement) are available

Planetary roller screws

according to drawing on request

Advantages:

- Very high rotating speed (up to 6000 rpm)
- Very long service life
- Very high rigidity
- High dynamic capacity

Threaded spindles and nuts

We manufacture spindles and nuts with trapezoidal, metric, saw-tooth, ACME and special threads from 8—160 mm fl and up to a length of 6 metres (longer on request) in single and multi-start designs, ready to install to drawing.

We also carry out all follow up operations in our factory such as CNC turning, CNC milling, CNC grinding, etc. as well as the straightening of spindles for maximum concentricity using modern straightening presses.

When choosing the material for the turning and spinning of spindles with accurate leads it must be ensured that a homogeneous, consistently low stressed spindle material is used. We would ask you to consider our suggested materials where possible.

Rolled threads are manufactured in diameters of up to 60 mm and a lead of up to 9 mm.

When machining parts supplied by others on a piecework basis, the preparation carried out by you should be agreed with us in each case. The same applies to the choice of material for spindles and nuts.

Worms and worm shafts

Worms and worm shafts (single and multiple start) are manufactured from module 2—12 and up to an outside diameter of 160 mm.

Worms are manufactured by turning or spinning; in this way we can achieve flank shapes approximating to DIN 3975 K.

Worms and worm shafts are manufactured exclusively to customer drawings.

Lead screws

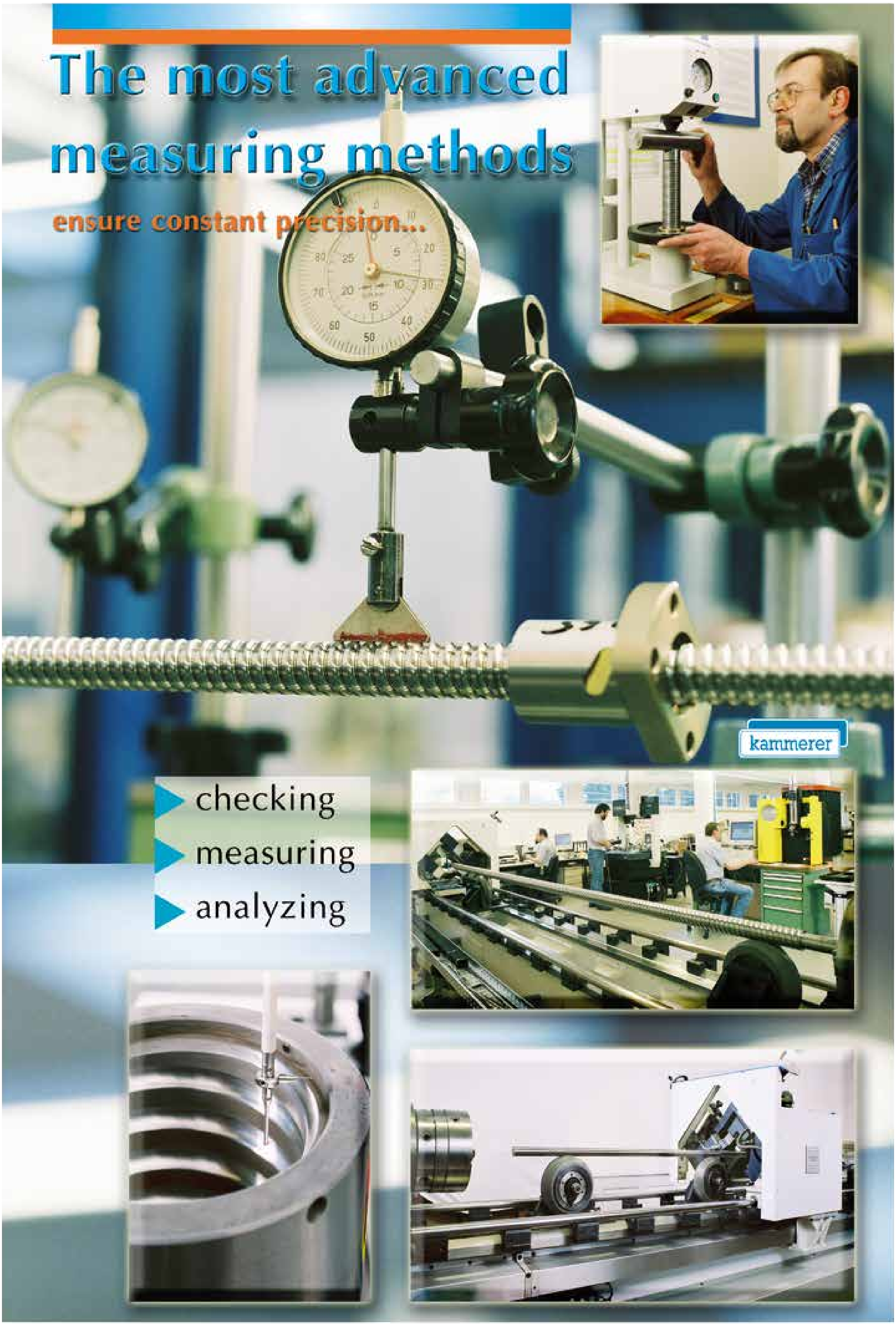
Kammerer also manufactures lead screws in the trapezoidal and ball screw range up to 1xD, larger on request

We also provide customer-specific assemblies and complete solutions.

Quality assurance

The most advanced measuring methods

ensure constant precision...



kammerer

- checking
- measuring
- analyzing

Rely on the tested „Kammerer quality"

What is checked?

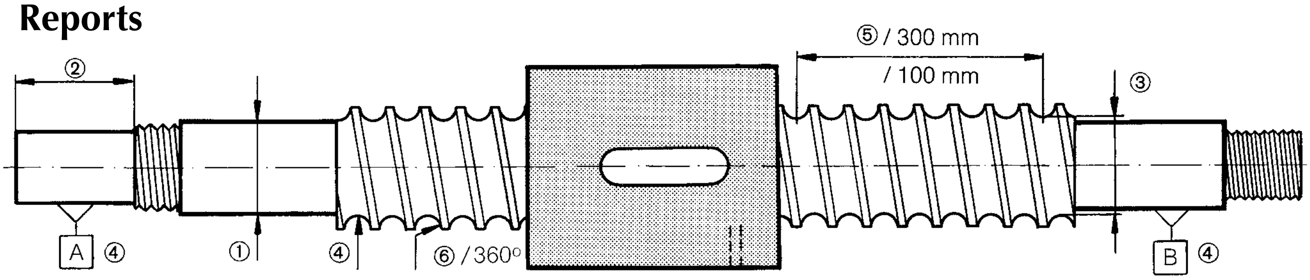
Measurement of the lead accuracy every 300 mm of the ball screw (to DIN 69051)
the individual pitch of each thread or, for example, every 100 mm
the wobble error
the radial runout error at the spindle ends
the length of the spindle
the flank diameter (accuracy and radial runout)

Ball screws are drive units that make it possible to position machine components highly accurately, e.g. in machine tools and measuring equipment. To achieve the required accuracy, extensive measurements are also essential between the individual processing phases to check the manufacture.

Check measurements and tests are carried out for the following criteria, whereby some are of course only performed at the customer's request:

- Radial and axial runout
- Parallelism
- Axial play
- Tooth bearing
- Pre-loading
- No-load and load torques
- Rigidity
- Lead variation
- Material
- Thread profile
- Hardness
- Hardening cracks
- Straightness
- Dimensions
- Fit

Reports



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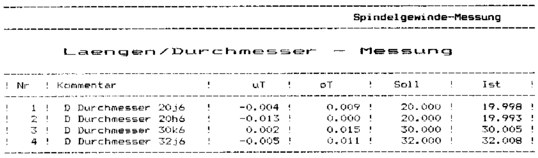
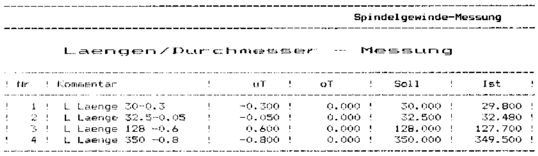


Spindelgewinde-Messung

Laengen/Durchmesser – Messung

Nr	Kommentar	uT	oT	Soll	Ist
1	D Durchmesser 20j6	-0.004	0.009	20.000	19.998
2	D Durchmesser 20h6	-0.013	0.000	20.000	19.993
3	D Durchmesser 30k6	0.002	0.015	30.000	30.005
4	D Durchmesser 32j6	-0.005	0.011	32.000	32.008

②

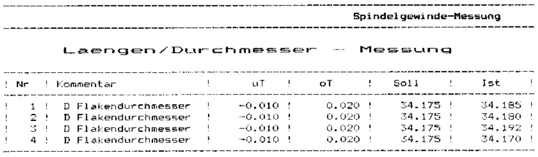


Spindelgewinde-Messung

Laengen/Durchmesser – Messung

Nr	Kommentar	uT	oT	Soll	Ist
1	L Laenge 30-0.3	-0.300	0.000	30.000	29.800
2	L Laenge 32.5-0.05	-0.050	0.000	32.500	32.480
3	L Laenge 128 -0.6	0.600	0.000	128.000	127.700
4	L Laenge 350 -0.8	-0.800	0.000	350.000	349.500

③

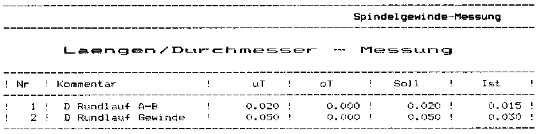


Spindelgewinde-Messung

Laengen/Durchmesser – Messung

Nr	Kommentar	uT	oT	Soll	Ist
1	D Flakendurchmesser	-0.010	0.020	34.175	34.185
2	D Flakendurchmesser	-0.010	0.020	34.175	34.180
3	D Flakendurchmesser	-0.010	0.020	34.175	34.192
4	D Flakendurchmesser	-0.010	0.020	34.175	34.170

④

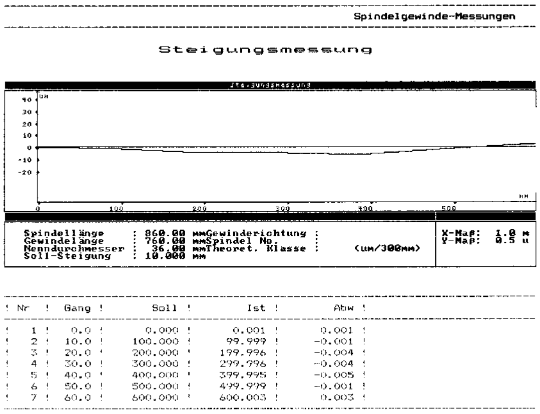


Spindelgewinde-Messung

Laengen/Durchmesser – Messung

Nr	Kommentar	uT	oT	Soll	Ist
1	D Rundlauf A-B	0.020	0.000	0.020	0.015
2	D Rundlauf Gewinde	0.050	0.000	0.050	0.030

⑤



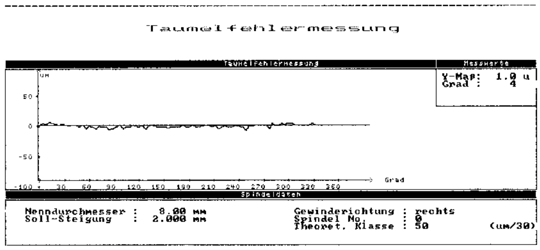
Spindelgewinde-Messungen

Steigungsmessung

Spindellänge : 860.00 mm
Gewindelänge : 760.00 mm
Nenndurchmesser : 36.00 mm
Soll-Steigung : 10.000 mm
Gewinderichtung :
Spindel No. :
Theoret. Klasse : (um/300mm)
X-Maß: 1.0 m
Y-Maß: 0.5 u

Nr	Gang	Soll	Ist	Abw
1	0.0	0.000	0.001	0.001
2	10.0	100.000	99.999	-0.001
3	20.0	200.000	199.996	-0.004
4	30.0	300.000	299.996	-0.004
5	40.0	400.000	399.995	-0.005
6	50.0	500.000	499.999	-0.001
7	60.0	600.000	600.003	0.003

⑥



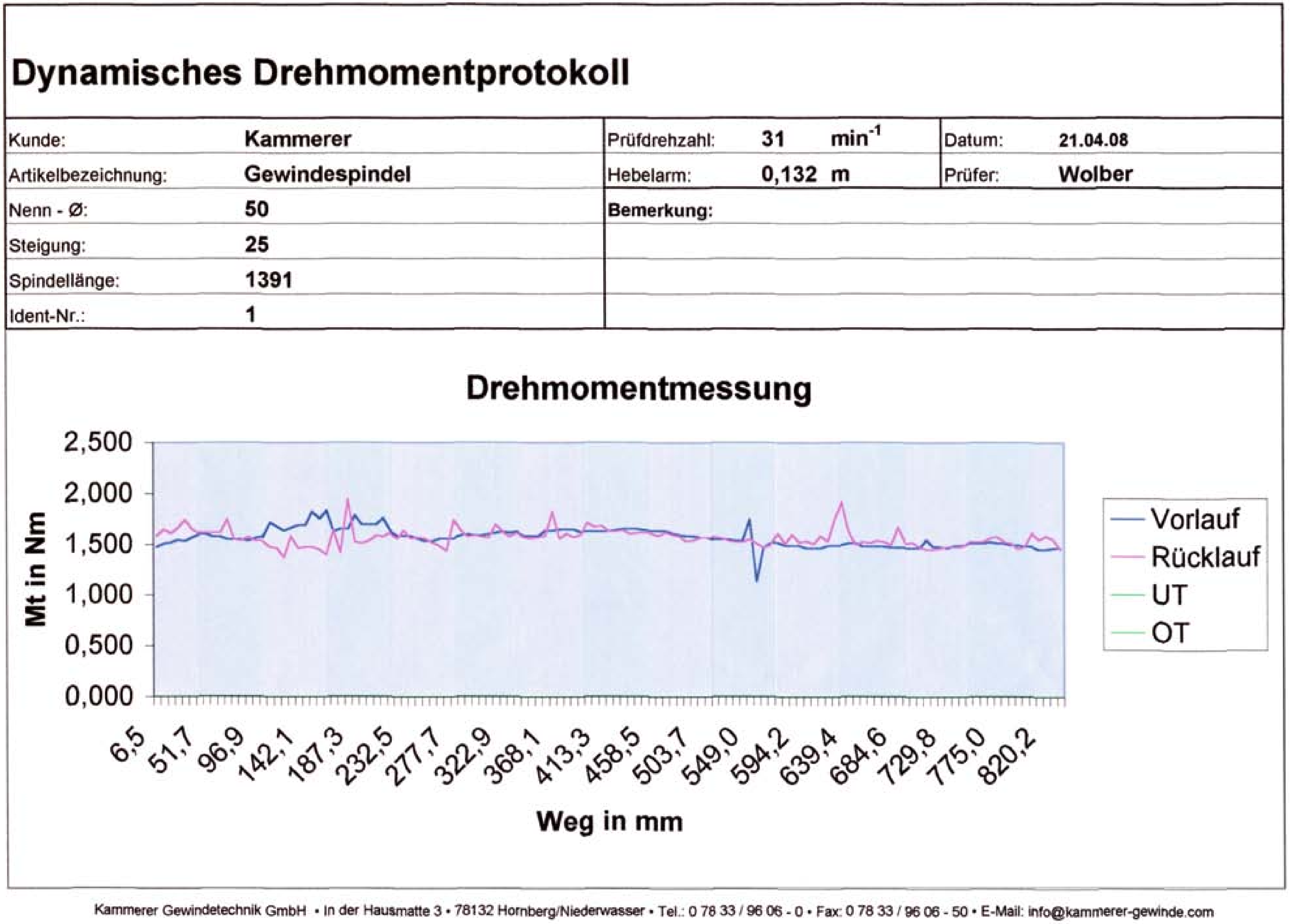
Taumelfehlermessung

Y-Maß: 1.0 u
Grad : 4

Nenndurchmesser : 8.00 mm
Soll-Steigung : 2.000 mm
Gewinderichtung : rechts
Spindel No. : 0
Theoret. Klasse : 50 (um/30)

We can make all the necessary measurements on ball screw spindles and nuts on our test machine with its computer analysed lead and measurement reports. Test reports can be supplied on request.

Dynamic torque protocol



Dynamisches Drehmomentprotokoll

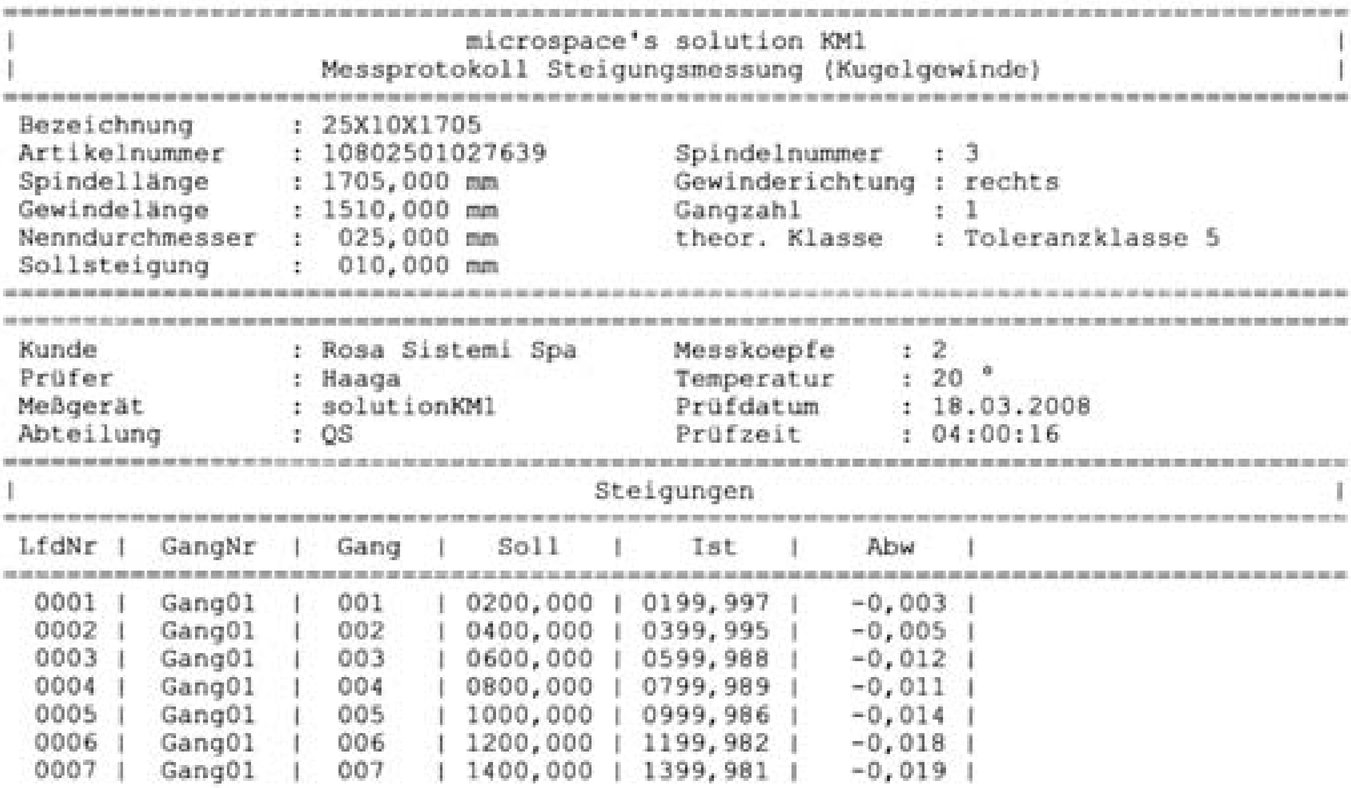
Kunde:	**Kammerer**	Prüfdrehzahl:	**31**	**min^{-1}**	Datum:	**21.04.08**
Artikelbezeichnung:	**Gewindespindel**	Hebelarm:	**0,132**	**m**	Prüfer:	**Wolber**
Nenn - Ø:	**50**	**Bemerkung:**				
Steigung:	**25**					
Spindellänge:	**1391**					
Ident-Nr.:	**1**					

Drehmomentmessung

Kammerer Gewindetechnik GmbH • In der Hausmatte 3 • 78132 Hornberg/Niederwasser • Tel.: 0 78 33 / 96 06 - 0 • Fax: 0 78 33 / 96 06 - 50 • E-Mail: info@kammerer-gewinde.com

Pitch measurement log (ball thread)

Firma Rosa Sistemi Spa



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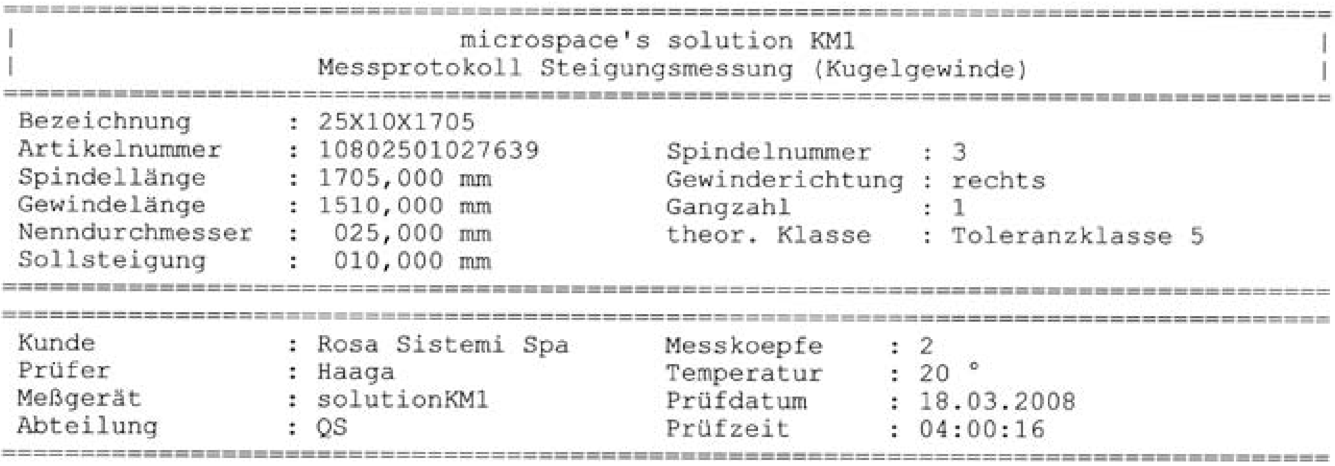
|                        microspace's solution KM1                             |
|             Messprotokoll Steigungsmessung (Kugelgewinde)                    |
================================================================================
 Bezeichnung        : 25X10X1705
 Artikelnummer      : 10802501027639          Spindelnummer    : 3
 Spindellänge       : 1705,000 mm             Gewinderichtung  : rechts
 Gewindelänge       : 1510,000 mm             Gangzahl         : 1
 Nenndurchmesser    :  025,000 mm             theor. Klasse    : Toleranzklasse 5
 Sollsteigung       :  010,000 mm
================================================================================
================================================================================
 Kunde              : Rosa Sistemi Spa        Messkoepfe     : 2
 Prüfer             : Haaga                   Temperatur     : 20 °
 Meßgerät           : solutionKM1             Prüfdatum      : 18.03.2008
 Abteilung          : QS                      Prüfzeit       : 04:00:16
================================================================================
|                               Steigungen                                     |
================================================================================
 LfdNr |  GangNr   |  Gang   |   Soll    |    Ist    |    Abw    |
================================================================================
  0001 |  Gang01   |  001    | 0200,000 | 0199,997 |   -0,003 |
  0002 |  Gang01   |  002    | 0400,000 | 0399,995 |   -0,005 |
  0003 |  Gang01   |  003    | 0600,000 | 0599,988 |   -0,012 |
  0004 |  Gang01   |  004    | 0800,000 | 0799,989 |   -0,011 |
  0005 |  Gang01   |  005    | 1000,000 | 0999,986 |   -0,014 |
  0006 |  Gang01   |  006    | 1200,000 | 1199,982 |   -0,018 |
  0007 |  Gang01   |  007    | 1400,000 | 1399,981 |   -0,019 |
```

▶ Pitch measurement log (ball thread)

Firma Rosa Sistemi Spa



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================================================================================
|                        microspace's solution KM1                             |
|              Messprotokoll Steigungsmessung (Kugelgewinde)                   |
================================================================================
 Bezeichnung        : 25X10X1705
 Artikelnummer      : 10802501027639       Spindelnummer    : 3
 Spindellänge       : 1705,000 mm          Gewinderichtung  : rechts
 Gewindelänge       : 1510,000 mm          Gangzahl         : 1
 Nenndurchmesser    :  025,000 mm          theor. Klasse    : Toleranzklasse 5
 Sollsteigung       :  010,000 mm
================================================================================
================================================================================
 Kunde              : Rosa Sistemi Spa     Messkoepfe     : 2
 Prüfer             : Haaga                Temperatur     : 20 °
 Meßgerät           : solutionKM1          Prüfdatum      : 18.03.2008
 Abteilung          : QS                   Prüfzeit       : 04:00:16
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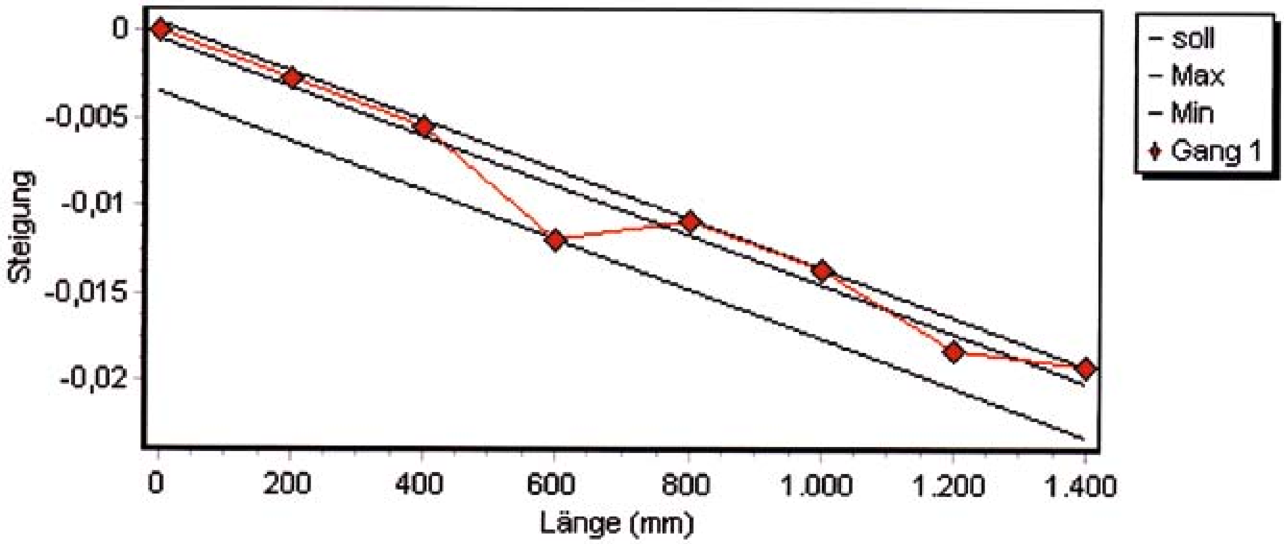
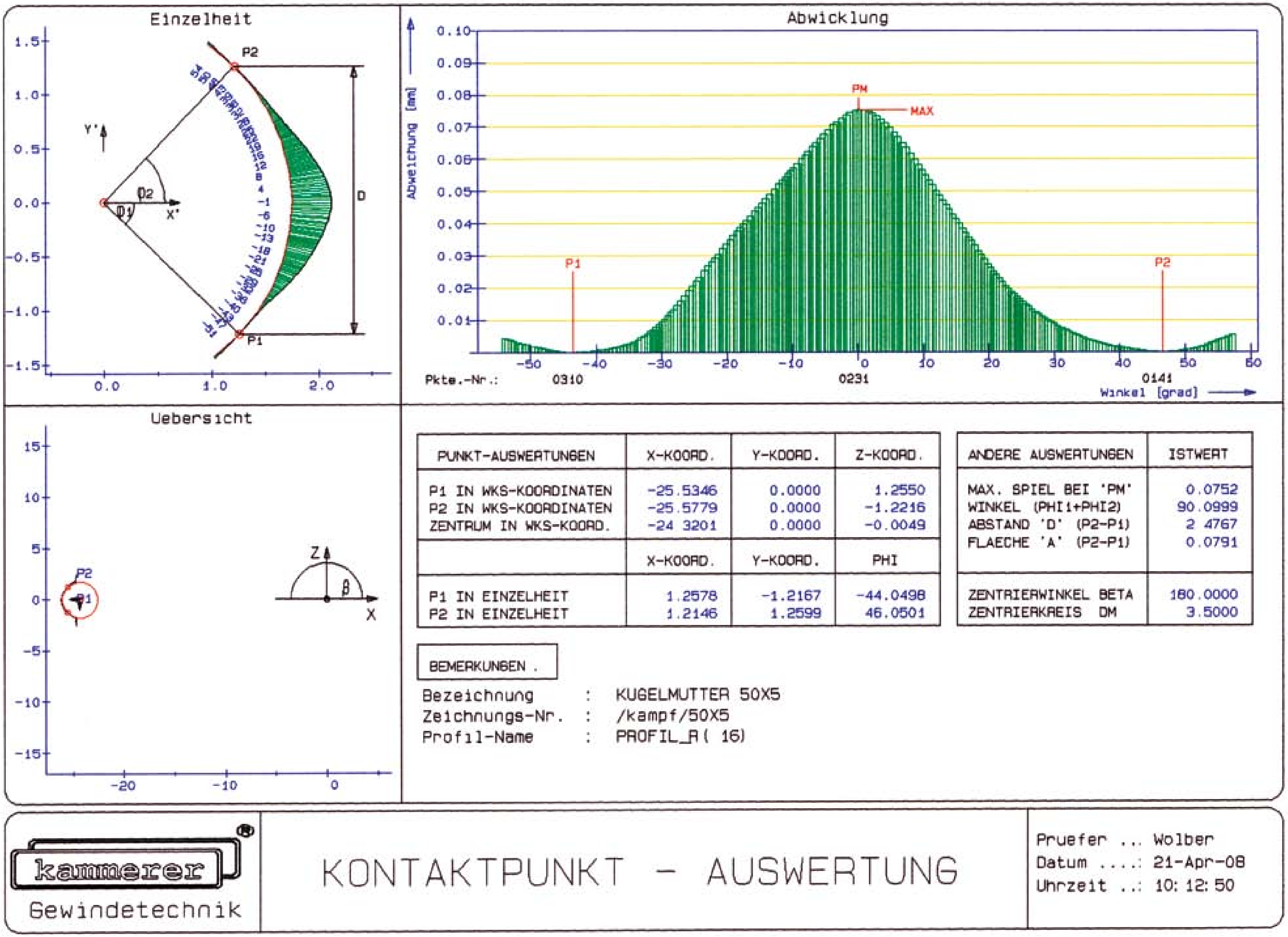


Thread profile protocol



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P1 IN WKS-KOORDINATEN	-25.5346	0.0000	1.2550
P2 IN WKS-KOORDINATEN	-25.5779	0.0000	-1.2216
ZENTRUM IN WKS-KOORD.	-24 3201	0.0000	-0.0049
	X-KOORD.	Y-KOORD.	PHI
P1 IN EINZELHEIT	1.2578	-1.2167	-44.0498
P2 IN EINZELHEIT	1.2146	1.2599	46.0501

ANDERE AUSWERTUNGEN	ISTWERT
MAX. SPIEL BEI 'PM'	0.0752
WINKEL (PHI1+PHI2)	90.0999
ABSTAND 'D' (P2-P1)	2 4767
FLAECHE 'A' (P2-P1)	0.0791
ZENTRIERWINKEL BETA	180.0000
ZENTRIERKREIS DM	3.5000

BEMERKUNGEN .

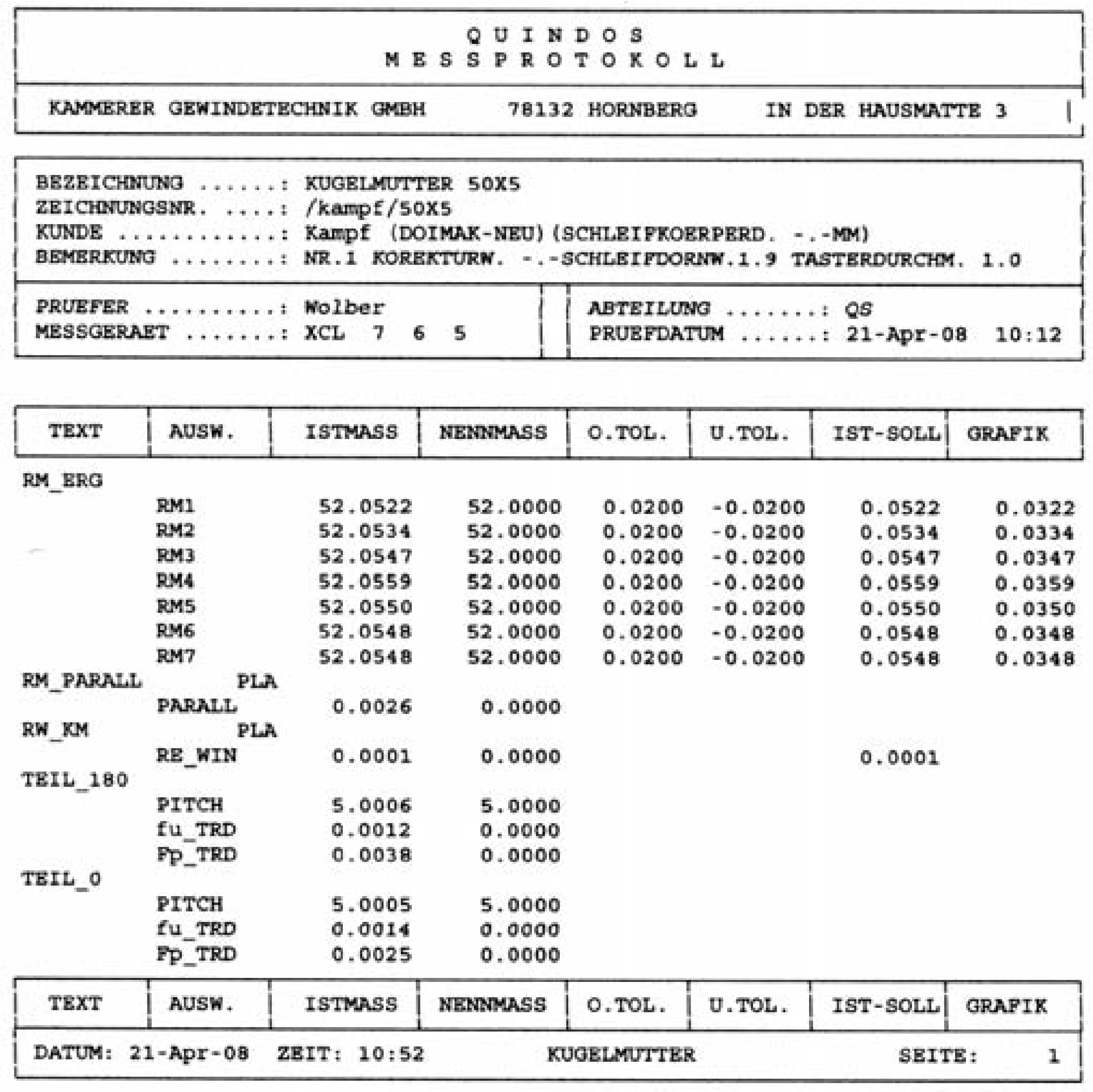
Bezeichnung : KUGELMUTTER 50X5
Zeichnungs-Nr. : /kampf/50X5
Profil-Name : PROFIL_R(16)

Gewindetechnik

KONTAKTPUNKT - AUSWERTUNG

Pruefer ... Wolber
Datum ....: 21-Apr-08
Uhrzeit ..: 10: 12: 50

▶ Thread profile protocol



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                               Q U I N D O S
                           M E S S P R O T O K O L L

 KAMMERER GEWINDETECHNIK GMBH       78132 HORNBERG      IN DER HAUSMATTE 3

 BEZEICHNUNG .......: KUGELMUTTER 50X5
 ZEICHNUNGSNR. .....: /kampf/50X5
 KUNDE .............: Kampf  (DOIMAK-NEU)(SCHLEIFKOERPERD. -.-MM)
 BEMERKUNG .........: NR.1 KOREKTURW. -.-SCHLEIFDORNW.1.9 TASTERDURCHM. 1.0

 PRUEFER ...........: Wolber              ABTEILUNG .......: QS
 MESSGERAET ........: XCL  7  6  5        PRUEFDATUM ......: 21-Apr-08  10:12

 TEXT       AUSW.      ISTMASS    NENNMASS    O.TOL.    U.TOL.    IST-SOLL  GRAFIK
 RM_ERG
            RM1        52.0522    52.0000     0.0200    -0.0200    0.0522    0.0322
            RM2        52.0534    52.0000     0.0200    -0.0200    0.0534    0.0334
            RM3        52.0547    52.0000     0.0200    -0.0200    0.0547    0.0347
            RM4        52.0559    52.0000     0.0200    -0.0200    0.0559    0.0359
            RM5        52.0550    52.0000     0.0200    -0.0200    0.0550    0.0350
            RM6        52.0548    52.0000     0.0200    -0.0200    0.0548    0.0348
            RM7        52.0548    52.0000     0.0200    -0.0200    0.0548    0.0348
 RM_PARALL        PLA
            PARALL      0.0026     0.0000
 RW_KM            PLA
            RE_WIN      0.0001     0.0000                          0.0001
 TEIL_180
            PITCH       5.0006     5.0000
            fu_TRD      0.0012     0.0000
            Fp_TRD      0.0038     0.0000
 TEIL_0
            PITCH       5.0005     5.0000
            fu_TRD      0.0014     0.0000
            Fp_TRD      0.0025     0.0000
 TEXT       AUSW.      ISTMASS    NENNMASS    O.TOL.    U.TOL.    IST-SOLL  GRAFIK
 DATUM: 21-Apr-08  ZEIT: 10:52          KUGELMUTTER                   SEITE:     1
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DK 621.9.06-23:621.833.389.02 DEUTSCHE NORM *Entwurf* **September 1987**

Werkzeugmaschinen

Kugelgewindetriebe

Abnahmebedingungen und Abnahmeprüfungen

DIN 69051
Teil 3

Machine tools; ball screws; acceptance conditions and acceptance tests

Machines-outils; vis à billes; conditions de réception et méthodes d'essais

Einsprüche bis 31. Dez 1987

Anwendungswarnvermerk auf der letzten Seite beachten!

Zusammenhang mit dem von der International Organization for Standardization (ISO) veröffentlichten Internationalen Norm-Vorschlag ISO/DP 3408/3, siehe Erläuterungen.

Maße in mm

1 Anwendungsbereich und Zweck

In diesem Norm-Entwurf werden für Kugelgewindetriebe technische Abnahmebedingungen einschließlich der für die Abnahmeprüfungen in der jeweiligen Toleranzklasse geltenden Toleranzen festgelegt.

Die im einzelnen durchzuführenden Abnahmeprüfungen sind zu vereinbaren (siehe hierzu Abschnitt 4).

2 Begriffe

Begriffe nach DIN 69051 Teil 1 (z.Z. Entwurf)

3 Prüfungen und Toleranzen

Die Prüfungen werden in Anlehnung an die Grundtoleranzklassen IT nach ISO/DIS 286/1 in fünf Toleranzklassen unterteilt (siehe Tabelle 1).

Tabelle 1. Toleranzklassen

Toleranzklasse 1
Toleranzklasse 3
Toleranzklasse 5
Toleranzklasse 7
Toleranzklasse 10

↑ Steigende Genauigkeits- und Funktionsanforderungen

3.1 Geometrische Prüfungen

Die Grenzabmaße e_p für die mittlere Istwegabweichung über den Nutzweg l_u (siehe Prüfung Nr 1.1 und Nr 1.2) und die Werte für Wegschwankung v_{300} über 300 mm Axialweg wurden der ISO/DIS 286 Teil 1 entnommen, wobei die Werte für den Nutzweg $l_u > 3150$ mm durch lineare Extrapolation errechnet wurden (siehe Tabelle A.1).

Die Toleranzen der Wegschwankung v_{up} über den Nutzweg l_u wurden nach folgenden auf Erfahrung beruhenden Gleichungen berechnet:

Toleranzklasse 1: $v_{up} = 0{,}0046 \cdot \bar{l}_u + 4{,}6$ (µm) (1)

Toleranzklasse 3: $v_{up} = 0{,}0092 \cdot \bar{l}_u + 9{,}2$ (µm) (2)

Toleranzklasse 5: $v_{up} = 0{,}0184 \cdot \bar{l}_u + 18{,}4$ (µm) (3)

wobei $\bar{l}_u$ das geometrische Mittel aus dem größten und dem kleinsten Wert für l_u jedes Längenbereiches ist.

$$\bar{l}_u = \sqrt{l_{u\,max} \cdot l_{u\,min}} \quad \text{(mm)} \qquad (4)$$

3.1.1 Wegabweichungen und Wegschwankungen

Für Positionier- oder Transport-Kugelgewindetriebe gelten folgende Abnahmeprüfungen (siehe Tabellen 2 und 3).

Tabelle 2. Prüfung der Wegabweichungen und Wegschwankungen

Wegabweichung	Positionier-	Transport-
	Kugelgewindetriebe	
Wegkompensation c über den Nutzweg l_u	durch Anwender festgelegt	c = 0
Grenzabmaß e_p für die mittlere Istwegabweichung	Prüfung Nr 1.1	Prüfung Nr 1.2
Toleranz v_u der Wegschwankung über den Nutzweg l_u	Prüfung Nr 2	----
Toleranz v_{300} der Wegschwankung über 300 mm Weg	Prüfung Nr 3	Prüfung Nr 3
Toleranz $v_{2\pi}$ der Wegschwankung über 2πrad (= 1 Umdrehung)	Prüfung Nr 4	----

Fortsetzung Seite 2 bis 13

Normenausschuß Werkzeugmaschinen (NWM) im DIN Deutsches Institut für Normung e.V.

Alleinverkauf der Normen durch Beuth Verlag GmbH, Burggrafenstraße 6, 1000 Berlin 30
09.87

Entwurf DIN 69 051 Teil 3 Sep 1987 Preisgr. 9
Vertr.-Nr. 0009

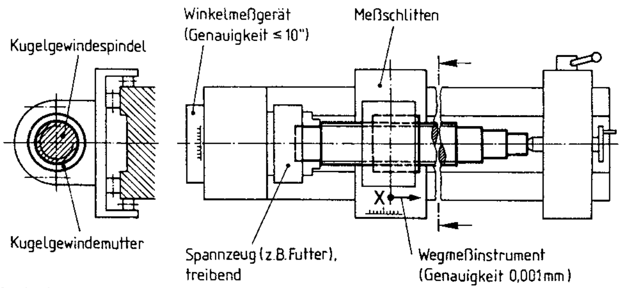


Bild 1. Meßprinzip

Prüfungen und Toleranzen beziehen sich auf die Verschiebung der Kugelgewindemutter gegenüber der Kugelgewindespindel.

Als alternative Meßmethode ist eine Gang-zu-Gang-Messung zulässig; dabei wird das Gewindeprofil der Kugellaufbahn mittels Meßkugel angetastet. Meßabstände entsprechend Tabelle A.2.

Die Ermittlung der Wegschwankungstoleranz $v_{2\pi a}$ innerhalb von 2π rad erfolgt durch 9 Messungen (8 x 45°) pro Umdrehung oder kontinuierlich über einen Gang am Anfang, in der Mitte und am Ende des Nutzweges, sofern diese Prüfung besonders vereinbart wurde.

3.1.1.1 Auswertung der Meßdiagramme

Zur Ermittlung der mittleren Istwegabweichung innerhalb des Nutzweges ist die mathematische Methode definitionsgemäß exakt.

Für die Praxis wird für die Auswertung die einfache und schnelle graphische Methode als gebräuchliche Näherungsmethode empfohlen.

3.1.1.1.1 Mathematische Methode

Die Gerade der mittleren Istabweichung ergibt sich aus der allgemeinen Gleichung

$$y = a + bx \tag{5}$$

mit
$$a = \frac{\Sigma x_i^2 \cdot \Sigma y_i - \Sigma x_i \cdot \Sigma x_i y_i}{n \cdot \Sigma x_i^2 - (\Sigma x_i)^2} \tag{6}$$

und
$$b = \frac{n \cdot \Sigma x_i y_i - \Sigma x_i \cdot \Sigma y_i}{n \cdot \Sigma x_i^2 - (\Sigma x_i)^2} \tag{7}$$

Es ist

x = Drehwinkel (Soll- bzw. Nennweg)

x_i = Drehwinkel (Soll- bzw. Nennweg) bezogen auf den Meßpunkt i

y = Wegabweichung vom Soll- bzw. Nennweg

y_i = Wegabweichung (oder Weg) vom Soll- oder Nennweg für den Drehwinkel (oder Weg) bezogen auf den Meßpunkt i

n = Anzahl der Meßpunkte

3.1.1.1.2 Graphische Methode

Die Ermittlung der mittleren Istwegabweichung aus dem Wegabweichungsdiagramm geschieht wie folgt (siehe Bilder 2 und 3)

a) Man ziehe eine oder mehrere Geraden (l_1, l_2 ...), die mindestens zwei obere Spitzen der Istwegabweichungskurve berühren und wiederhole diesen Vorgang für die unteren Spitzen (l_3, ...).

b) Man ermittle den jeweils größten Abstand (e_1, e_2, e_3) zwischen den Geraden l_1, l_2 und l_3 der Istwegabweichungskurve und wähle daraus den geringsten Abstand aus, im Bild 2 bzw. 3 der Abstand e_2.

c) Man ziehe durch diesen Punkt des geringsten Abstandes parallel zur zugehörigen Geraden eine weitere Gerade, hier l'_2 parallel zu l_2.

d) Man erhält nun die mittlere Istabweichung e_{sa} bzw. e_{0a} als Mittellinie zwischen diesen beiden parallelen Geraden (l_2, l'_2) und die Bandbreite der Wegschwankung v_{ua} über den Nutzweg l_u als Abstand der Parallelen e_2.

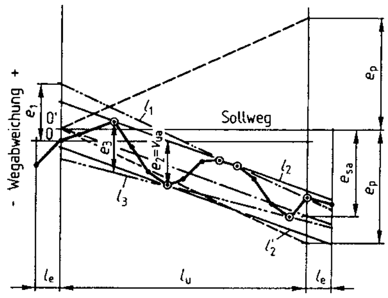


Bild 2. Graphische Ermittlung der mittleren Istwegabweichung bezogen auf den Sollweg

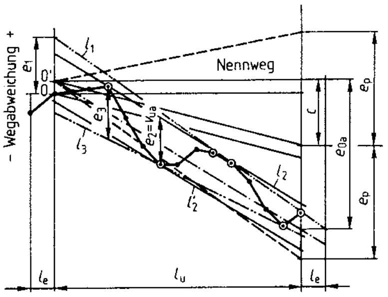


Bild 3. Graphische Ermittlung der mittleren Istwegabweichung bezogen auf den Nennweg bei Wegkompensation

3.1.2 Lauf- und Lagetoleranzen

In der Tabelle 4 sind Abnahmeprüfungen für Lauf- und Lagetoleranzen für Kugelgewindespindeln und für Kugelgewindemuttern aufgrund von Erfahrungen festgelegt (Prüfung Nr 5 bis Nr 11). In der Spalte "Prüfanleitung" ist jeweils am Schluß des Textes die entsprechende Abschnittsnummer aus DIN 8601, Ausgabe Dezember 1986, angegeben, sofern die betreffende Prüfung mit den dort enthaltenen Festlegungen übereinstimmt.

3.2 Funktionsprüfungen

Die Tabelle 5 gibt die Prüfung des Leerlaufdrehmomentes einer Kugelgewindemutter mit Vorspannung und zugehörige Toleranzen an (siehe Prüfung Nr 12).

In Prüfung Nr 13 wird ein Verfahren zur Ermittlung der axialen Steifigkeit einer Kugelgewindemutter angegeben.

4 Bezeichnung

Bezeichnung der vollständigen Abnahmebedingungen für Kugelgewindetriebe nach DIN 69051 Teil 3 (3):

Abnahmebedingungen DIN 69051 - 3

Bezeichnung der Abnahmebedingungen für Kugelgewindetriebe nach DIN 69051 Teil 3 (3), Einzelprüfung Nr 4 (4):

Prüfung DIN 69051 - 3 - 4

Anhang A

Tabelle A.1 Toleranzklassen und Toleranzen entsprechend ISO/DIS 286 Teil 1

Meßlänge		Toleranzen in um für Toleranzklasse				
über	bis	1	3	5	7	10
	315	6	12	23	52	210
315	400	7	13	25	57	230
400	500	8	15	27	63	250
500	630	9	16	30	70	280
630	800	10	18	35	80	320
800	1000	11	21	40	90	360
1000	1250	13	24	46	105	420
1250	1600	15	29	54	125	500
1600	2000	18	35	65	150	600
2000	2500	22	41	77	175	700
2500	3150	26	50	93	210	860
3150	4000	32*	62*	115*	260*	1050*
4000	5000	39*	76*	140*	320*	1300*
5000	6300	48*	92*	170*	390*	1550*

* Diese Werte wurden durch lineare Extrapolation der IT-Werte für Längen über 500 bis 3150 mm errechnet.

Tabelle A.2 Mindestanzahl der Messungen innerhalb von 300 mm (Meßintervalle)

Steigung P_h	Toleranzklasse				
	1	3	5	7	10
2,5	30	20	10	5	1
5	15	10	6	3	1
10	10	5	3	1	1
20	5	5	3	1	1
40	-	2	1	1	1

Tabelle A.3 Oberlauf l_e

Steigung	2,5	5	10	20	40
größter Oberlauf l_e	10	20	40	60	100

Tabelle 3. Wegabweichungen und Wegschwankungen

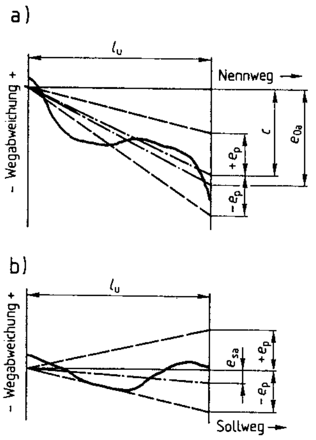
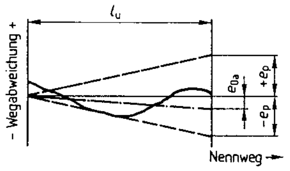
<table>
<tr><th>Nr</th><th>Gegenstand der Prüfung</th><th>Bild</th><th>Prüfmittel</th><th>Prüfanleitung</th><th>Grenzabmaße bzw. Toleranzen</th><th>Meßergebnisse, Bemerkungen</th></tr>
<tr><td>1.1</td><td>Mittlere Istwegabweichung e_p über den Nutzweg l_u
a) bezogen auf den Nennweg
b) bezogen auf den Sollweg</td><td>
</td><td>siehe Bild 1</td><td>siehe Bild 1</td><td>Positionier-Kugelgewindetriebe
<table>
<tr><th colspan="2">l_u</th><th colspan="5">e_p in µm für Toleranzklasse</th></tr>
<tr><th>über</th><th>bis</th><th>1</th><th>3</th><th>5</th><th>7</th><th>10</th></tr>
<tr><td></td><td>315</td><td>6</td><td>12</td><td>23</td><td>-</td><td>-</td></tr>
<tr><td>315</td><td>400</td><td>7</td><td>13</td><td>25</td><td>-</td><td>-</td></tr>
<tr><td>400</td><td>500</td><td>8</td><td>15</td><td>27</td><td>-</td><td>-</td></tr>
<tr><td>500</td><td>630</td><td>9</td><td>16</td><td>30</td><td>-</td><td>-</td></tr>
<tr><td>630</td><td>800</td><td>10</td><td>18</td><td>35</td><td>-</td><td>-</td></tr>
<tr><td>800</td><td>1000</td><td>11</td><td>21</td><td>40</td><td>-</td><td>-</td></tr>
<tr><td>1000</td><td>1250</td><td>13</td><td>24</td><td>46</td><td>-</td><td>-</td></tr>
<tr><td>1250</td><td>1600</td><td>15</td><td>29</td><td>54</td><td>-</td><td>-</td></tr>
<tr><td>1600</td><td>2000</td><td>18</td><td>35</td><td>65</td><td>-</td><td>-</td></tr>
<tr><td>2000</td><td>2500</td><td>22</td><td>41</td><td>77</td><td>-</td><td>-</td></tr>
<tr><td>2500</td><td>3150</td><td>26</td><td>50</td><td>93</td><td>-</td><td>-</td></tr>
<tr><td>3150</td><td>4000</td><td>32</td><td>62</td><td>115</td><td>-</td><td>-</td></tr>
<tr><td>4000</td><td>5000</td><td>-</td><td>76</td><td>140</td><td>-</td><td>-</td></tr>
<tr><td>5000</td><td>6300</td><td>-</td><td>-</td><td>170</td><td>-</td><td>-</td></tr>
</table></td><td>a)
Wegkompensation c nach Angabe des Anwenders
c = ... µm
e_{0a} = ... µm
b)
e_{sa} = ... µm</td></tr>
<tr><td>1.2</td><td>Mittlere Istwegabweichung e_p über den Nutzweg l_u</td><td>
</td><td>siehe Bild 1</td><td>siehe Bild 1</td><td>Transport-Kugelgewindetriebe
<table>
<tr><th colspan="5">e_p in µm für Toleranzklasse</th></tr>
<tr><th>1</th><th>3</th><th>5</th><th>7</th><th>10</th></tr>
<tr><td colspan="5">$e_p = 2 \frac{l_u}{300} v_{300p}$</td></tr>
<tr><td colspan="5">v_{300p} siehe Prüfung 3</td></tr>
</table></td><td>e_{0a} = ... µm</td></tr>
</table>

Tabelle 3. (Fortsetzung)

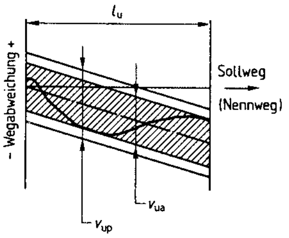
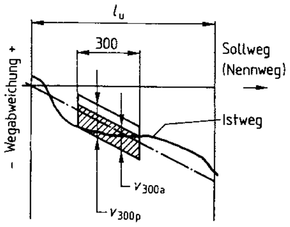
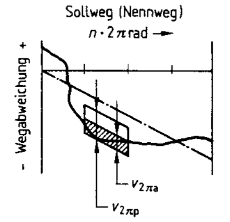
<table>
<tr><th>Nr</th><th>Gegenstand der Prüfung</th><th>Bild</th><th>Prüfmittel</th><th>Prüfanleitung</th><th>Grenzabmaße bzw. Toleranzen</th><th>Meßergebnisse, Bemerkungen</th></tr>
<tr><td>2</td><td>Wegschwankung v_u über den Nutzweg l_u</td><td>
</td><td>siehe Bild 1</td><td>siehe Bild 1</td><td>Positionier-Kugelgewindetriebe
<table>
<tr><th colspan="2">l_u</th><th colspan="5">v_{up} in µm für Toleranzklasse</th></tr>
<tr><th>über</th><th>bis</th><th>1</th><th>3</th><th>5</th><th>7</th><th>10</th></tr>
<tr><td></td><td>315</td><td>6</td><td>12</td><td>23</td><td>-</td><td>-</td></tr>
<tr><td>315</td><td>400</td><td>6</td><td>12</td><td>25</td><td>-</td><td>-</td></tr>
<tr><td>400</td><td>500</td><td>7</td><td>13</td><td>26</td><td>-</td><td>-</td></tr>
<tr><td>500</td><td>630</td><td>7</td><td>14</td><td>29</td><td>-</td><td>-</td></tr>
<tr><td>630</td><td>800</td><td>8</td><td>16</td><td>31</td><td>-</td><td>-</td></tr>
<tr><td>800</td><td>1000</td><td>9</td><td>17</td><td>35</td><td>-</td><td>-</td></tr>
<tr><td>1000</td><td>1250</td><td>10</td><td>19</td><td>39</td><td>-</td><td>-</td></tr>
<tr><td>1250</td><td>1600</td><td>11</td><td>22</td><td>44</td><td>-</td><td>-</td></tr>
<tr><td>1600</td><td>2000</td><td>13</td><td>25</td><td>51</td><td>-</td><td>-</td></tr>
<tr><td>2000</td><td>2500</td><td>15</td><td>29</td><td>59</td><td>-</td><td>-</td></tr>
<tr><td>2500</td><td>3150</td><td>17</td><td>34</td><td>69</td><td>-</td><td>-</td></tr>
<tr><td>3150</td><td>4000</td><td>21</td><td>41</td><td>82</td><td>-</td><td>-</td></tr>
<tr><td>4000</td><td>5000</td><td>-</td><td>49</td><td>99</td><td>-</td><td>-</td></tr>
<tr><td>5000</td><td>6300</td><td>-</td><td>-</td><td>119</td><td>-</td><td>-</td></tr>
</table>
Transport- Kugelgewindetriebe
v_{up}
nicht festgelegt</td><td>v_{ua} = ... µm
v_{ua} = ... µm</td></tr>
<tr><td>3</td><td>Wegschwankung v_{300} über 300 mm Axialweg</td><td>
</td><td>siehe Bild 1</td><td>siehe Bild 1</td><td>Positionier- und Transport-Kugelgewindetriebe
<table>
<tr><th colspan="5">v_{300p} in µm für Toleranzklasse</th></tr>
<tr><th>1</th><th>3</th><th>5</th><th>7</th><th>10</th></tr>
<tr><td>6</td><td>12</td><td>23</td><td>52</td><td>210</td></tr>
</table></td><td>max. v_{300a} =
.... µm</td></tr>
</table>

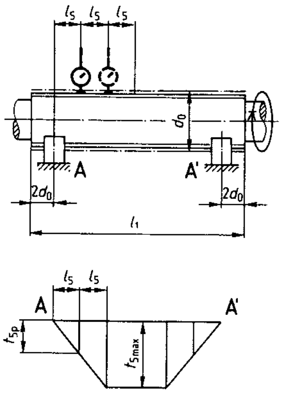
Tabelle 3. (Fortsetzung)

Nr	Gegenstand der Prüfung	Bild	Prüfmittel	Prüfanleitung	Grenzabmaße bzw. Toleranzen	Meßergebnisse, Bemerkungen
4	Wegschwankung $v_{2\pi}$ innerhalb von 2π rad (= 1 Umdrehung)		siehe Bild 2	siehe Bild 2	Positionier-Kugelgewindetriebe	max. $v_{2\pi a}$ = ... µm

$v_{2\pi p}$ in µm für Toleranzklasse

1	3	5	7	10
4	6	8	-	-

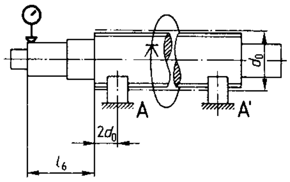
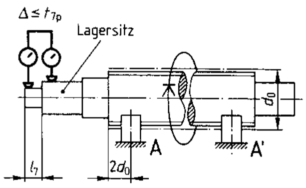
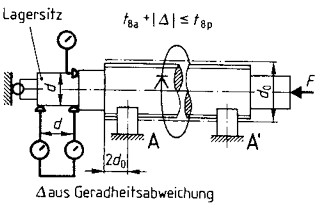
Tabelle 4. Lauf- und Lageprüfungen

Nr	Gegenstand der Prüfung	Bild	Prüfmittel	Prüfanleitung	Grenzabmaße bzw. Toleranzen	Meßergebnisse, Bemerkungen
5	Rundlaufabweichung t_5 des Kugelgewindespindel-Außendurchmessers auf die Länge l_5 zur Bestimmung der Geradheit bezogen auf AA'		Feinzeiger nach DIN 879 Teil 1 Prüfprismen nach DIN 2274, paarig	Kugelgewindespindel an den Punkten A und A' in Prüfprismen lagern. Feinzeiger mit planem Meßeinsatz senkrecht zur Achse der Kugelgewindespindel im Abstand l_5 vom Auflagepunkt A anstellen. Kugelgewindespindel langsam drehen und Rundlaufabweichung t_{5a} als Differenz zwischen größter und kleinster Anzeige während einer ganzen Umdrehung ablesen. Messung in den angegebenen Abständen l_5 wiederholen. Anmerkung 1: Abnahme der Kugelgewindespindel zwischen Spitzen nach Vereinbarung. Anmerkung 2: Wenn $l_1 < 2l_5$ ist, erfolgt die Messung bei $l_1/2$. Anmerkung 3: Es ist darauf zu achten, daß die Meßergebnisse nicht durch andere Abweichungen, mit der die Kugelgewindemutter behaftet ist, beeinflußt werden (Kugelgewindemutter jeweils entgegengesetzt zur Meßposition drehen). 5.6.1.2.2	Positionier- und Transport-Kugelgewindetriebe	t_{5a} = ... µm $t_{5a\ max.}$ = ... µm

Nenndurchmesser d_0 über	bis	l_5	t_{5p} in µm für l_5 für Toleranzklasse 1	3	5	7	10
6	12	80	20	25	32	40	80
12	25	160					
25	50	315					
50	100	630					
100	200	1250					

	$t_{5\ max.}$ in µm für $l_1 \geq 4l_5$ für Toleranzklasse 1	3	5	7	10
$l_1/d_0 \leq 40$	40	50	64	80	60
$40 < l_1/d_0 \leq 60$	60	75	96	120	240
$60 < l_1/d_0 \leq 80$	100	125	160	200	400
$80 < l_1/d_0 \leq 100$	160	200	256	320	640

Tabelle 4. (Fortsetzung)

Nr	Gegenstand der Prüfung	Bild	Prüfmittel	Prüfanleitung	Grenzabmaße bzw. Toleranzen	Meßergebnisse, Bemerkungen
6	Rundlaufabweichung t_6 des Lagerzapfens bezogen auf AA' für $l_6 \leq l$. Für $l_6 > l$ gilt $t_{6a} \leq t_{6p} \cdot \frac{l_6}{l}$		Feinzeiger nach DIN 879 Teil 1 Prüfprismen nach DIN 2274, paarig	Kugelgewindespindel an den Punkten A und A' in Prüfprismen lagern. Feinzeiger senkrecht zur Mantelfläche im Abstand l_6 an Lagerzapfen anstellen. Kugelgewindespindel langsam drehen und Rundlaufabweichung t_{6a} als Differenz zwischen größter und kleinster Anzeige während einer ganzen Umdrehung ablesen. 5.6.1.2.2	Positionier- und Transport-Kugelgewindetriebe	Lagerzapfen-Ø: .... t_{6a} µm: ....
7	Koaxialitätsabweichung t_7 des Endzapfens der Kugelgewindespindel bezogen auf den Lagerzapfen (Differenzmessung Δ) für $l_7 \leq l$. Für $l_7 > l$ gilt $t_{7a} \leq t_{7p} \cdot \frac{l_7}{l}$		Feinzeiger nach DIN 879 Teil 1 Prüfprismen nach DIN 2274, paarig	Kugelgewindespindel an den Punkten A und A' in Prüfprismen lagern. Zwei Feinzeiger senkrecht zu den Mantelflächen im Abstand l_7 an den Endzapfen und den Lagerzapfen anstellen. Kugelgewindespindel langsam drehen und Koaxialitätsabweichung t_{7a} als größte Differenz Δ zwischen den Anzeigen beider Feinzeiger während einer ganzen Umdrehung ablesen. 5.6.1.2.2	Positionier- und Transport-Kugelgewindetriebe	Endzapfen-Ø: .... t_{7a} µm: ....
8	Planlaufabweichung t_8 der Lagerzapfenschulter der Kugelgewindespindel bezogen auf AA'		Feinzeiger nach DIN 879 Teil 1 Prüfprismen nach DIN 2274, paarig	Kugelgewindespindel an den Punkten A und A' in Prüfprismen lagen und in axialer Richtung gegen Verschieben sichern (z.B. durch Kugel zwischen Zentrierbohrung und Anlagefläche). Feinzeiger senkrecht zur Planfläche der Lagerzapfenschulter bzw. Mantelfläche des Lagerzapfens anstellen. Kugelgewindespindel langsam drehen und t_{8a} als Differenz zwischen größter und kleinster Anzeige während einer Umdrehung ablesen; gegebenenfalls Δ berücksichtigen. 5.6.3.2	Positionier- und Transport-Kugelgewindetriebe	Lagerzapfen-Ø: .... t_{8a} µm: ....

Nr 6:

Nenndurchmesser d_0 über	bis	Bezugslänge l	t_{6p} in µm für $l_6 \leq l$ für Toleranzklasse 1	3	5	7	10
6	20	80	10	12	20	40	63
20	50	125	12	16	25	50	80
50	125	200	16	20	32	63	100
125	200	315	-	25	40	80	125

Nr 7:

Nenndurchmesser d_0 über	bis	Bezugslänge l	t_{7p} in µm für $l_7 \leq l$ für Toleranzklasse 1	3	5	7	10
6	20	80	5	6	8	12	16
20	50	125	6	8	10	16	20
50	125	200	8	10	12	20	25
125	200	315	-	12	16	25	32

Nr 8:

Nenndurchmesser d_0 über	bis	t_{8p} in µm für Toleranzklasse 1	3	5	7	10
6	63	3	4	5	6	10
63	125	4	5	6	8	12
125	200	-	6	8	10	16

Tabelle 4. (Fortsetzung)

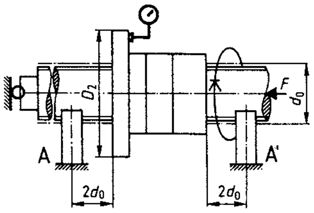
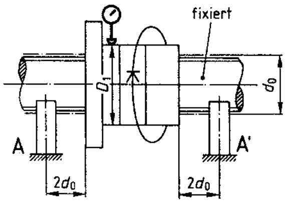
<table>
<tr><th>Nr</th><th>Gegenstand der Prüfung</th><th>Bild</th><th>Prüfmittel</th><th>Prüfanleitung</th><th>Grenzabmaße bzw. Toleranzen</th><th>Meßergebnisse, Bemerkungen</th></tr>
<tr><td>9</td><td>Planlaufabweichung t_9 der Anlagefläche der Kugelgewindemutter bezogen auf A und A'
(Nur für vorgespannte Kugelgewindemuttern)</td><td>
</td><td>Feinzeiger nach DIN 879 Teil 1
Prüfprismen nach DIN 2274, paarig</td><td>Kugelgewindespindel an den Punkten A und A' in Prüfprismen lagern und in axialer Richtung gegen Verschieben sichern (z.B. Kugel zwischen Zentrierbohrung und Anlagefläche).
Kugelgewindemutter gegenüber Kugelgewindespindel gegen Verdrehen sichern.
Feinzeiger senkrecht zur Flanschanlagefläche der Kugelgewindemutter an deren größtmöglichen Durchmesser D_2 anstellen.
Kugelgewindespindel mit Kugelgewindemutter langsam drehen und Planlaufabweichung t_{9a} als Differenz zwischen größter und kleinster Anzeige während einer ganzen Umdrehung ablesen.
5.6.3.2</td><td>Positionier- und Transport-Kugelgewindetriebe
<table>
<tr><th colspan="2">Flanschdurchmesser D_2</th><th colspan="5">t_{9p} in µm für Toleranzklasse</th></tr>
<tr><th>über</th><th>bis</th><th>1</th><th>3</th><th>5</th><th>7</th><th>10</th></tr>
<tr><td>16</td><td>32</td><td>10</td><td>12</td><td>16</td><td>20</td><td>-</td></tr>
<tr><td>32</td><td>63</td><td>12</td><td>16</td><td>20</td><td>25</td><td>-</td></tr>
<tr><td>63</td><td>125</td><td>16</td><td>20</td><td>25</td><td>32</td><td>-</td></tr>
<tr><td>125</td><td>250</td><td>20</td><td>25</td><td>32</td><td>40</td><td>-</td></tr>
<tr><td>250</td><td>500</td><td>-</td><td>32</td><td>40</td><td>50</td><td>-</td></tr>
</table></td><td>t_{9a} = ... µm</td></tr>
<tr><td>10</td><td>Rundlaufabweichung t_{10} des Aufnahmedurchmessers D_1 der Kugelgewindemutter bezogen auf A und A'
(Nur für vorgespannte und drehende Kugelgewindemuttern)</td><td>
</td><td>Feinzeiger nach DIN 879 Teil 1
Prüfprismen nach DIN 2274, paarig</td><td>Kugelgewindespindel an den Punkten A und A''in Prüfprismen lagern und gegen Verdrehen in den Auflagern sichern.
Feinzeiger senkrecht zur Mantelfläche der Kugelgewindemutter mit dem Aufnahmedurchmesser D_1 anstellen.
Kugelgewindemutter langsam drehen und Rundlaufabweichung t_{10a} als Differenz zwischen größter und kleinster Anzeige während einer ganzen Umdrehung ablesen.
5.6.1.2.2</td><td>Positionier- und Transport-Kugelgewindetriebe
<table>
<tr><th colspan="2">Aufnahmedurchmesser D_1</th><th colspan="5">t_{10p} in µm für Toleranzklasse</th></tr>
<tr><th>über</th><th>bis</th><th>1</th><th>3</th><th>5</th><th>7</th><th>10</th></tr>
<tr><td>16</td><td>32</td><td>10</td><td>12</td><td>16</td><td>20</td><td>-</td></tr>
<tr><td>32</td><td>63</td><td>12</td><td>16</td><td>20</td><td>25</td><td>-</td></tr>
<tr><td>63</td><td>125</td><td>16</td><td>20</td><td>25</td><td>32</td><td>-</td></tr>
<tr><td>125</td><td>250</td><td>20</td><td>25</td><td>32</td><td>40</td><td>-</td></tr>
<tr><td>250</td><td>500</td><td>-</td><td>32</td><td>40</td><td>50</td><td></td></tr>
</table></td><td>t_{10a} = ... µm</td></tr>
</table>

Tabelle 4. (Fortsetzung)

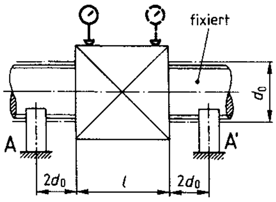
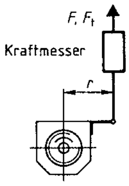
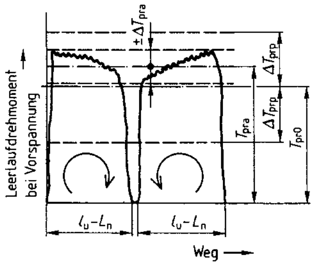
<table>
<tr><th>Nr</th><th>Gegenstand der Prüfung</th><th>Bild</th><th>Prüfmittel</th><th>Prüfanleitung</th><th>Grenzabmaße bzw. Toleranzen</th><th>Meßergebnisse, Bemerkungen</th></tr>
<tr><td>11</td><td>Parallelitätsabweichung t_{11} der Anlagefläche einer rechteckigen Kugelgewindemutter bezogen auf A und A'
(Nur für vorgespannte Kugelgewindemuttern)</td><td>
</td><td>Feinzeiger nach DIN 879 Teil 1
Prüfprismen nach DIN 2274, paarig</td><td>Kugelgewindespindel an den Punkten A und A' in Prüfprismen lagern und gegen Verdrehen in den Auflagern sichern.
Feinzeiger senkrecht zur Prüffläche anstellen und auf dieser parallel zur Achse der Kugelgewindespindel längs verschieben.
Parallelitätsabweichung t_{11a} als Differenz zwischen größter und kleinster Anzeige während der Verschiebung ablesen.
5.4.1.2.2</td><td>Positionier- und Transport-Kugelgewindetriebe
<table>
<tr><th colspan="5">t_{11p} in µm je 100 mm (kumulativ) für Toleranzklasse</th></tr>
<tr><th>1</th><th>3</th><th>5</th><th>7</th><th>10</th></tr>
<tr><td>16</td><td>20</td><td>25</td><td>32</td><td>-</td></tr>
</table></td><td>t_{11a} .... µm</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Tabelle 5. Funktionsprüfungen

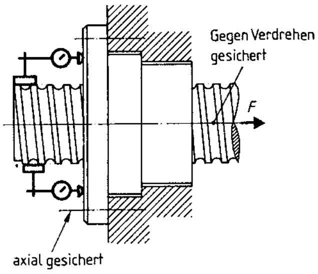
<table>
<tr><th>Nr</th><th>Gegenstand der Prüfung</th><th>Bild</th><th>Prüfmittel</th><th>Prüfanleitung</th><th>Grenzabmaße bzw. Toleranzen</th><th>Meßergebnisse, Bemerkungen</th></tr>
<tr>
<td>12</td>
<td>Grenzabweichung ΔT_{prp} für das Leerlaufdrehmoment T_{pr0} infolge Vorspannung
(Nur für vorgespannte Kugelgewindemuttern)</td>
<td>


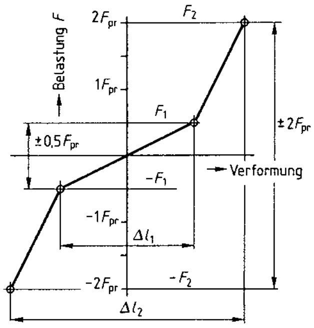
ohne Abstreifer $T_{pr} = F \cdot r$
mit Abstreifer $T_t = F_t \cdot r$



$l_u - l_n$ = Nutzweg minus Länge der Kugelgewindemutter
</td>
<td>Prüfbank mit Kraftmeßeinrichtung</td>
<td>Kugelgewindespindel aufnehmen und Kugelgewindemutter zur Messung der radialen Vorspannkraft F, F_t (ohne/mit Abstreifer) mit der Kraftmeßeinrichtung im Abstand r von der Drehachse verbinden.
Prüfung bei einer Drehzahl der Kugelgewindespindel von 100 min^{-1} in beiden Drehrichtungen vornehmen.
Zur Schmierung ist ein Schmieröl der Viskositätsklasse ISO VG 100 zu verwenden.
Abweichende Drehzahlen, Schmierung und Prüfmittel nach Vereinbarung zwischen Anwender und Hersteller.</td>
<td>Positionier- und Transport-Kugelgewindetriebe
<table>
<tr><th colspan="2">T_{pr0} (Nm)</th><th colspan="5">für $\frac{l_u}{d_0} \leq 40$; $l_u \leq 4000$
ΔT_{prp} (% vom T_{pr0})
für Toleranzklasse</th></tr>
<tr><th>über</th><th>bis</th><th>1</th><th>3</th><th>5</th><th>7</th><th>10</th></tr>
<tr><td>0,2</td><td>0,4</td><td>35</td><td>40</td><td>50</td><td>-</td><td>-</td></tr>
<tr><td>0,4</td><td>0,6</td><td>25</td><td>40</td><td>40</td><td>-</td><td>-</td></tr>
<tr><td>0,6</td><td>1,0</td><td>25</td><td>30</td><td>35</td><td>40</td><td>-</td></tr>
<tr><td>1,0</td><td>2,5</td><td>20</td><td>25</td><td>30</td><td>35</td><td>-</td></tr>
<tr><td>2,5</td><td>6,3</td><td>15</td><td>20</td><td>25</td><td>30</td><td>-</td></tr>
<tr><td>6,3</td><td>10,0</td><td>-</td><td>15</td><td>20</td><td>30</td><td>-</td></tr>
<tr><th colspan="2">T_{pr0} (Nm)</th><th colspan="5">für $\frac{l_u}{d_0} \leq 60$; $l_u \leq 4000$
ΔT_{prp} (% von T_{pr0})
für Toleranzklasse</th></tr>
<tr><th>über</th><th>bis</th><th>1</th><th>3</th><th>5</th><th>7</th><th>10</th></tr>
<tr><td>0,2</td><td>0,4</td><td>40</td><td>50</td><td>60</td><td>-</td><td>-</td></tr>
<tr><td>0,4</td><td>0,6</td><td>33</td><td>40</td><td>45</td><td>-</td><td>-</td></tr>
<tr><td>0,6</td><td>1,0</td><td>30</td><td>35</td><td>40</td><td>45</td><td>-</td></tr>
<tr><td>1,0</td><td>2,5</td><td>25</td><td>30</td><td>35</td><td>40</td><td>-</td></tr>
<tr><td>2,5</td><td>6,3</td><td>20</td><td>25</td><td>30</td><td>35</td><td>-</td></tr>
<tr><td>6,3</td><td>10,0</td><td>-</td><td>20</td><td>25</td><td>35</td><td>-</td></tr>
<tr><th colspan="2">T_{pr0} (Nm)</th><th colspan="5">für $l_u > 4000$
ΔT_{prp} (% von T_{pr0})
für Toleranzklasse</th></tr>
<tr><th>über</th><th>bis</th><th>1</th><th>3</th><th>5</th><th>7</th><th>10</th></tr>
<tr><td></td><td>0,6</td><td colspan="5">nicht festgelegt</td></tr>
<tr><td>0,6</td><td>1,0</td><td>-</td><td>40</td><td>45</td><td>50</td><td>-</td></tr>
<tr><td>1,0</td><td>2,5</td><td>-</td><td>35</td><td>40</td><td>45</td><td>-</td></tr>
<tr><td>2,5</td><td>6,3</td><td>-</td><td>30</td><td>35</td><td>40</td><td>-</td></tr>
<tr><td>6,3</td><td>10,0</td><td>-</td><td>25</td><td>30</td><td>35</td><td>-</td></tr>
</table>
</td>
<td><u>ohne Abstreifer</u>
r = ... m
F = ... N
T_{pra} = ... Nm
ΔT_{pra} = ±.... Nm
≙ ±.....%
<u>mit Abstreifer</u>
r = ... m
F_t = ... N
T_{ta} = ... Nm
ΔT_{ta} = ± ... Nm
≙ ± ... %</td>
</tr>
</table>

Tabelle 5. (Fortsetzung)

<table>
<tr><th>Nr</th><th>Gegenstand der Prüfung</th><th>Bild</th><th>Prüfmittel</th><th>Prüfanleitung</th><th>Grenzabmaße bzw. Toleranzen</th><th>Meßergebnisse, Bemerkungen</th></tr>
<tr>
<td>13</td>
<td>Axiale Steifigkeit R_{nu}</td>
<td>




</td>
<td>Feinzeiger nach DIN 879 Teil 1
Prüfvorrichtung</td>
<td>Vorgespannte Kugelgewindemutter in beiden Richtungen gegen axiales Verschieben und Kugelgewindespindel gegen Verdrehen sichern.
Stative der Feinzeiger an der Kugelgewindespindel aufsetzen und die Meßbolzen mit möglichst geringem Abstand parallel zur Achse des Kugelgewindetriebes an die Stirnfläche der Kugelgewindemutter anstellen.
Die axialen Lasten $F_1 = 0{,}5\ F_{pr}$ bzw. $F_2 = 2\ F_{pr}$ in Zug- und Druckrichtung auf die Kugelgewindespindel aufbringen (F_{pr} = Vorspannkraft).
Die Werte Δl_1 bzw. Δl_2 (als arithmetischer Mittelwert aus den Ablesungen beider Feinzeiger) sind elastische Verformungen (Umkehrbereich), hervorgerufen durch die axialen Prüflasten $\pm F_1$ bzw. $\pm F_2$.
Die Steifigkeit im Bereich $\pm F_1$ ist:
$R_{nu1} = \frac{2F_1}{\Delta l_1} = \frac{F_{pr}}{\Delta l_1}$
Die Steifigkeit im Bereich $+ F_1$ bis $+ F_2$ und $- F_1$ bis $- F_2$ ist:
$R_{nu2} = \frac{2(F_2 - F_1)}{\Delta l_2 - \Delta l_1} = \frac{3F_{pr}}{\Delta l_2 - \Delta l_1}$
———
Andere Prüflasten nach Vereinbarung zwischen Anwender und Hersteller.</td>
<td>Positionier- und Transport-Kugelgewindetriebe
z.Z. keine Festlegungen</td>
<td>F_{pr} = ...N
F_1 = ...N
F_2 = ...N
Δl_1 = ...µm
Δl_2 = ...µm
R_{nu1} = ...N/µm
R_{nu2} = ...N/µm</td>
</tr>
</table>

Quality in the manufacturing process

Application examples

Ball screw

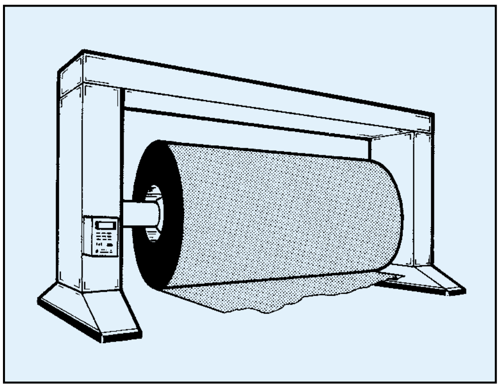
Main areas of application:
Due to its high precision, the ball screw brings outstanding performance to measurement and control technology, which is a deciding factor in the following areas of application.

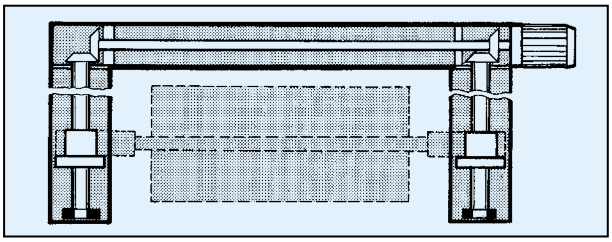
- Machine tool manufacture
- Conveyor technology
- Aviation industry
- Reactor technology
- Handling technology
- Medicine technology
- Military technology
- Measurement and testing technology
- Traffic engineering
- Radar and antenna technology

Problem: Adjustment of textile rollers

Solution: The heavy rollers are adjusted by two ball screws installed vertically. The high efficiency of the KGT spindle enables a small drive to be used.

Textile processing

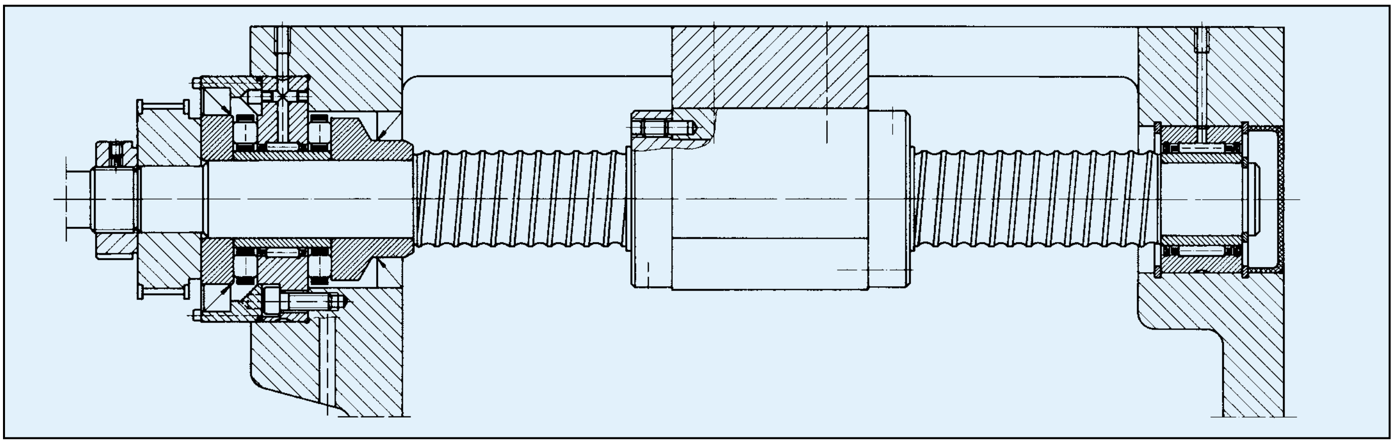




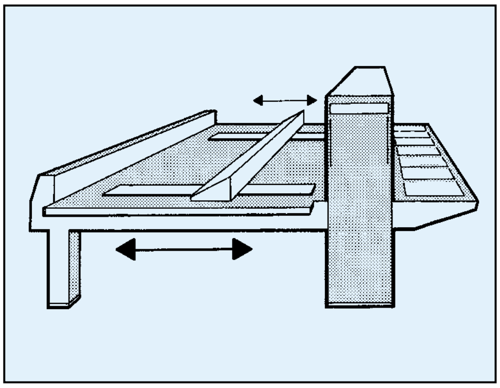
Axial support

The diagram shows a part section of the axial support of a numerically controlled lathe. The fast feed speed is 1200 rpm. Pre-loaded and rigid bearings are required for the ball screw spindle in this application.

Design solution
This type of ball screw spindle bearing is a typical standard solution for precision ball screws. The drive side of the ball screw spindle is mounted in a needle axial cylindrical roller bearing from the ZARF..LTN range. This has a long life due to the high dynamic rating. The positioning accuracy and repeatability of the ball screw is guaranteed by the considerable rigidity of the bearing.

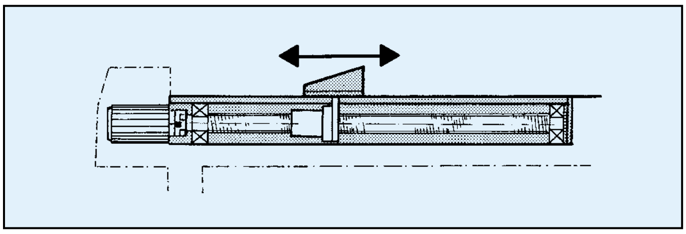


Positioning technology

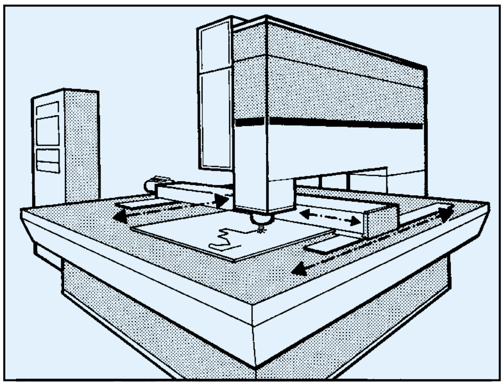


Problem: Exact adjustment of a stop.

Solution: A fast and accurate positioning of the stop can be achieved by using a ball screw.

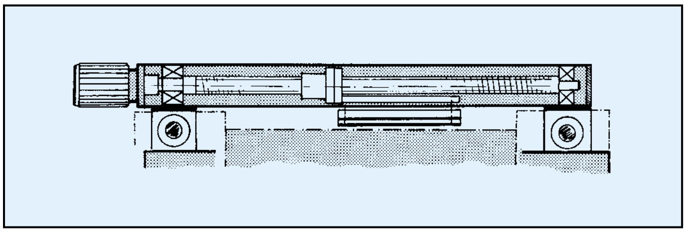


Steel sheet processing machine



Problem: Rapid movement of sheets for laser cutting.

Solution: The coordinate table is moved using a ball screw in the X and Y axis. Long life and positional accuracy are achieved here without any problem.



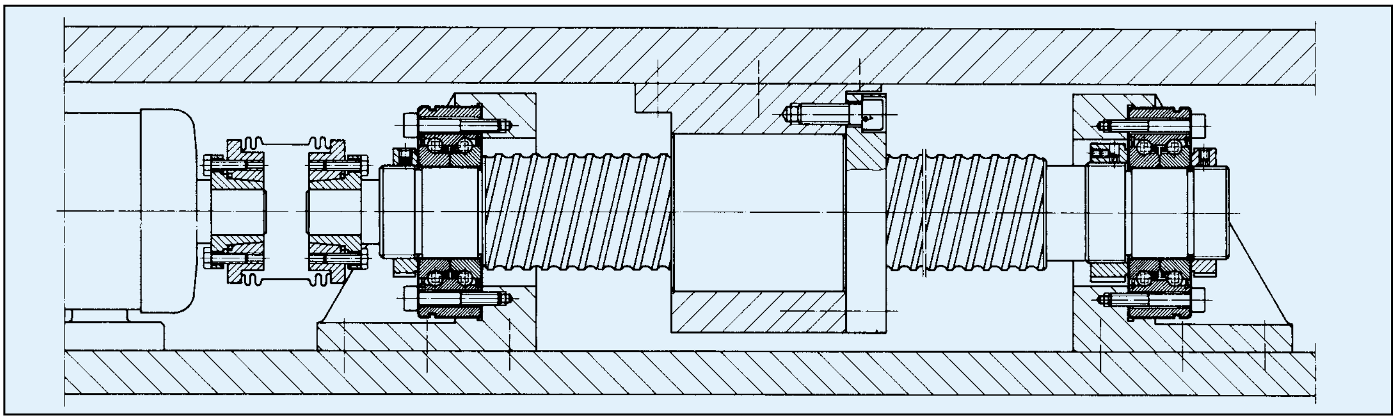
The drawing shows the feed spindle of a CNC controlled laser cutting machine. The ball screw spindle has a nominal diameter of 63 mm and a length of 3000 mm. Low friction and high precision determine the choice of bearing.

The operating conditions of the laser cutting machine are characterised by low feed forces and a maximum spindle speed of 500 rpm.

Design solution

The ball screw spindle is mounted at both ends in angular-contact ball bearings from the ZKLF… 2RS range. The long spindle is stretched by means of an adjusting nut. A second, inner, slotted nut pre-loads the bearing. The O-arrangement in the axial angular-contact ball bearings with a contact angle of 60° works against the deflection of the spindle. The axial angular-contact ball bearings are bolted directly to the bearing blocks by their thick-walled, rigid outer rings.
They absorb the axial forces that occur without any difficulty and guarantee low friction in operation. They are sealed on both sides with sealing rings from the RS range. Additional seals in the surrounding construction are unnecessary. The bearings are greased for life with a synthetic lubricating grease with high ageing resistance.

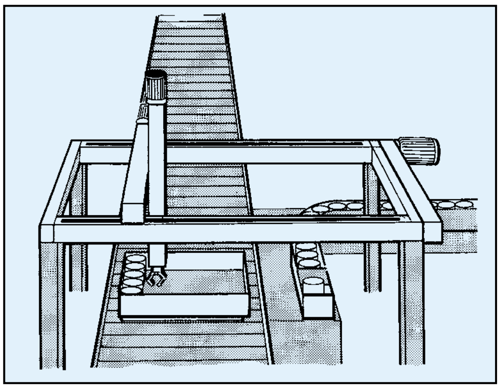
▶ Bearing arrangement for ball screw spindle



Applications

Ball screw

3-co-ordinate manipulator



Problem: Magazining of production parts.

Solution: A gripper and four ball screws in the X, Y and Z axes are moved by motors via a CNC control. Rapid movements are made possible by the low inherent weight of the design and the high efficiency of the ball screw.

Bearing arrangement for the ball screw nut

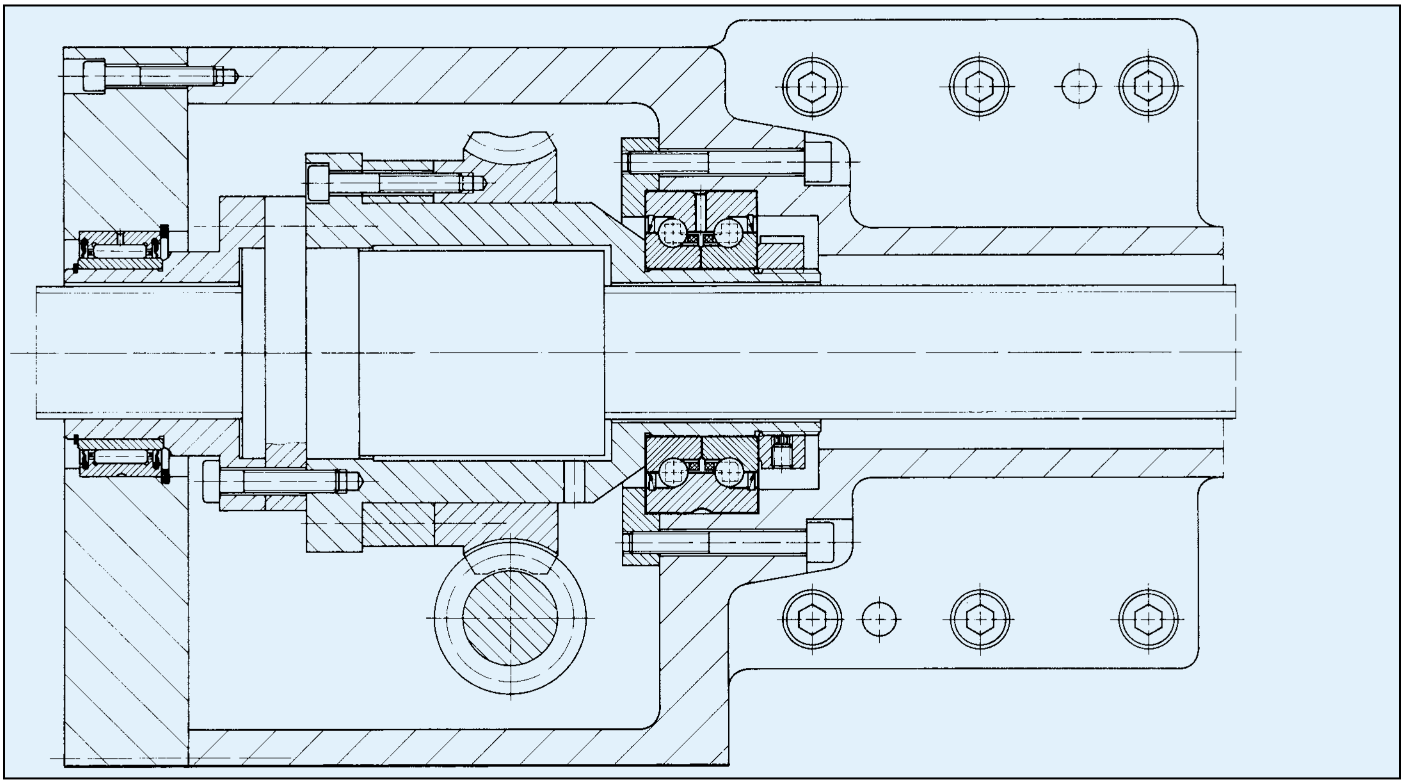
The primary products manufactured on this flat grinding machine are profiled workpieces. The vertical movement of the grinding head is to take place by means of an electro-mechanical drive with a ball screw spindle.

Design solution

Very small, continually varying adjustments to the grinding wheel are often necessary when grinding profiles.

The sealed and greased for life angular contact ball bearing, type ZKLN…2RS, prevents the stick-slip effect with these adjustments. By this means, it is possible to achieve grinding results of the highest precision. In order to keep the oscillations from the ball screw as small as possible, in this case the rotating ball screw nut is mounted in bearings while the ball screw spindle is stationary. The two ball races in the anti-friction bearing are arranged in O-formation at 60° contact angle to one another and are pre-loaded.

In order that the pullout torque of the motor is not absorbed solely by the fixed bearing, a needle bearing from the NA…2RS VGS range is provided as an additional supporting bearing. The needle bearing is fitted with a pre-ground inner ring. This design allows the inner ring to be finishground in the assembled state in order to achieve the smallest possible radial play.



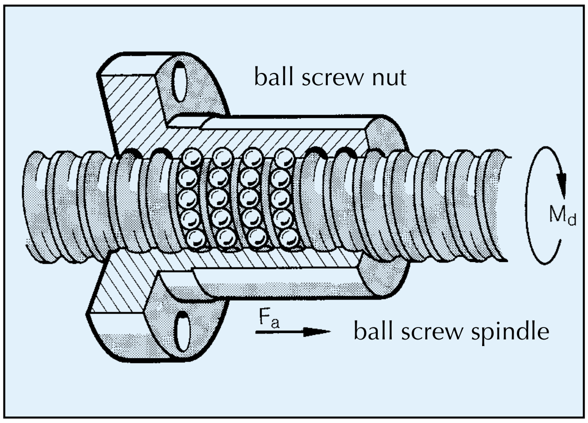
Future-oriented manufacturing process Technological advancement

kammerer

External thread grinding machine 6 m grinding length up to Ø 160 mm

Ball screw technology

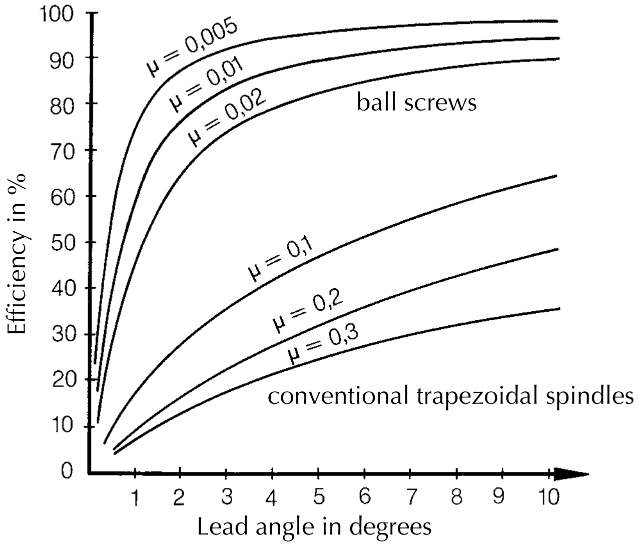
The ball screw is a working unit for converting a rotary to a linear movement and vice-versa.



It consists of the spindle, the nut system with ball feedback elements and the balls as anti-friction elements. The balls form the connection between the spindle and the nut by rolling in the appropriate tracks in the spindle and the nut. The forces to be transmitted are distributed over a number of balls so that the result is a relatively small specific loading. On account of its rolling friction, the ball screw has an extremely low coefficient of friction.

Efficiency

The efficiency of ball screws is considerably higher than that of conventional trapezoidal screws due to the rolling friction that occurs in this case. Furthermore, there is no slip-stick effect, which makes it possible to traverse even the smallest distances accurately. With ball screws it is fundamentally possible to reverse the motion due to the low frictional losses even at relatively small lead angles, i.e. to convert a linear movement into a rotary one. Therefore, in installations where self-retardation is required, the appropriate safeguards such as brakes, for example, must be provided.



Advantages: Long life, which is many times that of the slide screw. The heat developed is considerably less, which means that higher traverse speeds are possible.

The higher cost of the ball screw can be compensated for to a great extent by these factors. At the same time, the fact that it is not self-retarding may need to be taken into account.

When sliding friction is combined with low relative speeds (creep), intermittent sliding always occurs, the so-called slip-stick effect, even though a proportionately sized drive and a constant speed are used.
This undesirable slip-stick effect does not occur with rolling friction enabling the same position to be achieved repeatedly.

Installation: Before installation, the ball screw must be cleaned with a cleaning fluid such as benzene, if necessary. Cleaning fluids must not act aggressively on the wiper materials such as nylon or felt. It is not usually necessary to remove the preservative.

Ball screws are protected against corrosion in the factory and must be lubricated (oil and grease) before putting to use.

Materials for ball screws

Spindles

Steel for surface hardening	Cf53
Material No. 1.1213	
Surface hardness	60 + 2 HRC
Tensile strength Rm	600 N/mm^2
Elastic limit Rp	400 N/mm^2
Material No. 1.7225	42 CrMo 4
Surface hardness	60 + 2 HRC
Tensile strength Rm	900 N/mm^2
Elastic limit Rp	600 N/mm^2

Balls

100 Cr 6. Accuracy quality class I – III (highest quality class) to DIN 5401, Hardness 63 ± 3 HRC.

Nuts

Material No. 1.2067	100 Cr 6
Hardness	61 + 2 HRC
Tensile strength Rm	980 N/mm^2
Elastic limit Rp	980 N/mm^2
Hard up to Rm	2100 N/mm^2
Material No. 1.3536	
Hardness	61 + 2 HRC
Tensile strength Rm	690 N/mm^2
Elastic limit Rp	390 N/mm^2
Hard up to Rm	1800 N/mm^2

Material specification for 100Cr6:
Material No. 1.3505, designation to DIN 17 006
Special materials on request.

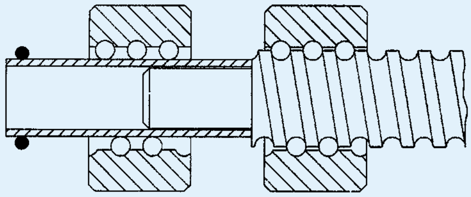
Wipers

Ball screws should be basically protected against dirt and impurities.
With the Kammerer's ball screws, this is done by means of standard plastic wipers, which, however, might slightly protrude the nut housing.
We recommend replacing the wipers, as far as possible, after the respective running time of the ball screws. This has a positive effect on the service lift.
According to customer requirements, we deliver also plastic wipers offering improved sliding properties.

The best solution however is to completely cover the ball screw using a spiral spring cover, for example.

Plastic wipers

Dismantling the nut:
If possible, the nut and the spindle should not be dismantled. However, if this should be necessary, an assembly sleeve must be used (see sketch).



Outside ø of sleeve = core ø of spindle $^{-0.1}_{-0.3}$ mm.

Slide the sleeve over the end of the spindle as far as the start of the thread and then screw the nut carefully from the thread onto the sleeve. Dismantling must be carried out without the use of force. Make sure that the nut cannot slip off the sleeve (O-ring or similar). When screwing the nut on to the spindle, the start of the thread must be screwed in carefully.

Note: The balls must not be allowed to get behind the return sections. Cleanliness must be ensured !!!

Track profile

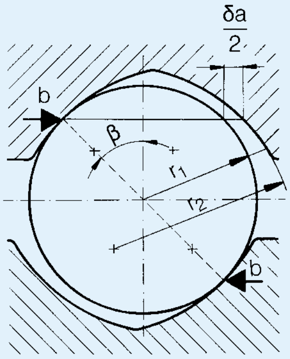
Kammerer ball screws are basically equipped with Gothic track profiles and offer the following advantages:

Good running characteristics, high rigidity and a good contact angle β, of around 45° are aimed for.

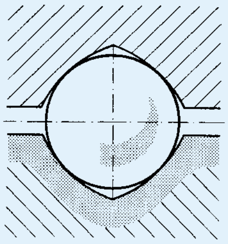
β = contact angle
δ_a = axial play
r_1 = ball radius
r_2 = track radius

This profile with the largest possible load angle β, good lubrication conditions and a ball diameter calculated for the appropriate application brings the following advantages:

- highest ratings and thus long lifetime
- best running characteristics
- efficiency up to 98 %
- maximum rigidity
- almost constant drive torque

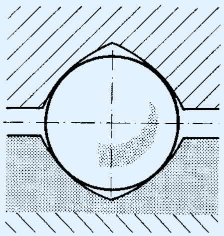


Full-hardened nut



Spindle, deep dry nitride hardened

Full-hardened nut

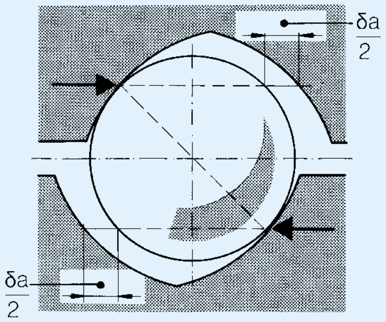


Spindle, inductive hardened

Axial play with a single nut

Like the anti-friction bearing, due to its design, the ball screw with a single nut has an axial play of 0.02 to 0.05 mm depending upon its dimensions, which is constant regardless of loading.

Loading causes an elastic deformation of the materials with a hysteresis-like character, which in addition gives rise to an axial displacement (see Page 32, Rigidity).



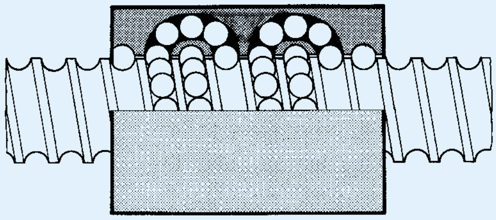
Ball feedback systems

nternal axial ball feedback with single or multiple returns depending upon the number of turns of the thread, which bear the load. The three-dimensional space curve causes the balls to run softly and with little noise, as these are taken off tangentially to the ball reference circle. The return system is independent of the lead. Leads of 1 x D or a maximum of 2 x D of the spindle are also possible.

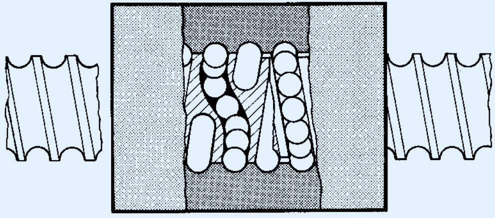
This return system is used by Kammerer.

External ball feedback systems (tube returns). Here, the balls are fed back through a return tube fixed to the outside of the ball screw nut.

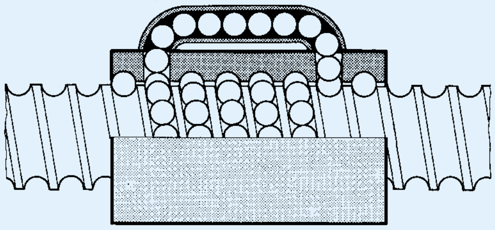
Internal axial return system



Internal return system



Tube return system



Pre-loading

In order to achieve the smallest possible relative movement between the nut and the spindle, certain single nuts are tensioned against one another.

F_b = operating load [N]
F_v = pre-loading force [N]
δ_v = deformation due to F_v
δ_a = axial play
δ_b = deformation due to F_b
$2 \cdot \delta_b$ = return distance

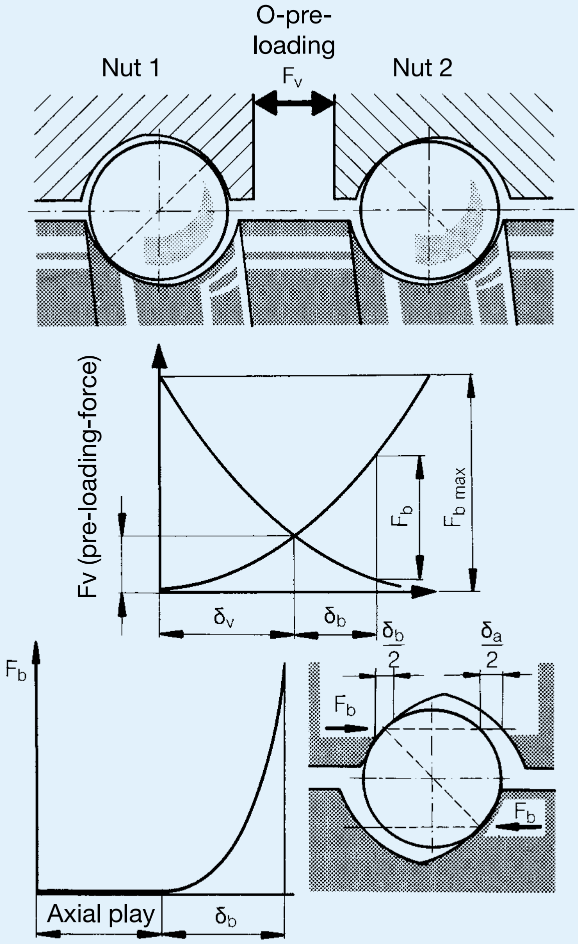
- the pre-loading force amounts to $\frac{1}{2.83}$ of the average operating load.

  Loads over and above this cause the balls of the unloaded nut to lose contact and the return distance to increase.

- The average operating load is defined as the load consistent with a life of 20 · 106 revolutions.

- The following relationship can be derived from the above:

$$F_v = \frac{C}{\sqrt[3]{20} \cdot 2.83} = \frac{C}{7.68} \text{ [N]}$$



Pre-loading nut systems

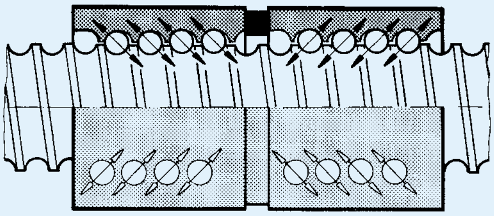
In order to eliminate the axial play and to keep the axial displacement due to the material deformation as small as possible, nuts are pre-loaded.

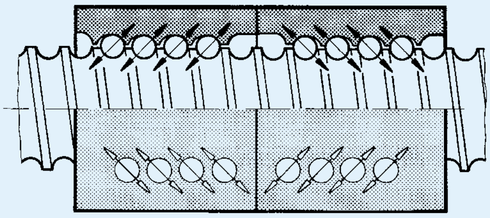
Three types of pre-loading are distinguished:

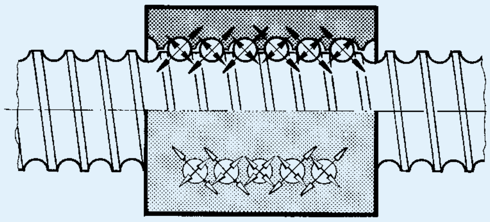
X-pre-loading: The forces are directed inwards. The spindle is under compression in the pre-loading range. The pre-loading is increased by forcing the nuts together.

O-pre-loading: The forces are directed outwards. The spindle is under tension in the pre-loading range. The pre-loading is increased by forcing the nuts apart.

Pre-loading using oversized balls: The most cost-effective solution, as only half the nut length has to be manufactured, creates the pre-loading by the oversize of the balls (= four point contact) and which is thus finding more frequent usage.
The pre-loading is adjusted by varying the diameter of the balls.

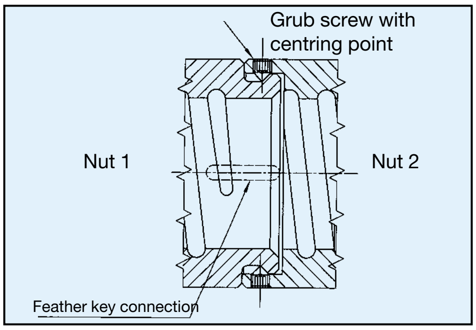






Pre-loading – Kammerer

Pre-loading No. 1 is the preferred method used by Kammerer.



Pre-loading of spindles

Spindles are pre-loaded to increase the positioning accuracy. Changes in length due to foreseeable temperature differences are avoided.

For this purpose, spindles must be ground with a lead going into the minus range. The necessary variation in the lead (Δ P) over the whole length is given by the following equation:

$\Delta P = a \cdot l \cdot \Delta t$ [mm]

a = coefficient of expansion (steel = 0.011 mm/m · degree)
l = total length of spindle (m)

Δt = temperature difference (°C)

A temperature difference of ca. 5° can be expected here. The nominal lead is achieved by stretching the spindle during assembly. The axial force necessary for stretching the spindle (F2) must be produced by the bearings and is calculated from:

$$F_2 = \frac{\Delta P \cdot E \cdot A}{l} \quad [N]$$

ΔP = necessary lead variation from equation
E = modulus of elasticity (21 x 10^4 N/mm² for steel)
A = spindle cross section (mm²), see equation
l = total length of spindle (mm)

$$A = \frac{d_m^2 \cdot \pi}{4} \quad [mm^2]$$

d_m = average spindle diameter

The speeds can also be increased when a spindle has been put under tension.

Values for stretching ball screws

• Diameter	32 mm	0.03/1000mm	A =	594 mm²
• Diameter	40 mm	0.04/1000mm	A =	990 mm²
• Diameter	50 mm	0.05/1000mm	A =	1625 mm²
• Diameter	63 mm	0.06/1000mm	A =	2552 mm²
• Diameter	80 mm	0.07/1000mm	A =	4596 mm²
• Diameter	100 mm	0.07/1000mm	A =	7314 mm²

Delta P = (a* l* Delta t) /1000 (mm)
F2 = (Delta P * E * A) / l (N)
A = (dm² * 3.1416)/ 4 (mm²)

P = pitch (mm)
a = thermal coefficient of expansion (steel = 0.011mm/m* degrees)
l = spindle length in (mm)
t = temperature difference (degree) max value 5 °C otherwise consultation with Kammerer.
E = modulus of elasticity 210000 N/mm² (steel)
A = spindle cross sectional area (mm²)

Rigidity

The total rigidity (C_{tot}) of a system is made up of the individual rigidities (ball screw, bearings ...). The effect of all the factors should therefore be taken into account.

For the ball screw:

$$\frac{1}{C_{ges}} = \frac{1}{C_k} + \frac{1}{C_m} + \frac{1}{C_s} = \frac{1}{C_{me}} + \frac{1}{C_s} \quad [N/\mu m]$$

Rigidity in the ball area (C_k)

The axial rigidity in the ball area is derived from:

$$C_k \approx \frac{F_b}{\delta_b} \quad [N/\mu m]$$

The rigidity values for the ball area can be read off from the table on Page 32.

The rigidities for designs not given in the table can be calculated from the following overview and formulae. For double nuts, assuming the same number of revolutions for each nut and a ratio of

$$\frac{F_b}{F_v} = 2.83$$

$C_k = 2 \cdot \sqrt[3]{F_b (k \cdot i)^2}$ [N/μm]
F_b = operating load [N]
F_v = pre-loading force [N]
K = rigidity factor [N/μm$^{2/3}$]
i = number of revolutions 3/2

Rigidity of the body of the nut (c_m)

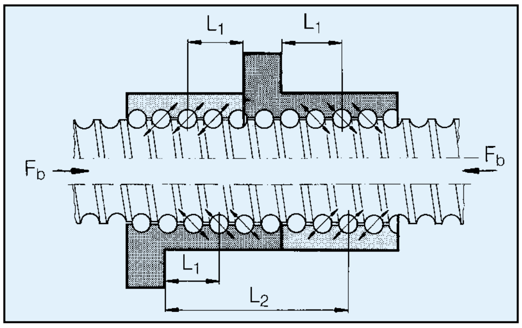
$$c_m = \frac{A \cdot E}{L \cdot 10^3} \quad [N/\mu m]$$

A = nut cross sectional area [mm²]

E = modulus of elasticity 21 · 10^4 [N/mm²]

Use L_1 or L_2 according to the direction of the operating load F_b

$L_1 \approx 0.5$ · nut length
$L_2 \approx 0.75$ · nut length



Rigidity of the nut unit (c_{me})

For an approximate calculation it is sufficient to say:

$c_{me} = f_{cm} \cdot c_k$ [N/μm]

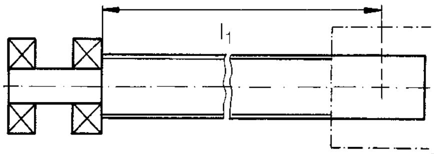
f_{cm} = 0.55 (internal pre-loading for single nuts)
f_{cm} = 0.70 (pre-loaded double nut)

Rigidity of the spindle between bearings (c_s)

The rigidity of the spindle is dependent upon the type of bearings.

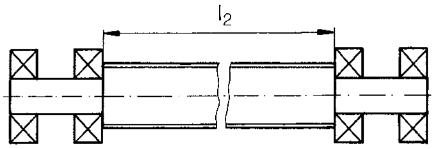
Single-sided fixed bearing, case 1

$$c_S = \frac{A \cdot E}{l_1 \cdot 10^3} \quad [\text{N/µm}]$$



Single-sided fixed bearing, case 2

$$c_S = \frac{4 \cdot A \cdot E}{l_2 \cdot 10^3} \quad [\text{N/µm}]$$



E = modulus of elasticity $21 \cdot 10^4$ [N/mm²]

l = length between bearings or between bearing and nut [mm]

A = spindle cross sectional area [mm²]

d_m = average spindle diameter [mm] (see table on Page 41 (“critical bending speed”)

$$A = \frac{d^2_m \cdot \pi}{4} \quad [\text{mm}^2]$$

Calculation of the total rigidity

1. Rigidity of the ball area

$$c_k = 2 \cdot \sqrt[3]{F_b \cdot (k \cdot i)^2}$$
$$= 2 \cdot \sqrt[3]{25000 \cdot (53,51 \cdot 5)^2}$$
$$c_k = 2428 \quad N / \mu m$$

2. Rigidity of the nut area

$$c_{me} \approx 0,7 \cdot c_k$$
$$\approx 0,7 \cdot 2428 = 1700 \quad N / \mu m$$

3.Rigidity of the nut body

$$c_m = \frac{A_2 \cdot E}{l \cdot 10^3} \quad [N / \mu m]$$
$$c_m = \frac{1970 \cdot 21 \cdot 10^4}{98 \cdot 10^3}$$
$$c_m = 4221 \quad N / \mu m$$

3. Rigidity of the spindle

3.1 Single-sided fixed bearing

$$c_s = \frac{A_1 \cdot E}{l \cdot 10^3} \quad [N / \mu m]$$
$$c_s = \frac{1548 \cdot 21 \cdot 10^4}{1000 \cdot 10^3}$$
$$c_s = 325 \quad N / \mu m$$

3.2 Double-sided fixed bearing

$$c_s = \frac{4 \cdot A_1 \cdot E}{l \cdot 10^3} \quad [N / \mu m]$$
$$c_s = 4 \cdot 325 = 1300 \quad N / \mu m$$

4. Total rigidity

$$\frac{1}{c_{ges}} = \frac{1}{c_k} + \frac{1}{c_m} + \frac{1}{c_s} = \frac{1}{c_{me}} + \frac{1}{c_s}$$

Example – Calculation of rigidity

Nut system DIN 69051	according to dimension sheet
Nominal diameter	d_0 = 50 mm
Lead	P = 10 mm
Number of revolutions	i = 5
Dynamic rating	C = 98 400 N
Operating load max.	F_b = 25 000 N
Spindle length between bearings	l = 1 000 mm
Rigidity factor	k = 53.51 N/µm
Spindle cross sectional area	A_1 = 1 548 mm²
Nut cross sectional area	A_2 = 1 970 mm²

4.1 Single-sided fixed bearing

$$\frac{1}{c_{ges}} = \frac{1}{1700} + \frac{1}{325}$$
$$c_{ges} = 273 \quad N / \mu m$$

4.2 Double-sided fixed bearing

$$\frac{1}{c_{ges}} = \frac{1}{1700} + \frac{1}{1300}$$
$$c_{ges} = 737 \quad N / \mu m$$

4.3 Single-sided fixed bearing

$$\frac{1}{c_{ges}} = \frac{1}{c_k} + \frac{1}{c_m} + \frac{1}{c_s}$$
$$\frac{1}{c_{ges}} = \frac{1}{2428} + \frac{1}{4221} + \frac{1}{325} = 268 \quad N / \mu m$$

4.4 Double-sided fixed bearing

$$\frac{1}{c_{ges}} = \frac{1}{2428} + \frac{1}{4221} + \frac{1}{1300} = 705 \quad N / \mu m$$

For further rigidity values (bearing rigidity values) see Page 66–72 “Spindle end machining with bearings”.

Rigidity

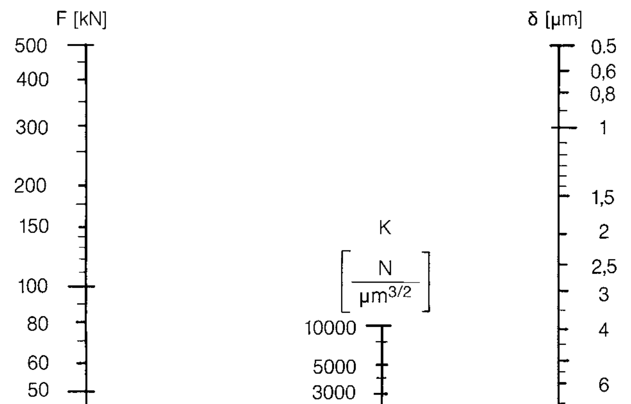
D_K = ball diameter
d = ball reference circle
i = number of threads bearing the load
K = rigidity factor per thread
c_k = rigidity of the double nut

Calculation of the axial resilience of a ball screw in the ball area with a rigidity factor K (see adjacent table).

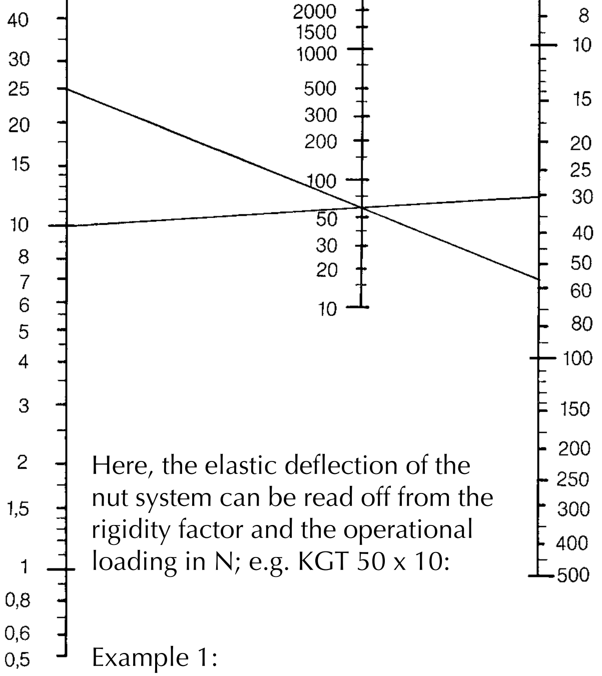
Dimen-sion and pitch		DK Ø	d	i	Cdyn (N)	K/ Ball	K	DpM / Rnu,ar	EfM / Rnu,ar
	Spindle-Ø h6	Ball-Ø	Ball re-ference circle	Circula-tions	Load rating		Rigidity characte-ristic	Rigidity	Rigidity
								5%Cdyn	5%Cdyn
10x2	10	1,58	10,2	2	2200	24,62	49,24	56	70
12x2	12	1,58	12,2	2	2600	28,74	57,48	63	80
12x3	12	2,38	12,42	2	4000	23,43	46,86	87	110
12x5	12	2,38	12,42	2	4000	23,31	46,62	122	155
16x5	16	2,38	16,42	4	10400	31,74	126,96	196	248
16x10	16	2,38	16,42	3	7900	31,31	93,93	282	356
16x16	16	2,38	16,42	2	5300	32,07	64,14	341	431
20x5	20	3,175	20,5	5	20900	34,78	173,9	262	331
20x10	20	3,175	20,5	3	13000	34,48	103,44	352	444
20x20	20	3,175	20,5	2	8600	35,17	70,34	494	622
25x5	24	3,5	24,5	5	25900	38,59	192,95	300	377
25x10	24	3,5	24,5	3	16100	38,34	115,02	403	506
25x20	24	3,5	24,5	2	10800	39,39	78,78	568	713
25x25	24	3,5	24,5	2	10700	38,71	77,42	651	819
32x5	30	3,5	30,5	5	28600	48,78	243,9	360	452
32x10	30	4,5	31,0	4	32900	43,61	174,44	555	637
32x10	30	6,35	31,5	4	51800	38,18	152,72	591	743
32x20	30	6,35	31,5	3	39300	37,61	112,83	849	1069
32x32	30	6,35	31,5	2	26200	36,51	73,02	991	1245
40x5	38	3,5	38,5	5	31600	63,04	315,2	437	548
40x10	38	6,35	39,5	4	58400	46,45	185,8	745	935
40x20	38	6,35	39,5	3	44500	46,00	138	997	1249
40x20	38	8	39,5	3	59700	42,52	127,56	1048	1315

Nut rigidity $C_{me} = f_{cm} \cdot c_k$

f_{cm} = 0.55 for internally pre-loaded single nuts
f_{cm} = 0.70 for pre-loaded double nuts



40x20	38	9,52	40,04	3	74300	39,78	119,34	1080	1355
40x40	38	8	39,5	2	39600	40,99	81,98	1415	1775
40x40	38	9,52	40,04	2	49400	38,38	76,76	1459	1830
50x5	48	3,5	48,5	6	40800	79,33	475,98	551	690
50x10	48	7,5	48,5	5	98400	53,51	267,55	897	1121
50x20	48	7,5	48,5	4	80000	53,18	212,72	1331	1666
50x20	48	8	49,5	4	88000	51,88	207,52	1359	1704
50x30	48	7,5	48,5	4	79500	55,58	222,32	1804	2261
50x30	48	8	49,5	4	87400	51,36	205,44	1778	2234
50x40	48	7,5	48,5	4	78800	54,82	219,28	2174	2726
50x40	48	8	49,5	4	86700	53,63	214,52	2218	2789
50x50	48	7,5	48,5	3	59700	53,88	161,64	2259	2831
50x50	48	8	49,5	3	65700	52,72	158,16	2308	2898
63x5	60	3,5	60,5	6	44500	97,66	585,96	642	801
63x10	60	7,5	60,5	6	128600	68,43	410,58	1146	1429
63x20	60	7,5	60,5	4	88900	68,16	272,64	1598	1991
63x20	60	9,52	62,04	6	178500	60,11	360,66	1890	2368
63x40	60	7,5	60,5	4	88000	67,10	268,4	2546	3185
63x40	60	9,52	62,04	4	122500	59,20	236,8	2614	3273
63x50	60	7,5	60,5	3	66900	66,34	199,02	2656	3317
63x50	60	9,52	62,04	3	93200	61,79	185,37	2822	3524
80x10	80	6,35	81,5	6	115800	98,62	591,72	1340	1651
80x10	80	7,5	80,5	6	145300	89,31	535,86	1365	1685
80x20	80	12,7	82,5	4	207800	69,57	278,28	2095	2596
80x20	80	12,7	82,5	6	299800	69,57	417,42	2428	3026
80x40	80	12,7	82,5	4	206700	68,96	275,84	3372	4200
80x60	80	12,7	82,5	3	157000	67,98	203,94	3977	4948
100x10	100	6,35	101,5	6	126300	123,31	739,86	1527	1862
100x10	100	7,5	100,5	6	159000	113,16	678,96	1573	1922
100x20	100	12,7	102,5	4	230000	85,12	340,48	2424	2988
100x20	100	12,7	102,5	6	331800	85,12	510,72	2823	3504
100x40	100	12,7	102,5	4	229200	84,64	338,56	3928	4870
120x10	120	7,5	120,5	6	170700	134,03	804,18	1865	2295
120x20	120	12,7	122,5	4	248600	104,53	418,12	2750	3361
120x20	120	12,7	122,5	6	358600	104,53	627,18	3229	3980
120x40	120	12,7	122,5	4	248000	104,11	416,44	4493	5531
160x20	160	12,7	162,5	4	279200	139,47	557,88	3212	3862
160x20	160	12,7	162,5	6	402900	139,47	836,82	3831	4660
160x40	160	12,7	162,5	4	278800	139,15	556,6	5325	6464



Here, the elastic deflection of the nut system can be read off from the rigidity factor and the operational loading in N; e.g. KGT 50 x 10:

Example 1:
K = 53.51
F = 10,000 N
→δ ≈ 30 µm

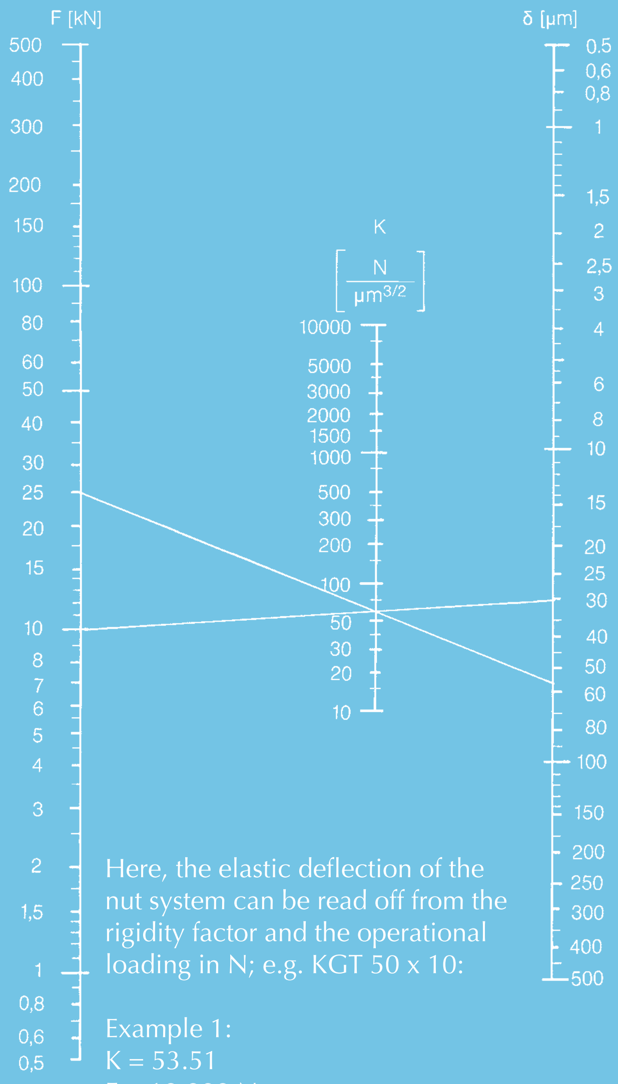
Example 2:
K = 53.51
F = 25,000 N
→δ ≈ 57 µm

Rigidity

Nut rigidity $C_{me} = f_{cm} \cdot c_k$

f_{cm} = 0.55 for internally pre-loaded single nuts

f_{cm} = 0.70 for pre-loaded double nuts



Here, the elastic deflection of the nut system can be read off from the rigidity factor and the operational loading in N; e.g. KGT 50 x 10:

Example 1:
K = 53.51
F = 10,000 N
→δ ≈ 30 µm

Example 2:
K = 53.51
F = 25,000 N
→δ ≈ 57 µm

Average loading

Constant speed / varying load

$$F_{Bm} = \sqrt[3]{F^3_{b1} \cdot \frac{q_1}{100} + F^3_{b2} \cdot \frac{q_2}{100} + F^3_{b3} \cdot \frac{q_3}{100} + \ldots \text{etc.}} \qquad [N]$$

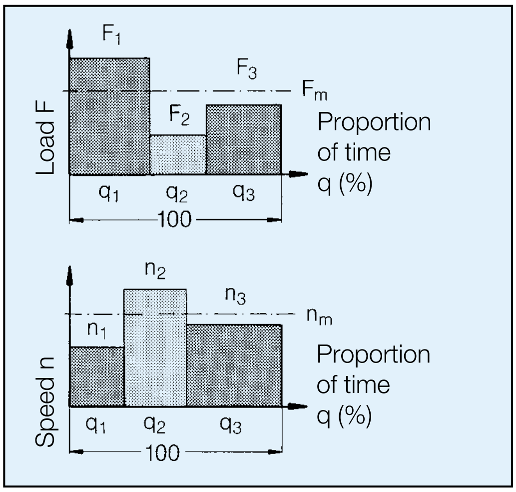
Constant speed / linearly varying load

$$F_{Bm} = \frac{F_{b\,min} + 2\,F_{b\,max}}{3} \qquad [N]$$

Speed and load varying

$$F_{Bm} = \sqrt[3]{F^3_{b1} \cdot \frac{n_1}{n_m} \cdot \frac{q_1}{100} + F^3_{b2} \cdot \frac{n_2}{n_m} \cdot \frac{q_2}{100} + \ldots \text{etc.}} \qquad [N]$$

F_{bm} = average axial load [N]
n_m = average speed [rpm]
q_1 = proportion of time used referred to 100 %
n_1 = speed values



Average speed

$$n_m = n_1 \cdot \frac{q_1}{100} + n_2 \cdot \frac{q_2}{100} + n_3 \cdot \frac{q_3}{100} + \ldots \text{etc.} \qquad [rpm]$$

Drive torque and drive power

If a torque is to be converted to a longitudinal force, then:

$$M_a = \frac{F \cdot P}{2000 \cdot \pi \cdot \eta}$$

When a longitudinal force is converted to a torque (lead angle α ≥ 5°):

$$M_e = \frac{F \cdot P \cdot \eta'}{2000 \cdot \pi}$$

The drive power is calculated from:

$$P_a = \frac{M_a \cdot n}{9550}$$

F = Force [N]
M_a = Drive torque [N_m]
M_e = Output torque [N_m]
n = Speed [rpm]
P = Lead [mm]
P_a = Power [kW]
η = Efficiency [0.9 – 0.95]

Calculation DIN 69051

Life time rigidity **4/10/2008 10:25**				
Customer Kammerer	**Drawing no.**	**Z axis**	**G DYN**	
Type		KGT50 x 40 x	1480	
Pitch	Ph	50	mm	
Contact Angle	a	45	°	
Reference Circle Diameter	DpW	62,04	mm	
Ball Diameter	DW	9,525	mm	
Number of Threads	g	1		
Ball Circulation	i	3		
Osculation	frs(rn)	0,54		
Hardness HV10	HV10	720		
Smelting factor	fm	1,44		
Dynamic factor and ceramic spheres	fdyn	1		Normal sphere filling
Reliability Factor	fr	1		
Tolerance Factor	fac	1		
Speed Correction Factor	fk	0,32		
Buckling Factor	Fkn	0,25		
Duty Cycle in % ED.	ED	100	%	
Nut Ø	D1	95	mm	
Nut Length	L2	100	mm	
Unsupported spindle length	Ls	1350	mm	
Initial Tension of Nut for Rigidity	FvM	2000	N	
Axial Force for Torque Calculation	Fm	49000	N	
Max. Actual Speed of Nut	Max. M	2000	U/min	
C stat.	Cstat	168.705	N	
C dyn.	Cdyn	93.351	N	
DIN Simulation Calculation Normal = 0	3	0		
Rigidity Values		EM		DpM
Spindle rigidity with fixed-loose bearing	Rs 1	375	N/ym	375
Spindle rigidity with fixed-fixed bearing	Rs 2	1502	N/ym	1502
Spindle rigidity	Rs 1min	375	N/ym	375
Spindle rigidity	Rs 2min	1494	N/ym	1494
Nut Rigidity incl. spindle in nut area	Rnuar	2822	N/ym	3524
Total rigidity fixed-loose +Rnuar	Rtot1	283	N/ym	283
Total rigidity fixed-fixed +Rnuar	Rtot2	977	N/ym	977
Deformation of track by pretension	lb/t=	1,3	ym	1,3
Existing rigidity up to max. 2.83*pretensioning force	Rb/t=	5518	N/ym	7022
Nut rigidity incl. spindle in nut area	Rnu=	5131	N/ym	6407

Calculation DIN 69051

Life time rigidity **4/10/2008 10:25**					
Customer Kammerer	**Drawing no.**	**Z axis**	**G DYN**		
C stat.	Cstat	168.705	N		
C dyn.	Cdyn	93.351	N		
Equivalent no. of revolutions	nm	601	rpm		
Equivalent load	Fm	18493	N		
Dyn. equivalent load	Fma	12822	N		
	Fma2	-5671	N		
Life time EM	Lm	128622831	rpm.		
Life time DpM sym. circ.	Lm	128622831	rpm.		
Life time in hours		3568	h		
Life time in hours with ED %	100 %	3568	h		
Whipping speed	rpm	1047			
Total rotating spindle mass.	N	273			
Roll proportion	Üf	6,51	i		
Limit speed of roller element		13026	rpm.		
Torque	Ma	395,12	N/m		
Torque	Me	384,74	N/m		
Torque	Mi	2,39	N/m		
Efficiency 1	h	0,99			
Efficiency 2	h	0,99			
Drive power	KW	82,75			
Buckling factor	Fkn	106609	N		
Mass reactance torque int. diam. KGT spindle	Kg/m^2	0,017			
Load summary					
Type of burden 1 speed 1 rotat.	50	Axial force 1 in N	7245	Time share 1 in %	12,50
Type of burden 2 speed 2 rotat.	50	Axial force 1 in N	23245	Time share 2 in %	12,50
Type of burden 3 speed 3 rotat.	200	Axial force 1 in N	13245	Time share 3 in %	25,00
Type of burden 4 speed 4 rotat.	200	Axial force 1 in N	17245	Time share 4 in %	25,00
Type of burden 5 speed 5 rotat.	2000	Axial force 1 in N	14245	Time share 5 in %	11,50
Type of burden 6 speed 6 rotat.	2000	Axial force 1 in N	16245	Time share 6 in %	11,50
Type of burden 7 speed 7 rotat.	1414	Axial force 1 in N	19742	Time share 7 in %	1,00
Type of burden 8 speed 8 rotat.	1414	Axial force 1 in N	48232	Time share 8 in %	1,00
Type of burden 9 speed 9 rotat.	0	Axial force 1 in N	0	Time share 9 in %	0,00
Type of burden 10 speed 10 rotat.	0	Axial force 1 in N	0	Time share 10 in %	0,00
Type of burden 11 speed 11 rotat.	0	Axial force 1 in N	0	Time share 11 in %	0,00
Type of burden 12 speed 12 rotat.	0	Axial force 1 in N	0	Time share 12 in %	0,00

Efficiency η or η′

$$\tan \alpha = \frac{P}{d_o \cdot \pi}$$

α = lead angle [°]
P = lead [mm]
d_o = ball reference circle [mm]
ρ = angle of friction [°] ≈ 0,2° to 0,35°

If a torque is to be converted to a longitudinal force, then:

$$\eta \approx \frac{\tan \alpha}{\tan (\alpha + \rho)}$$

When a longitudinal force is converted to a torque:

$$\eta' \approx \frac{\tan (\alpha - \rho)}{\tan \alpha}$$

Lifetime

The lifetime (better, nominal life) is expressed by the number of revolutions (or number of operating hours at constant speed) that 90 % of a sufficiently large number of identical ball screws achieve or exceed before the first signs of material fatigue occur. The nominal lifetime is designated with L or L_h if the figure is expressed in revolutions or hours respectively.

The dynamic rating C is to be understood to mean an axial load acting centrally (given in N) of unvarying magnitude and direction under which a sufficiently large number of identical ball screws achieve a nominal life of one million revolutions.

The static rating C_0 is to be understood to mean an axial load acting centrally (given in N) which causes a total permanent deformation of 0.0001 x the ball diameter between the ball and the ball track.

As ball screws are sensitive to radial and eccentric loads, these should be avoided if possible.

$$F_{bm} \leqq F_{b\,max} \leqq C_o$$

$$L = \left[\frac{C}{F_{am}}\right]^3 \cdot 10^6$$

$$C = \sqrt[3]{\frac{L \cdot F_{am}{}^3}{10^6}}$$

$$F_{am} = \sqrt[3]{\frac{C^3 \cdot 10^6}{L}}$$

$$L_h = \frac{L}{60 \cdot n_m \cdot f_n}$$

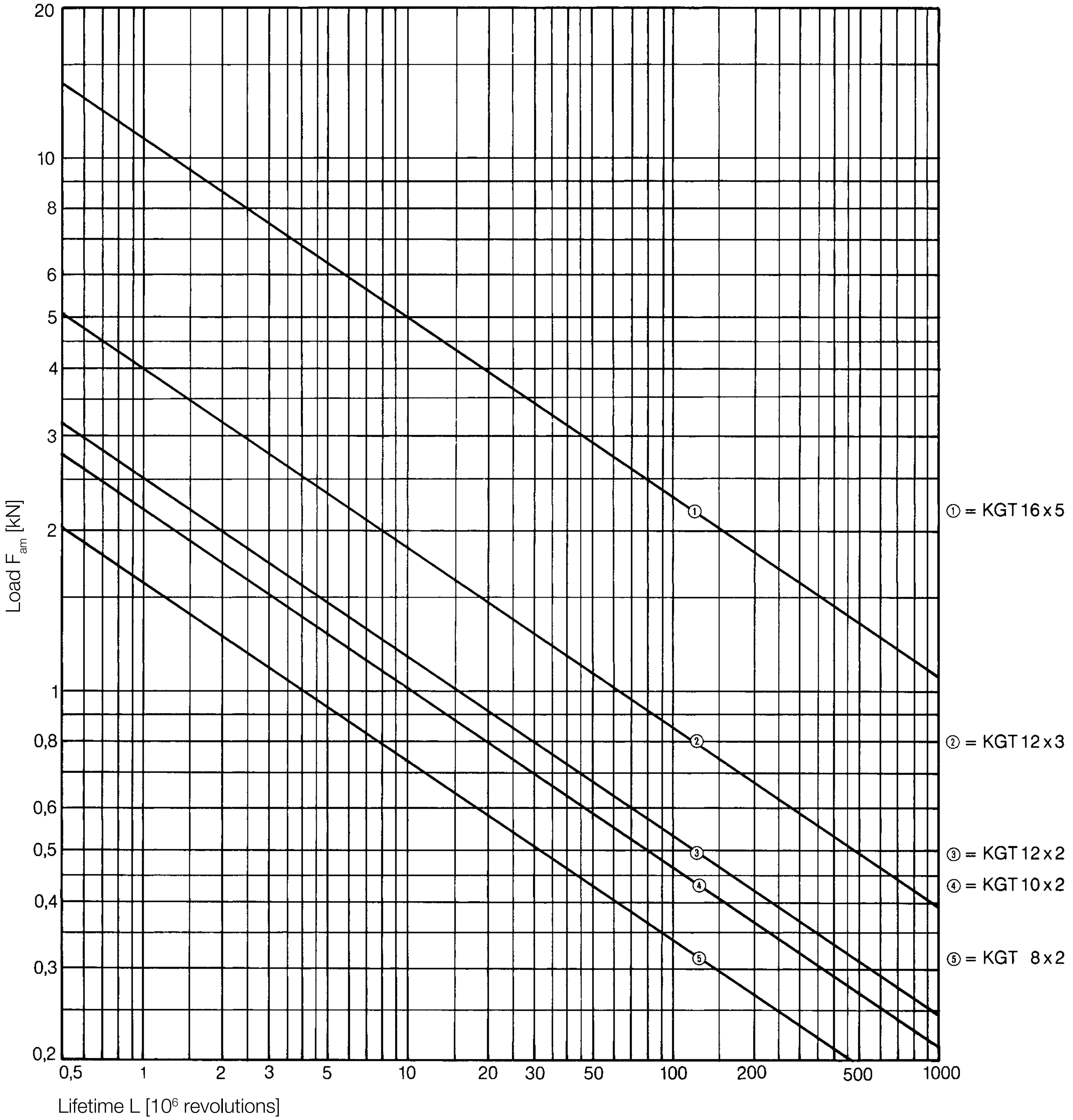
L = lifetime [revolutions]
L_h = lifetime [h]
C_o = static rating [N]
C = dynamic rating [N]
F_{am} = average axial load [N]
$F_{a\,max}$ = max. axial load [N]
n_m = average speed [rpm]
f_n = utilisation factor

$$f_n = \frac{\text{Duration of use (h)}}{\text{Planned utilisation of the machine (h)}}$$

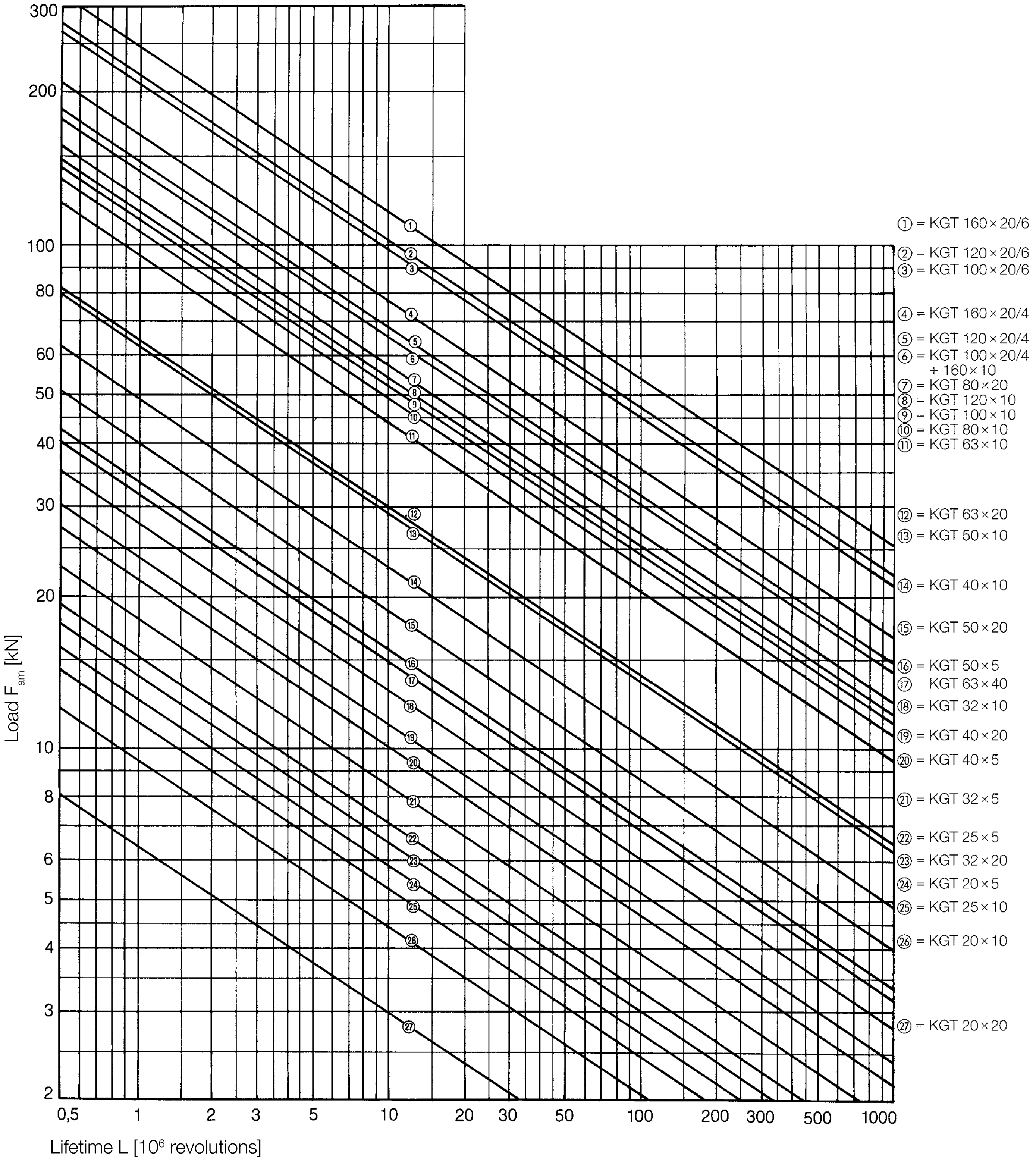
Guide values for machine life:

1-shift: 10,000 to 20,000 hours
2-shift: 20,000 to 40,000 hours

Lifetime diagram
Mini-KGT (Ø 8 – Ø 16)



Lifetime diagram
KGT (Ø 16 – Ø 160)



Example – Calculation of lifetime

Given load and speed values:
Fast speed: n_1 = 1200 rpm, F_{b1} = 7,500 N, q_1 = 25 %
Roughing work: n_2 = 60 rpm, F_{b2} = 25,000 N, q_2 = 40 %
Finish machining: n_3 = 150 rpm, F_{b3} = 18,000 N, q_3 = 35 %
Lifetime of the machine: L_h = 10,000 h
Utilisation factor of the ball screw: f_n = 0.5

Required nominal diameter of the ball screw 40 or 50 mm, lead 10 mm.
(These two diameters are derived from the critical speed and the installation conditions).

1. Calculating the average speed (n_m) [rpm]

$$n_m = n_1 \cdot \frac{q_1}{100} + n_2 \cdot \frac{q_2}{100} + n_3 \cdot \frac{q_3}{100} + \cdots$$

$$n_m = 1200 \cdot \frac{25}{100} + 60 \cdot \frac{40}{100} + 150 \cdot \frac{35}{100} = 376{,}5 \text{ rpm}$$

2. Calculating the average load (F_{bm}) [N]

$$F_{bm} = \sqrt[3]{F_{b1}^{\ 3} \cdot \frac{n_1}{n_m} \cdot \frac{q_1}{100} + F_{b2}^{\ 3} \cdot \frac{n_2}{n_m} \cdot \frac{q_2}{100} + F_{b3}^{\ 3} \cdot \frac{n_3}{n_m} \cdot \frac{q_3}{100} + \cdots}$$

$$F_{bm} = \sqrt[3]{7500^3 \cdot \frac{1200}{376{,}5} \cdot \frac{25}{100} + 25.000^3 \cdot \frac{60}{376{,}5} \cdot \frac{40}{100} + 18.000^3 \cdot \frac{150}{376{,}5} \cdot \frac{35}{100}} = 12.897 \ N$$

3. Required lifetime (L): $L = 60 \cdot L_h \cdot n_m \cdot f_n$

$$L = 60 \cdot 10.000 \cdot 376{,}5 \cdot 0{,}5 = 112{,}95 \cdot 10^6 \text{ rpm}$$

4. Calculation of the required dynamic loading capacity (C)

$$C = F_{bm} \cdot \sqrt[3]{\frac{L}{10^6}}$$

$$C = 12.897 \cdot \sqrt[3]{\frac{112{,}95 \cdot 10^6}{10^6}} = 62.342 \ N$$

Here, a ball screw with a nominal diameter of 50 mm, nominal lead = 10 mm and 4 load-bearing threads with a dynamic rating of C = 98,400 N is chosen from the dimension sheets.

5. Re-examination of the expected lifetime (L and L_h)

$$L = \left[\frac{C}{F_{bm}}\right]^3 \cdot 10^6 \quad [\text{rpm}] \qquad L_h = \frac{L}{60 \cdot n_m \cdot f_n} \quad [h]$$

$$L = \left[\frac{98.400}{12.897}\right]^3 \cdot 10^6 = 444 \cdot 10^6 \text{ rpm} \qquad L_h = \frac{444 \cdot 10^6}{60 \cdot 376{,}5 \cdot 0{,}5} = 39.322 \ h$$

Speed limits referred to the nut system

The maximum speed possible for a ball screw depends above all on the type of construction and the ball feedback system. Furthermore, it is dependent upon the size and type of the lubrication system (oil or grease).
Under the assumption that the ball screw is relatively lightly loaded and that it is well lubricated, the maximum possible speed can be calculated by a formula.

Speed factor for grease lubrication K ≈ 60,000 – 100,000
oil lubrication K ≈ 90,000 – 200,000

Je nach Durchmesser +
Überrollverhältnis = (AD/Kugel-Ø)

$$n_{max} = \frac{K}{d}$$

n_{max} = max. speed (rpm)
K = speed factor
d = spindle diameter (mm)

The maximum possible traverse speed can be calculated from the formula:

$$v_{max} = \frac{K \cdot P}{60 \cdot d}$$

v_{max} = max. possible traverse speed (mm/sec)
P = thread lead (mm)

With speed factors above 20,000, the dynamic rating of the ball screw should include a safety margin of at least 20 %.
The same can be achieved by an appropriate tapering off of the load. However, too small a loading should be avoided at maximum traverse speed as otherwise the wear factor (lifetime) will be adversely affected.
These figures are purely for guidance. It should be especially noted that above speeds of 3000 rpm, technical consultation with our engineers is necessary. With ceramic spheres filling ≈ limit speed 30 % higher.

Calculation of critical bending speed

Calculation of the critical bending speed n_{kr}
Take speed limits of the nut system into account
(see Page 40)

$$n_{kr} = \frac{30}{\pi} \cdot \sqrt{\frac{21 \cdot 10^4 \cdot d_m^4 \cdot 10^4}{0{,}013 \cdot F \cdot l_a^3 \cdot 20}}$$

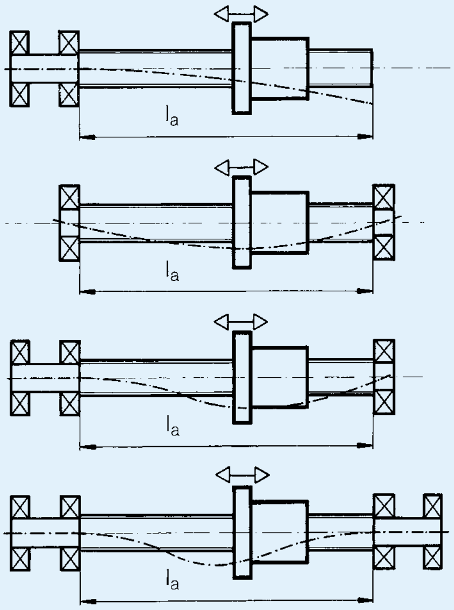
$$n_{zul} = 0{,}8 \cdot n_{kr} \cdot f_k$$

0.8 = safety factor
n_{kr} = critical speed from the diagram [rpm]
f_k = correction factor
d_m = average thread diameter, see table below
F = weight of the unsupported spindle length in N
l_a = bearing spacing [mm]
n_{zul} = permissible speed [rpm]

KGT Type	**Ball-Ø**	**d_m Ø**	**N/m**
10x 2	1,58	9,3	5,3
12x 3	2,38	11,0	7,4
12x 5	2,38	11,0	7,4
16x 5	2,38	15,0	13,9
20x 5	3,175	18,6	21,3
25x 5	3,5	22,5	31,3
32x 5	3,5	28,5	49,9
40x 5	3,5	36,5	81,9
50x 5	3,5	46,5	133,0
63x 5	3,5	58,5	210,6
32x10	4,5	28,2	49,0
32x10	6,35	27,5	46,6
40x10	6,35	35,5	77,7
50x10	7,5	44,4	121,5
63x10	7,5	56,4	196,1
80x10	6,35	77,5	370,3
80x10	7,5	76,4	359,9
100x10	7,5	96,4	572,9
120x10	7,5	116,4	835,3
63x20	7,5	56,4	196,1
80x20	12,7	74,8	344,5
100x20	12,7	94,8	553,5
120x20	12,7	114,8	811,8
160x20	12,7	154,8	1476,5

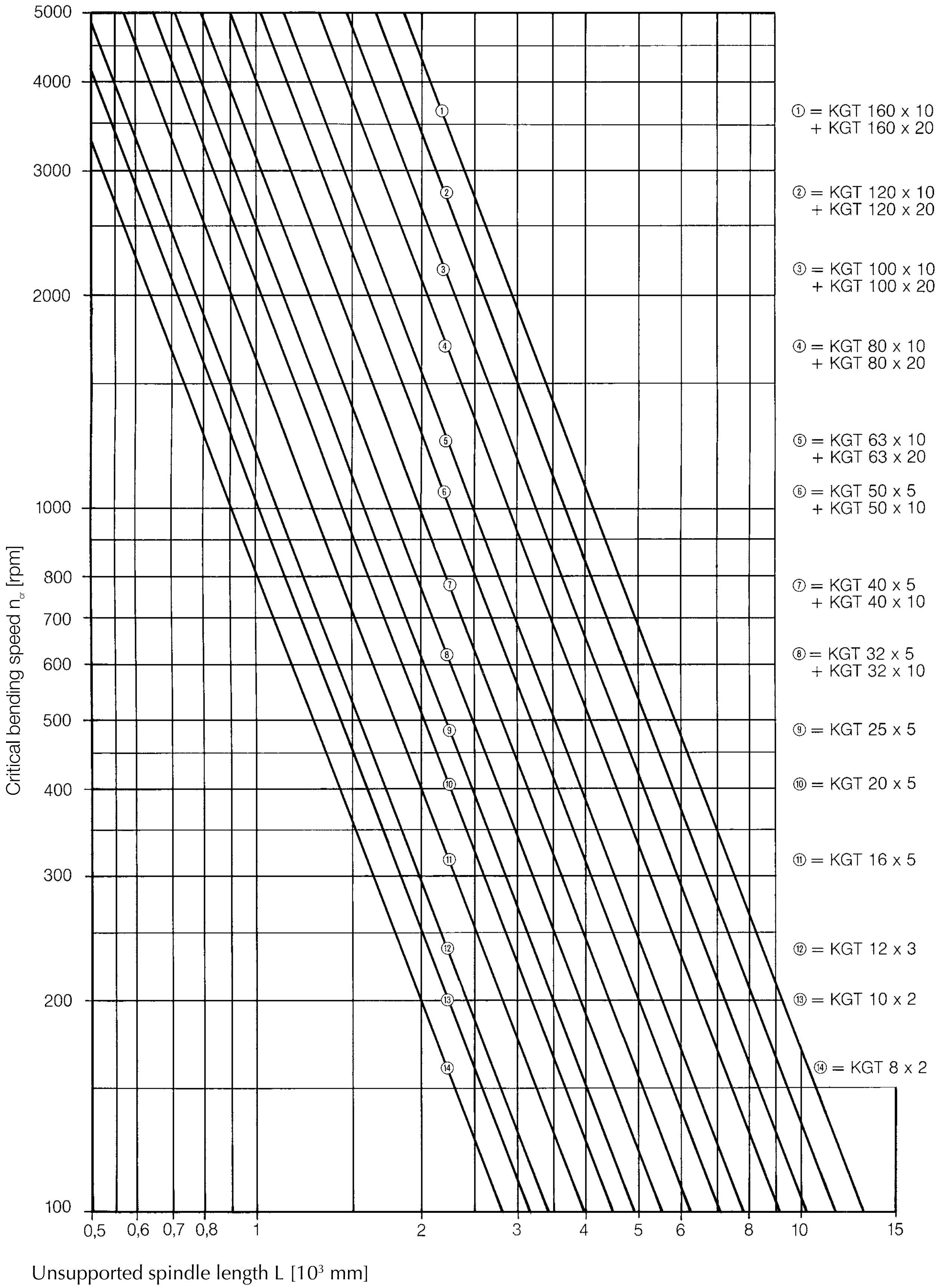
Average thread diameter = d_m
Weight of the spindle/metre = N/m

Correction factor



$f_{kr} = 0{,}32$	case 1
$f_{kr} = 1{,}0$	case 2
$f_{kr} = 1{,}55$	case 3
$f_{kr} = 2{,}24$	case 4

Critical bending speed diagram



Speed limits of the nut system are to be observed, see Page 40.
Correction factor depending on bearing type to be observed, see Page 41.

Buckling

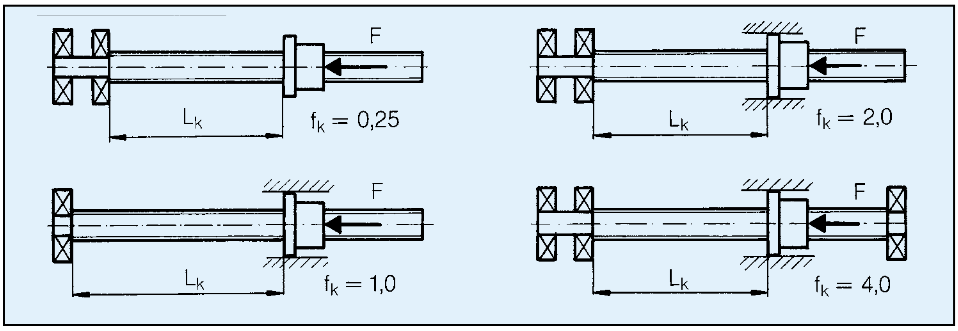
Calculation of the buckling force F_{kn} as a function of the spindle length L_k and the core diameter of the spindle.

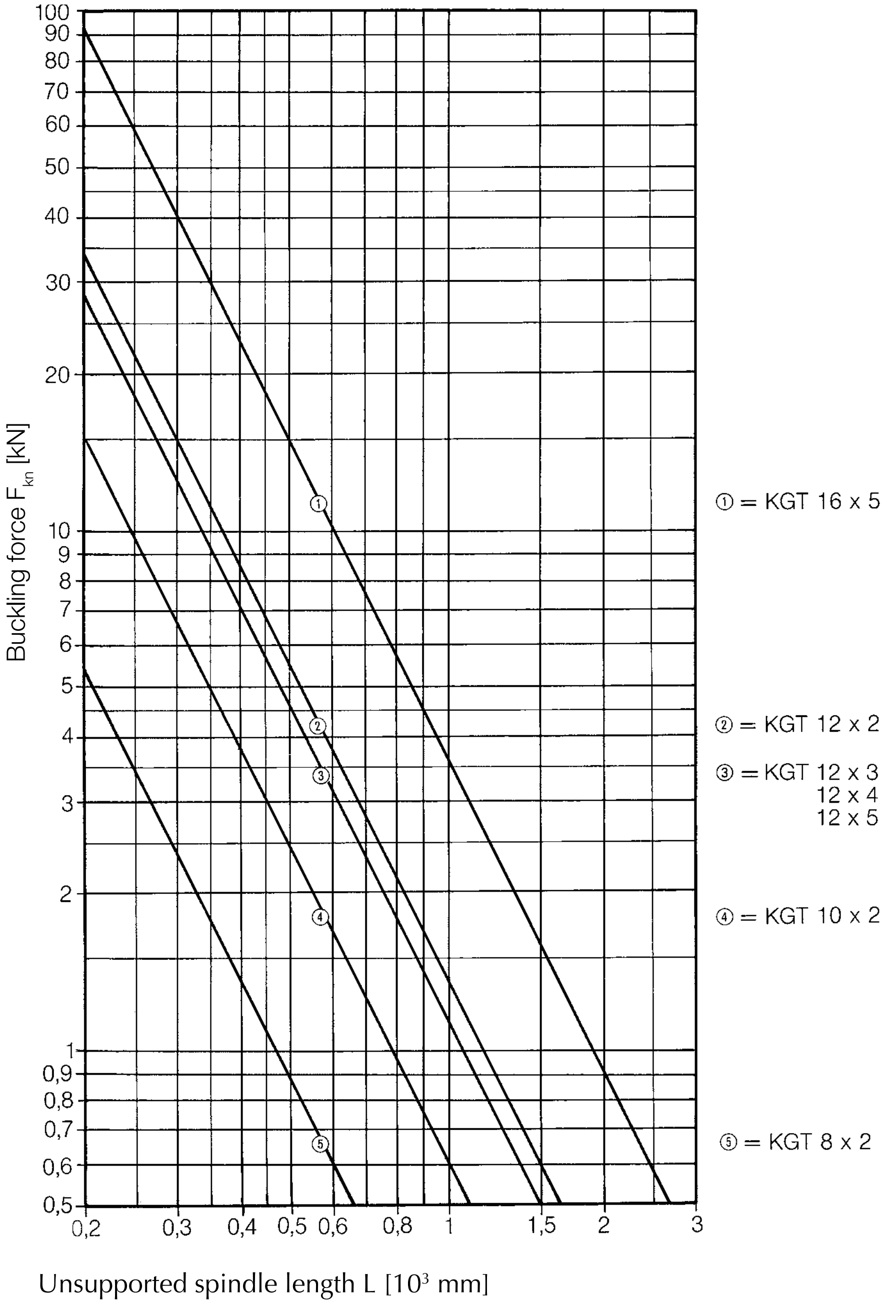
$$F_{kn} = \frac{21 \cdot 10^4 \cdot d_k^4 \cdot \pi^3 \cdot f_k}{64 \cdot L_k^2}$$

d_k = core diameter of the spindle
L_k = unsupported spindle length
f_k = correction factor for bearing type

Core diameter see Nut dimensions tables, page 47 to 55.

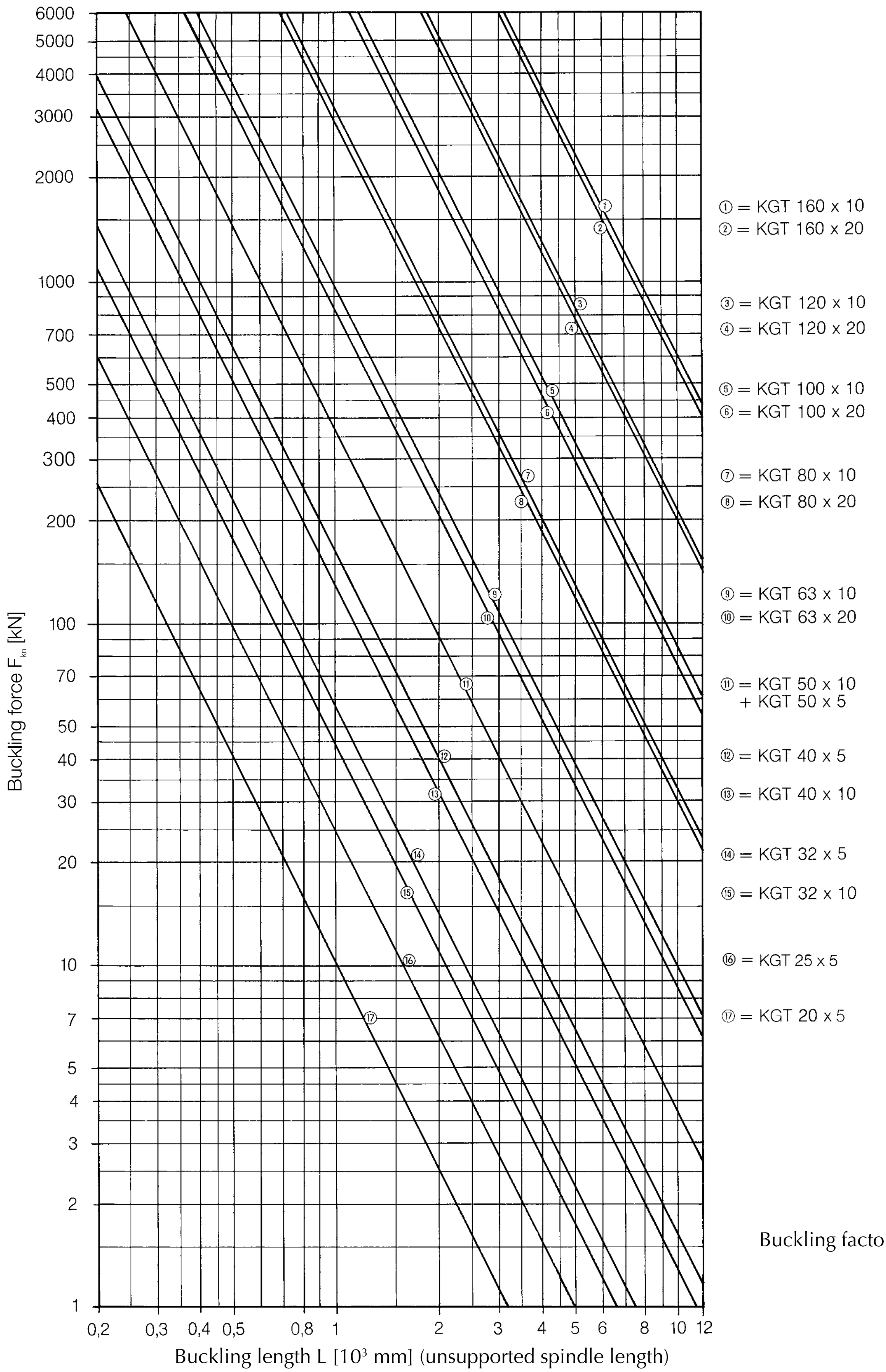
Correction factor f_k for taking the type of bearing into account:





Buckling – diagram

KGT (Ø 20–160)



Buckling factor see Page 43

Leads – Overview

	Spindle ø	Lead – standard												
KGT 8	8	2	2,5			5								
KGT 10	10	2		3		5		8						
KGT 12	12	2		3	4	5								
KGT 16	16					5			10					
KGT 20	20				4	5	6			20				
KGT 25	24				4	5	6	8	10					
KGT 32	30					5	6	8	10	20	30			
KGT 40	38					5	6	8	10	20		40		
KGT 50	48					5		8	10	20			50	
KGT 63	60							8	10	20		40		60
KGT 80	80								10	20		40		60
KGT 100	100								10	20		40		60
KGT 120	120								10	20		40		60
KGT 160	160								10	20		40		60

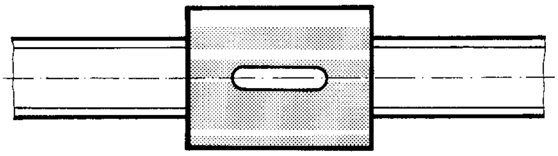
We can supply **any lead** on request (maximum lead = 2 x diameter). The spindle length can be up to 6000 mm depending on the diameter. Even special lengths are no problem for us.

▨ preferred standard range

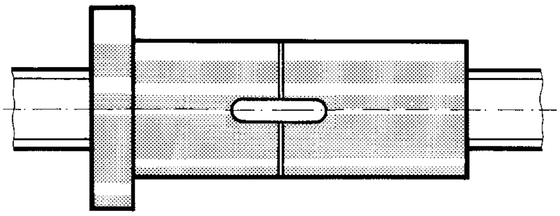
How accurate are the leads and how are they produced?
The lead accuracies are in accordance with DIN 69051, Part 3: 3/5/7/10. Test certificates can be provided. Depending on the application, the leads are ground, fine turned or rolled.

Nut systems

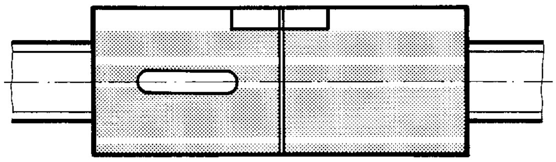
Cylindrical single nut



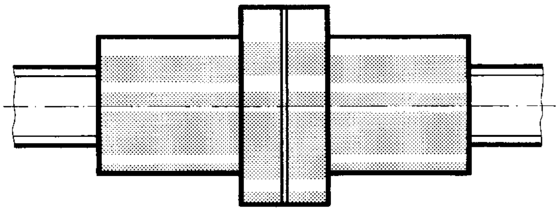
Pre-loaded flanged double nut



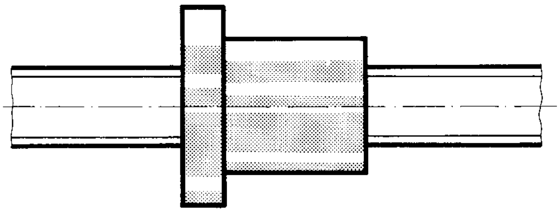
Cylindrical double nut



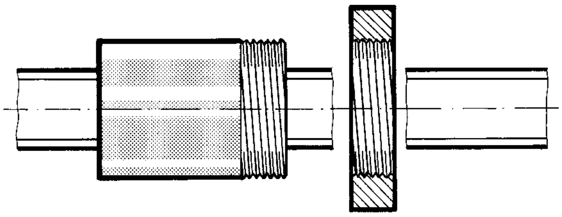
Pre-loaded centre-flanged double nut



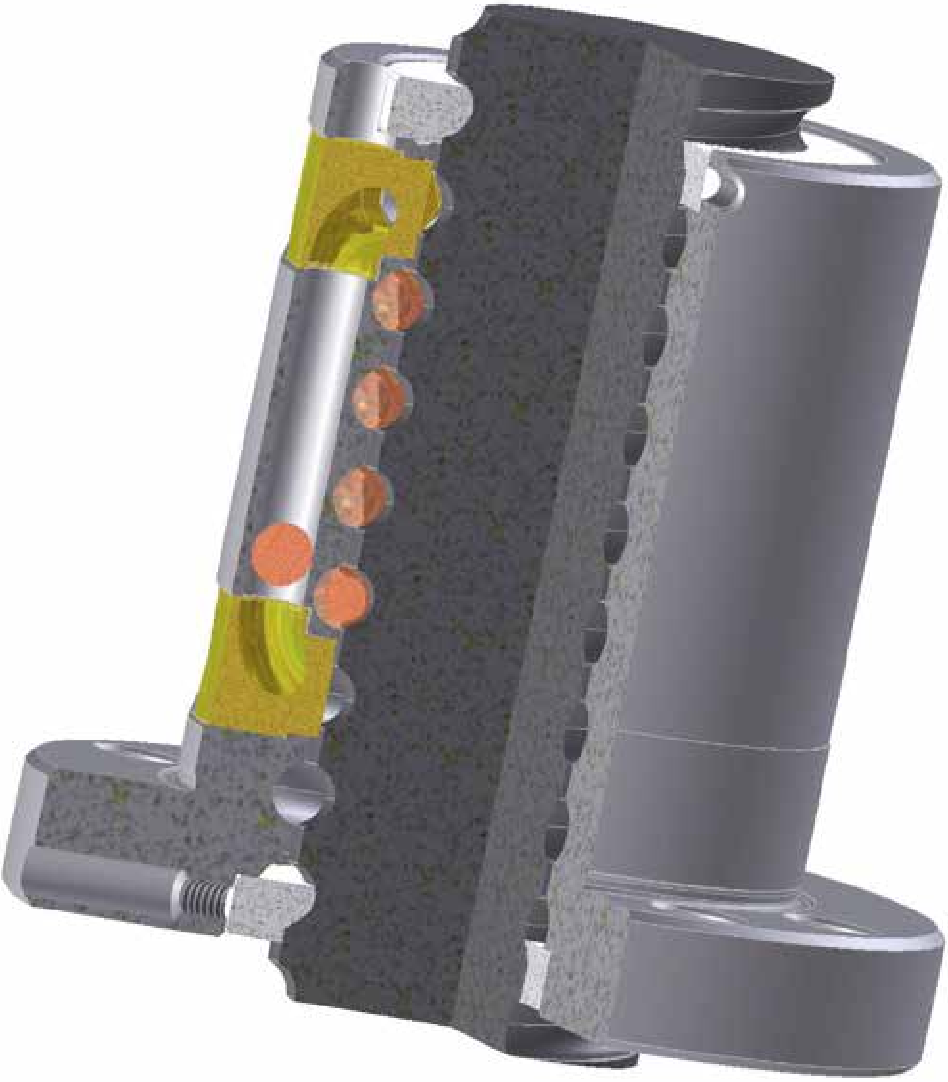
Flanged single nut or internally pre-loaded flanged single nut



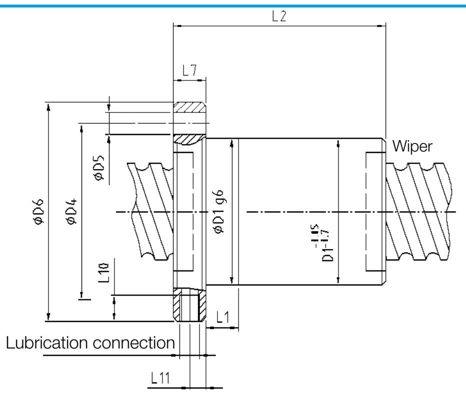
Single nut with and without screw flange



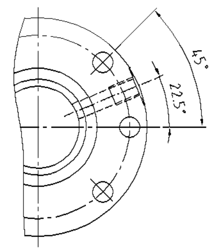
FM Nut



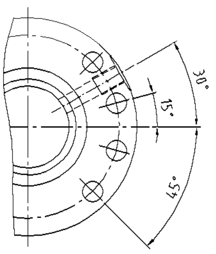
Nut dimensions table **FM**



Drilling diagram 1



Drilling diagram 2

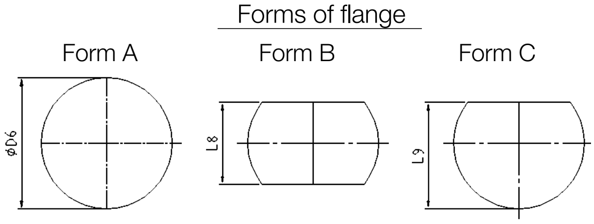


Dimension and lead	Spindle-Ø h6	Ball-Ø	Core-Ø	D_{1g6}	D_4	Drilling diagramm	No. of holes	D_5	D_6	Fit
			Spindle	Centr-Ø	Geometrical-Ø			Drilling-Ø	Flange-Ø	
16x5	16	2,38	14,0	28	38	1	6	5,5	48	
16x10	16	2,38	14,0	28	38	1	6	5,5	48	
16x16	16	2,38	14,0	28	38	1	6	5,5	48	
20x5	20	3,175	17,2	36	47	1	6	6,6	58	
20x10	20	3,175	17,2	36	47	1	6	6,6	58	
20x20	20	3,175	17,2	36	47	1	6	6,6	58	
25x5	24	3,5	20,9	40	51	1	6	6,6	62	
25x10	24	3,5	20,9	40	51	1	6	6,6	62	
25x20	24	3,5	20,9	40	51	1	6	6,6	62	
25x25	24	3,5	20,9	40	51	1	6	6,6	62	
32x5	30	3,5	26,9	50	65	1	6	9	80	
32x10	30	4,5	26,4	50	65	1	6	9	80	
32x10	30	6,35	25,0	56	71	1	6	9	86	
32x20	30	6,35	25,0	56	71	1	6	9	86	
32x32	30	6,35	25,0	56	71	1	6	9	86	
40x5	38	3,5	34,9	63	78	2	8	9	93	
40x10	38	6,35	33,0	63	78	2	8	9	93	
40x20	38	6,35	33,0	63	78	2	8	9	93	
40x20	38	8,0	31,3	70	85	2	8	9	100	
40x20	38	9,52	30,3	75	93	2	8	11	110	
40x40	38	8,0	31,3	70	85	2	8	9	100	
40x40	38	9,52	30,3	75	93	2	8	11	110	
50x5	48	3,5	44,9	75	93	2	8	11	110	
50x10	48	7,5	40,8	75	93	2	8	11	110	
50x20	48	7,5	40,8	75	93	2	8	11	110	
50x20	48	8,0	41,3	82	100	2	8	11	118	
50x30	48	7,5	40,8	75	93	2	8	11	110	
50x30	48	8,0	41,3	82	100	2	8	11	118	
50x40	48	7,5	40,8	75	93	2	8	11	110	
50x40	48	8,0	41,3	82	100	2	8	11	118	
50x50	48	7,5	40,8	75	93	2	8	11	110	
50x50	48	8,0	41,3	82	100	2	8	11	118	
63x5	60	3,5	56,9	90	108	2	8	11	125	
63x10	60	7,5	52,8	90	108	2	8	11	125	
63x20	60	7,5	52,8	90	108	2	8	11	125	
63x20	60	9,52	52,3	95	115	2	8	13,5	135	
63x40	60	7,5	52,8	90	108	2	8	11	125	
63x40	60	9,52	52,3	95	115	2	8	13,5	135	
63x50	60	7,5	52,8	90	108	2	8	11	125	
63x50	60	9,52	52,3	95	115	2	8	13,5	135	
80x10	80	6,35	75,0	105	125	2	8	13,5	145	
80x10	80	7,5	72,8	108	128	2	8	13,5	148	
80x20	80	12,7	69,5	125	145	2	8	13,5	165	
80x20	80	12,7	69,5	125	145	2	8	13,5	165	
80x40	80	12,7	69,5	125	145	2	8	13,5	165	
80x60	80	12,7	69,5	125	145	2	8	13,5	165	
100x10	100	6,35	95,0	125	145	2	8	13,5	165	
100x10	100	7,5	92,8	128	148	2	8	13,5	168	
100x20	100	12,7	89,5	150	176	2	8	17,5	202	
100x20	100	12,7	89,5	150	176	2	8	17,5	202	
100x40	100	12,7	89,5	150	176	2	8	17,5	202	
120x10	120	7,5	112,8	150	176	2	8	17,5	202	
120x20	120	12,7	109,5	170	196	2	8	17,5	222	
120x20	120	12,7	109,5	170	196	2	8	17,5	222	
120x40	120	12,7	109,5	170	196	2	8	17,5	222	
160x20	160	12,7	149,5	210	243	2	8	22	275	
160x20	160	12,7	149,5	210	243	2	8	22	275	
160x40	160	12,7	149,5	210	243	2	8	22	275	

FM 08.04.2008 Same-construction left-handed threads, special pitches and double-thread versions are available on request.

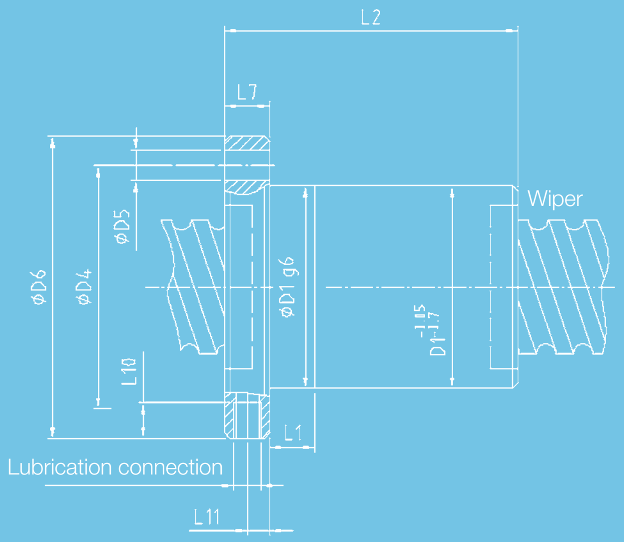
Identical to versions of previous catalog

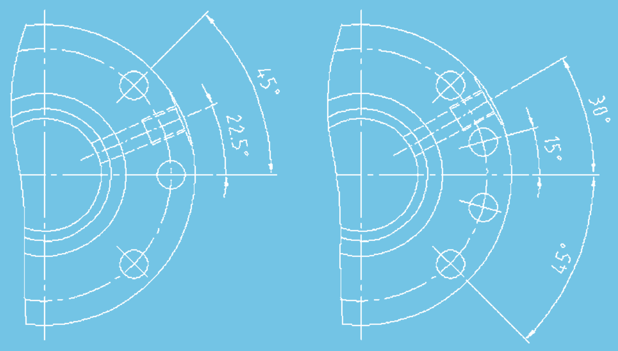
Yellow: special diameter D1+3 mm due to thin walls.



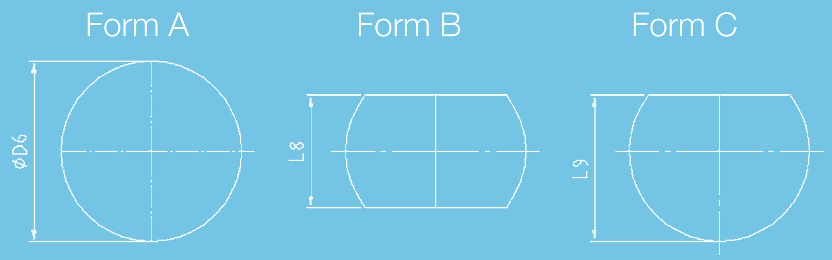
L_1 size	L_2 Total length	L_7 Flange width	L_8 Form B	L_9 Form C	L_{10} Thread depth	L_{11} Dist. lubr. width	Lubrication connection	C_{dyn} (KN) Rating	C_{stat} (KN) Rating	i Number of revolution
10	45	10	40	44	8	5	M6	10,4	15,2	4
10	55	10	40	44	8	5	M6	7,9	11,0	3
10	60	10	40	44	8	5	M6	5,3	6,9	2
10	52	10	44	51	8	5	M6	20,9	32,1	5
10	60	10	44	51	8	5	M6	13,0	18,4	3
10	70	10	44	51	8	5	M6	8,6	11,6	2
10	60	10	48	55	8	5	M6	25,9	42,5	5
10	60	10	48	55	8	5	M6	16,1	24,2	3
10	70	10	48	55	8	5	M6	10,8	15,2	2
10	85	10	48	55	8	5	M6	10,7	15,3	2
10	60	12	62	71	8	6	M6	28,6	53,5	5
10	80	12	62	71	8	6	M6	32,9	54,4	4
20	80	14	65	75,5	8	7	M6	51,8	75,5	4
20	95	14	65	75,5	8	7	M6	39,3	54,8	3
20	105	14	65	75,5	8	7	M6	26,2	34,2	2
10	70	14	70	81,5	10	7	M8x1	31,6	68,4	5
20	88	14	70	81,5	10	7	M8x1	58,4	97,1	4
20	95	14	70	81,5	10	7	M8x1	44,5	70,8	3
25	110	14	75	87,5	10	7	M8x1	59,7	87,6	3
25	110	16	85	97,5	10	8	M8x1	74,3	104,8	3
25	130	14	75	87,5	10	7	M8x1	39,6	54,3	2
25	140	16	85	97,5	10	8	M8x1	49,4	64,6	2
16	70	16	85	97,5	10	8	M8x1	40,8	105,5	6
16	98	16	85	97,5	10	8	M8x1	98,4	179,5	5
20	135	16	85	97,5	10	8	M8x1	80,0	140,8	4
25	135	16	92	105	10	8	M8x1	88,0	153,4	4
20	170	16	85	97,5	10	8	M8x1	79,5	141,2	4
25	170	16	92	105	10	8	M8x1	87,4	154,0	4
20	220	16	85	97,5	10	8	M8x1	78,8	141,0	4
25	220	16	92	105	10	8	M8x1	86,7	153,9	4
20	210	16	85	97,5	10	8	M8x1	59,7	102,5	3
25	210	16	92	105	10	8	M8x1	65,7	112,5	3
16	70	18	95	110	10	9	M8x1	44,5	132,1	6
16	120	18	95	110	10	9	M8x1	128,6	275,6	6
25	135	18	95	110	10	9	M8x1	88,9	179,1	4
25	190	20	100	117,5	10	10	M8x1	178,5	355,2	6
25	220	18	95	110	10	9	M8x1	88,0	178,1	4
25	220	20	100	117,5	10	10	M8x1	122,5	230,2	4
25	220	18	95	110	10	9	M8x1	66,9	129,7	3
25	220	20	100	117,5	10	10	M8x1	93,2	168,5	3
16	125	20	110	127,5	10	10	M8x1	115,8	321,3	6
16	125	20	113	130,5	10	10	M8x1	145,3	372,0	6
25	160	25	130	147,5	10	12,5	M8x1	207,8	406,1	4
25	200	25	130	147,5	10	12,5	M8x1	299,8	628,1	6
25	240	25	130	147,5	10	12,5	M8x1	206,7	407,9	4
25	260	25	130	147,5	10	12,5	M8x1	157,0	296,3	3
16	125	22	130	147,5	10	11	M8x1	126,3	401,9	6
16	125	22	133	150,5	10	11	M8x1	159,0	468,4	6
25	190	30	155	178,5	10	15	M8x1	230,0	510,1	4
25	220	30	155	178,5	10	15	M8x1	331,8	789,8	6
25	250	30	155	178,5	10	15	M8x1	229,2	512,6	4
25	125	25	155	178,5	10	12,5	M8x1	170,7	562,8	6
25	180	30	175	198,5	10	15	M8x1	248,6	619,6	4
25	220	30	175	198,5	10	15	M8x1	358,6	951,3	6
25	260	30	175	198,5	10	15	M8x1	248,0	616,9	4
25	190	40	215	245	10	20	M8x1	279,2	827,0	4
25	230	40	215	245	10	20	M8x1	402,9	1279,6	6
25	270	40	215	245	10	20	M8x1	278,8	830,6	4

FM

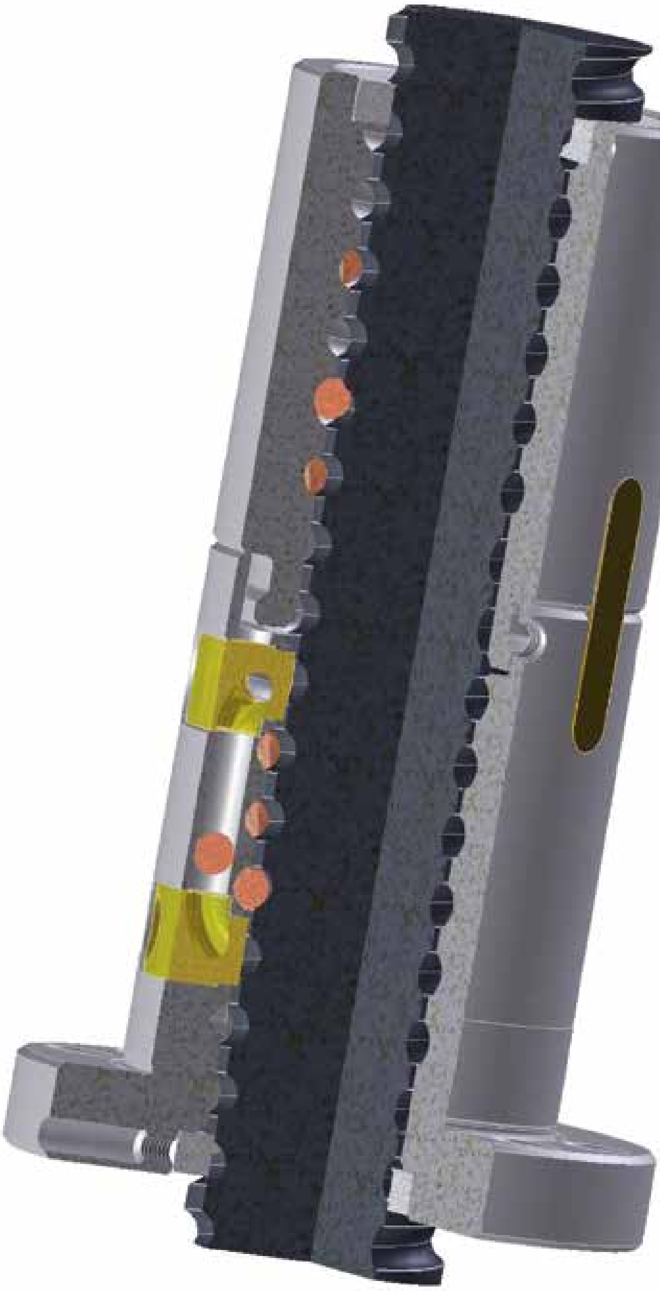




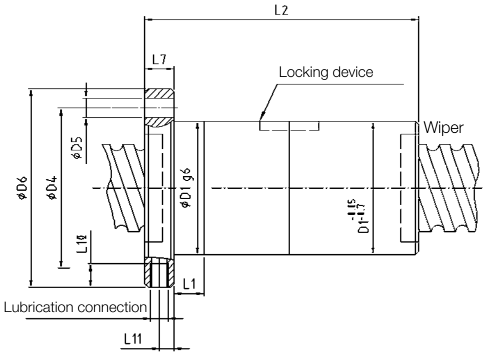
Forms of flange



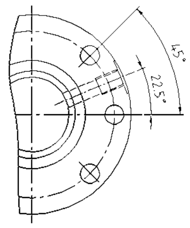
DpFM Nut



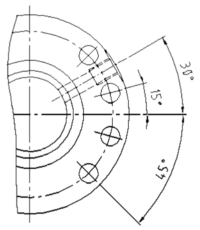
Nut dimensions table **DpfM**



Drilling diagram 1



Drilling diagram 2

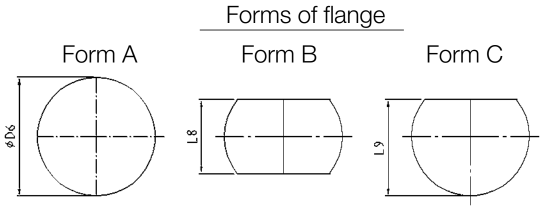


Dimensions and lead	Spindle-Ø h6	Ball-Ø	Core-Ø	D_{1g6}	D_4	Drilling diagramm	No. of holes	D_5	D_6	
			Spindle	Centr-Ø	Geometrical-Ø			Drilling-Ø	Flange-Ø	Fit
16x5	16	2,38	14,0	28	38	1	6	5,5	48	1
16x10	16	2,38	14,0	28	38	1	6	5,5	48	1
16x16	16	2,38	14,0	28	38	1	6	5,5	48	1
20x5	20	3,175	17,2	36	47	1	6	6,6	58	1
20x10	20	3,175	17,2	36	47	1	6	6,6	58	1
20x20	20	3,175	17,2	36	47	1	6	6,6	58	1
25x5	24	3,5	20,9	40	51	1	6	6,6	62	1
25x10	24	3,5	20,9	40	51	1	6	6,6	62	1
25x20	24	3,5	20,9	40	51	1	6	6,6	62	1
25x25	24	3,5	20,9	40	51	1	6	6,6	62	1
32x5	30	3,5	26,9	50	65	1	6	9	80	1
32x10	30	4,5	26,4	50	65	1	6	9	80	1
32x10	30	6,35	25,0	56	71	1	6	9	86	2
32x20	30	6,35	25,0	56	71	1	6	9	86	2
32x32	30	6,35	25,0	56	71	1	6	9	86	2
40x5	38	3,5	34,9	63	78	2	8	9	93	1
40x10	38	6,35	33,0	63	78	2	8	9	93	2
40x20	38	6,35	33,0	63	78	2	8	9	93	2
40x20	38	8,0	31,3	70	85	2	8	9	100	2
40x20	38	9,52	30,3	75	93	2	8	11	110	2
40x40	38	8,0	31,3	70	85	2	8	9	100	2
40x40	38	9,52	30,3	75	93	2	8	11	110	2
50x5	48	3,5	44,9	75	93	2	8	11	110	1
50x10	48	7,5	40,8	75	93	2	8	11	110	1
50x20	48	7,5	40,8	75	93	2	8	11	110	2
50x20	48	8,0	41,3	82	100	2	8	11	118	2
50x30	48	7,5	40,8	75	93	2	8	11	110	2
50x30	48	8,0	41,3	82	100	2	8	11	118	2
50x40	48	7,5	40,8	75	93	2	8	11	110	2
50x40	48	8,0	41,3	82	100	2	8	11	118	2
50x50	48	7,5	40,8	75	93	2	8	11	110	2
50x50	48	8,0	41,3	82	100	2	8	11	118	2
63x5	60	3,5	56,9	90	108	2	8	11	125	1
63x10	60	7,5	52,8	90	108	2	8	11	125	1
63x20	60	7,5	52,8	90	108	2	8	11	125	2
63x20	60	9,52	52,3	95	115	2	8	13,5	135	2
63x40	60	7,5	52,8	90	108	2	8	11	125	2
63x40	60	9,52	52,3	95	115	2	8	13,5	135	2
63x50	60	7,5	52,8	90	108	2	8	11	125	2
63x50	60	9,52	52,3	95	115	2	8	13,5	135	2
80x10	80	6,35	75,0	105	125	2	8	13,5	145	1
80x10	80	7,5	72,8	108	128	2	8	13,5	148	1
80x20	80	12,7	69,5	125	145	2	8	13,5	165	2
80x20	80	12,7	69,5	125	145	2	8	13,5	165	2
80x40	80	12,7	69,5	125	145	2	8	13,5	165	2
80x60	80	12,7	69,5	125	145	2	8	13,5	165	2
100x10	100	6,35	95,0	125	145	2	8	13,5	165	1
100x10	100	7,5	92,8	128	148	2	8	13,5	168	1
100x20	100	12,7	89,5	150	176	2	8	17,5	202	2
100x20	100	12,7	89,5	150	176	2	8	17,5	202	2
100x40	100	12,7	89,5	150	176	2	8	17,5	202	2
120x10	120	7,5	112,8	150	176	2	8	17,5	202	2
120x20	120	12,7	109,5	170	196	2	8	17,5	222	2
120x20	120	12,7	109,5	170	196	2	8	17,5	222	2
120x40	120	12,7	109,5	170	196	2	8	17,5	222	2
160x20	160	12,7	149,5	210	243	2	8	22	275	2
160x20	160	12,7	149,5	210	243	2	8	22	275	2
160x40	160	12,7	149,5	210	243	2	8	22	275	2

DpfM 08.04.2008 Same-construction left-handed threads, special pitches and double-thread versions are available on request.

Identical to versions of previous catalog

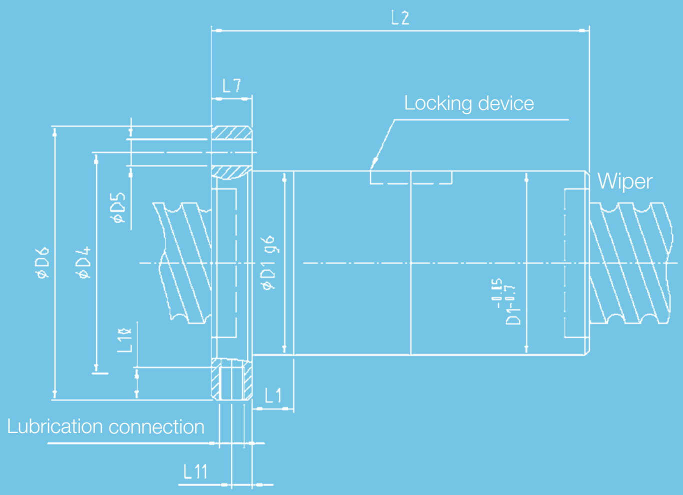
Yellow: special diameter D1+3 mm due to thin walls.



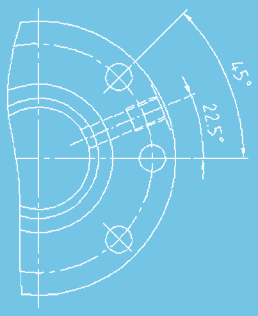
-1	L_2	L_7	L_8	L_9	L_{10}	L_{11}	**Lubrication connection**	C_{dyn} (KN)	C_{stat} (KN)	i
size	**Total length**	**Flange width**	**Form B**	**Form C**	**Thread depth**	**Dist. lubr. width**		**Rating**	**Rating**	**Number of revolution**
0	85	10	40	44	8	5	M6	10,4	15,2	4
0	110	10	40	44	8	5	M6	7,9	11,0	3
0	115	10	40	44	8	5	M6	5,3	6,9	2
0	95	10	44	51	8	5	M6	20,9	32,1	5
0	110	10	44	51	8	5	M6	13,0	18,4	3
0	135	10	44	51	8	5	M6	8,6	11,6	2
0	95	10	48	55	8	5	M6	25,9	42,5	5
0	110	10	48	55	8	5	M6	16,1	24,2	3
0	135	10	48	55	8	5	M6	10,8	15,2	2
0	155	10	48	55	8	5	M6	10,7	15,3	2
0	105	12	62	71	8	6	M6	28,6	53,5	5
0	150	12	62	71	8	6	M6	32,9	54,4	4
0	150	14	65	75,5	8	7	M6	51,8	75,5	4
0	190	14	65	75,5	8	7	M6	39,3	54,8	3
0	200	14	65	75,5	8	7	M6	26,2	34,2	2
0	110	14	70	81,5	10	7	M8x1	31,6	68,4	5
0	160	14	70	81,5	10	7	M8x1	58,4	97,1	4
0	192	14	70	81,5	10	7	M8x1	44,5	70,8	3
5	210	14	75	87,5	10	7	M8x1	59,7	87,6	3
5	210	16	85	97,5	10	8	M8x1	74,3	104,8	3
5	250	14	75	87,5	10	7	M8x1	39,6	54,3	2
5	250	16	85	97,5	10	8	M8x1	49,4	64,6	2
6	130	16	85	97,5	10	8	M8x1	40,8	105,5	6
6	185	16	85	97,5	10	8	M8x1	98,4	179,5	5
0	240	16	85	97,5	10	8	M8x1	80,0	140,8	4
5	250	16	92	105	10	8	M8x1	88,0	153,4	4
0	330	16	85	97,5	10	8	M8x1	79,5	141,2	4
5	330	16	92	105	10	8	M8x1	87,4	154,0	4
0	410	16	85	97,5	10	8	M8x1	78,8	141,0	4
5	410	16	92	105	10	8	M8x1	86,7	153,9	4
0	400	16	85	97,5	10	8	M8x1	59,7	102,5	3
5	400	16	92	105	10	8	M8x1	65,7	112,5	3
6	130	18	95	110	10	9	M8x1	44,5	132,1	6
6	210	18	95	110	10	9	M8x1	128,6	275,6	6
5	250	18	95	110	10	9	M8x1	88,9	179,1	4
5	350	20	100	117,5	10	10	M8x1	178,5	355,2	6
5	420	18	95	110	10	9	M8x1	88,0	178,1	4
5	430	20	100	117,5	10	10	M8x1	122,5	230,2	4
5	420	18	95	110	10	9	M8x1	66,9	129,7	3
5	420	20	100	117,5	10	10	M8x1	93,2	168,5	3
6	225	20	110	127,5	10	10	M8x1	115,8	321,3	6
6	225	20	113	130,5	10	10	M8x1	145,3	372,0	6
5	300	25	130	147,5	10	12,5	M8x1	207,8	406,1	4
5	350	25	130	147,5	10	12,5	M8x1	299,8	628,1	6
5	440	25	130	147,5	10	12,5	M8x1	206,7	407,9	4
5	480	25	130	147,5	10	12,5	M8x1	157,0	296,3	3
6	230	22	130	147,5	10	11	M8x1	126,3	401,9	6
6	230	22	133	150,5	10	11	M8x1	159,0	468,4	6
5	300	30	155	178,5	10	15	M8x1	230,0	510,1	4
5	380	30	155	178,5	10	15	M8x1	331,8	789,8	6
5	450	30	155	178,5	10	15	M8x1	229,2	512,6	4
5	235	25	155	178,5	10	12,5	M8x1	170,7	562,8	6
5	310	30	175	198,5	10	15	M8x1	248,6	619,6	4
5	390	30	175	198,5	10	15	M8x1	358,6	951,3	6
5	470	30	175	198,5	10	15	M8x1	248,0	616,9	4
5	320	40	215	245	10	20	M8x1	279,2	827,0	4
5	400	40	215	245	10	20	M8x1	402,9	1279,6	6
5	480	40	215	245	10	20	M8x1	278,8	830,6	4

Nut dimensions table **DpfM**

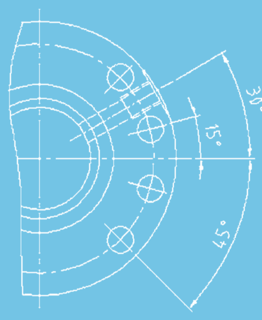
DpfM



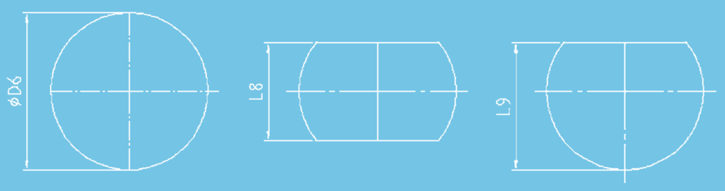
Drilling diagram 1



Drilling diagram 2



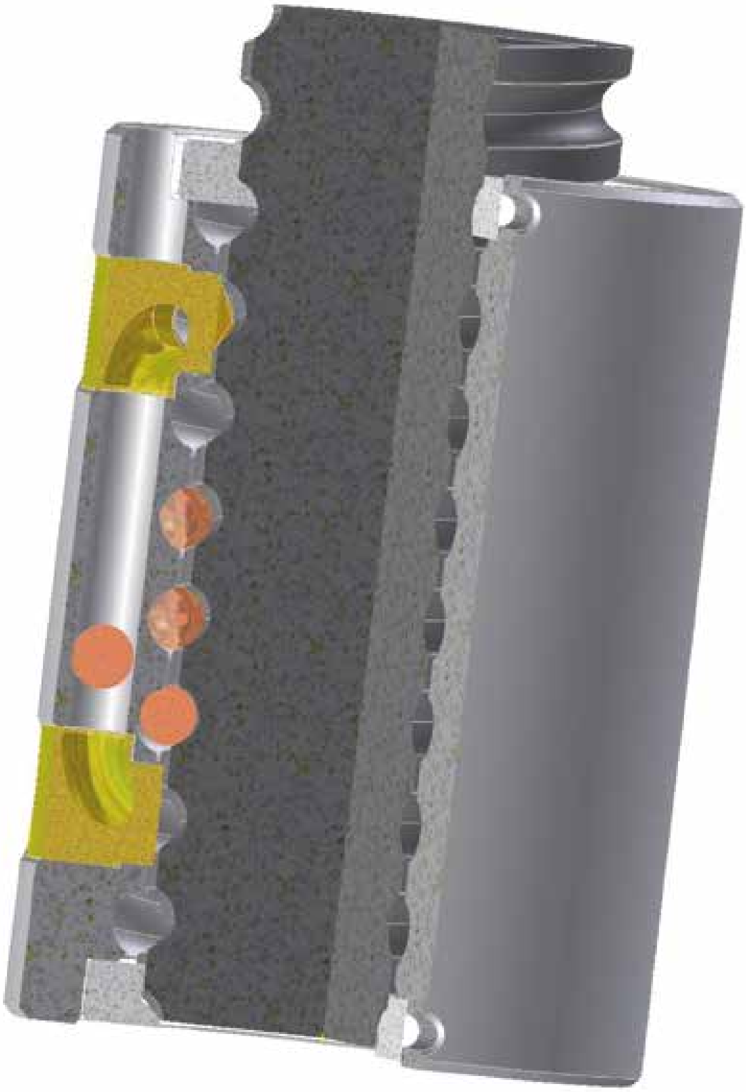
Forms of flange


Form A

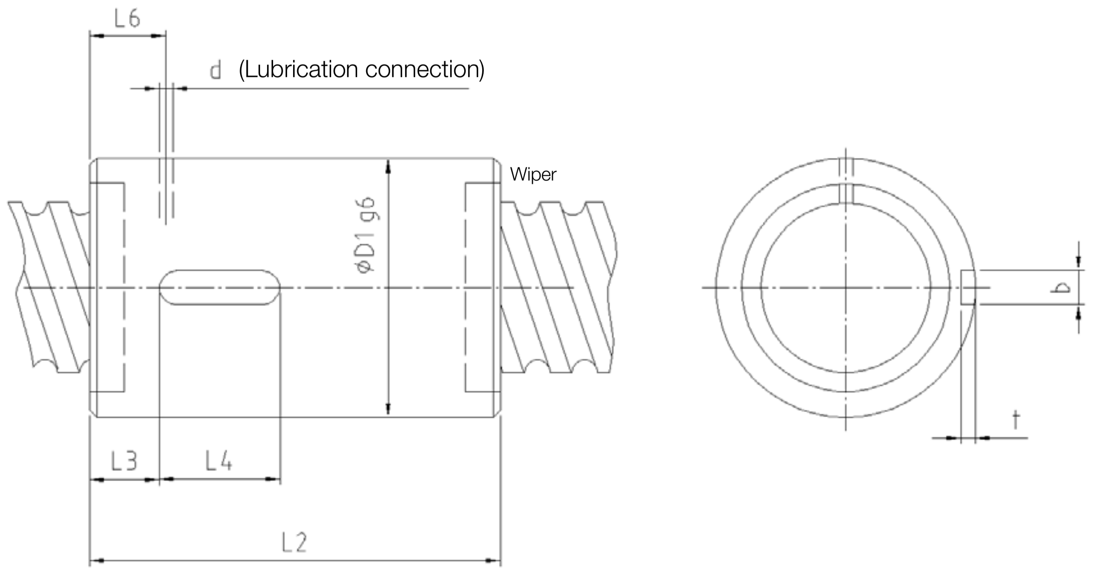
Form B

Form C

▶ **EM** Nut



Nut dimensions table **EM**



Dimension and lead	Spindle-Ø h6	Ball-Ø	Core-Ø Spindle	$D_{1\ g6}$	L_2	L_3	L_4	L_6	d	b_{P9}	t	C_{dyn} (KN)	C_{stat} (KN)	i
				Centr.Ø	Total length	Groove distance	Groove length	Drinning distance	Drill.Ø	Groove width	Groove depth	Rating	Rating	No. of revolution
16x5	16	2,38	14,0	28	45	10	16	10	4	4	2,4	10,4	15,2	4
16x10	16	2,38	14,0	28	55	10	16	10	4	4	2,4	7,9	11,0	3
16x16	16	2,38	14,0	28	60	10	16	10	4	4	2,4	5,3	6,9	2
20x5	20	3,175	17,2	36	52	11	20	10	4	5	2,9	20,9	32,1	5
20x10	20	3,175	17,2	36	55	11	20	10	4	5	2,9	13,0	18,4	3
20x20	20	3,175	17,2	36	65	11	20	10	4	5	2,9	8,6	11,6	2
25x5	24	3,5	20,9	40	60	12	20	10	4	5	2,9	25,9	42,5	5
25x10	24	3,5	20,9	40	60	12	20	10	4	5	2,9	16,1	24,2	3
25x20	24	3,5	20,9	40	70	12	20	10	4	5	2,9	10,8	15,2	2
25x25	24	3,5	20,9	40	80	12	20	10	4	5	2,9	10,7	15,3	2
32x5	30	3,5	26,9	50	60	13	20	10	4	5	2,9	28,6	53,5	5
32x10	30	4,5	26,4	50	80	20	28	12	4	5	2,9	41,1	68,0	5
32x10	30	6,35	25,0	56	75	20	28	12	4	5	2,9	51,8	75,5	4
32x20	30	6,35	25,0	56	95	20	28	12	4	5	2,9	39,3	54,8	3
32x32	30	6,35	25,0	56	95	20	28	12	4	5	2,9	26,2	34,2	2
40x5	38	3,5	34,9	63	70	15	20	12	4	6	3,5	31,6	68,4	5
40x10	38	6,35	33,0	63	88	25	28	12	4	6	3,5	58,4	97,1	4
40x20	38	6,35	33,0	63	90	25	28	12	4	6	3,5	44,5	70,8	3
40x20	38	8	31,3	70	105	25	28	12	4	6	3,5	59,7	87,6	3
40x20	38	9,52	30,3	75	105	25	28	12	4	6	3,5	74,3	104,8	3
40x40	38	8	31,3	70	130	25	28	12	4	6	3,5	39,6	54,3	2

40x40	38	9,52	30,3	75	130	25	28	12	4	6	3,5	49,4	64,6	2
50x5	48	3,5	44,9	75	90	28	28	12	4	6	3,5	40,8	105,5	6
50x10	48	7,5	40,8	75	98	28	28	12	4	6	3,5	98,4	179,5	5
50x20	48	7,5	40,8	75	125	28	28	12	4	6	3,5	80,0	140,8	4
50x20	48	8	41,3	82	125	28	28	12	4	6	3,5	88,0	153,4	4
50x30	48	7,5	40,8	75	160	28	28	12	4	6	3,5	79,5	141,2	4
50x30	48	8	41,3	82	160	28	28	12	4	6	3,5	87,4	154,0	4
50x40	48	7,5	40,8	75	210	28	28	12	4	6	3,5	78,8	141,0	4
50x40	48	8	41,3	82	210	28	28	12	4	6	3,5	86,7	153,9	4
50x50	48	7,5	40,8	75	200	28	28	12	4	6	3,5	59,7	102,5	3
50x50	48	8	41,3	82	200	28	28	12	4	6	3,5	65,7	112,5	3
63x5	60	3,5	56,9	90	70	28	28	12	4	6	3,5	44,5	132,1	6
63x10	60	7,5	52,8	90	120	32	28	12	4	6	3,5	128,6	275,6	6
63x20	60	7,5	52,8	90	125	40	45	16	4	8	4,1	88,9	179,1	4
63x20	60	9,52	52,3	95	180	40	45	16	4	8	4,1	178,5	355,2	6
63x40	60	7,5	52,8	90	210	40	45	16	4	8	4,1	88,0	178,1	4
63x40	60	9,52	52,3	95	210	40	45	16	4	8	4,1	122,5	230,2	4
63x50	60	7,5	52,8	90	210	40	45	16	4	8	4,1	66,9	129,7	3
63x50	60	9,52	52,3	95	210	40	45	16	4	8	4,1	93,2	168,5	3
80x10	80	6,35	75,0	105	125	35	28	14	4	6	3,5	115,8	321,3	6
80x10	80	7,5	72,8	108	125	35	28	14	4	6	3,5	145,3	372,0	6
80x20	80	12,7	69,5	125	150	40	45	16	4	8	4,1	207,8	406,1	4
80x20	80	12,7	69,5	125	190	40	45	16	4	8	4,1	299,8	628,1	6
80x40	80	12,7	69,5	125	220	40	45	16	4	8	4,1	206,7	407,9	4
80x60	80	12,7	69,5	125	240	40	45	16	4	8	4,1	157,0	296,3	3
100x10	100	6,35	95,0	125	125	40	28	14	4	6	3,5	126,3	401,9	6
100x10	100	7,5	92,8	128	125	40	28	14	4	6	3,5	159,0	468,4	6
100x20	100	12,7	89,5	150	160	50	45	16	4	10	4,7	230,0	510,1	4
100x20	100	12,7	89,5	150	190	50	45	16	4	10	4,7	331,8	789,8	6
100x40	100	12,7	89,5	150	230	50	45	16	4	10	4,7	229,2	512,6	4
120x10	120	7,5	112,8	150	125	40	28	14	4	8	4,1	170,7	562,8	6
120x20	120	12,7	109,5	170	160	50	55	16	4	10	4,7	248,6	619,6	4
120x20	120	12,7	109,5	170	190	50	55	16	4	10	4,7	358,6	951,3	6
120x40	120	12,7	109,5	170	240	50	55	16	4	10	4,7	248,0	616,9	4
160x20	160	12,7	149,5	210	160	50	55	16	4	10	4,7	279,2	827,0	4
160x20	160	12,7	149,5	210	190	50	55	16	4	10	4,7	402,9	1279,6	6
160x40	160	12,7	149,5	210	240	50	55	16	4	10	4,7	278,8	830,6	4

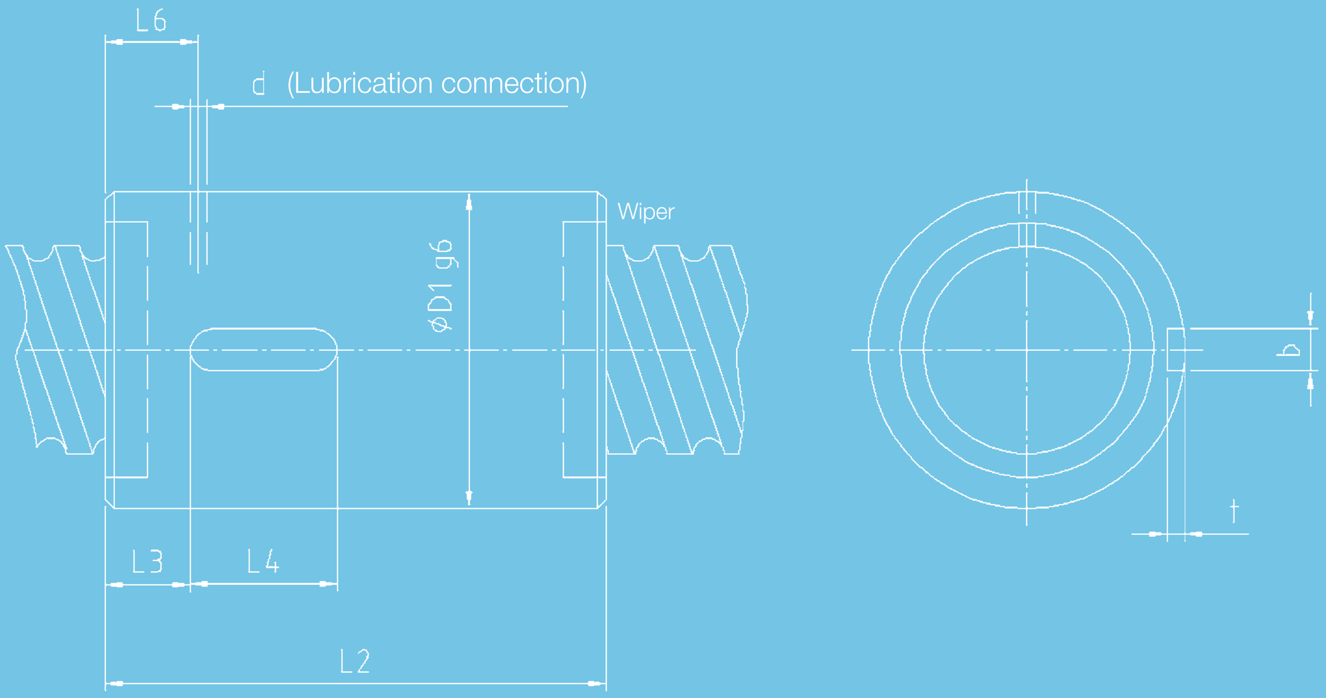
EM 08.04.2008

Same-construction left-handed threads, special pitches and double-thread versions are available on request.

Identical to versions of previous catalog

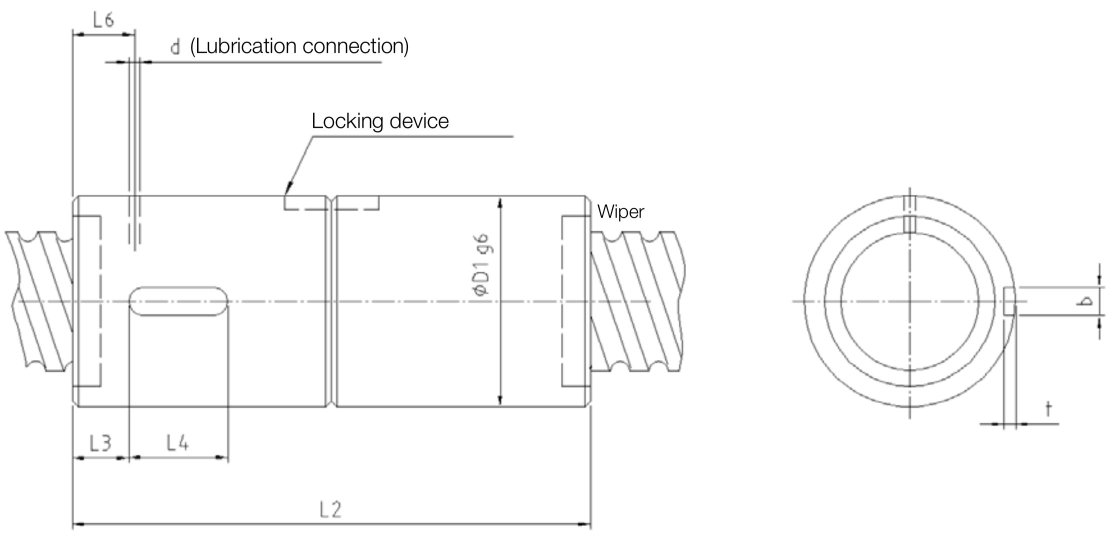
Yellow: special diameter D1+3mm due to thin walls.

EM



DpM Nut

Nut dimensions table **DpM**



Dimensions and lead	Spindle-Ø h6	Ball-Ø	Core-Ø Spindle	$D_{1\ g6}$ Centr.Ø	L_2 Total length	L_3 Groove distance	L_4 Groove length	L_6 Drilling distance	d Drill. Ø	b_{P9} Groove width	t Groove depth	C_{dyn} (KN) Rating	C_{stat} (KN) Rating	i No. of revolution
16x5	16	2,38	14,0	28	80	10	16	10	4	4	2,4	10,4	15,2	4
16x10	16	2,38	14,0	28	110	10	16	10	4	4	2,4	7,9	11,0	3
16x16	16	2,38	14,0	28	110	10	16	10	4	4	2,4	5,3	6,9	2
20x5	20	3,175	17,2	36	90	11	20	10	4	5	2,9	20,9	32,1	5
20x10	20	3,175	17,2	36	105	12	20	10	4	5	2,9	13,0	18,4	3
20x20	20	3,175	17,2	36	130	12	20	10	4	5	2,9	8,6	11,6	2
25x5	24	3,5	20,9	40	90	12	20	10	4	5	2,9	25,9	42,5	5
25x10	24	3,5	20,9	40	105	12	20	10	4	5	2,9	16,1	24,2	3
25x20	24	3,5	20,9	40	130	12	20	10	4	5	2,9	10,8	15,2	2
25x25	24	3,5	20,9	40	150	12	20	10	4	5	2,9	10,7	15,3	2
32x5	30	3,5	26,9	50	100	13	20	10	4	5	2,9	28,6	53,5	5
32x10	30	4,5	26,4	50	140	20	28	12	4	5	2,9	32,9	54,4	4
32x10	30	6,35	25,0	56	140	20	28	12	4	6	3,5	51,8	75,5	4
32x20	30	6,35	25,0	56	180	20	28	12	4	6	3,5	39,3	54,8	3
32x32	30	6,35	25,0	56	190	20	28	12	4	6	3,5	26,2	34,2	2
40x5	38	3,5	34,9	63	108	15	20	12	4	6	3,5	31,6	68,4	5
40x10	38	6,35	33,0	63	150	25	28	12	4	6	3,5	58,4	97,1	4
40x20	38	6,35	33,0	63	175	25	28	12	4	6	3,5	44,5	70,8	3
40x20	38	8	31,3	75	200	25	28	12	4	6	3,5	59,7	87,6	3
40x20	38	9,52	30,3	75	200	25	28	12	4	6	3,5	74,3	104,8	3
40x40	38	8	31,3	70	240	25	28	12	4	6	3,5	39,6	54,3	2

40x40	38	9,52	30,3	75	240	25	28	12	4	6	3,5	49,4	64,6	2
50x5	48	3,5	44,9	75	150	25	28	12	4	6	3,5	40,8	105,5	6
50x10	48	7,5	40,8	75	170	28	28	12	4	6	3,5	98,4	179,5	5
50x20	48	7,5	40,8	75	230	28	28	12	4	6	3,5	80,0	140,8	4
50x20	48	8	41,3	82	240	28	28	12	4	6	3,5	88,0	153,4	4
50x30	48	7,5	40,8	75	320	28	28	12	4	6	3,5	79,5	141,2	4
50x30	48	8	41,3	82	320	28	28	12	4	6	3,5	87,4	154,0	4
50x40	48	7,5	40,8	75	400	28	28	12	4	6	3,5	78,8	141,0	4
50x40	48	8	41,3	82	400	28	28	12	4	6	3,5	86,7	153,9	4
50x50	48	7,5	40,8	75	390	28	28	12	4	6	3,5	59,7	102,5	3
50x50	48	8	41,3	82	390	28	28	12	4	6	3,5	65,7	112,5	3
63x5	60	3,5	56,9	90	120	28	28	12	4	6	3,5	44,5	132,1	6
63x10	60	7,5	52,8	90	190	32	28	12	4	6	3,5	128,6	275,6	6
63x20	60	7,5	52,8	90	240	40	45	16	4	8	4,1	88,9	179,1	4
63x20	60	9,52	52,3	95	330	40	45	16	4	8	4,1	178,5	355,2	6
63x40	60	7,5	52,8	90	410	40	45	16	4	8	4,1	88,0	178,1	4
63x40	60	9,52	52,3	95	420	40	45	16	4	8	4,1	122,5	230,2	4
63x50	60	7,5	52,8	90	400	40	45	16	4	8	4,1	66,9	129,7	3
63x50	60	9,52	52,3	95	400	40	45	16	4	8	4,1	93,2	168,5	3
80x10	80	6,35	75,0	105	200	35	45	14	4	8	4,1	115,8	321,3	6
80x10	80	7,5	72,8	108	200	35	45	14	4	8	4,1	145,3	372,0	6
80x20	80	12,7	69,5	125	285	40	45	16	4	8	4,1	207,8	406,1	4
80x20	80	12,7	69,5	125	330	40	45	16	4	8	4,1	299,8	628,1	6
80x40	80	12,7	69,5	125	420	40	45	16	4	8	4,1	206,7	407,9	4
80x60	80	12,7	69,5	125	460	40	45	16	4	8	4,1	157,0	296,3	3
100x10	100	6,35	95,0	125	210	40	45	14	4	8	4,1	126,3	401,9	6
100x10	100	7,5	92,8	128	210	40	45	14	4	8	4,1	159,0	468,4	6
100x20	100	12,7	89,5	150	280	50	45	16	4	10	4,7	230,0	510,1	4
100x20	100	12,7	89,5	150	360	50	45	16	4	10	4,7	331,8	789,8	6
100x40	100	12,7	89,5	150	430	50	45	16	4	10	4,7	229,2	512,6	4
120x10	120	7,5	112,8	150	215	40	28	14	4	8	4,1	170,7	562,8	6
120x20	120	12,7	109,5	170	290	50	55	16	4	10	4,7	248,6	619,6	4
120x20	120	12,7	109,5	170	370	50	55	16	4	10	4,7	358,6	951,3	6
120x40	120	12,7	109,5	170	450	50	55	16	4	10	4,7	248,0	616,9	4
160x20	160	12,7	149,5	210	300	50	55	16	4	10	4,7	279,2	827,0	4
160x20	160	12,7	149,5	210	380	50	55	16	4	10	4,7	402,9	1279,6	6
160x40	160	12,7	149,5	210	460	50	55	16	4	10	4,7	278,8	830,6	4

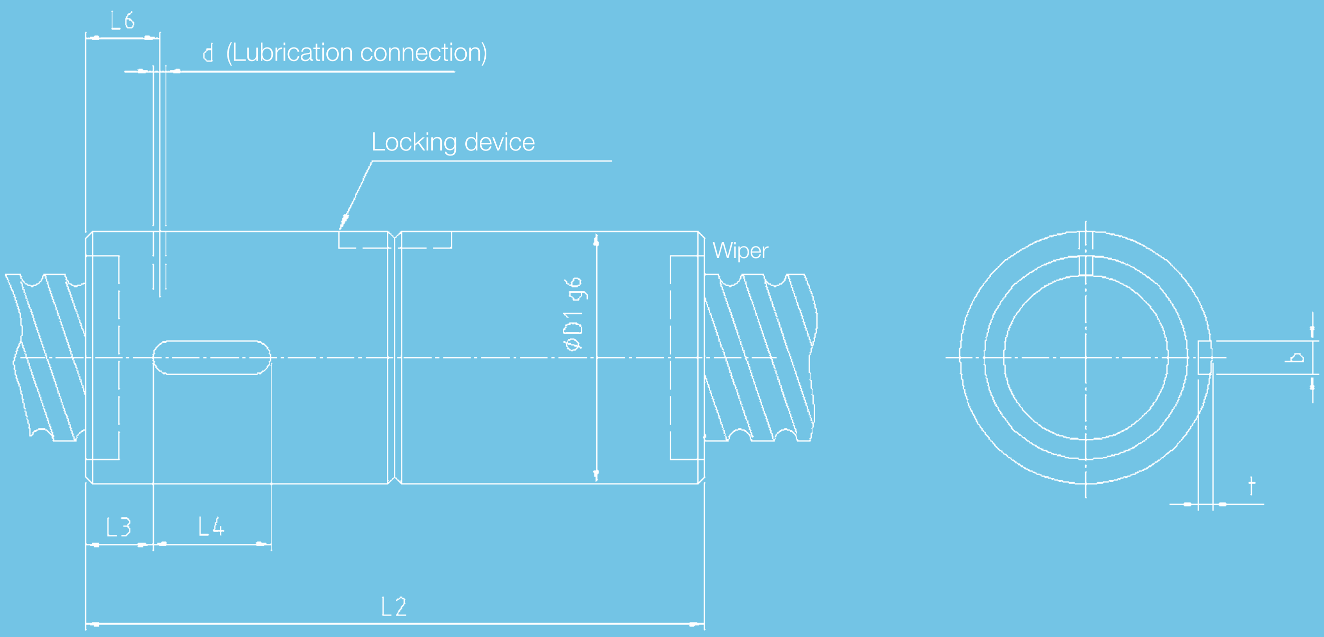
DpM 08.04.2008

Same-construction left-handed threads, special pitches and double-thread versions are available on request.

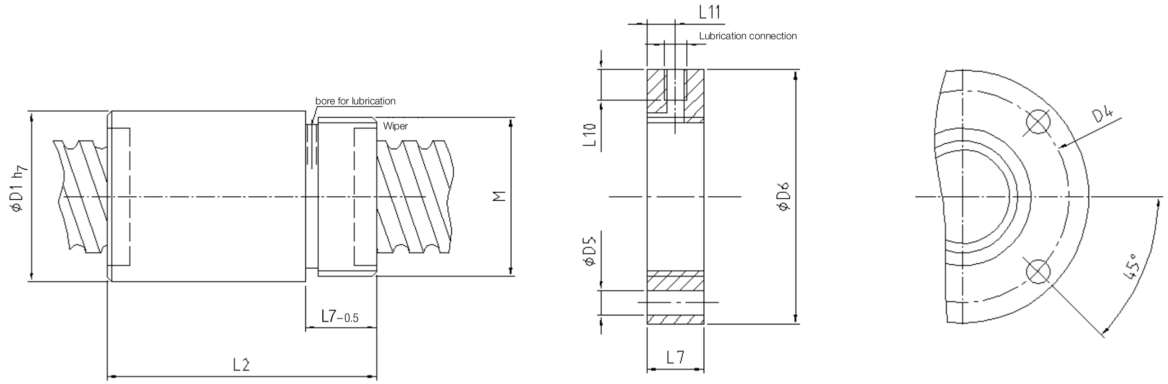
Identical to versions of previous catalog

Yellow: special diameter D1+3mm due to thin walls.

DpM


L6
d (Lubrication connection)
Locking device
Wiper
ØD1 g6
L3
L4
L2
b
t

Nut dimensions table **FG**



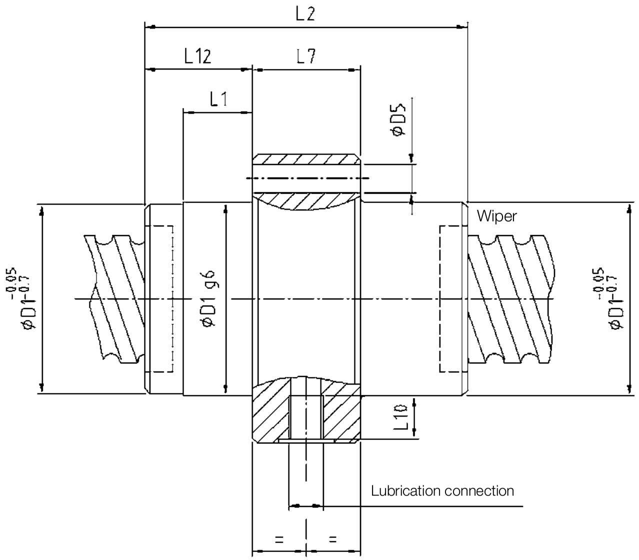
Dimensions and lead	Spindle-Ø h6	Ball-Ø	Core-Ø Spindle	$D_{1\,h7}$	D_4	No. of holes	D_5	D_6	L_2	L_7	L_{10}	L_{11}	Lubric. connect.	M	C_{dyn} (KN)	C_{stat} (KN)	i
				Centr. Ø	Geome-trical Ø		Drill.-Ø	Flange-Ø	Total length	Flange width	Thread depth	Distance lubrication		Tread	Rating	Rating	Revolu-tions
16x5	16	3,175	14,0	32	45	4	6	60	42	12	8	6	M6	M26x1,5	11,7	14,6	3
20x5	20	3,175	17,3	40	55	4	7	70	52	12	8	6	M6	M35x1,5	17,0	25,3	4
20x10	20	4,5	16,4	40	55	4	7	70	65	12	8	6	M6	M35x1,5	20,5	26,3	3
25x5	24	3,5	20,9	45	65	4	9	84	60	15	8	7,5	M6	M40x1,5	25,9	42,5	5
25x10	24	3,5	20,9	45	65	4	9	84	60	12	8	6	M6	M40x1,5	16,1	24,2	3
32x5	30	3,5	26,9	52	72	4	9	90	60	15	8	7,5	M6	M48x1,5	28,6	53,5	5
32x10	30	6,35	25,0	56	80	4	11	100	80	15	8	7,5	M6	M52x1,5	51,8	75,5	4
40x5	38	3,5	34,9	65	90	4	11	110	70	18	10	9	M8x1	M60x1,5	37,2	83,2	6
40x10	38	6,35	33,0	65	90	4	11	110	88	18	10	9	M8x1	M60x1,5	58,4	97,1	4
40x20	38	6,35	33,0	65	90	4	11	110	88	18	10	9	M8x1	M60x1,5	30,2	44,1	2
40x30	38	6,35	33,0	65	90	4	11	110	100	18	10	9	M8x1	M60x1,5	29,9	44,7	2
50x10	48	7,5	40,8	80	110	4	14	135	100	20	10	10	M8x1	M75x1,5	98,4	179,5	5
50x20	48	7,5	40,8	80	110	4	14	135	114	20	10	10	M8x1	M75x1,5	61,4	103,2	3
63x10	60	7,5	52,8	95	125	6	14	150	120	20	10	10	M8x1	M90x1,5	128,6	275,6	6
63x20	60	8	53,3	95	125	6	14	150	138	20	10	10	M8x1	M90x1,5	97,7	192,5	4
63x40	60	8	53,3	95	125	6	14	150	138	20	10	10	M8x1	M90x1,5	50,4	87,3	2

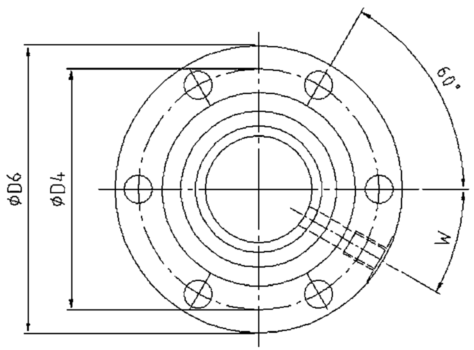
FG 08.04.2008

Same-construction left-handed threads, special pitches and double-thread versions are available on request.

Identical to versions of previous catalog

Nut dimensions table **MFM**





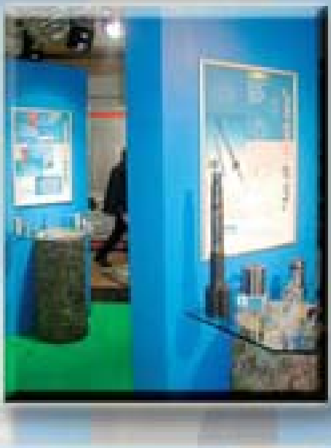
Dimensions and lead	Spindle-Ø h6	Ball-Ø	Core-Ø Spindle	D_{1g6}	D_4	No. of holes	D_5	D_6	L_1	L_2	L_7	W	L_{10}	L_{12}	D_7	C_{dyn} (KN)	C_{stat} (KN)	i
				Centr. Ø	Geo-metr. Ø		Drill.-Ø	Flange-Ø	Fit size	Total length	Flange width	Angle	Thread depth	neck length	Lubric. connect.	Rating	Rating	Revolu-tions
16x10	16	2,38	14,0	33	45	6x60°	6,6	58	10	45	15	40	8	15	M6	7,9	11,0	3
16x16	16	2,38	14,0	33	45	6x60°	6,6	58	10	55	15	40	8	20	M6	5,3	6,9	2
20x10	20	3,175	17,2	38	50	6x60°	6,6	63	10	64	20	30	8	22	M6	16,9	25,1	4
20x20	20	3,175	17,2	38	50	6x60°	6,6	63	10	64	20	30	8	22	M6	8,6	11,6	2
25x20	24	4,5	20,4	48	60	6x60°	6,6	73	16	90	25	42	8	32,5	M6	22,3	31,3	3
25x25	24	4,5	20,4	48	60	6x60°	6,6	73	16	80	25	42	8	27,5	M6	15,0	19,9	2
32x20	30	6,35	25,0	56	68	6x60°	6,6	80	16	88	20	30	8	34	M6	39,3	54,8	3
32x32	30	6,35	25,0	56	68	6x60°	6,6	80	16	92	20	30	8	36	M6	26,2	34,2	2
40x20	38	6,35	33,0	63	78	6x60°	9	95	16	88	25	30	10	31,5	M8x1	44,5	70,8	3
40x40	38	6,35	33,0	72	90	6x60°	11	110	16	113	40	41	10	36,5	M8x1	29,5	43,8	2
50x20	48	9,52	40,3	85	105	6x60°	11	125	16	92	30	30	10	31	M8x1	84,8	131,2	3
50x40	48	9,52	40,3	85	105	6x60°	11	125	16	113	30	30	10	41,5	M8x1	56,7	81,6	2
63x40	60	9,52	52,3	95	118	6x60°	14	140	16	120	30	20	10	45	M8x1	63,8	104,6	2
63x50	60	9,52	52,3	95	118	6x60°	14	140	16	140	30	20	10	55	M8x1	63,3	103,4	2
80x40	80	12,7	69,5	125	152	6x60°	18	180	16	133	30	30	10	51,5	M8x1	107,6	187,8	2
80x60	80	12,7	69,5	125	152	6x60°	18	180	16	165	30	30	10	67,5	M8x1	106,6	185,6	2

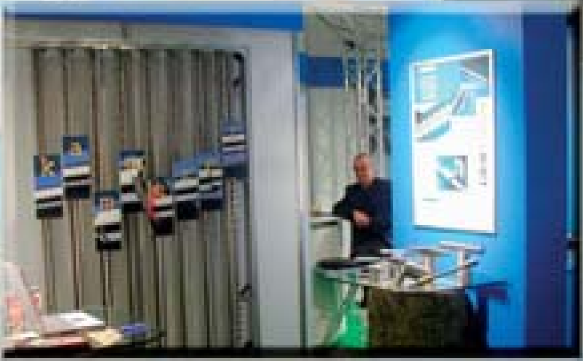
MFM 04.04.2008 Same-construction left-handed threads, special pitches and double-thread versions are available on request.

Identical to versions of previous catalog

Fair impressions

EMO

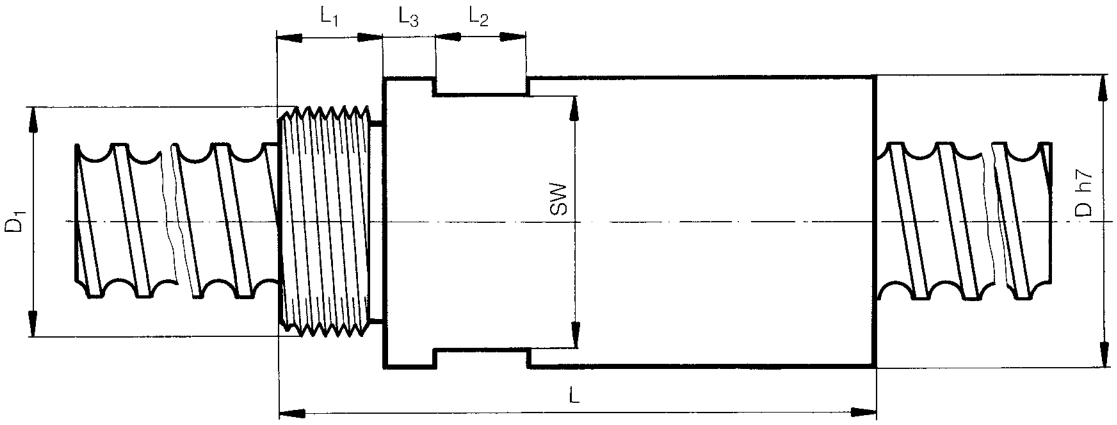




For our customers...

...individual services

Miniature single nut

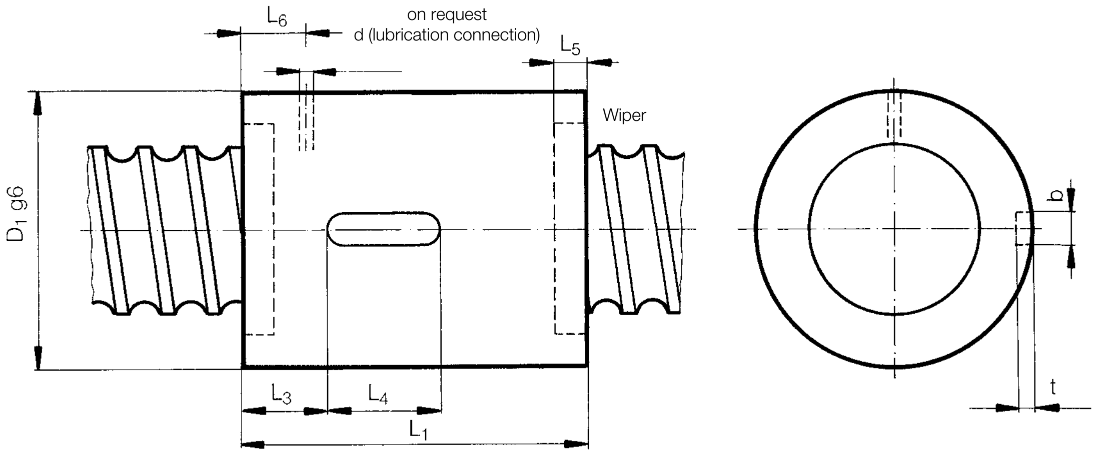


For exact outside diameter of spindles see page 45

D x P	D h7	D_1	L	L_1	L_2	L_3	SW	o = single nut x = double nut internally pre-loaded	C_{dyn}	C_{stat}
KGT 6 x 1	15	M 10 x 1	35	5	6	5	14	o	600 N	900 N
KGT 8 x 1	20	M 14 x 1	40	8	6	5	17	o	700 N	1.300 N
KGT 8 x 2	20	M 14 x 1	40	8	6	5	17	o	900 N	1.500 N
KGT 10 x 2	25	M 18 x 1	50	10	8	5	22	o	1.500 N	2.900 N
KGT 12 x 2	24	M 18 x 1	42	10	10	6,5	22	x	2.500 N	3.200 N
KGT 12 x 3	26	M 18 x 1	46	10	10	6,5	24	x	4.000 N	4.900 N
KGT 12 x 4	26	M 18 x 1	50	10	10	6,5	24	x	4.000 N	4.900 N
KGT 12 x 5	26	M 18 x 1	54	10	10	6,5	24	x	4.000 N	4.900 N
KGT 12 x 8	26	M 18 x 1	46	10	10	6,5	24	o	4.000 N	4.900 N

Any special leads and imperial threads can be provided on request.

Miniature single nut without flange

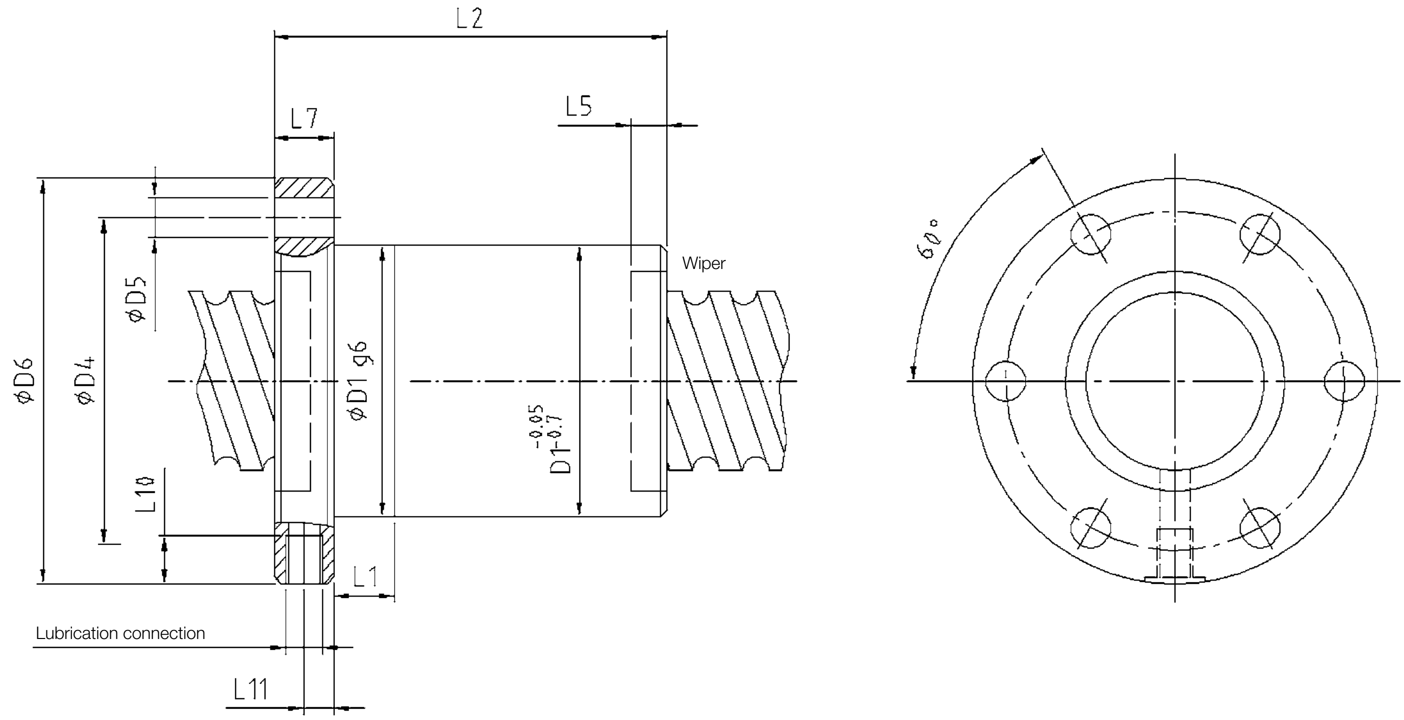


For exact outside diameter of spindles see page 45

D x P	$D_{1\ g6}$	d	L_1	L_3	L_4	L_6	b_{P9}	t	L_5	i	o = single nut x = double nut internally pre-loaded	C_{dyn}	C_{stat}
KGT 6 x 1	12	–	11	–	–	–	–	–	–	2	o	600 N	900 N
KGT 8 x 1	14	–	13	–	–	–	–	–	–	3	o	700 N	1.300 N
KGT 8 x 2	14	–	13	–	–	–	–	–	–	2	o	900 N	1.500 N
KGT 10 x 2	18	–	19	–	–	–	–	–	–	3	o	1.500 N	2.900 N
KGT 12 x 2	24	2	22	5,0	10	5	4	2,4	4	2	o	2.500 N	3.200 N
KGT 12 x 3	26	2	22	6,0	10	5	4	2,4	4	2	o	4.000 N	4.900 N
KGT 12 x 4	26	2	24	7,0	10	5	4	2,4	4	2	o	4.000 N	4.900 N
KGT 12 x 5	26	2	26	8,0	10	5	4	2,4	4	2	o	4.000 N	4.900 N
KGT 12 x 8	26	2	32	8,0	16	5	4	2,4	4	2	o	4.000 N	4.900 N
KGT 12 x 2	24	2	28	6,0	16	5	4	2,4	4	2/2	x	2.300 N	3.200 N
KGT 12 x 3	26	2	32	8,0	16	5	4	2,4	4	2/2	x	4.000 N	4.900 N
KGT 12 x 4	26	2	36	8,0	20	5	4	2,4	4	2/2	x	4.000 N	4.900 N
KGT 12 x 5	26	2	40	10,0	20	5	4	2,4	4	2/2	x	4.000 N	4.900 N
KGT 12 x 8	26	2	52	16,0	20	5	4	2,4	4	2/2	x	4.000 N	4.900 N

Any special leads and imperial threads can be provided on request.

Miniature single nut with flange



For exact outside diameter of spindles see page 45

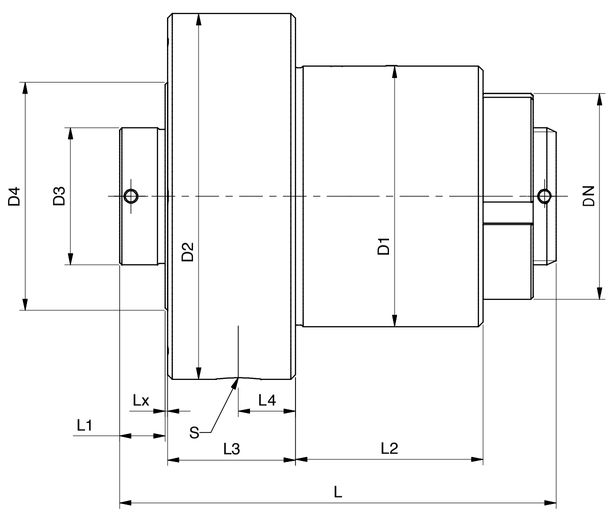
D x P	$D_{1\ g6}$	D_4	D_5	D_6	L_1	L_2	L_5	L_7	L_{10}	L_{11}	Lub. conn.	i	o = single nut x = double nut internally pre-loaded	C_{dyn}	C_{stat}
KGT 6 x 1	12	18	3,3	24	11	15	–	4	–	–	*)	2	o	600 N	900 N
KGT 8 x 1	14	21	3,3	27	12	16	–	4	–	–	*)	3	o	700 N	1.300 N
KGT 8 x 2	14	21	3,3	27	12	16	–	4	–	–	*)	2	o	900 N	1.500 N
KGT 10 x 2	18	27	4,5	35	23	28	–	5	–	–	*)	3	o	1.500 N	2.900 N
KGT 12 x 2	24	31	4,5	38	7	25	4	8	7	4	M6	2	o	2.500 N	3.200 N
KGT 12 x 3	26	33	4,5	40	7	24	4	8	7	4	M6	2	o	4.000 N	4.900 N
KGT 12 x 4	26	33	4,5	40	7	26	4	8	7	4	M6	2	o	4.000 N	4.900 N
KGT 12 x 5	26	33	4,5	40	7	28	4	8	7	4	M6	2	o	4.000 N	4.900 N
KGT 12 x 8	26	33	4,5	40	7	34	4	8	7	4	M6	2	o	4.000 N	4.900 N
KGT 12 x 2	24	31	4,5	38	7	30	4	8	7	4	M6	2/2	x	2.500 N	3.200 N
KGT 12 x 3	26	33	4,5	40	7	34	4	8	7	4	M6	2/2	x	4.000 N	4.900 N
KGT 12 x 4	26	33	4,5	40	7	38	4	8	7	4	M6	2/2	x	4.000 N	4.900 N
KGT 12 x 5	26	33	4,5	40	7	42	4	8	7	4	M6	2/2	x	4.000 N	4.900 N
KGT 12 x 8	26	33	4,5	40	7	54	4	8	7	4	M6	2/2	x	4.000 N	4.900 N

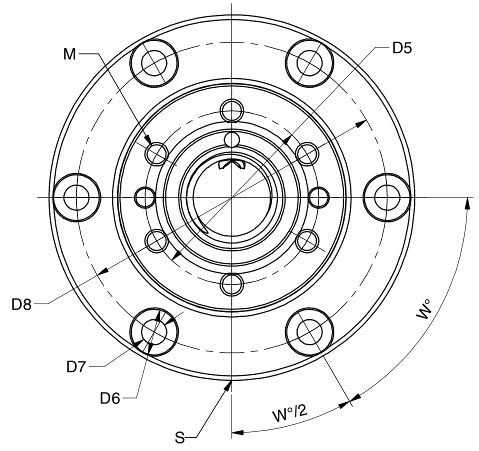
Any special leads and imperial threads can be provided on request.

*) = on request (special)

We offer innovation, competence, efficiency

Driven nut





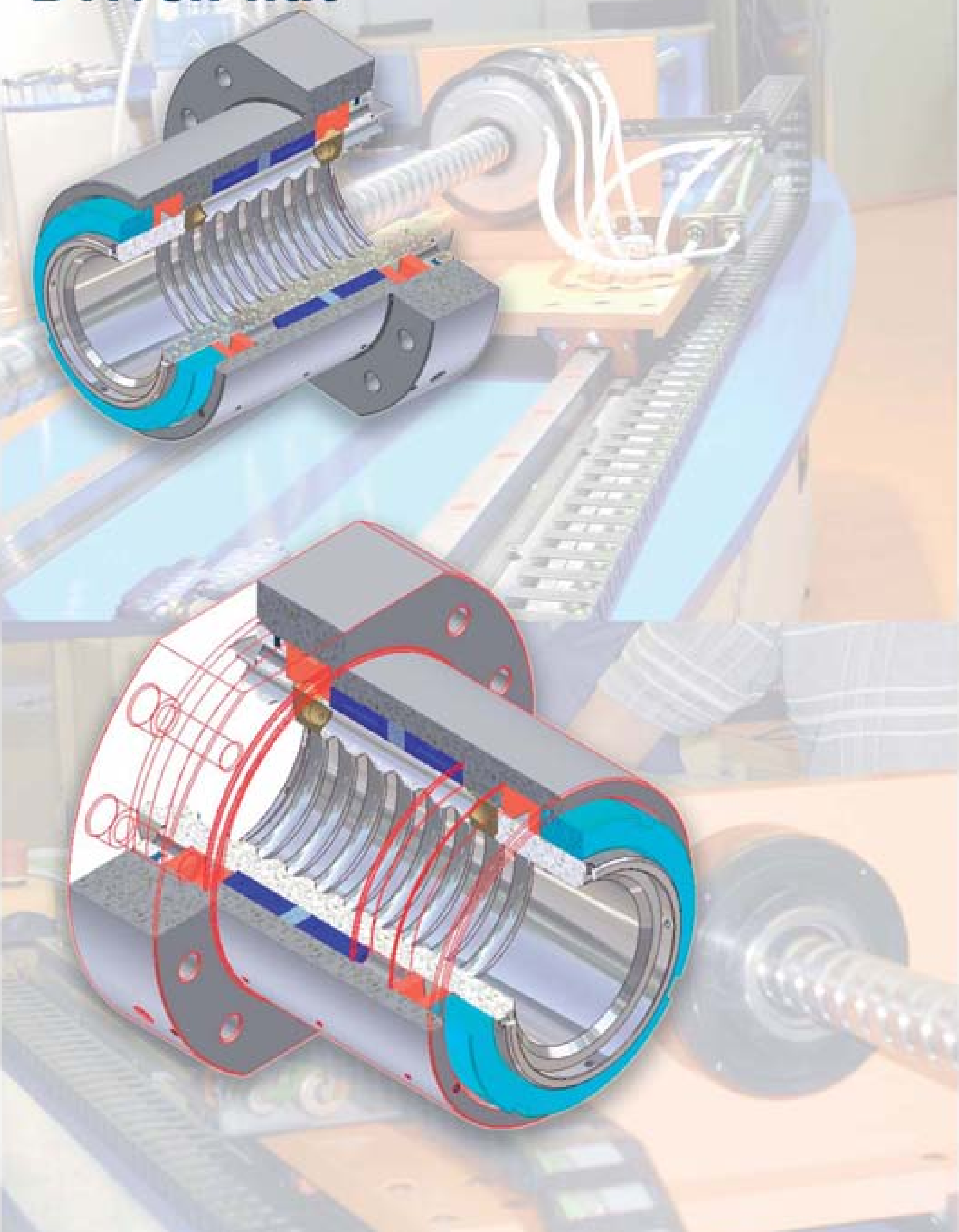
We recommend lubrication with oil/air mixture (oil mist).
The nuts require three times the lubrication quantity of standard nuts.
The connection is provided with a check valve to avoid return of the lubricant.
More information on request.

Dimension KGT	Lead max.	No. of revolut.	Ball-Ø	Limit speed (*1)	Load rating C stat. (KN)	Load rating C dyn. (KN)	$D_{1\ g6}$	D_2	$D_{3\ g6}$	$D_{4-0,2}$	$D_{5\pm0,2}$	D_6	D_7	$D_{8\pm0,2}$	DN	L	L_1	L_2	L_3	L_4	M	W
KGT 16x5	16	5	3,175	3000	25	18	57	80	30	50	38	10	5,5	68	45	95,5	10	41	28	12,5	6xM5/10	6x60°
KGT 20x5	20	5	3,175	3000	32	20	60	80	35	55	43	10	5,5	68	52	108,5	10	56	28	12	6xM5/10	6x60°
KGT 20x10	20	5	3,175	3000	32	20	60	80	35	55	43	10	5,5	68	52	118,5	10	66	28	12	6xM5/10	6x60°
KGT 25x5	25	6	3,5	3000	51	30	70	95	43	65	52	11	6,6	82	58	119	15	50	35	13	6xM6/13	6x60°
KGT 25x6	25	5	4,5	3000	55	36	70	95	43	65	52	11	6,6	82	58	119	15	50	35	13	6xM6/13	6x60°
KGT 32x5	10	6	3,5	3000	65	33	75	110	49	75	60	15	9	93	65	131,5	15	67,5	35	13	6xM6/13	6x60°
KGT 32x6	20	5	4,5	3000	69	40	75	110	49	75	60	15	9	93	65	131,5	15	67,5	35	13	6xM6/13	6x60°
KGT 32x10	32	4	6,35	3000	75	51	85	120	55	78	63	15	9	100	70	139,5	15	68	40	17	6xM6/13	6x60°
KGT 40x5	40	6	3,5	3000	83	37	90	125	54	85	68	15	9	105	75	136,5	15	61	40	16,5	6xM8/15	6x60°
KGT 40x10	40	6	6,35	3000	149	84	95	130	62	90	73	15	9	110	80	155,5	15	79	40	16	6xM8/15	8x45°
KGT 40x20	40	4	9,52	3000	142	97	105	140	73	105	86	15	9	122	85	187	15	103	45	20,5	8xM8/15	8x45°
KGT 40x40	40	2	9,52	3000	64	49	105	140	73	105	86	15	9	122	85	190,5	15	106,5	45	20,5	8xM8/15	8x45°
KGT 50x5	10	6	3,5	3000	105	40	105	140	65	100	82	15	9	122	92	163,5	15	78	47	17,5	6xM8/16	6x60°
KGT 50x10	50	5	7,5	3000	179	98	120	155	72	110	90	15	9	136	105	171	15	92	47	17,5	6xM8/16	8x45°
KGT 50x20	50	3	9,52	3000	131	84	120	155	83	115	95	15	9	136	105	192,5	15	112	47	17,5	6xM8/16	8x45°
KGT 63x10	60	5	6,35	3000	197	87	120	170	85	115	96	18	11	145	105	183,5	15	102	45	20	8xM8/15,5	8x45°
KGT 63x20	60	5	9,52	2450	291	151	140	190	95	135	110	20	13,5	165	110	204,5	15	112	55	27,5	8xM8/15,5	8x45°
KGT 80x20	60	6	12,7	2000	628	300	190	270	125	170	144	26	17,5	230	155	252	20	138	70	35	8xM10/20,5	12x30°
KGT 100x20	100	6	12,7	1600	790	331	220	300	135	200	166	33	22	260	195	282	30	158	70	28,5	8xM12/23	8x45°
KGT 100x40	100	6	12,7	1600	790	330	220	300	135	200	166	33	22	260	195	400	30	276	70	28,5	8xM12/23	8x45°
KGT 120x20	100	6	12,7	1500	951	358	250	330	170	225	190	33	22	290	220	280	30	156	70	28	8xM16/23	12x30°

(*1) Speed limit due to
nut or bearing specifications
with oil lubrication
(grease lubrication -30 %)

We recommend the use of screws of propoerty class 10.9 or higher

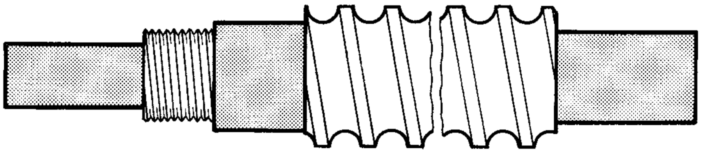
Driven nut



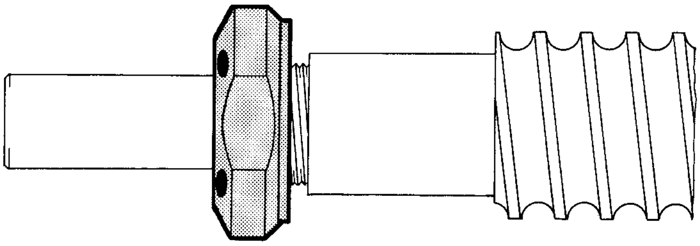
Fair impressions

EMO

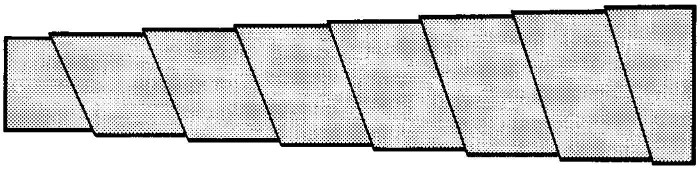
▶ Spindle ends



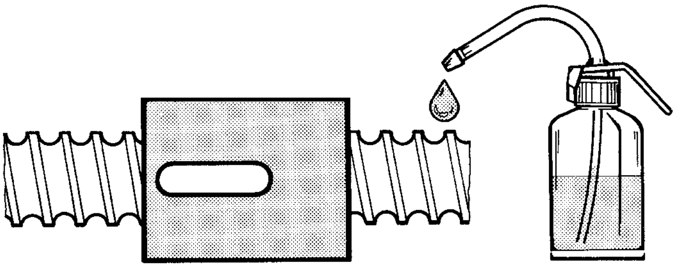
▶ KMT nuts



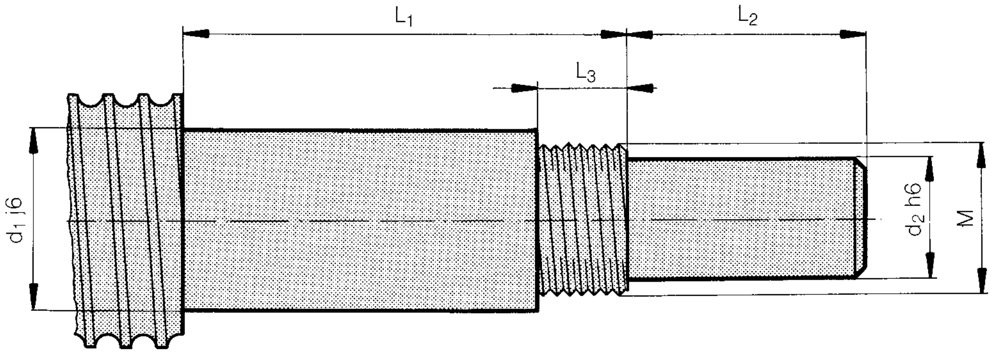
▶ Spiral spring covers

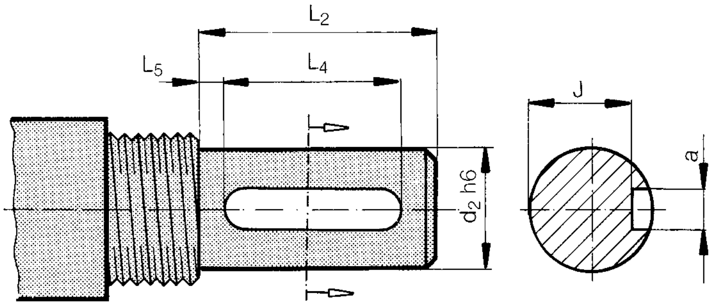


▶ Lubrication – Lubricants



Standard spindle ends

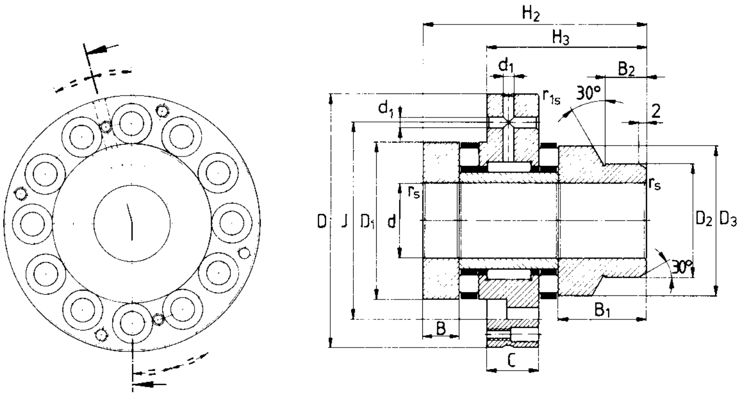




KGT	d_1 j6	d_2 h6	L_1	L_2	L_3	L_4	L_5	M	J	a_{P9}	Bearing ZARF/LTN	Lock nut
25 x 5	15	12	70	25	18	16	3	M 15x1	9,5	4	1560 LTN	KMT 2 M 15x1
32 x 5	20	15	79	30	20	22	4	M 20x1	12,0	5	2068 LTN	KMT 4 M 20x1
32 x 10	20	15	94	30	20	22	4	M 20x1	12,0	5	2080 LTN	KMT 4 M 20x1
40 x 5	25	20	86	40	22	28	5	M 25x1,5	16,5	6	2575 LTN	KMT 5 M 25x1,5
40 x 10	25	20	86	40	22	28	5	M 25x1,5	16,5	6	2590 LTN	KMT 5 M 25x1,5
50 x 10	35	25	105	60	24	40	8	M 35x1,5	20,8	8	35110 LTN	KMT 7 M 35x1,5
63 x 10	40	30	115	80	24	63	8	M 40x1,5	25,0	10	40115 LTN	KMT 8 M 40x1,5
80 x 10	55	40	128	110	27	90	8	M 55x2	34,5	14	55145 LTN	KMT 11 M 55x2

Needle axial cylinder roller bearings

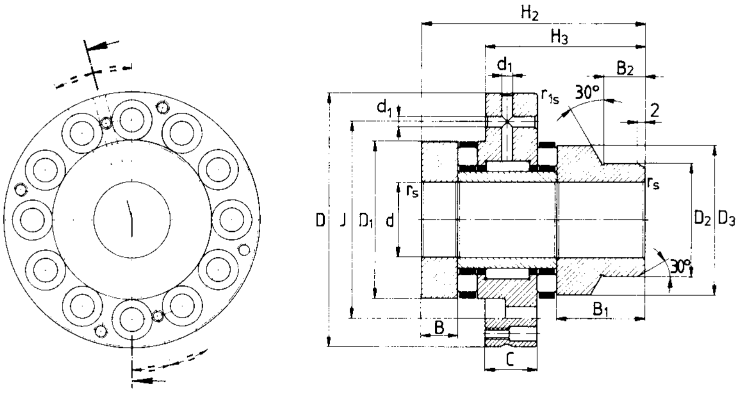
Range ZARF .. L
Light duty range



Shaft diameter	Code	Weight	Dimensions																	Fixing screws DIN 912 1) 10.9 Qty		Ratings				Limiting speed		Axial rigidity c_{al} N/µm
		kg	d	D	H	H_1	H_2	H_3	C	D_1	D_2	D_3	B	B_1	B_2	r_s min.	r_{1s} min.	d_1	J			axial dyn. C N	stat. C_0 N	radial dyn. C N	stat. C_0 N	n_g oil rpm	n_g grease rpm	
15	ZARF 1560 LTN	0,45	15	60	–	–	53	39	14	35	24	34	7,5	20,5	11	0,3	0,6	3,2	46	M6	6	24.900	53.000	13.000	17.500	8.500	2.200	1.400
20	ZARF 2068 LTN	0,61	20	68	–	–	60	43	14	42	30	40	10	24	11	0,3	0,6	3,2	53	M6	8	33.500	76.000	14.900	22.400	7.000	2.000	1.800
25	ZARF 2575 LTN	0,84	25	75	–	–	65	48	18	47	36	45	10	25	11	0,3	0,6	3,2	58	M6	8	35.500	86.000	22.600	36.000	6.000	1.900	1.900

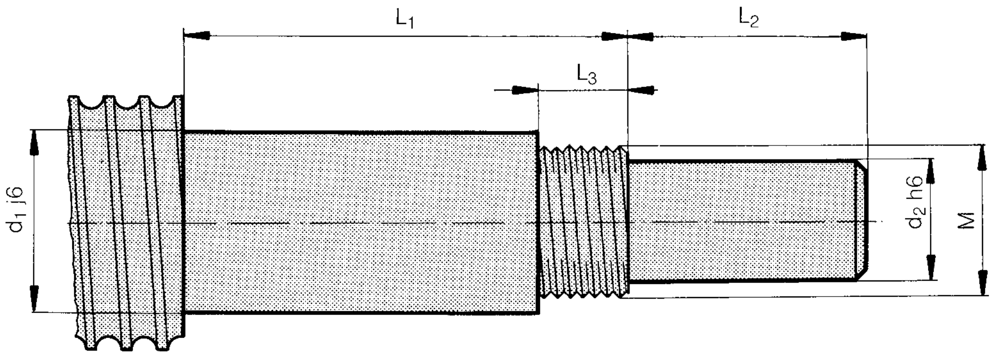
Needle axial cylinder roller bearings

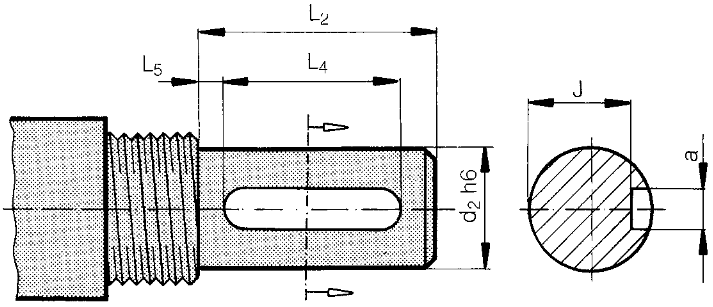
Range ZARF .. L
Heavy duty range



Shaft diameter	Code	Weight	Dimensions																	Fixing screws DIN 912 1) 10.9 Qty		Ratings				Limiting speed		Axial rigidity c_{al} N/µm
		kg	d	D	H	H_1	H_2	H_3	C	D_1	D_2	D_3	B	B_1	B_2	r_s min.	r_{1s} min.	d_1	J			axial dyn. C N	stat. C_0 N	radial dyn. C N	stat. C_0 N	n_g oil rpm	n_g grease rpm	
20	ZARF 2080 LTN	1,22	20	80	–	–	75	53	18	52	40	50	12,5	27,5	11	0,3	0,6	3,2	63	M6	12	64.000	141.000	22.600	36.000	6.000	1.500	2.300
25	ZARF 2590 LTN	1,75	25	90	–	–	75	53	18	62	48	60	12,5	27,5	11	0,3	0,6	3,2	73	M6	12	80.000	199.000	24.300	41.500	4.900	1.400	3.000
35	ZARF 35110 LTN	1,85	35	110	–	–	82	57	18	73	60	73	14	30	12	0,3	0,6	3,2	88	M8	12	110.000	285.000	27.500	53.000	4.000	1.250	3.500
40	ZARF 40115 LTN	3	40	115	–	–	93	65,5	22,5	78	60	78	16	34	12	0,3	0,6	6	94	M8	12	117.000	315.000	38.000	74.000	3.700	1.200	3.800
55	ZARF 55145 LTN	5	55	145	–	–	103	72	22,5	100	80	98	17,5	38,5	14	0,3	0,6	6	118	M10	12	177.000	500.000	44.000	98.000	2.900	1.000	4.900

Standard spindle ends

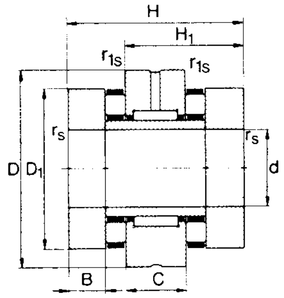




KGT	d_1 j6	d_2 h6	L_1	L_2	L_3	L_4	L_5	M	J	a_{P9}	Bearing ZARN/TN	Lock nut
25 x 5	15	12	57	25	18	16	3	M 15x1	9,5	4	1545 TN	KMT 2 M 15x1
32 x 5	20	15	65	30	20	22	4	M 20x1	12,0	5	2052 TN	KMT 4 M 20x1
32 x 10	20	15	79	30	20	22	4	M 20x1	12,0	5	2062 TN	KMT 4 M 20x1
40 x 5	25	20	71	40	22	28	5	M 25x1,5	16,5	6	2557 TN	KMT 5 M 25x1,5
40 x 10	25	20	81	40	22	28	5	M 25x1,5	16,5	6	2572 TN	KMT 5 M 25x1,5
50 x 10	35	25	89	60	24	40	8	M 35x1,5	20,8	8	3585 TN	KMT 7 M 35x1,5
63 x 10	40	30	98	80	24	63	8	M 40x1,5	25,0	10	4090 TN	KMT 8 M 40x1,5
80 x 10	55	40	108	110	27	90	8	M 55x2	34,5	14	55115 TN	KMT 11 M 55x2

Needle axial cylinder roller bearings

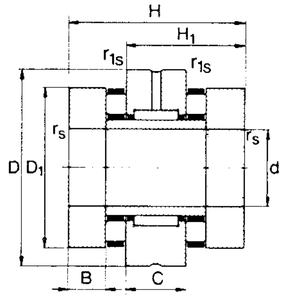
Range ZARN
Light duty range



Shaft diameter	Code	Weight	Dimensions															Ratings				Limiting speed		Axial rigidity c_a N/µm
		kg	d	D	H	H_1	H_2	H_3	C	D_1	D_2	D_3	B	B_1	B_2	r_s min.	r_{1s} min.	axial dyn. C N	stat. C_0 N	radial dyn. C N	stat. C_0 N	n_s oil rpm	n_s grease rpm	
15	ZARN 1545 TN	0,34	15	45	40	28	–	–	16	35	–	–	7,5	–	–	0,3	0,6	24.900	53.000	13.000	17.500	8.500	2.200	1.400
20	ZARN 2052 TN	0,41	20	52	46	31	–	–	16	42	–	–	10	–	–	0,3	0,6	33.500	76.000	14.900	22.400	7.000	2.000	1.800
25	ZARN 2557 TN	0,53	25	57	50	35	–	–	20	47	–	–	10	–	–	0,3	0,6	35.500	86.000	22.600	36.000	6.000	1.900	1.900

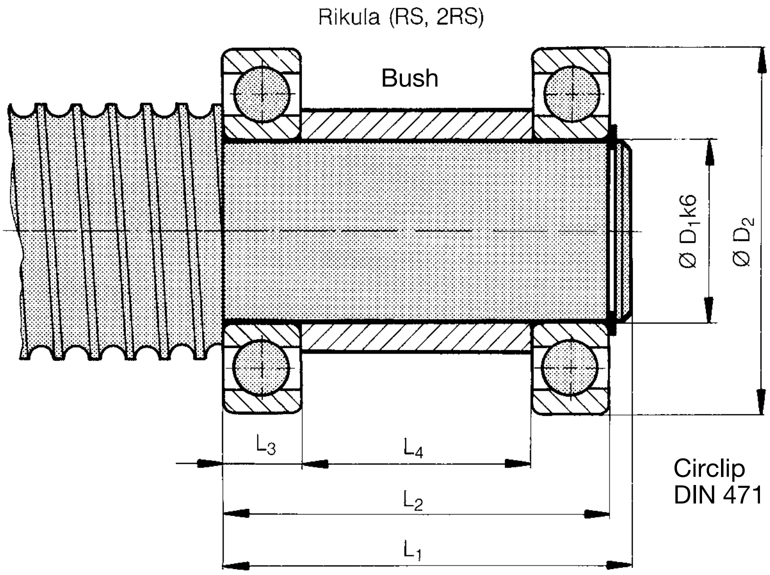
Needle axial cylinder roller bearings

Range ZARN
Heavy duty range



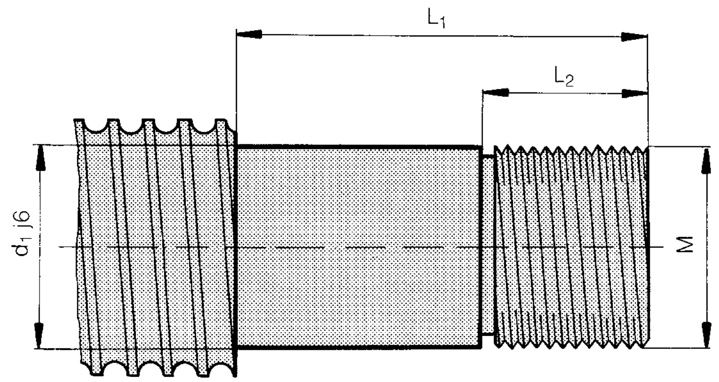
Shaft diameter	Code	Weight	Dimensions															Ratings				Limiting speed		Axial rigidity c_a N/µm
		kg	d	D	H	H_1	H_2	H_3	C	D_1	D_2	D_3	B	B_1	B_2	r_s min.	r_{1s} min.	axial dyn. C N	stat. C_0 N	radial dyn. C N	stat. C_0 N	n_s oil rpm	n_s greae rpm	
20	ZARN 2062 TN	0,87	20	62	60	40	–	–	20	52	–	–	12,5	–	–	0,3	0,6	64.000	141.000	22.600	36.000	6.000	1.500	2.300
25	ZARN 2572 TN	1,17	25	72	60	40	–	–	20	62	–	–	12,5	–	–	0,3	0,6	80.000	199.000	24.300	41.500	4.900	1.400	3.000
35	ZARN 3585 TN	1,65	35	85	66	43	–	–	20	73	–	–	14	–	–	0,3	0,6	110.000	285.000	27.500	53.000	4.000	1.250	3.500
40	ZARN 4090 TN	2,09	40	90	75	50	–	–	25	78	–	–	16	–	–	0,3	0,6	117.000	315.000	38.000	74.000	3.700	1.200	3.800
55	ZARN 55115 TN	3,5	55	115	82	53,5	–	–	25	100	–	–	17,5	–	–	0,3	0,6	177.000	500.000	44.000	98.000	2.900	1.000	4.900

Standard spindle ends



KGT	D$_1$ k6	D$_2$	L$_1$	L$_2$	L$_3$	L$_4$	Rikula 2RS Size	Bush ø x ø x L$_4$	Circlip DIN 471
8 x 2–5	6	19	28	24	6	12	626	9 x 6,1 x 12	6 x 0,7
10 x 2–8	8	22	32	28	7	14	608	11 x 8,1 x 14	8 x 0,8
12 x 2–8	10	26	36	32	8	16	6000	13 x 10,1 x 16	10 x 1,0
16 x 5	12	28	45	40	8	24	6001	18 x 12,1 x 24	12 x 1,0
20 x 5 20 x 20	15	32	51	46	9	28	6002	21 x 15,1 x 28	15 x 1,0
25 x 5	20	42	58	53	12	29	6004	27 x 20,1 x 29	20 x 1,2
32 x 5 32 x 10 32 x 40	25	52	58	53	15	23	6205	32 x 25,1 x 23	25 x 1,2
40 x 5 40 x 10	30	62	68	60	16	28	6206	40 x 30,1 x 28	30 x 1,5
50 x 10	40	80	88	80	18	44	6208	50 x 40,1 x 44	40 x 1,75
63 x 10	55	100	110	102	21	60	6211	65 x 55,1 x 60	55 x 2,0
80 x 10	70	125	130	122	24	74	6214	80 x 70,1 x 74	70 x 2,5

Standard spindle ends



D x P	d_1 j6	L_1	L_2	M	Bearing ZKLN/RS	KMT Shaft Nuts
8 x 2–5	6	24	10	M 6 x 0,5	0624 2RS	INA ZM 06
10 x 2–8	6	24	10	M 6 x 0,5	0624 2RS	INA ZM 06
12 x 2–5	8	29	10	M 8 x 0,75	0832 2RS	INA ZM 08
16 x 5	12	40	16	M12 x 1,0	1242 2RS	SKF KMT 1
20 x 5	15	42	18	M15 x 1,0	1545 2RS	SKF KMT 2
25 x 5	17	44	20	M17 x 1,0	1747 2RS	SKF KMT 3
32 x 5	25	49	22	M25 x 1,5	2557 2RS	SKF KMT 5
40 x 5	30	49	22	M30 x 1,5	3062 2RS	SKF KMT 6
50 x 5	40	57	24	M40 x 1,5	4075 2RS	SKF KMT 8
32 x 10	25	49	22	M25 x 1,5	2557 2RS	SKF KMT 5
40 x 10	30	49	22	M30 x 1,5	3080 2RS	SKF KMT 6
50 x 10	40	56	24	M40 x 1,5	4075 2RS	SKF KMT 8
63 x 10	50	60	28	M50 x 1,5	5090 2RS	SKF KMT 10

Axial angular-contact ball bearings

Double-sided action
Range ZKLN … 2RS

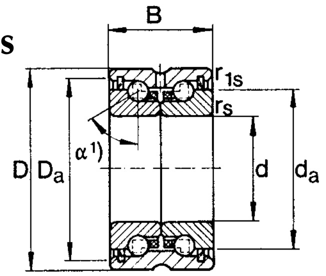
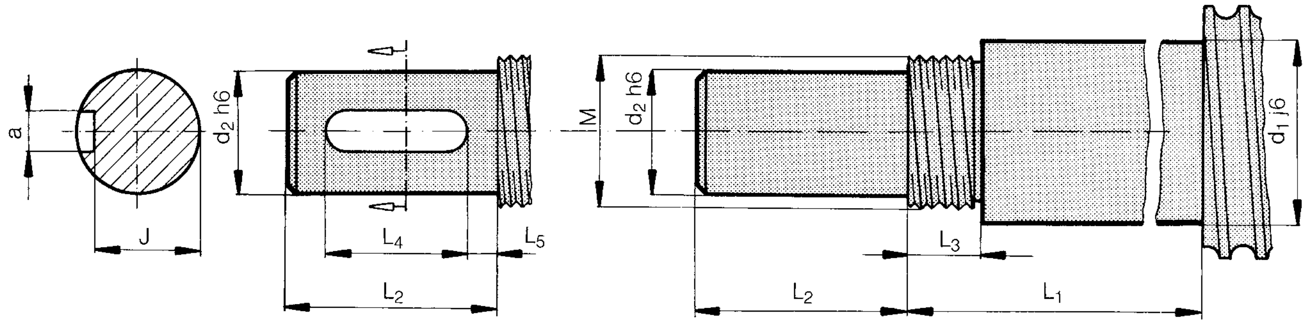


Table of dimensions. Dimensions in mm

Shaft diameter	Code	Weight	Dimensions									Connection dimensions		Fixing screws DIN 912 10.9 Qty		Ratings		Limiting speed	Axial rigidity
		kg	d −0,005	D −0,010	B −0,25	r_s min.	r_{1s} min.	J	d_1	b	l	D_a max.	d_a min.			dyn. C N	stat. C_0 M	n_g grease rpm	c_{al} N/µm
6	ZKLN 0624.2RS	–	6	24	15	0,3	0,6	–	–	–	–	19	9	–	–	5.600	4.800	6.800	200
8	ZKLN 0832.2RS	0,09	8	32	20	0,3	0,6	–	–	–	–	26	12	–	–	10.100	9.200	5.100	250
10	ZKLN 1034.2RS	0,10	10	34	20	0,3	0,6	–	–	–	–	28	14	–	–	10.800	10.600	4.600	325
12	ZKLN 1242.2RS	0,20	12	42	25	0,3	0,6	–	–	–	–	33	16	–	–	13.600	13.900	3.800	375
15	ZKLN 1545.2RS	0,21	15	45	25	0,3	0,6	–	–	–	–	35	20	–	–	14.400	15.800	3.500	400
17	ZKLN 1747.2RS	0,22	17	47	25	0,3	0,6	–	–	–	–	37	23	–	–	15.100	17.600	3.300	450
20	ZKLN 2052.2RS	0,31	20	52	28	0,3	0,6	–	–	–	–	43	25	–	–	20.800	26.500	3.000	650
25	ZKLN 2557.2RS	0,34	25	57	28	0,3	0,6	–	–	–	–	48	32	–	–	22.100	31.000	2.600	750
30	ZKLN 3062.2RS	0,39	30	62	28	0,3	0,6	–	–	–	–	53	40	–	–	23.400	36.000	2.200	850
40	ZKLN 4075.2RS	0,61	40	75	34	0,3	0,6	–	–	–	–	67	50	–	–	34.500	57.000	1.800	1.000
50	ZKLN 5090.2RS	0,88	50	90	34	0,3	0,6	–	–	–	–	81	63	–	–	37.500	71.000	1.500	1.250

Standard spindle ends

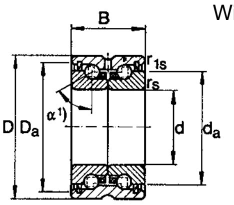


KGT	d_1 j6	d_2 h6	L_1	L_2	L_3	L_4	L_5	M	J	a_{P9}	Bearing ZKLF/2RS	Lock nut
16x5–10	12	10	40	20	16	16	1	M12 x 1	8,2	3	1255	KMT 1 M12 x 1
20x5–20	15	12	42	23	18	16	3	M15 x 1	9,5	4	1560	KMT 2 M15 x 1
25x5–10	20	15	47	30	20	22	3	M20 x 1	12,0	5	2068	KMT 4 M20 x 1
32x5–10	25	20	49	40	22	28	4	M25 x 1,5	16,5	6	2575	KMT 5 M25 x 1,5
40x5	30	25	49	50	22	36	6	M30 x 1,5	21,0	8	3080	KMT 6 M30 x 1,5
50x5	40	30	57	55	24	40	7	M40 x 1,5	26,0	8	40100	KMT 8 M40 x 1,5
											ZKLN/2RS	
8 x 2–5	6	5	24	10	10	–	–	M 6 x 0,5	–	–	0624	INA ZM06
10 x 2–8	6	5	24	10	10	–	–	M 6 x 0,5	–	–	0624	INA ZM06
12 x 2–5	8	6	29	12	10	–	–	M 8 x 0,75	–	–	0832	INA ZM08

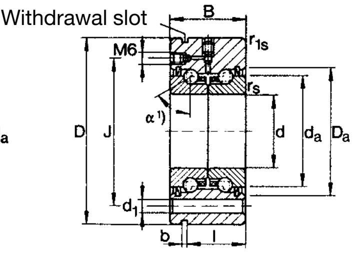
Axial angular-contact ball bearings

Double-sided action
Range ZKLN … 2RS

Double-sided action, screw fixing
Range ZKLF … 2RS



ZKLN..2RS



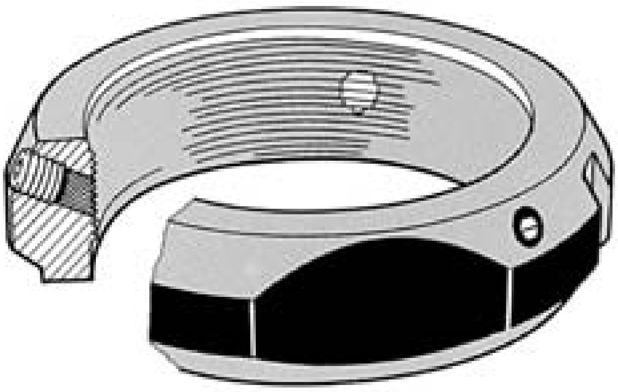
ZKLF..2RS

Table of dimensions. Dimensions in mm

Shaft diameter	Code	Weight	Dimensions									Connection dimensions		Fixing screws DIN 912 10.9 Qty		Rating		Limiting speed	Axial rigidity
		kg	d −0,005	D −0,010	B −0,25	r_s min.	r_{1s} min.	J	d_1	b	l	D_a max.	d_a min.			dyn. C N	stat. C_0 N	n_g grease rpm	c_{al} N/µm
6	ZKLN 0624.2RS	–	6	24	15	0,3	0,6	–	–	–	–	19	9	–	–	5.600	4.800	6.800	200
8	ZKLN 0832.2RS	0,09	8	32	20	0,3	0,6	–	–	–	–	26	12	–	–	10.100	9.200	5.100	250
12	ZKLF 1255.2RS	0,37	12	55	25	0,3	0,6	42	6,5	3	17	33	16	M6	3	13.600	13.900	3.800	375
15	ZKLF 1560.2RS	0,43	15	60	25	0,3	0,6	46	6,5	3	17	35	20	M6	3	14.400	15.800	3.500	400
20	ZKLF 2068.2RS	0,61	20	68	28	0,3	0,6	53	6,5	3	19	43	25	M6	4	20.800	26.500	3.000	650
25	ZKLF 2575.2RS	0,72	25	75	28	0,3	0,6	58	6,5	3	19	48	32	M6	4	22.100	31.000	2.600	750
30	ZKLF 3080.2RS	0,78	30	80	28	0,3	0,6	63	6,5	3	19	53	40	M6	6	23.400	36.000	2.200	850
40	ZKLF 40100.2RS	1,46	40	100	34	0,3	0,6	80	8,5	3	25	67	50	M8	4	34.500	57.000	1.800	1.000

Modern CNC machines

Shaft nut KMT



Material: High-strength steel (similar to StE47)
Surface treatment: phosphatised, oiled
Locking pins: hard drawn brass
Adjusting screws: P6SS (ISO 2343/DIN 913), hardness class 12.9 – 14.9
Nut thread tolerance: 5 H (ISO 965/3)
Tolerance 6G is recommended for the shaft thread

The KMT shaft nut secures without damaging the shaft

The KMT nut is secured with three brass locking pins distributed equally around the circumference and which are set into the nut at an angle. The slope angle of the pins is equal to the flank angle of the nut thread, which is also cut into the end surfaces of the locking pins in one continuous process.

The KMT shaft nut does not need a keyway

As a result, the shaft diameter can be made smaller. Costs for the manufacture of the keyway and the key can be avoided.

The KMT shaft nut locking system does not suffer from material fatigue

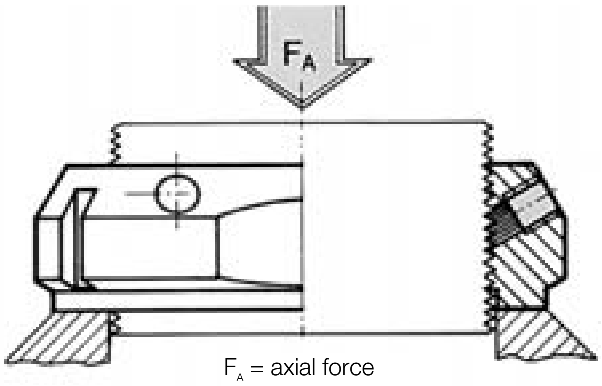
The locking pins are pressed against the shaft thread with the help of adjusting screws.
Axial forces are absorbed by the flanks of the thread and not by the locking pins. Securing the nut against turning is based exclusively on the friction between the pins and the screw thread. As the locking pins do not become distorted, KMT shaft nuts can be used as often as required with the same high accuracy.

The KMT shaft nut locking system is reliable

Even when the generously sized adjusting screws are only gently tightened, a high locking force is achieved. The force applied by the adjusting screws is used exclusively for locking the nut, i.e.
- load is not taken off the flanks of the nut thread
- the nut is not distorted.

The KMT shaft nut is adjustable

When securing the KMT nut, the three locking pins arranged equally around the circumference enable an exact right-angled adjustment to be made. Variations or inaccuracies of other components sitting on the shaft can be compensated for by means of the KMT nut.



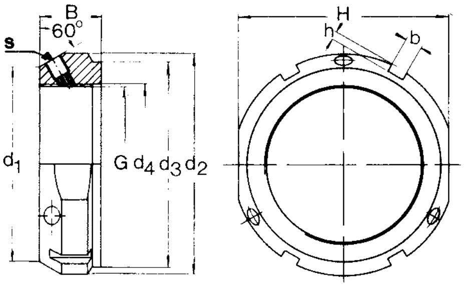
F_A = axial force

Shaft nut KMT/KMTA Code	Permissible axial load F_A KMT/KMTA	Tightening torque for adjusting screws, max. KMT	Breakaway torque[1] KMT/KMTA
–	N	Nm	Nm
0	35.000	4,5	15
1	40.000	4,5	18
2	60.000	4,5	20
3	80.000	8	25
4	90.000	8	35
5	130.000	8	45
6	160.000	8	55
7	190.000	8	65
8	210.000	8	80
9	240.000	8	95
10	300.000	8	115
11	340.000	18	225
12	380.000	18	245
13	460.000	18	265
14	490.000	18	285
15	520.000	18	305
16	620.000	18	325
17	650.000	35	660
18	680.000	35	720
19	710.000	35	780
20	740.000	35	840
22	800.000	35	960
24	860.000	35	1080

[1] Applies for adjusting screws tightened to max. tightening torque.

Shaft nuts KMT – Data

KMT nuts are to be used where simple fitting and reliable locking with high accuracy are required. They can be tightened and released using simple tools such as open-ended spanners, adjustable spanners, hooked spanners or impact spanners.



Shaft nut thread G	Code	Dimensions									Weight	Suitable hook spanner Code
		d_1	d_2	d_3	d_4	B	H	b	h	S		
mm	–	mm								–	kg	–
M 10 x 0,75	KMT 0	21	28	23	11	14	24	4	2	M 5	0,045	HN 2/ 3
M 12 x 1	KMT 1	23	30	25	13	14	27	4	2	M 5	0,050	HN 3
M 15 x 1	KMT 2	26	33	28	16	16	30	4	2	M 5	0,075	HN 4
M 17 x 1	KMT 3	29	37	33	18	18	34	5	2	M 6	0,10	HN 4
M 20 x 1	KMT 4	32	40	35	21	18	36	5	2	M 6	0,11	HN 5
M 25 x 1,5	KMT 5	36	44	39	26	20	41	5	2	M 6	0,13	HN 5
M 30 x 1,5	KMT 6	41	49	44	32	20	46	5	2	M 6	0,16	HN 6
M 35 x 1,5	KMT 7	46	54	49	38	22	50	5	2	M 6	0,19	HN 7
M 40 x 1,5	KMT 8	56	65	59	42	22	60	6	2,5	M 6	0,30	HN 8/ 9
M 45 x 1,5	KMT 9	61	70	64	48	22	65	6	2,5	M 6	0,33	HN 9/10
M 50 x 1,5	KMT 10	65	75	68	52	25	70	7	3	M 6	0,40	HN10/11
M 55 x 2	KMT 11	74	85	78	58	25	80	7	3	M 8	0,54	HN12/13
M 60 x 2	KMT 12	78	90	82	62	26	85	8	3,5	M 8	0,61	HN13
M 65 x 2	KMT 13	83	95	87	68	28	90	8	3,5	M 8	0,71	HN14
M 70 x 2	KMT 14	88	100	92	72	28	95	8	3,5	M 8	0,75	HN15
M 75 x 2	KMT 15	93	105	97	77	28	100	8	3,5	M 8	0,80	HN15/16
M 80 x 2	KMT 16	98	110	100	83	32	–	8	3,5	M 8	0,90	HN16/17
M 85 x 2	KMT 17	107	120	110	88	32	–	10	4	M10	1,15	HN17/18
M 90 x 2	KMT 18	112	125	115	93	32	–	10	4	M10	1,20	HN18/19
M 95 x 2	KMT 19	117	130	120	98	32	–	10	4	M10	1,25	HN19/20
M100 x 2	KMT 20	122	135	125	103	32	–	10	4	M10	1,30	HN20
M110 x 2	KMT 22	132	145	134	112	32	–	10	4	M10	1,45	HN22
M120 x 2	KMT 24	142	155	144	122	32	–	10	4	M10	1,60	–

Slotted nuts

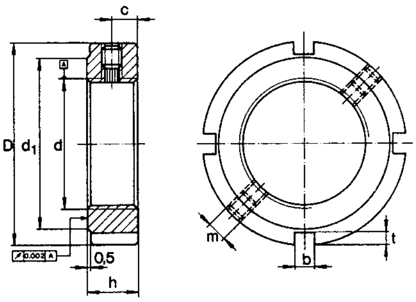


Table of dimensions. Dimensions in mm

Thread d	Code	Weight kg	Dimensions									Axial breaking load F_{aB}
			D	h	b	t	d_1	d_2	d_3	c	m	
M 6 x 0,5	ZM 06	0,01	16	8	3	2	12	–	–	4	M4	16.600
M 8 x 0,75	ZM 08	0,01	16	8	3	2	12	–	–	4	M4	23.300

Spiral spring covers

… protect shafts, spindles, columns and screws against contamination and damage and reduce the risk of accident in this area.
… can be used in all swarf-producing and swarfless machines, etc.
… are made of high-quality, hardened spring steel and have optimum characteristics due to their special method of manufacture.
… are designed in a spiral shape and are manufactured in the diameters and installation lengths shown below. Different strip widths guarantee faultless operation for the different stroke lengths.
… achieve very good sealing between the individual turns in any position. Simple centring flanges are all that are required for mounting the springs, as shown adjacent. The flanges must however accomodate the rotary movements of the spring that occur. The centring flanges are not included in the scope of supply.

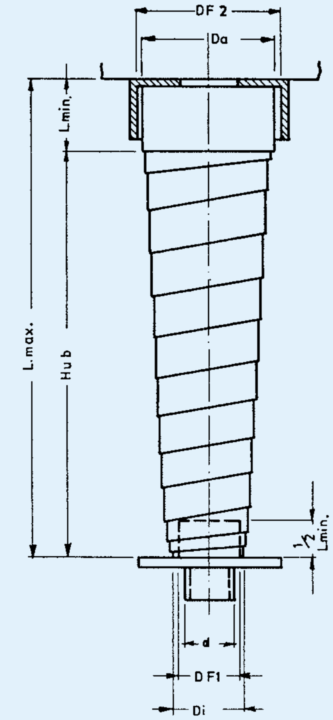
When installing vertically, it is recommended that the large diameter is fitted at the top and when installing horizontally it is fitted towards the accumulation of swarf.

No maintenance is necessary. However, it is recommended that cleaning be carried out depending upon the degree of contamination and that a light film of oil be subsequently applied.

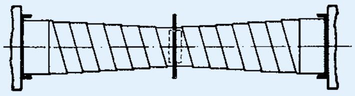
For functional reasons it is necessary when enquiring or ordering to state whether the HEMA spiral springs are to be fitted horizontally or vertically. **When fitted horizontally, the dimension D_a is increased by ca. 3–5 mm.**

HEMA spiral springs help to maintain the precision of your machines and also increase their life.

Design: spring steel, blued, stainless on request.



Can be fitted horizontally and vertically



Explanation of drawing:

d = max. diameter of the part to be covered
D_1 = inside diameter of spring
D_a = outside diameter of spring
$L_{min.}$ = minimum installation length
$L_{max.}$ = maximum installation length

DF_1 = outside diameter of the centring flange (D_1 – 2 mm)
DF_2 = inside diameter of the centring flange (D_a + 4 mm)
Stroke = largest possible travel

All dimensions in mm

As ball screws are sensitive to dirt and swarf, they must fundamentally be protected by sealed covers such as bellows or telescopic springs.

Spiral spring cover	for KGT-Type
SF 20	KGT- 12
SF 25	KGT- 16
SF 30	KGT- 20 und KGT- 25
SF 40	KGT- 32/5
SF 50	KGT- 32/10
SF 55	KGT- 40/5+10
SF 65	KGT- 50/5+10
SF 75	KGT- 63/10+20
SF 90	KGT- 80/10+20
SF 110	KGT-100/10+20

All dimensions in mm

Type	D_1 ± 1 mm	D_a ± 2 mm	L max.	L min.
SF 20/100/20	20	31	100	20
SF 20/150/20	20	34	150	20
SF 20/200/20	20	36	200	20
SF 20/250/20	20	40	250	20
SF 20/300/30	20	39	300	30
SF 20/350/30	20	42	350	30
SF 20/400/30	20	45	400	30
SF 25/100/20	25	35	100	20
SF 25/150/20	25	38	150	20
SF 25/200/20	25	40	200	20
SF 25/250/20	25	44	250	20
SF 25/300/30	25	43	300	30
SF 25/350/30	25	46	350	30
SF 25/400/30	25	49	400	30
SF 25/450/40	25	48	450	40
SF 25/500/40	25	51	500	40
SF 30/150/30	30	39	150	30
SF 30/250/30	30	44	250	30
SF 30/350/30	30	49	350	30
SF 30/450/40	30	53	450	40
SF 30/550/40	30	58	550	40
SF 30/650/50	30	55	650	50
SF 30/750/50	30	59	750	50
SF 40/150/30	40	51	150	30
SF 40/250/30	40	56	250	30
SF 40/350/30	40	60	350	30
SF 40/450/40	40	63	450	40
SF 40/550/40	40	68	550	40
SF 40/350/50	40	55	350	50
SF 40/450/50	40	58	450	50
SF 40/550/50	40	61	550	50
SF 40/650/50	40	65	650	50
SF 40/750/50	40	69	750	50
SF 40/450/60	40	55	450	60
SF 40/550/60	40	58	550	60
SF 40/650/60	40	62	650	60
SF 40/750/60	40	66	750	60
SF 40/900/60	40	70	900	60
SF 40/650/75	40	62	650	75
SF 40/750/75	40	66	750	75
SF 40/900/75	40	72	900	75
SF 40/1100/75	40	78	1100	75
SF 40/1300/75	40	84	1300	75
SF 40/1500/75	40	90	1500	75
SF 40/1000/100	40	66	1000	100
SF 40/1200/100	40	70	1200	100
SF 40/1500/100	40	78	1500	100
SF 40/1800/100	40	82	1800	100
SF 40/1800/120	40	82	1800	120
SF 40/2000/120	40	86	2000	120
SF 40/2200/120	40	91	2200	120
SF 50/150/30	50	63	150	30
SF 50/250/30	50	68	250	30
SF 50/250/50	50	62	250	50
SF 50/350/50	50	66	350	50
SF 50/450/50	50	70	450	50
SF 50/550/50	50	73	550	50
SF 50/550/60	50	68	550	60
SF 50/650/60	50	72	650	60
SF 50/750/60	50	76	750	60
SF 50/750/75	50	78	750	75
SF 50/900/75	50	84	900	75
SF 50/1100/75	50	90	1100	75
SF 50/1100/100	50	75	1100	100
SF 50/1300/100	50	79	1300	100
SF 50/1500/100	50	86	1500	100
SF 50/1800/100	50	94	1800	100
SF 50/1700/120	50	91	1700	120
SF 50/1700/120	50	91	1700	120
SF 50/1900/120	50	95	1900	120
SF 50/2100/120	50	100	2100	120
SF 50/2300/120	50	105	2300	120
SF 50/2500/120	50	111	2500	120
SF 50/2800/120	50	118	2800	120
SF 50/2800/150	50	118	2800	150
SF 50/3000/150	50	123	3000	150
SF 50/3000/180	50	123	3000	180
SF 50/3250/180	50	128	3250	180
SF 50/3250/200	50	128	3250	200
SF 50/3500/200	50	134	3500	200
SF 55/150/30	55	68	150	30
SF 55/250/30	55	73	250	30
SF 55/250/50	55	66	250	50
SF 55/350/50	55	71	350	50
SF 55/450/50	55	74	450	50
SF 55/550/50	55	77	550	50
SF 55/550/60	55	75	550	60
SF 55/650/60	55	79	650	60
SF 55/750/60	55	83	750	60
SF 55/750/75	55	83	750	75
SF 55/900/75	55	89	900	75
SF 55/1100/75	55	94	1100	75
SF 55/1100/100	55	83	1100	100
SF 55/1300/100	55	87	1300	100
SF 55/1500/100	55	94	1500	100
SF 55/1800/100	55	102	1800	100
SF 55/1700/120	55	96	1700	120
SF 55/1900/120	55	100	1900	120
SF 55/2100/120	55	105	2100	120
SF 55/2300/120	55	110	2300	120
SF 55/2500/120	55	116	2500	120
SF 55/2800/120	55	123	2800	120
SF 55/2800/150	55	121	2800	150
SF 55/3000/150	55	126	3000	150
SF 55/3000/180	55	126	3000	180
SF 55/3250/180	55	130	3250	180
SF 55/3250/200	55	130	3250	200
SF 55/3500/200	55	137	3500	200
SF 65/150/30	65	78	150	30
SF 65/250/30	65	85	250	30
SF 65/250/50	65	76	250	50
SF 65/350/50	65	83	350	50
SF 65/450/50	65	88	450	50
SF 65/550/60	65	88	550	60
SF 65/650/60	65	92	650	60
SF 65/750/60	65	95	750	60
SF 65/750/75	65	93	750	75
SF 65/900/75	65	99	900	75
SF 65/1100/75	65	107	1100	75
SF 65/1100/100	65	95	1100	100
SF 65/1300/100	65	99	1300	100
SF 65/1500/100	65	108	1500	100
SF 65/1800/100	65	117	1800	100
SF 65/1700/120	65	106	1700	120
SF 65/1900/120	65	109	1900	120
SF 65/2100/120	65	113	2100	120
SF 65/2300/120	65	118	2300	120
SF 65/2500/120	65	123	2500	120
SF 65/2800/120	65	128	2800	120
SF 65/2800/150	65	132	2800	150
SF 65/3000/150	65	142	3000	150
SF 65/3000/180	65	136	3000	180
SF 65/3250/180	65	145	3250	180
SF 65/3250/200	65	138	3250	200
SF 65/3500/200	65	148	3500	200
SF 75/150/30	75	92	150	30
SF 75/250/30	75	99	250	30
SF 75/250/50	75	89	250	50
SF 75/350/50	75	94	350	50
SF 75/450/50	75	101	450	50
SF 75/550/60	75	99	550	60
SF 75/650/60	75	103	650	60
SF 75/750/60	75	108	750	60
SF 75/650/75	75	99	650	75
SF 75/750/75	75	104	750	75
SF 75/900/75	75	111	900	75
SF 75/1100/100	75	108	1100	100
SF 75/1300/100	75	112	1300	100
SF 75/1500/100	75	120	1500	100
SF 75/1700/100	75	126	1700	100
SF 75/1500/120	75	115	1500	120
SF 75/1800/120	75	122	1800	120
SF 75/2000/120	75	127	2000	120
SF 75/2200/120	75	132	2200	120
SF 75/2000/150	75	135	2000	150
SF 75/2400/150	75	141	2400	150
SF 75/2800/150	75	145	2800	150
SF 75/2800/180	75	142	2800	180
SF 75/3000/180	75	148	3000	180
SF 75/3250/180	75	156	3250	180
SF 75/3250/200	75	148	3250	200
SF 75/3500/200	75	158	3500	200
SF 90/150/50	90	112	150	50
SF 90/250/50	90	116	250	50
SF 90/350/50	90	121	350	50
SF 90/350/60	90	112	350	60
SF 90/450/60	90	114	450	60
SF 90/450/75	90	114	450	75
SF 90/550/75	90	119	550	75
SF 90/650/75	90	124	650	75
SF 90/750/100	90	115	750	100
SF 90/900/100	90	120	900	100
SF 90/1100/100	90	126	1100	100
SF 90/1300/100	90	132	1300	100
SF 90/1300/120	90	125	1300	120
SF 90/1500/120	90	131	1500	120
SF 90/1800/120	90	138	1800	120
SF 90/1800/150	90	144	1800	150
SF 90/2000/150	90	149	2000	150
SF 90/2300/150	90	154	2300	150
SF 90/2600/150	90	159	2600	150
SF 90/2600/180	90	152	2600	180
SF 90/2800/180	90	158	2800	180
SF 90/3000/180	90	164	3000	180
SF 90/3000/200	90	162	3000	200
SF 90/3250/200	90	166	3250	200
SF 90/3500/200	90	170	3500	200
SF 110/250/60	110	131	250	60
SF 110/350/60	110	135	350	60
SF 110/450/60	110	139	450	60
SF 110/350/75	110	130	350	75
SF 110/450/75	110	135	450	75
SF 110/600/75	110	140	600	75
SF 110/650/100	110	129	650	100
SF 110/750/100	110	133	750	100
SF 110/900/100	110	138	900	100
SF 110/1100/120	110	139	1100	120
SF 110/1300/120	110	145	1300	120
SF 110/1500/150	110	155	1500	150
SF 110/1800/150	110	159	1800	150
SF 110/2000/150	110	165	2000	150
SF 110/2000/180	110	159	2000	180
SF 110/2200/180	110	165	2200	180
SF 110/2400/180	110	170	2400	180
SF 110/2400/200	110	162	2400	200
SF 110/2600/200	110	166	2600	200
SF 110/2800/200	110	172	2800	200

Lubrication of ball screws

Basically, the same lubricants can be used for lubricating ball screws as for anti-friction bearings, i.e. both oil and grease.

In contrast to anti-friction bearings, the maximum operating temperature is of far more importance with ball screws, as it affects the accuracy of the ball screw due to the longitudinal expansion along its axis. A single filling of grease for the ball screw as a lifelong lubrication is not generally adequate, as grease is continually removed due to the spindle shaft repeatedly moving in and out of the lubricated area and thus damage could occur within a foreseeable time due to lack of lubrication. If grease nipples are specified for re-lubrication purposes, damage may also be expected if the maintenance intervals are not observed or if the ball screw is over greased.

As central lubrication systems are available in many installations, oil lubrication predominates with ball screws.

Oil lubrication

Oil lubrication by means of a central lubrication system has the advantage that it is always possible for an adequate film of lubricant to build up and for low heating of the ball screw to occur due to the improved heat transfer. Furthermore any excess oil is removed by the wiper.

Basically, circulating oils with active ingredients for increasing the corrosion protection and the ageing resistance in accordance with C-L to DIN 51517 Part 2, as are also used for lubricating anti-friction bearings, are suitable for supplying ball screws. The viscosity of the lubricant to be used depends primarily on the speed and the ambient temperature as well as the loading. In order to guarantee an adequate film of lubricant at all times and under all operating conditions, a somewhat higher viscosity of lubricant should be aimed for. In most cases it is sufficient to select the lubricant in accordance with the following table.

If the ball screw speeds are less than 20 rpm and/or high loading is to be expected, it is recommended that a circulating oil with active ingredients to increase the ageing resistance of the corrosion protection as well as additives for increasing the loading capability and improving the protection against wear in accordance with C-LP to DIN 51517 Part 3 is used.

The amount of oil required for each ball revolution is about 3-6 cm3/h. With immersed lubrication, it is sufficient if the oil level is maintained at the centre of the lowest roller when installed horizontally.

Grease lubrication

Lubrication of ball screws with grease suggests itself when it is not possible to install central lubrication systems and low speeds are to be expected. Further advantages are the improved sealing effect, the avoidance of running dry and the independence from the installation orientation. The re-lubrication intervals are to be agreed with Kammerer for each application in order to avoid damage due to lack of lubrication.

Lubricating greases are divided into NLGI classes according to DIN 51818 corresponding to their flexing penetration. In normal cases (operating temperature –20 °C to +120 °C), class K2k water resistant greases to DIN 51825 are to be used for ball screws. In special cases, greases to NLGI 1 (for very high speeds) or NLGI 3 (for highest loads or low speeds) are possible.

The mixing of greases based on different saponifications should be avoided. Consultation with the manufacturer is necessary if the operating temperatures lie above or below the given values.

The amount of grease to be applied is such that the cavities are approximately half filled. In order to avoid unnecessary overheating of the ball screw due to over greasing, it must be ensured that the design enables used or excess grease to escape.

Lubricants

Viscosity ISO	Designation DIN 51 517	ARAL	AVIA	BP	ELF
VG 32	C-L 32	Vitam GF 32, Degol BG 32	Avilub RL 32-C	Energol HLP-D 32, HL 32	Elf Polytelis 32
	C-LP 32	Vitam HF 32, Degol BG 32	Avilub RSL 32	Energol HLP 32, HLP-D 32	Elf Olna 32
VG 46	C-L 46	Vitam GF 46, Degol BG 46	Avilub RL 46-C	Energol HLP-D 46, HL 46	Elf Polytelis 46
	C-LP 46	Vitam HF 46, Degol BG 46	Avilub RSL 46	Energol HLP 46, HLP-D 46, GR-XP 46	Elf Olna 46
VG 68	C-L 68	Vitam GF 68, Degol TU 68	Avilub RL 68	Energol HLP-D 68, RC 68	Elf Polytelis 68
	C-LP 68	Degol TU 68, BG 68	Avilub RSL 68	Energol HLP 68, HLP-D 68, GR-XP 68	Reductelf SP 68
VG 100	C-L 100	Vitam GF 100, Degol TU 100	Avilub RL 100	Energol RC 100	Elf Polytelis 100
	C-LP 100	Degol TU 100, BG 100	Avilub RSL 100	Energol GR-XP 100	Reductelf SP 100
VG 220	C-L 220	Degol TU 220	Avilub RL 220	Energol IC 220	Elf Polytelis 220
	C-LP 220	Degol BG 220	Avilub RSL 220, RSX 220	Energol GR-XP 220	Reductelf SP 220
VG 320	C-L 320	Degul TU 320	Avilub RL 320		Elf Polytelis 320
	C-LP 320	Degol BG 320	Avilub RSX 320	Energol GR-XP 320	Reductelf SP 320
VG 680	C-L 680	Degol BG 680	Avilub RL 690		Reductelf SP 680
	C-LP 680	Degol BG 680	Avilub RSX 680	Energol GR-XP 680	Reductelf SP 680
VG 1000	C-L 1000	Wisal C			Reductelf SP 1000
	C-LP 1000	Degol BMB 1300	Avilub RSX 1000		Reductelf SP 1000
No ISO norms	DIN 51 825				
	K 1k				Elf Epexa 1
	K 2k	Aralub HL 2, LF 2 multi-purpose grease	Avia multi-purpose grease Avilub special grease EP	Energrease LS 2	Els Epexa 2 Elf Multi 2
	K 3k	Aralub HL 3, LF 3	Avilub special grease A	Energrease LS 3	Elf Rolexa 3

Viscosity ISO	Designation DIN 51 517	ESSO	FINA	FUCHS	KLÜBER
VG 32	C-L 32	Esstic 32, Teresso 32	Fina Cirkan 32	Renolin DTA 10, Renolin 205	Crucolan 32
	C-LP 32	Nuto H 32	Fina Hydran 32	Renolin MR 10, Renolin B 10	Lamora 32
VG 46	C-L 46	Esstic 46, Teresso 46	Fina Hydran 46, Cirkan 46	Renolin DTA 15, Renolin 206	Crucolan 46
	C-LP 46	Nuto H 46	Fina Hydran 46	Renolin MR 15, Renolin B 15	Lamora 46
VG 68	C-L 68	Esstic 68, Teresso 68	Fina Cirkan 68	Renolin DTA 20, Renolin 207	Crucolan 68
	C-LP 68	Spartan EP 68, Nuto H 68	Fina Hydran 68, Giran 68	Renolin MR 20, Renolin B 20	Lamora 68
VG 100	C-L 100	Esstic 100, Teresso 100	Fina Cirkan 100	Renolin DTA 30, Renolin 208	Crucolan 100
	C-LP 100	Spartan EP 100, Nuto H 100	Fina Hydran 100, Giran 100	Renolin MR 30, Renolin B 30	Lamora 100
VG 220	C-L 220	Esstic 220, Teresso 220	Fina Cirkan 220	Renolin 211	Crucolan 220
	C-LP 220	Spartan EP 220	Fina Hydran 220, Giran 220	Renep Compound 106	Lamora 220
VG 320	C-L 320	Teresso 320	Fina Solna 320	Renolin 212	Crucolan 320
	C-LP 320	Spartan EP 320	Fina Giran 320	Renep Compound 108	Lamora 320
VG 680	C-L 680		Fina Solna 680	Renolin CN 8	Crucolan 680
	C-LP 680	Spartan EP 680	Fina Giran 680	Renep Compound 112	Lamora 680
VG 1000	C-L 1000			Renolin CH 30	Crucolan 1000
	C-LP 1000			Renep Compound 112	Lamora 1000
No ISO norms	DIN 51 825				
	K 1k	Cazar K 1	Fina Marson L 1	Renolit FWA 120	Centoplex H 1
	K 2k	Beacon 2	Fina Marson L 2	Renolit FWA 160 Renoplex EP 2	Centoplex 2
	K 3k	Beacon 3	Fina Marson L 3	Renolit FWA 220	Centoplex 3

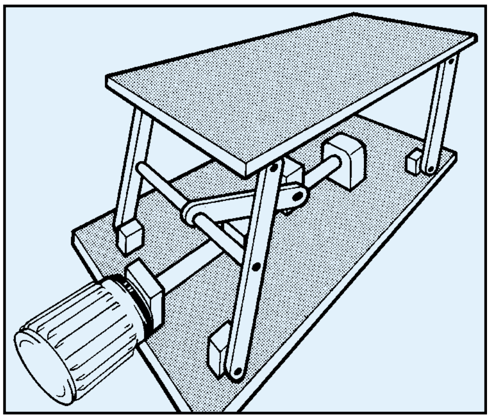
Viscosity ISO	Designation DIN 51 517	MOBIL	SHELL	TEXACO	VALVOLINE
VG 32	C-L 32	Mobil D.T.E. Oil Light, Mobil Vactra Oil Light	Tellus C 32	Rando Oil 32	Valvoline IRL
	C-LP 32	Mobil D.T.E. 24	Tellus 32	Rando Oil HD A-32, HD AZ 32	Valvoline ETC-25
VG 46	C-L 46	Mobil D.T.E. Oil Medium, Mobil Vactra Oil Medium	Tellus C 46	Rando Oil 46	Valvoline ETC-10
	C-LP 46	Mobil D.T.E. 25	Tellus 46	Rando Oil HD B-46	Valvoline ETC-30, WA-4
VG 68	C-L 68	Mobil D.T.E. Oil Heavy Medium, Mobil Vactra Oil Heavy Medium	Tellus C 68	Rando Oil 68	Valvoline IRW
	C-LP 68	Mobilgear 626, Mobil D.T.E. 26	Omala 68	Rando Oil HD C-68, HD CZ 68, Meropa 68	Valvoline ETC-35
VG 100	C-L 100	Mobil D.T.E. Oil Heavy, Mobil Vactra Oilo Heavy	Tellus C 100	Rando Oil 100	Valvoline IRS
	C-LP 100	Mobilgear 627, Mobil D.T.E. 27	Omala 100	Rando Oil HD E-100, Meropa 100	Valvoline WA-7
VG 220	C-L 220	Mobil D.T.E. Oil BB	Tellus C 220	Regal Oil R & O 220, Ursa Oil P-220	Valvoline IRF
	C-LP 220	Mobilgear 630	Omala 220	Meropa 220	Valvoline WA-15
VG 320	C-L 320	Mobil D.T.E. Oil AA	Tellus C 320	Regal Oil R & O 320, Omnis Oil P-320	
	C-LP 320	Mobilgear 632	Omala 320	Meropa 320	Valvoline WA-20
VG 680	C-L 680				
	C-LP 680	Mobilgear 636	Omala 680	Meropa 680	
VG 1000	C-L 1000				
	C-LP 1000			Meropa 1000	
No ISO norms	DIN 51 825	Sovarex Grease L 1			
	K 1k	Mobilux 1 (im Ausland)	Alvania EP 1	Multifak EP 1	
	K 2k	Sovarex Grease L 2 Mobilux 2, Mobilux EP 2	Alvania R 2	Multifak 20 Multifak 2	Valvoline LB-2 Fett Nr. 6
	K 3k	Mobilux 3	Alvania R 3	Multifak 30, Regal Starfak Premium 3	

Trapezoidal screws

Application examples

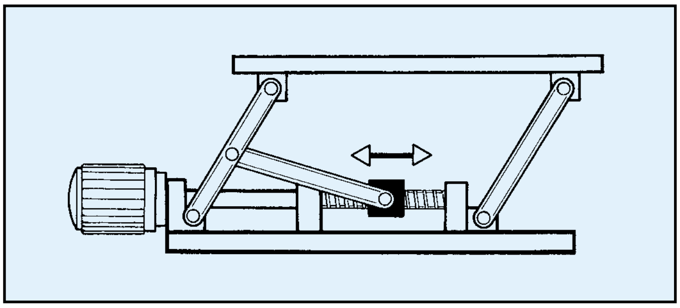
Example 1:

Lift table system



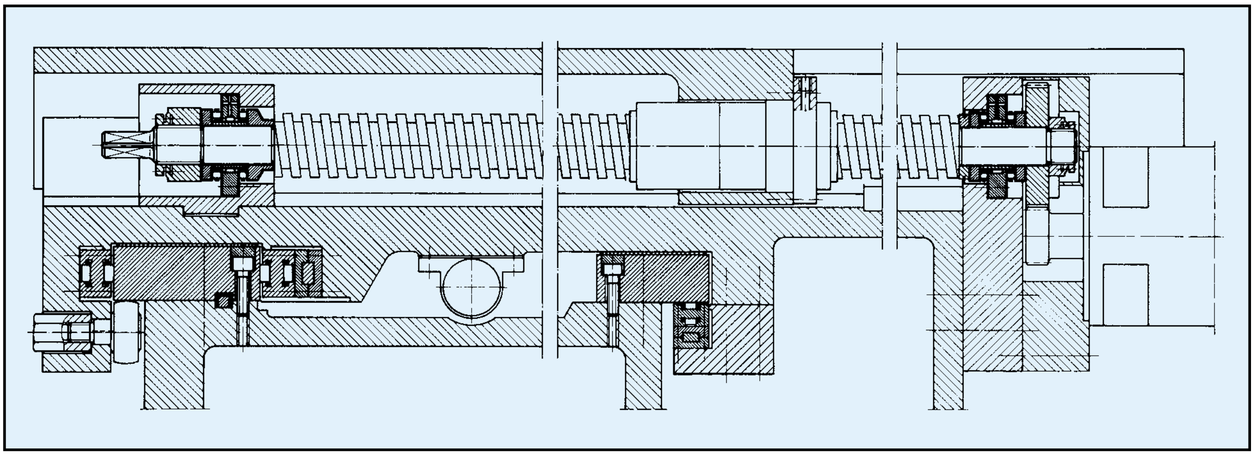
Problem: Lifting of machine parts

Solution: The trapezoidal spindle is adjusted by means of an electric motor. The design gives a progressive force characteristic and does not require a stopping brake.



Example 2:

Co-ordinate table



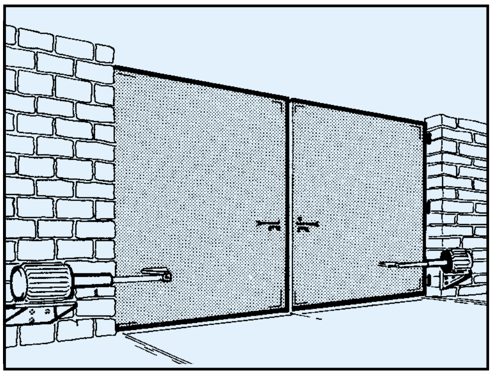
The co-ordinate table shown in section is integrated within a numerically controlled processing centre for rough milling operations.
The co-ordinate table is positioned using the trapezoidal screw. It has a clamping area of 1600 mm x 550 mm and can be traversed in the X-direction by up to 900 mm.
Due to the high traverse speed, a particularly rigid bearing arrangement is required for the spindle of the trapezoidal screw.
For situations requiring accurate processing, it is preferable to use ball screws.

Design solution

The trapezoidal spindle is mounted in a needle axial cylinder roller bearing ZARF..TN at the drive end and in a ZARF..L bearing at the other end. The stepped shaft disc of the ZARF..L TN bearing provides optimum support for the bearing at the other end of the spindle in spite of the small spindle shoulder. Both bearings can be bolted directly to the surrounding construction so that adaptation work and additional flange covers are not required. Sealing of the bearing positions is not necessary here, as the lubricant is allowed to escape.

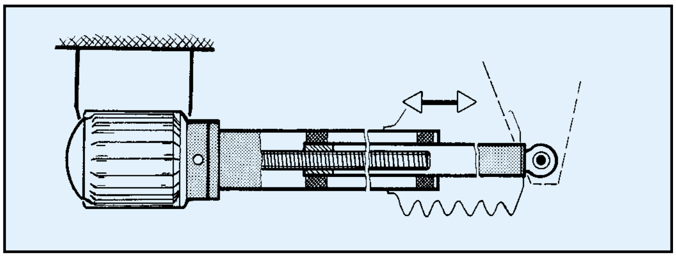
▶ Example 3:

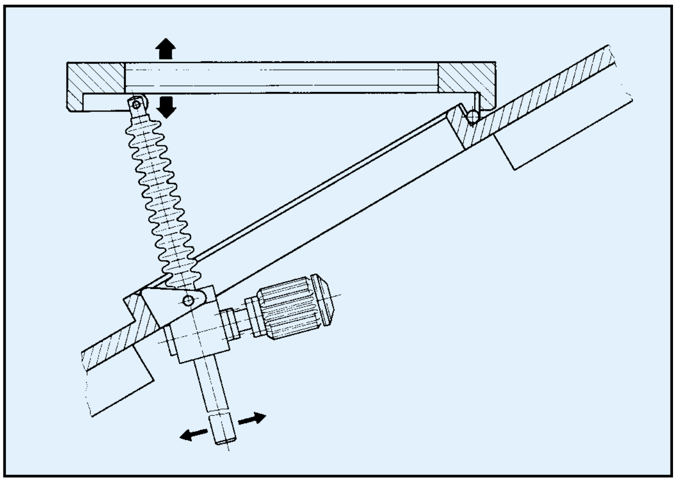
Entrance gate opener



Problem: electrically actuated entrance gate

Solution: Trapezoidal screw with electric motor and stroke limiter. The spindle is covered to avoid risk of injury and contamination (bellows).



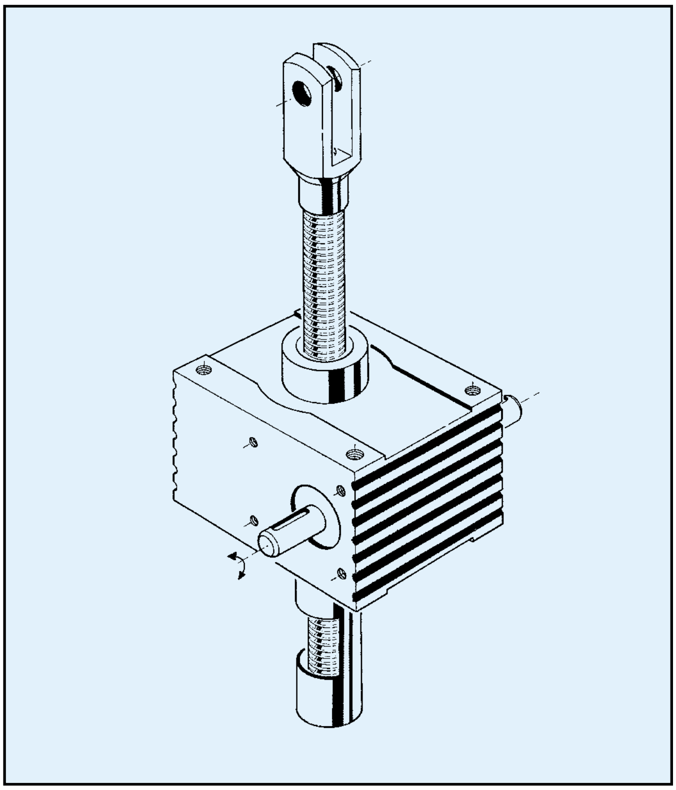


▶ Example 4:

Ventilation flap

Opening and closing a skylight or ventilation flap.

The gearing with drive and fittings is mounted using a cardan adapter.
The end points (fully open and fully closed) are restricted using limit switches.



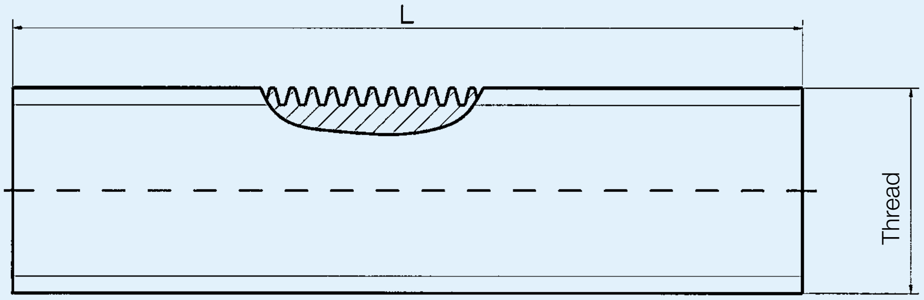
▶ Example 5:

Linear stroke gearbox

The lifting spindle travels through the linear stroke gearbox without rotating.
When using a single linear stroke gearbox, measures should be taken to prevent the spindle from turning.

Trapezoidal screw spindles

Sold by the metre, spun



- Trapezoidal thread to DIN 103, tolerance class 7e
- Standard lengths are 1m, 1.5m, 2m, 3m
- Other lengths possible on request
- The adjacent materials are available from us as standard
- Other materials and tolerances on request
- Two quality classes available (see table below)
- All sizes can also be supplied as left-hand thread

- C15
- C45
- 9SMn28K
- 42CrMo4V
- ETG 100

Ordering example:
Screw spindle Tr70 x 10 x 2m long, left-hand lead, spun GK2

Thread				
Tr 8x1,5	Tr 16x4	Tr 30x6	Tr 55x9	Tr 100x12
Tr 10x2	Tr 18x4	Tr 32x6	Tr 60x9	Tr 110x12
Tr 10x3	Tr 20x4	Tr 36x6	Tr 65x10	Tr 120x14
Tr 12x2	Tr 22x5	Tr 40x7	Tr 70x10	Tr 130x14
Tr 12x3	Tr 24x5	Tr 44x7	Tr 75x10	Tr 140x14
Tr 14x3	Tr 26x5	Tr 50x8	Tr 80x10	Tr 150x16
Tr 14x4	Tr 28x5	Tr 52x8	Tr 90x12	Tr 160x16

	Quality classes	
	GK 1	GK 2
Lead variation	0,05 / 300mm	0,15 / 300mm
Straightness	0,3 / 1000mm	0,8 / 1000mm
Outside ø tolerance	h9	h11

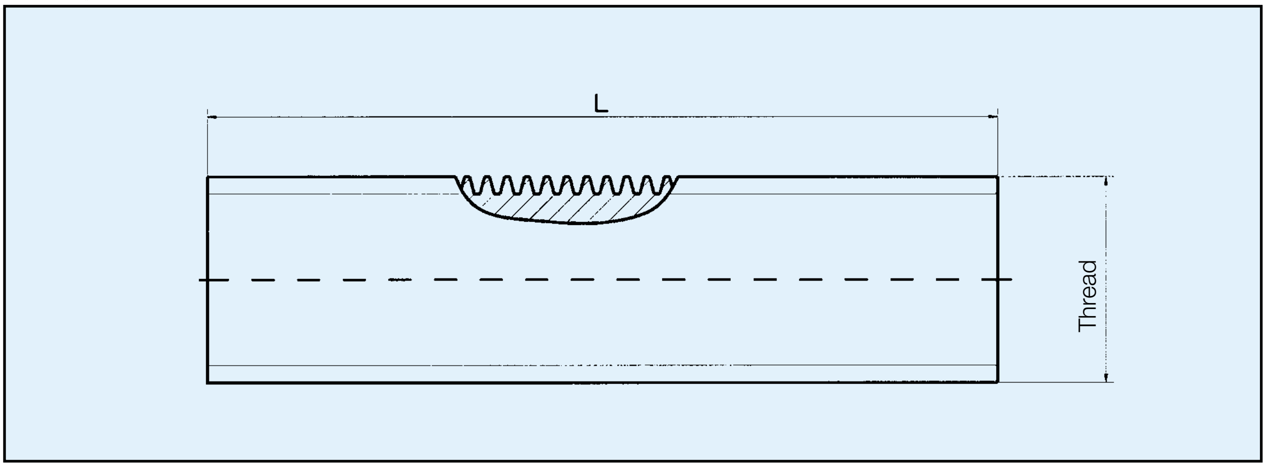
Quality classes to Kammerer norm

Other accuracies possible on request.

Further dimensions on request

Trapezoidal screw spindles

Sold by the metre, rolled



- Trapezoidal thread to DIN 103, tolerance class 7e
- Standard lengths are 1m, 1.5m, 2m, 3m
- Other lengths possible on request
- Material: C15
- Other materials and tolerances on request
- Two quality classes available (see table below)

Ordering example:
Screw spindle Tr20 x 4 x 2m long, right-hand lead, rolled GK1

Thread	Right	Left
Tr 8 x 1,5	X	X
Tr 10 x 2	X	X
Tr 10 x 3	X	X
Tr 12 x 2	X	X
Tr 12 x 3	X	X
Tr 14 x 3	X	X
Tr 14 x 4	X	X
Tr 16 x 4	X	X
Tr 18 x 4	X	X
Tr 20 x 4	X	X
Tr 22 x 5	X	X
Tr 24 x 5	X	X

Thread	Right	Left
Tr 26 x 5	X	X
Tr 28 x 5	X	X
Tr 30 x 6	X	X
Tr 32 x 6	X	X
Tr 36 x 6	X	X
Tr 40 x 7	X	X
Tr 44 x 7	X	X
Tr 50 x 8	X	X
Tr 52 x 8	X	X
Tr 60 x 9	X	

	Quality classes	
	GK 1	GK 2
Lead variation	0,1 / 300mm	0,3 / 300mm
Straightness	0,8 / 1000mm	–
Flaking	not permissible	permissible

Quality classes to Kammerer norm

Other accuracies possible on request.

Further dimensions on request

Rolled screw spindles

The rolling of threads is an economic manufacturing process. Based on swarfless cold deformation, it has a positive affect on the characteristics of the base material.

The natural course of the grain is not destroyed unlike with machine manufacturing processes (e.g. thread spinning, thread cutting, thread milling or thread grinding).

Thread rolling has a positive affect on the following physical and technical characteristics:

- higher resistance to wear, tensional strength and bending strength
- higher surface quality of the die-burnished flanks of the thread
- less corrosion
- high thread profile accuracy depending upon the quality of the rolling tool
- high flank diameter accuracy (parallelism) due to accurate pre-material tolerances

Plastic nuts are particularly well suited to rolled threads. The efficiency of the spindle drive is higher due to the high surface quality of the flanks of the rolled thread and the low friction of plastics.

According to DIN 103, the core diameter of rolled trapezoidal screws can be 0.15 x P less than with machined trapezoidal screws (flow radius required on the thread-rolling tool).

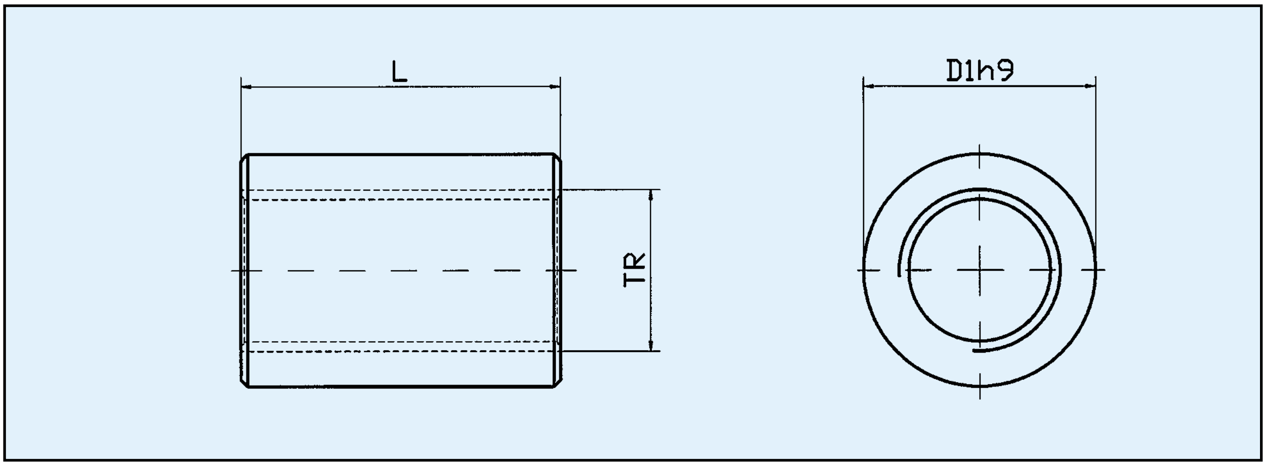
Rolled threads can display the so-called closing fold (undercut) on the outside diameter of the thread. This has no effect on the quality or the function of the thread. The undercut is only a criterion for making a judgement of the roll technology.

The disadvantages of rolled compared with spun trapezoidal screws:

- very high tooling and setup costs
- strong influence of the material characteristics on the accuracy of the lead (changes with each batch of material)
- spindles with larger form elements than the outside diameter of the thread cannot be rolled or can only be rolled at great expense.
- too high a surface quality due to polishing of the flanks of the thread can lead to a detachment of the lubricant film between the spindle and the nut and thus to “a tendency to seize” when grease lubrication is required (e.g. with steel or bronze nuts).
- not suitable for the manufacture of individual components and small production runs, as the affect on the thread rolling process (machine and tooling) is cost and parts-intensive.

Trapezoidal screw nuts

Round nut, short or long



- Trapezoidal thread to DIN 103, tolerance class 7H
- Max. runout error up to Tr 22x5 = 0.2 mm; from Tr24x5 = 0.3 mm
- These nuts are provided in the adjacent materials
- Other materials and tolerances on request
- Short design: L = 1.5 x nominal diameter
- Long design: L = 2 x nominal diameter

- C15
- C45
- CuSn12
- RG7
- GGC-25
- Plastic

Ordering example:
Round nut Tr 44x7, left-hand, made from CuSn12, short, in accordance with Kammerer catalogue

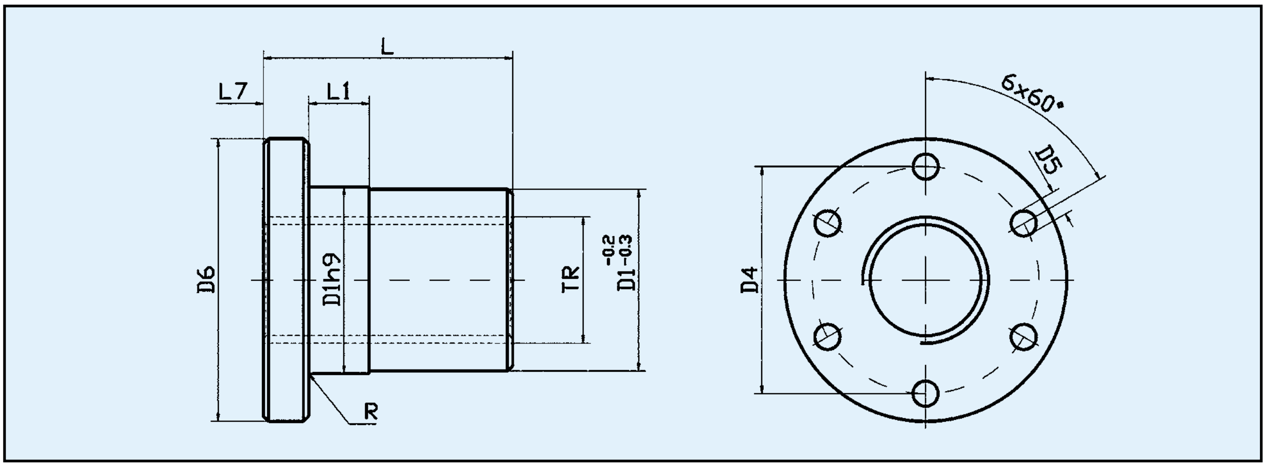
Short design		
Thread	**D1**	**L**
Tr 8 x 1,5	18	12
Tr 10 x 2	22	15
Tr 10 x 3	22	15
Tr 12 x 3	26	18
Tr 14 x 4	30	21
Tr 16 x 4	36	24
Tr 18 x 4	45	27
Tr 20 x 4	45	30
Tr 22 x 5	50	33
Tr 24 x 5	50	36
Tr 26 x 5	60	39
Tr 28 x 5	60	42
Tr 30 x 6	60	45
Tr 32 x 6	60	48
Tr 36 x 6	75	54
Tr 40 x 7	80	60
Tr 44 x 7	80	66
Tr 48 x 8	90	72
Tr 50 x 8	90	75
Tr 60 x 9	100	90
Tr 70 x 10	110	105
Tr 80 x 10	120	120
Tr 90 x 12	130	135

Long design		
Thread	**D1**	**L**
Tr 8 x 1,5	18	16
Tr 10 x 2	22	20
Tr 10 x 3	22	20
Tr 12 x 3	26	24
Tr 14 x 4	30	28
Tr 16 x 4	36	32
Tr 18 x 4	45	36
Tr 20 x 4	45	40
Tr 22 x 5	50	44
Tr 24 x 5	50	48
Tr 26 x 5	60	52
Tr 28 x 5	60	56
Tr 30 x 6	60	60
Tr 32 x 6	60	64
Tr 36 x 6	75	72
Tr 40 x 7	80	80
Tr 44 x 7	80	88
Tr 48 x 8	90	96
Tr 50 x 8	90	100
Tr 60 x 9	100	120
Tr 70 x 10	110	140
Tr 80 x 10	120	160
Tr 90 x 12	130	180

Further dimensions on request

Trapezoidal screw nuts

Flanged nut, short or long



- Trapezoidal thread to DIN 103, tolerance class 7H
- Max. runout error up to Tr 22x5 = 0.2 mm; from Tr24x5 = 0.3 mm
- These nuts are provided in the adjacent materials
- Other materials and tolerances on request
- Two designs (long or short), with or without fixing holes

- C15
- C45
- CuSn12
- RG7
- GGC-25
- Plastic

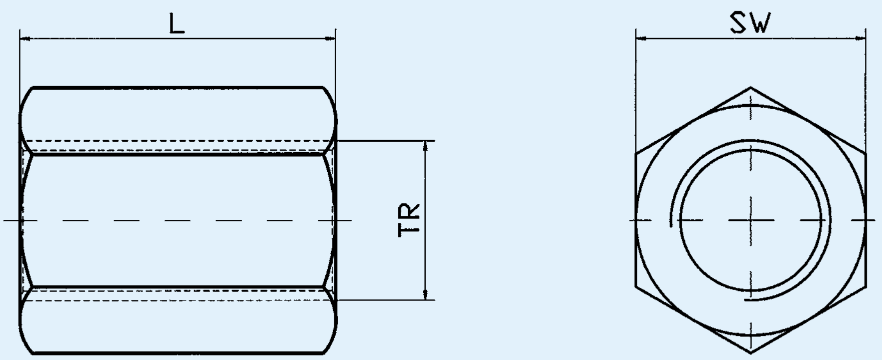
Ordering example:
Flanged nut Tr 20x4, right-hand, made from RG7, short,
in accordance with Kammerer catalogue

Thread	D1	D4	D5	D6	L (short)	L (long)	L1	L7
Tr 8 x 1,5	22	32	4	40	12	16	4	8
Tr 10 x 2	25	34	5	42	15	20	5	10
Tr 10 x 3	25	34	5	42	15	20	5	10
Tr 12 x 3	28	38	6	48	18	24	6	12
Tr 14 x 4	28	38	6	48	21	28	9	12
Tr 16 x 4	28	38	6	48	24	32	12	12
Tr 18 x 4	28	38	6	48	27	36	15	12
Tr 20 x 4	32	45	7	55	30	40	8	12
Tr 22 x 5	32	45	7	55	33	44	8	12
Tr 24 x 5	32	45	7	55	36	48	8	12
Tr 26 x 5	38	50	7	62	39	52	8	14
Tr 28 x 5	38	50	7	62	42	56	8	14
Tr 30 x 6	38	50	7	62	45	60	8	14
Tr 32 x 6	45	58	7	70	48	64	10	16
Tr 36 x 6	45	58	7	70	54	72	10	16
Tr 40 x 7	63	78	9	95	60	80	12	16
Tr 44 x 7	63	78	9	95	66	88	12	16
Tr 48 x 8	72	90	11	110	72	96	14	18
Tr 50 x 8	72	90	11	110	75	100	14	18
Tr 60 x 9	88	110	13	130	90	120	16	20
Tr 70 x 10	88	110	13	130	105	140	16	20
Tr 80 x 10	118	140	15	163	120	160	18	22
Tr 90 x 12	118	140	15	163	135	180	18	22

Further dimensions on request

Trapezoidal screw nuts

Hexagonal nut



- Trapezoidal thread to DIN 103, tolerance class 7H
- Not suitable for motion screws
- Material: 9SMn28K
- Other materials and tolerances on request

Ordering example:
Hexagonal nut Tr 10x3, right-hand, in accordance with Kammerer catalogue

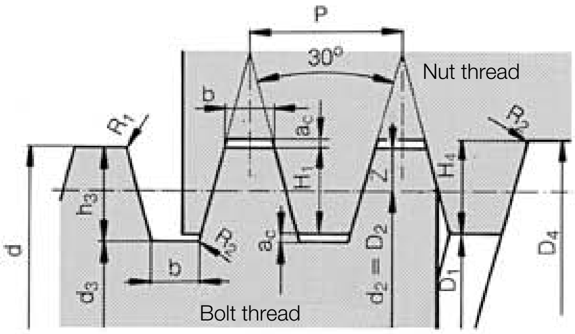
Thread	SW	L
Tr 8 x 1,5	14	12
Tr 10 x 2	17	15
Tr 10 x 3	17	15
Tr 12 x 3	19	18
Tr 14 x 4	22	21
Tr 16 x 4	27	24
Tr 18 x 4	27	27
Tr 20 x 4	30	30
Tr 22 x 5	32	33
Tr 24 x 5	36	36
Tr 26 x 5	41	39

Thread	SW	L
Tr 28 x 5	41	42
Tr 30 x 6	46	45
Tr 32 x 6	46	48
Tr 36 x 6	55	54
Tr 40 x 7	65	60
Tr 44 x 7	65	66
Tr 48 x 8	75	72
Tr 50 x 8	75	75
Tr 60 x 9	90	90
Tr 70 x 10	90	105

Further dimensions on request

Technical data

Metric ISO trapezoidal thread to DIN 103



Dim.	For lead P in mm			
	1	2…5	6…12	14…44
a_c	0,15	0,25	0,5	1
R_1	0,075	0,125	0,25	0,5
R_2	0,15	0,25	0,5	1

Nominal Ø . . . . .d

Lead for single start threads and
Pitch for multi-start threads . . . . P

Lead for multi-start threads . . . . P_h

Number of starts. . . . . $n = P_h : P$

Core Ø of bolt thread . . . . $d_3 = d - (P+2 \cdot a_c)$

Outside Ø of nut thread . . . .$D_4 = d + 2 \cdot a_c$

Core Ø of nut thread . . . .$D_1 = d - P$

Thread flank Ø . . . . $d_2 = D_2 = d - 0,5 \cdot P$

Depth of bolt
and nut threads. . . . .$h_3 = H_4 = 0,5 \cdot P + a_c$

Flank overlap . . . .$H_1 = 0,5 \cdot P$

Height of tooth tip . . . . $z = 0,25 \cdot P$

Tip clearance . . . . a_c

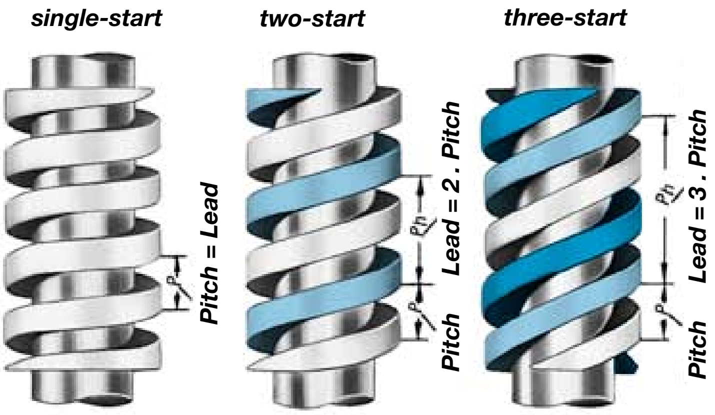
Rounding . . . . R_1 and R_2

Three chisel width. . . . . $b = 0,366 \cdot P - 0,54 \cdot a_c$

Flank angle . . . . $\alpha = 30°$

Thread designation D x P	Thread dimensions in mm				
	Flank ø $d_2 = D_2$	Core ø		Outside ø D_4	Thread depth $h_3 = H_4$
		Bolt d_3	Nut D_1		
Tr 8×1,5	7,25	6,2	6,5	8,3	0,9
Tr 9×2	8	6,5	7	9,5	1,25
Tr 10×2	9	7,5	8	10,5	1,25
Tr 12×3	10,5	8,5	9	12,5	1,75
Tr 14×3	12,5	10,5	11	14,5	1,75
Tr 16×4	14	11,5	12	16,5	2,25
Tr 18×4	16	13,5	14	18,5	2,25
Tr 20×4	18	15,5	16	20,5	2,25
Tr 22×5	19,5	16,5	17	22,5	2,75
Tr 24×5	21,5	18,5	19	24,5	2,75
Tr 28×5	25,5	22,5	23	28,5	2,75
Tr 30×6	27	23	24	31	3,5
Tr 32×6	29	25	26	33	3,5
Tr 36×6	33	29	30	37	3,5
Tr 40×7	36,5	32	33	41	4
Tr 44×7	40,5	36	37	45	4
Tr 48×8	44	39	40	49	4,5
Tr 52×8	48	43	44	53	4,5
Tr 60×9	55,5	50	51	61	5
Tr 70×10	65	59	60	71	5,5
Tr 80×10	75	69	70	81	5,5
Tr 90×12	84	77	78	91	6,5
Tr 100×12	94	87	88	101	6,5
Tr 120×14	113	104	106	122	8
Tr 140×14	132,5	124	126	142	8
Tr 160×16	151,5	142	144	162	9

Single and multi-start threads


single-start *two-start* *three-start*

P_h Lead: Distance along the line of the flank diameter between adjacent flanks of the same orientation of the same thread.

P Pitch: Distance along the line of the flank diameter between adjacent flanks of the same orientation.

Multi-start (n-start) threads have the same profile as single-start threads where the lead P_h = the pitch P.

Only the permissible values for the lead P (equal to the pitch P) of the single-start thread may be selected for the pitch P of the multi-start thread. A multiple of the pitch P of the multi-start thread does not however have to correspond to a permissible lead value for a single-start thread.

Thread diameters and leads

Dimensions in mm

Nominal thread diameter d			Lead P of the single-start trapezoidal thread																					
Series 1	Series 2	Series 3	44	40	36	32	28	24	22	20	18	16	14	12	10	9	8	7	6	5	4	3	2	1,5
8																								1,5
	9																						2	1,5
10																							2	1,5
	11																					3	2	
12																						3	2	
	14																					3	2	
16																					4		2	
	18																				4		2	
20																					4		2	
	22															8			5		3		
24																	8			5		3		
	26																8			5		3		
28																	8			5		3		
	30													10				6			3		
32															10				6			3		
	34														10				6			3		
36															10				6			3		
	38														10			7				3		
40															10			7				3		
	42														10			7				3		
44														12				7				3		
	46													12			8					3		
48														12			8					3		
	50													12			8					3		
52														12			8					3		
	55												14			9						3		
60													14			9						3		
	65											16			10						4			
70												16			10						4			
	75											16			10						4			
80												16			10						4			
	85										18			12							4			
90											18			12							4			
	95										18			12							4			
100										20				12							4			
		105								20				12							4			
	110									20				12							4			
		115							22				14						6					
120									22				14						6					
		125							22				14						6					
	130								22				14						6					
		135						24					14						6					
140								24					14						6					
		145						24					14						6					
	150							24				16							6					
		155						24				16							6					
160							28					16							6					
		165					28					16							6					

The size of thread can be chosen from the thread and lead table.

For example:
chosen diameter = 40 mm,
Preferred range = 7 mm,
Designation = Tr 40x7

A maximum of only three leads is recommended for each thread diameter. One of these is identified as the preferred lead in order to restrict the number of trapezoidal threads to be used still further. If, in special cases, other diameters are required in place of those listed, a lead should be chosen that is associated with the nearest diameter.

Permissible sliding speeds (guide values):

Material	CuSn and CuAl alloy/steel	Cast iron	GS, GTW
Sliding speed in m/s referred to flank Ø	permissible surface compression in N/mm²		
0,1	19,3	5,8	9,7
0,2	18,6	5,6	9,3
0,3	18,0	5,4	9,0
0,4	17,3	5,2	8,7
0,5	16,6	5,0	8,3
0,6	16,0	4,8	8,0
0,7	15,3	4,6	7,7
0,8	14,6	4,4	7,3
0,9	14,0	4,2	7,0
1,0	13,3	4,0	6,7
1,1	12,6	3,8	6,3
1,2	12,0	3,6	6,0
1,3	11,3	3,4	5,7
1,4	10,6	3,2	5,3
1,5	10,0	3,0	5,0
1,6	9,3	2,8	4,7
1,7	8,6	2,6	4,3
1,8	8,0	2,4	4,0
1,9	7,3	2,2	3,7
2,0	6,6	2,0	3,3
2,1	6,0	1,8	3,0
2,2	5,3	1,6	2,7
2,3	4,6	1,4	2,3
2,4	4,0	1,2	2,0
2,5	3,3	1,0	1,7
2,6	2,6	0,8	1,3
2,7	2,0	0,6	1,0
2,8	1,3	0,4	0,7
2,9	0,6	0,2	0,3

Max. loading of trapezoidal screws referred to the nut length

These values do not include any safety margin! Furthermore, buckling must be taken into account.
Based on a surface compression of 10 N/mm^2

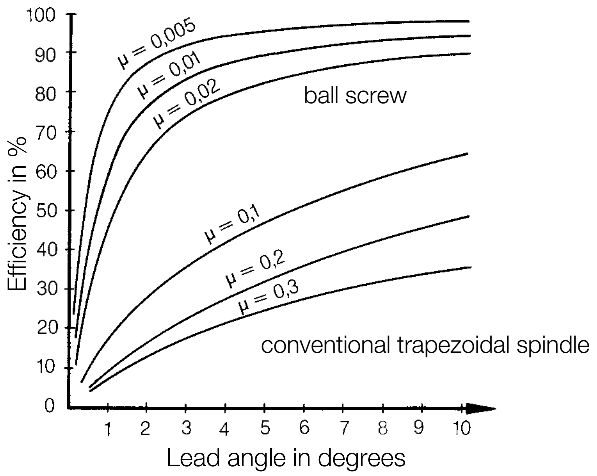
Tr	D2 in mm	P in mm	Length of nut	F in N/dyn
8 x 1,5	7,25	1,5	4	455.53
	7,25	1,5	8	911.06
	7,25	1,5	12	1366.59
	7,25	1,5	16	1822.12
	7,25	1,5	20	2277.65
	7,25	1,5	24	2733.18
9 x 2	8	2	4,5	565.48
	8	2	9	1130.97
	8	2	13,5	1696.45
	8	2	18	2261.94
	8	2	22,5	2827,43
	8	2	27	3392.91
10 x 2	9	2	5	706.85
	9	2	10	1413.71
	9	2	15	2120.57
	9	2	20	2827.43
	9	2	25	3534.28
	9	2	30	4241.14
12 x 3	10,5	3	6	989.60
	10,5	3	12	1979.20
	10,5	3	18	2968.80
	10,5	3	24	3958.40
	10,5	3	30	4948.00
	0,5	3	36	5937.60
14 x 3	12,5	3	7	1374.44
	12,5	3	14	2748.89
	12,5	3	21	4123.33
	12,5	3	28	5497.78
	12,5	3	35	6872.22
	17,5	3	42	8246.67
16 x 4	14	4	8	1759.29
	14	4	16	3518.58
	14	4	24	5277.87
	14	4	32	7037.16
	14	4	40	8796.45
	14	4	48	10555.74
18 x 4	16	4	9	2261.94
	16	4	18	4523.89
	16	4	27	6785.83
	16	4	36	9047.78
	16	4	45	11309.72
	16	4	54	13571.66
20 x 4	18	4	10	2827.43
	18	4	20	5654.86
	18	4	30	8482.29
	18	4	40	11309.72
	18	4	50	14137.15
	18	4	60	16964.58
22 x 5	19,5	5	11	3369.35
	19,5	5	22	6738.71
	19,5	5	33	10108.06
	19,5	5	44	13477.42
	19,5	5	55	16846.77
	19,5	5	66	20216.13
24 x 5	21,5	5	12	4052.65
	21,5	5	24	8105.30
	21,5	5	36	12157.95
	21,5	5	48	16210.60
	21,5	5	60	20263.25
	21,5	5	72	24315.90
28 x 5	25,5	5	14	5607.73
	25,5	5	28	11215.47
	25,5	5	42	16823.21
	25,5	5	56	22430.95
	25,5	5	70	28038.69
	25,5	5	84	33646.43
30 x 6	27	6	15	6361.72
	27	6	30	12723.44
	27	6	45	19085.16
	27	6	60	25446.88
	27	6	75	31808.60
	27	6	90	38170.32
32 x 6	29	6	16	7288.49
	29	6	32	14576.98
	29	6	48	21865.47
	29	6	64	29153.96
	29	6	80	36442.45
	29	6	96	43730.94

Tr	D2 in mm	P in mm	Length of nut	F in N/dyn
36 x 6	33	6	18	9330,51
	33	6	36	18661,04
	33	6	54	27991,56
	33	6	72	37322,09
	33	6	90	46652,61
	33	6	108	55983,13
40 x 7	36,5	7	20	11466,80
	36,5	7	40	22933,60
	36,5	7	60	34400,41
	36,5	7	80	45867,21
	36,5	7	100	57334,01
	36,5	7	120	68800,82
44 x 7	40,5	7	22	13995,78
	40,5	7	44	27991,56
	40,5	7	66	41987,35
	40,5	7	88	55983,13
	40,5	7	110	69978,93
	40,5	7	132	83974,71
48 x 8	44	8	24	16587,59
	44	8	48	33175,19
	44	8	72	49762,79
	44	8	96	66350,38
	44	8	120	82937,98
	44	8	144	99525,58
52 x 8	48	8	26	19603,52
	48	8	52	39207,04
	48	8	78	58810,56
	48	8	104	78414,08
	48	8	130	98017,61
	48	8	156	117621,10
60 x 9	55,5	9	30	26153,73
	55,5	9	60	52307,47
	55,5	9	90	78461,21
	55,5	9	120	104614,90
	55,5	9	150	130768,70
	55,5	9	180	156922,40
70 x 10	65	10	35	35735,58
	65	10	70	71471,18
	65	10	105	107206,80
	65	10	140	142942,40
	65	10	175	178677,90
	65	10	210	214413,50
80 x 10	75	10	40	47123,85
	75	10	80	94247,71
	75	10	120	141371,60
	75	10	160	188495,40
	75	10	200	235619,20
	75	10	240	282748,10
90 x 12	84	12	45	59376,06
	84	12	90	118752,10
	84	12	135	178128,20
	84	12	180	237504,20
	84	12	225	296880,30
	84	12	270	356256,30
100 x 12	94	12	50	73827,36
	94	12	100	147654,70
	94	12	150	221482,10
	94	12	200	295309,50
	94	12	250	369136,90
	94	12	300	442964,20
120 x 14	113	14	60	106499,90
	113	14	120	212999,80
	113	14	180	319499,70
	113	14	240	425999,70
	113	14	300	532499,50
	113	14	360	638999,50
140 x 14	132,5	14	70	145691,20
	132,5	14	140	291382,50
	132,5	14	210	437073,70
	132,5	14	280	582765,00
	132,5	14	350	728456,10
	132,5	14	420	874147,40
160 x 16	151,5	16	80	190380,40
	151,5	16	160	380760,70
	151,5	16	240	571141,10
	151,5	16	320	761521,40
	151,5	16	400	951901,80
	151,5	16	480	1142282,00

Efficiency of trapezoidal screws

Single-start							
D	P	cast iron dry	cast iron lubricated	CuSn, CuZn dry	CuSn, CuZn lubricated	plastic dry	plastic lubricated
8	1.5	.216	.36	.25	.36	.36	.576
10	2	.227	.375	.262	.375	.375	.592
12	3	.268	.427	.307	.427	.427	.643
14	3	.239	.391	.276	.391	.391	.608
16	4	.268	.427	.307	.427	.427	.643
18	4	.246	.399	.283	.399	.399	.616
20	4	.227	.375	.262	.375	.375	.592
22	5	.25	.405	.287	.405	.405	.622
24	5	.234	.384	.27	.384	.384	.601
26	5	.221	.366	.255	.366	.366	.582
28	5	.208	.349	.241	.349	.349	.564
30	6	.227	.375	.262	.375	.375	.592
32	6	.216	.36	.25	.36	.36	.576
34	6	.207	.346	.239	.346	.346	.561
36	6	.197	.334	.229	.334	.334	.547
38	7	.214	.356	.247	.356	.356	.572
40	7	.205	.344	.238	.344	.344	.559
42	7	.197	.334	.229	.334	.334	.547
44	7	.19	.323	.221	.323	.323	.536
46	8	.204	.343	.237	.343	.343	.558
48	8	.197	.334	.229	.334	.334	.547
50	8	.191	.325	.222	.325	.325	.537
52	8	.185	.316	.215	.316	.316	.528
55	9	.195	.33	.226	.33	.33	.543
60	9	.182	.311	.211	.311	.311	.521
65	10	.185	.316	.215	.316	.316	.528
70	10	.175	.301	.203	.301	.301	.509
75	10	.165	.286	.193	.286	.286	.482
80	10	.156	.273	.183	.273	.273	.476
85	12	.173	.298	.201	.298	.298	.506
90	12	.165	.286	.193	.286	.286	.492
95	12	.158	.276	.184	.276	.276	.479
100	12	.151	.265	.177	.265	.265	.466
105	12	.145	.256	.17	.256	.256	.454
110	12	.139	.247	.164	.247	.247	.442
115	14	.153	.268	.179	.268	.268	.469
120	14	.148	.26	.173	.26	.26	.459
125	14	.143	.252	.167	.252	.252	.449
130	14	.138	.245	.162	.245	.245	.439
135	14	.133	.238	.157	.238	.238	.43
140	14	.129	.232	.152	.232	.232	.421
145	14	.125	.226	.148	.226	.226	.413
150	16	.137	.243	.16	.243	.243	.437
155	16	.133	.237	.156	.237	.237	.429
160	16	.129	.232	.152	.232	.232	.421

Two-start							
D	P	cast iron dry	cast iron lubricated	CuSn, CuZn dry	CuSn, CuZn lubricated	plastic dry	plastic lubricated
8	3	.35	.525	.395	.525	.525	.728
10	4	.364	.54	.41	.54	.54	.741
12	6	.414	.592	.461	.592	.592	.779
14	6	.38	.557	.426	.557	.557	.753
16	8	.414	.592	.461	.592	.592	.779
18	8	.388	.565	.434	.565	.565	.759
20	8	.364	.54	.41	.54	.54	.741
22	10	.393	.57	.439	.57	.57	.763
24	10	.373	.55	.419	.55	.55	.748
26	10	.356	.531	.401	.531	.531	.733
28	10	.34	.513	.384	.513	.513	.719
30	12	.364	.54	.41	.54	.54	.741
32	12	.35	.525	.395	.525	.525	.728
34	12	.338	.511	.381	.511	.511	.717
36	12	.325	.497	.369	.497	.497	.705
38	14	.347	.521	.391	.521	.521	.725
40	14	.336	.509	.38	.509	.509	.715
42	14	.325	.497	.369	.497	.497	.705
44	14	.316	.486	.358	.486	.486	.696
46	16	.334	.507	.378	.507	.507	.714
48	16	.325	.497	.369	.497	.497	.705
50	16	.317	.487	.36	.487	.487	.697
52	16	.309	.477	.351	.477	.477	.689
55	18	.322	.492	.365	.492	.492	.701
60	18	.304	.471	.345	.471	.471	.683
65	20	.309	.477	.351	.477	.477	.689
70	20	.294	.459	.335	.459	.459	.673
75	20	.28	.443	.32	.443	.443	.658
80	20	.268	.427	.307	.427	.427	.643
85	24	.291	.457	.332	.457	.457	.67
90	24	.28	.443	.32	.443	.443	.658
95	24	.27	.43	.309	.43	.43	.646
100	24	.26	.418	.298	.418	.418	.634
105	24	.251	.406	.288	.406	.406	.623
110	24	.243	.395	.279	.395	.395	.612
115	28	.263	.421	.301	.421	.421	.637
120	28	.255	.411	.292	.411	.411	.628
125	28	.247	.401	.284	.401	.401	.618
130	28	.24	.392	.277	.392	.392	.609
135	28	.234	.383	.269	.383	.383	.6
140	28	.227	.375	.262	.375	.375	.592
145	28	.221	.367	.256	.367	.367	.583
150	32	.239	.39	.275	.39	.39	.607
155	32	.233	.382	.268	.382	.382	.599
160	32	.227	.375	.262	.375	.375	.592

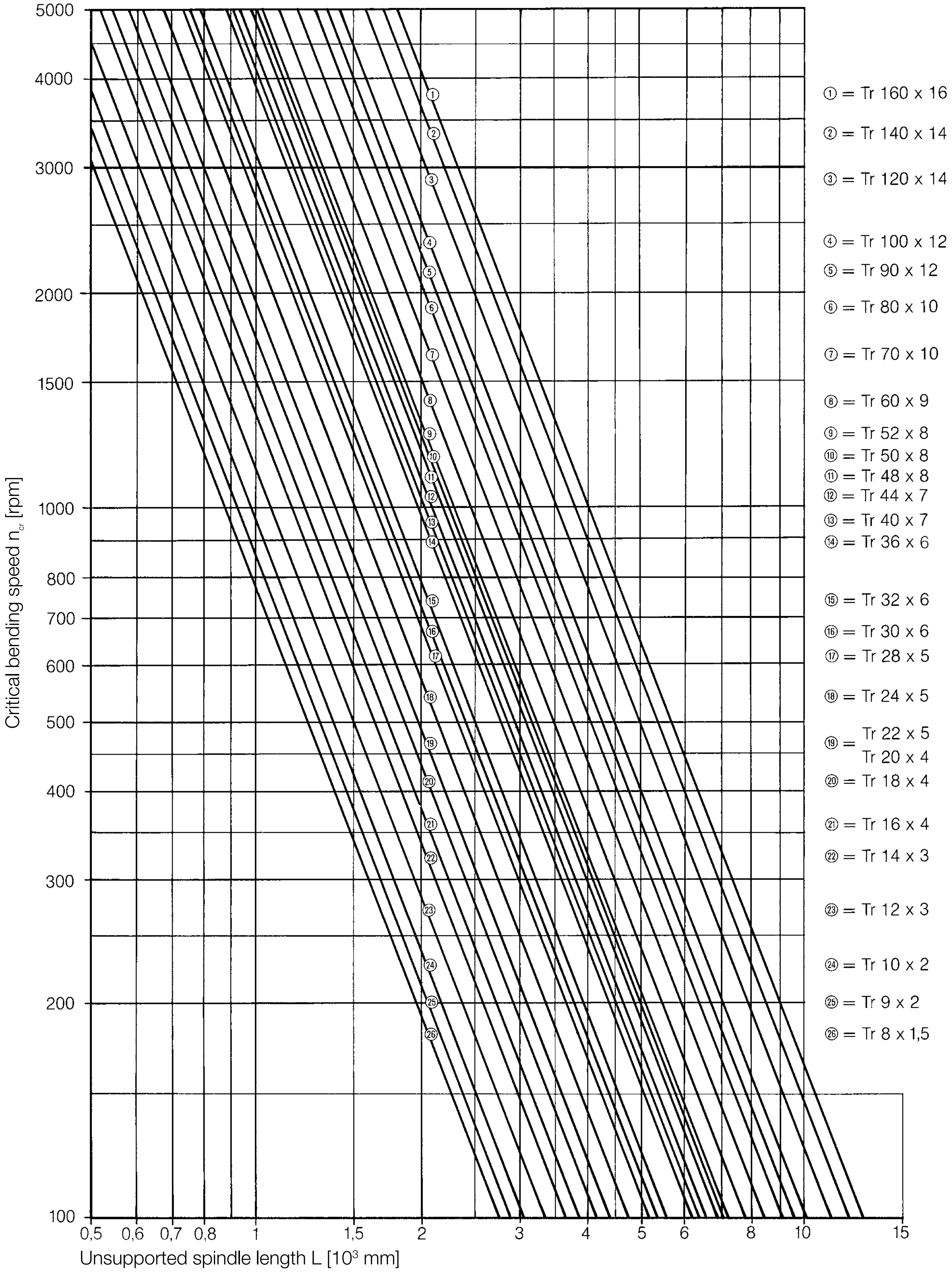


The efficiency of trapezoidal spindles is significantly less than that of ball screw spindles due to the sliding friction.

However, the trapezoidal screw is technically simpler and less expensive. A holding device (e.g. brake) is only required in rare cases due to the self-braking action of the trapezoidal screw spindle.

For an exact calculation, see Page 96 onwards.
Friction values, see Page 97.

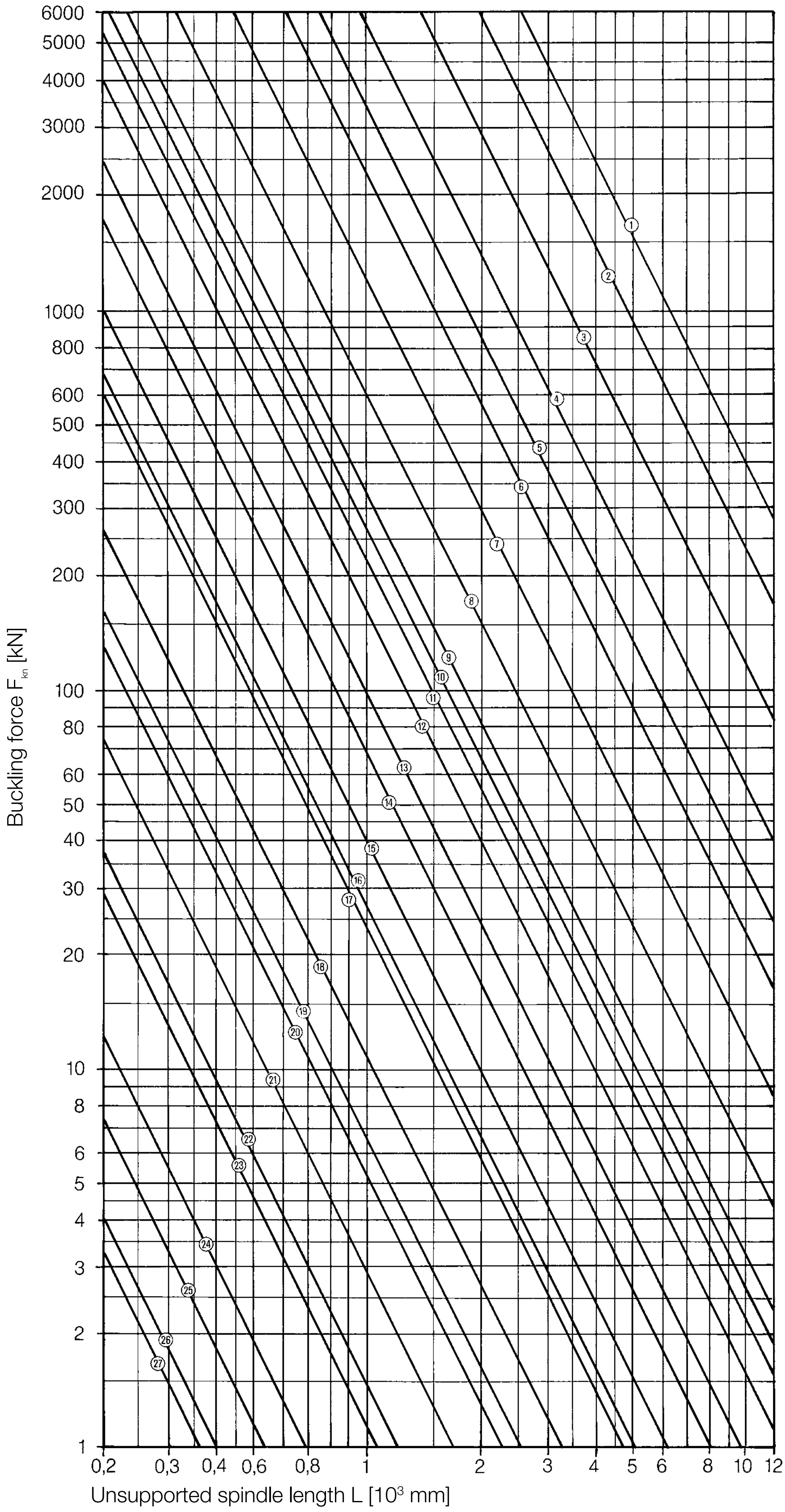
Critical bending speed – Diagram



For an exact calculation, see Page 94 onwards. Flank ø for trapezoidal spindles is to be taken into account, see Page 88. Note max. sliding speed at the flanks, see Page 94

Buckling – diagram

For an exact calculation (buckling factor), see Page 94 onwards. Characteristic diameter for trapezoidal spindles is to be taken into account, see Page 88.



① = Tr 160 x 16

② = Tr 140 x 14

③ = Tr 120 x 14

④ = Tr 100 x 12

⑤ = Tr 90 x 12

⑥ = Tr 80 x 10

⑦ = Tr 70 x 10

⑧ = Tr 60 x 9

⑨ = Tr 52 x 8
⑩ = Tr 50 x 8
⑪ = Tr 48 x 8

⑫ = Tr 44 x 7

⑬ = Tr 40 x 7

⑭ = Tr 36 x 6

⑮ = Tr 32 x 6

⑯ = Tr 30 x 6
⑰ = Tr 28 x 5

⑱ = Tr 24 x 5

⑲ = Tr 22 x 5
⑳ = Tr 20 x 4

㉑ = Tr 18 x 4

㉒ = Tr 16 x 4
㉓ = Tr 14 x 3

㉔ = Tr 12 x 3

㉕ = Tr 10 x 2

㉖ = Tr 9 x 2
㉗ = Tr 8 x 1,5

Calculations

Carrying capacity:
The ratings of trapezoidal screws are influenced by many factors. The most important factors are material pairings, surface quality, surface compression, duty, lubrication and temperature.
Select a screw according to your requirements (required feed speed, fitting space, etc.) and calculate the necessary length of nut for your application.

Arithmetical determination of the nut length

[01]
$$L_m = \frac{F \times P}{p_{zul.} \times d_2 \times \pi \times H_1 \times z}$$

L_m = nut length required [mm]
F = axial loading force [N]
P = thread lead [mm]
$p_{zul.}$ = permissible surface compression [N/mm^2]
d_2 = flank diameter [mm]
H_1 = thread bearing depth [mm] (0.5 x P)
z = number of starts

The permissible surface compression is dependent upon the sliding speed and the material used for the nut. A value of 10 N/mm^2 can be taken as a rough estimate. Approximate values for common materials can be found in the table below.

Existing surface compression depending on nut selected

[02]
$$p_{vorh.} = \frac{F \times P}{L_m \times d_2 \times \pi \times H_1 \times z}$$

$P_{vorh.}$ = existing surface compression [N/mm^2]
F = axial loading force [N]
P = thread lead [mm]
L_m = nut length required [mm]
d_2 = flank diameter [mm]
H_1 = thread bearing depth [mm] (0.5 x P)
z = number of starts

Sliding speed

[03]
$$v_g = \frac{n \times d_2 \times \pi}{60000}$$

v_g = sliding speed [m/s]
n = rotational speed [rpm]
d_2 = flank diameter [mm]

Screw feed speed

[04]
$$s = \frac{n \times P}{1000}$$

s = feed speed [m/min]
n = rotational speed [rpm]
P = lead [mm]

Material:	**Sliding speed**	**$p_{zul.}$**
	[m/s]	N/mm^2
Steel	1,5	10
CuSn alloy	1,5	10
CuAl alloy	1,5	10
Plastic PA	0,6	1

Approximate values for the permissible surface compression for sliding screws. Exact particulars can be requested from the material manufacturers.

Calculations

Drive torque

[05] $$M_{ta} = \frac{F \times P}{2000 \times \pi \times \eta}$$

[06] $$M_{te} = \frac{F \times P \times \eta'}{2000 \times \pi}$$

M_{ta} = drive torque [Nm] when converting a rotary to a linear movement
M_{te} = drive torque [Nm] when converting a linear to a rotary movement
F = axial loading force [N]
P = thread lead [mm]
η = efficiency
η' = efficiency

Efficiency

[07] $$\eta = \frac{\tan\alpha}{\tan(\alpha + \rho)}$$

[08] $$\eta' = \frac{\tan(\alpha - \rho)}{\tan\alpha}$$

η = efficiency (torque to linear force)
η' = efficiency (linear force to torque)
α = lead angle [°]
ρ = friction angle [°]

Lead angle

[09] $$\tan\alpha = \frac{P}{d_2 \times \pi}$$

α = lead angle [°]
P = thread lead [mm]
d_2 = flank diameter [mm]

Friction angle

[10] $$\tan\rho = \mu G$$

ρ = friction angle [°]
μG = see table below

The thread is self-locking
if pitch angle < friction angle

Drive power

[11] $$P_a = \frac{M_{ta} \times n}{9550}$$

P_a = drive power [kW]
M_{ta} = drive torque [Nm]
n = rotational speed [rpm]

Nut made from	**μG**	
	dry	lubricated
Cast iron GC	0,18	0,1
Steel	0,15	0,1
Bronze CuSn	0,1	0,05
Plastic	0,1	0,05

Friction values for common nut materials.

These values can be affected by lubrication, roughness, loading, etc.

Calculations

Critical bending speed

[12] $$n_{kr.} = \frac{30}{\pi} \times \sqrt{\frac{21 \times 10^4 \times d_2^{\,4} \times 10^4}{0{,}013 \times F \times l_a^{\,3} \times 20}}$$

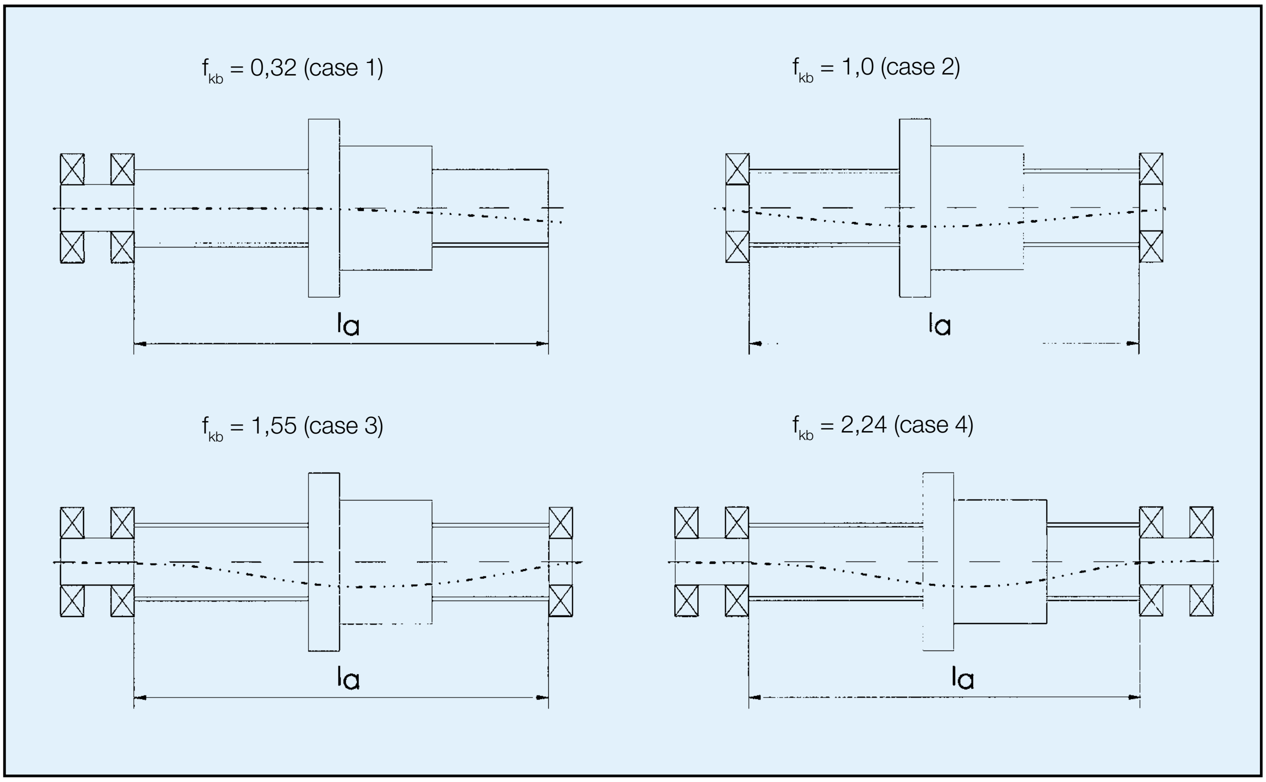
n_{cr} = critical speed due to weight and length of spindle [rpm]
d_2 = flank diameter of thread [mm]
F = weight of the unsupported spindle length [N]
l_a = distance between bearings [mm]

The critical bending speed is dependent upon the deflection of the spindle and thus upon the diameter and the distance between the bearings. The permissible speed can now be calculated from the way in which the spindle is mounted and from a safety factor.

Permissible speed

[13] $$n_{zul.} = 0.8 \times n_{kr.} \times f_{kb}$$

$n_{zul.}$ = permissible speed [rpm]
n_{cr} = critical speed due to weight and length of spindle [rpm]
f_{kb} = correction factor for deflection
0.8 = safety factor



Correction factor f_k for calculating the permissible speed.

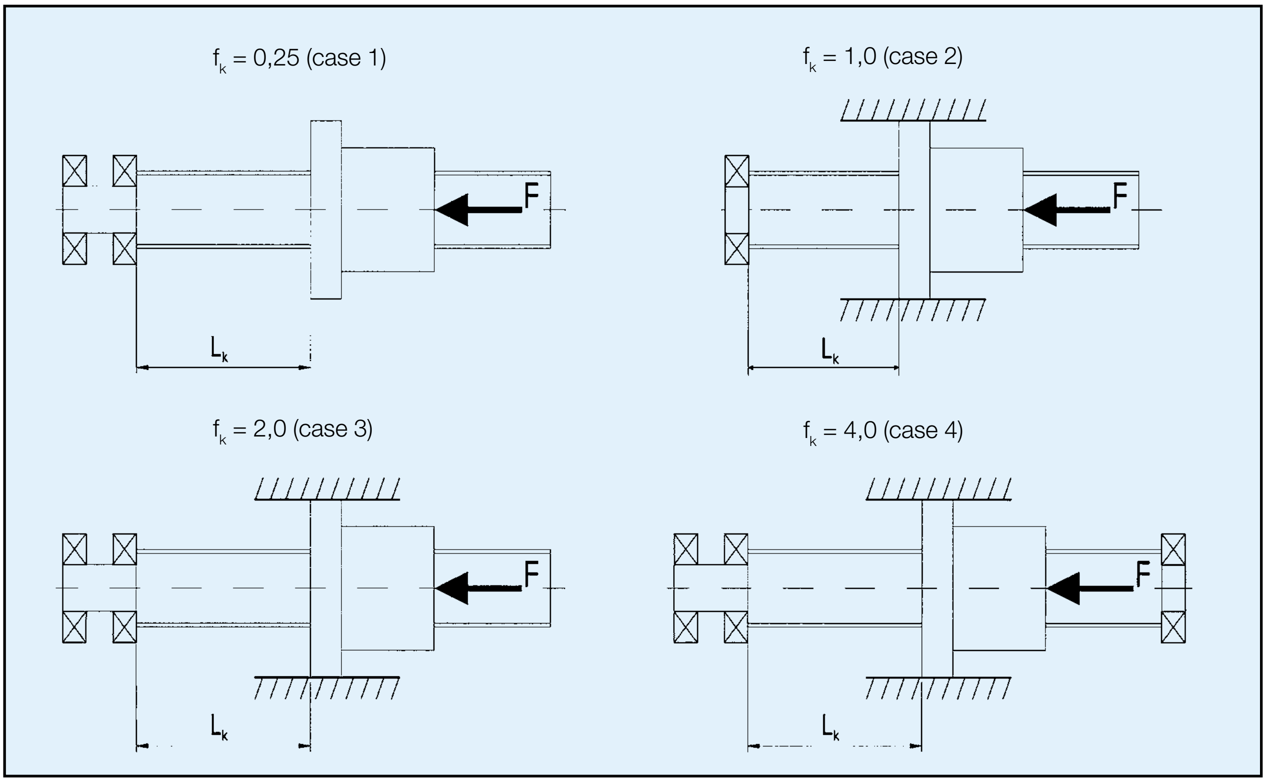
Calculations

Calculating the buckling force

$$[14]\quad F_{Kn} = \frac{21 \times 10^4 \times d_3^{\,4} \times \pi^3 \times f_k}{64 \times L_k^{\,2}}$$

F_{Kn} = buckling force for the spindle [N]
d_3 = spindle core diameter [mm]
f_k = correction factor for type of mounting
L_K = unsupported spindle length [mm]

The buckling force of the screw spindle is dependent upon the unsupported spindle length and the core diameter of the spindle.

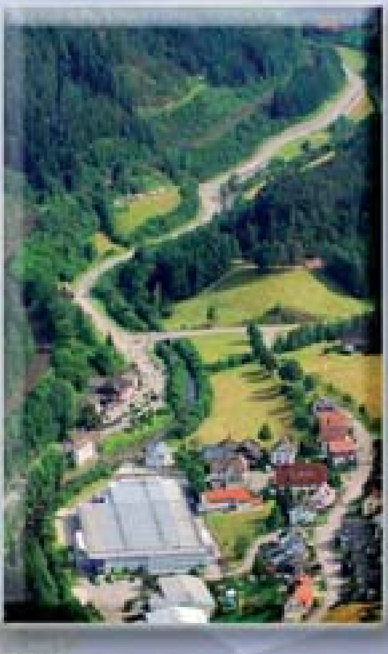


Correction factor f_k for taking into account the type of mounting.

You encounter our threads daily... also in large scale production

Hornberg - Niederwasser

Our production site is located where others spend their holiday - in the heart of the Black Forest. How about visiting us ?



How to find us

A look in our production


kammerer


doimak
doimak
kammerer


Highest
quality
from
request
to
delivery...

Questionnaire Part 1

Customer: ____________________ Customer No: ____________________
Address: ____
Telephone: ____________________ Telex: ____________________
Department: ____________________ Contact: ____________________
New design: ☐ Re-design: ☐
Enquiry dated: ____________________ Order dated:: ____________________

Order confirmation dated: ____________________ Order No: ☐
Customer drawing No: ____________________ dated: ____________________
No: ____________________ dated: ____________________
No: ____________________ dated: ____________________
Standard spindle, type: ____

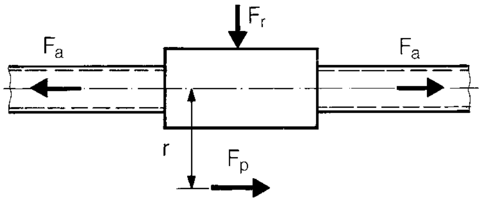
Quantity

Call-off of: ____________________ items ____________ monthly, yearly ____________________
______________ per order, or ____

We would ask you to provide us with as many technical details as possible. Our offer can then be worked out more carefully and appropriately for the application. If possible, please attach an installation drawing or draft sketch of the ball screw to this request.

Comments (or sketch)

1. Operating data
1.1 Drive via spindle shaft ☐ nut ☐
1.2 Static max. loading, axial (F_a) Tension: ____________ N, Compression: ____________ N
1.3 Dynamic max. loading: Tension: ____________ N, Compression: ____________ N
1.4 Non-axial loading: F_r = ________ N, F_p = ____________ N, r = ____________ mm



1.5 Safety factor in the loading figures: ____
1.6 Loading direction: single-sided ☐ two-sided ☐
1.7 Speed at the stated loads: v = ____________________ mm/min, n = ____________________ rpm
1.8 Max. speed: n_{max} = ______________ rpm
1.9 If the loads or speeds should vary, please provide details in the table below.

Collective load

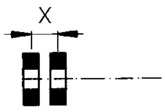
Type of load	Fa	n	or v	s	or q
	(N)	(rpm)	(mm/min)	(mm)	(%)

1.10 Utilisation factor: $f_n = \frac{\text{ball screw duty (h)}}{\text{machine duty}}$

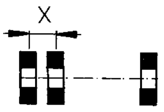
Questionnaire Part 2

1.11 Spindle mounting

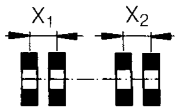
☐



☐
x = ____ mm



☐
x = ____ mm



☐
x_1 = ____ mm
x_2 = ____ mm

1.12 Distance between bearings: ____ mm
1.13 Installation orientation: vertical ☐ horizontal ☐ at an angle of ____ degrees
1.14 Max. permissible play: ____ mm
1.15 Required rigidity: ____ N/µm
1.16 Permissible no-load torque: ____ Nm
1.17 Required life: ____ operating hours, ____ x 10^6 revolutions

---

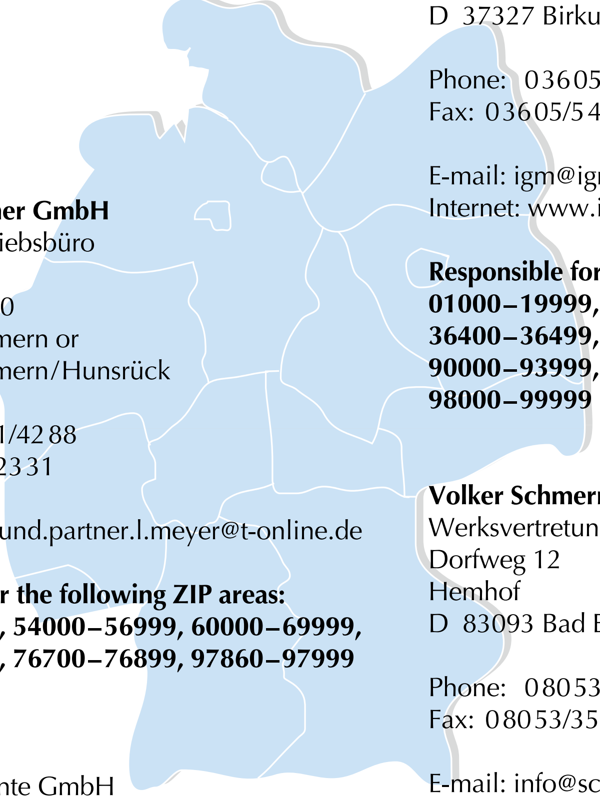
2.0 Operating conditions
2.1 Dust/dirt ☐ Moisture ☐ influence of chemicals ☐
2.2 Seal type: Bellows ☐ Telescopic spring ☐ Plastic wiper ☐ Felt wiper ☐
2.3 Operating temperature: ____ °C, Ambient temperature ____ °C
2.4 Type of lubrication: ____
2.5 Unusual operating conditions: ____

3.0 Characteristic data of spindle
3.1 Required nominal diameter ø A: ____ mm
3.2 Lead P: ____ mm
3.3 Lead direction: right-hand ☐ left-hand ☐
3.4 Permissible lead variation Δp/300 mm at 20 °C ____ µm
3.5 Δp/thread length at 20 °C ____ mm
3.6 Permissible lead variation according to drawing No: ____
3.7 Actual lead variation diagram required: ☐
3.8 Max. wobble error: ____ mm
3.9 Thread length: ____ mm
3.10 Total length: ____ mm
3.11 Spindle in tension ☐ Compression ☐ pre-loaded at F_v = ____ N
3.12 Material: ____ to ISO, DIN: ____
3.13 Material No: ____ Quality norm: ____
3.14 Surface treatment: ____
3.15 Hardness: ____ Depth of hardening zone: ____
3.16 Ball screw surface: ____ Roughness class: ____ Reference roughness value R_a: ____ µm
3.17 Accuracy class: ____

4.0 Characteristic data of nut
4.1 Max. length: ____ mm
4.2 Max. diameter: ____ mm
4.3 Housing to drawing No: ____
4.4 Single nut ☐ max. axial play ____
4.5 Double nut: Type of construction: ____ pre-loaded at F_v = ____ N
4.6 Max. axial displacement δa = ____ µm at F_{va} = ____ N
4.7 Max. reversal span δu = ____ µm at F_{va} = ____ N
4.8 Material: ____ to ISO, DIN: ____
4.9 Material No: ____ Quality norm: ____
4.10 Surface treatment: ____
4.11 Hardness: ____ Depth of hardening zone: ____
4.12 Ball screw surface: ____
4.13 Accuracy class: ____

Checked and approved (customer)	Checked (Kammerer)

Our agencies in Germany



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Responsible for Korea

Notes:

Notes:

Notes:

ZERTIFIKAT

ISO 9001:2000

bescheinigt hiermit, dass das Unternehmen

Kammerer Gewindetechnik GmbH

Bereiche:

Entwicklung, Herstellung und Vertrieb von Gewindetrieben

Standort:

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GEPRÜFTES
UMWELTMANAGEMENT

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For your information

The technical specifications of the products represented in this catalog are for informational purposes only. They are just a part of all possible manufacturing options with regard to dimensions, profiles, forms and material qualities.

Please contact us!

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