MOTION & CONTROL™

NSK

SUPER PRECISION BEARINGS FOR MACHINE TOOL APPLICATIONS

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As one of the world's leading manufacturers of rolling bearings, linear technology components and steering systems, we can be found on almost every continent – with production facilities, sales offices and technology centres – because our customers appreciate short decision-making channels, prompt deliveries and local service.

The NSK company

NSK commenced operations as the first Japanese manufacturer of rolling bearings back in 1916. Ever since, we have been continuously expanding and improving not only our product portfolio but also our range of services for various industrial sectors. In this context, we develop technologies in the fields of rolling bearings, linear systems, components for the automotive industry and mechatronic systems. Our research and production facilities in Europe, Americas and Asia are linked together in a global technology network. Here we concentrate not only on the development of new technologies, but also on the continuous optimisation of quality – at every process stage.

Among other things, our research activities include product design, simulation applications using a variety of analytical systems and the development of different steels and lubricants for rolling bearings.

Partnership based on trust – and trust based on quality

Total Quality by NSK: The synergies of our global network of NSK Technology Centres. Just one example of how we meet our requirements for high quality.

NSK is one of the leading companies with a long tradition in patent applications for machine parts. In our worldwide research centres, we not only concentrate on the development of new technologies, but also on the continual improvement of quality based on the integrated technology platform of tribology, material technology, analysis and mechatronics.

More about NSK at www.nskeurope.com or call us on + 44 (0) 1 636 605 123

Super Precision Bearings – Product Range

Several types of Super Precision Bearings are available from NSK. These include the ROBUST series of high performance bearings, special series of bearings for unique and specialised applications, and the standard series bearings.


Standard Series

NSKHPS High Precision Angular Contact Ball Bearings

Basic Super Precision Bearings manufactured to conform to ISO standards.

› 70xx, 72xx, 79xx series
› Contact angles: 15˚ (C), 25˚ (A5), 30˚ (A)
› Cage design: phenolic (TR) or polyamide (TYN), depending on application requirements
› Ball material: steel, ceramic (SN24)


Special Series

Sealed Angular Contact Ball Bearings

Pre-greased and sealed to reduce handling problems. Suitable for maintenance of machine tool spindles.

› Standard series super precision angular contact ball bearings
› ROBUST series high-speed angular contact ball bearings
› Bore size range: ø30–100 mm in ISO series 10 and 19 (70xx and 79xx)


Standard & High Rigidity Series

Double Row Cylindrical Roller Bearings

Designed to deliver high rigidity in high-speed applications such as lathe spindles.

› Cage material: brass (MB), PPS resin (TB)
› Standard specification E44: Outer ring oil holes and groove


Special Series

High Precision Angular Contact Ball Bearings

Suitable for high-speed and high precision motors.

› Cage material: ball guided polyamide cage (T1X,TYA), inner ring guided phenolic cage (T), selection depends on the application
› Suitable for silent or low vibration operation


BSR Series

Ultra High Precision Angular Contact Ball Bearings

High performance bearings developed specifically for internal grinding or high-speed motor applications under spring preload.

› Bore size range: ø6–25 mm, contact angle: 15°
› Ball material: steel (S type), ceramic (H and X type)
› Non separable type
› Universal combinations (DU and SU)


ROBUST Series: BAR & BTR

High-Speed Angular Contact Thrust Ball Bearings

High rigidity thrust bearings for lathe applications.

› Contact angles: 30° (BAR), 40° (BTR)
› Ball material: steel (S type), ceramic (H type)


ROBUST Series: BNR & BER

Ultra High-Speed Angular Contact Ball Bearings

High performance bearings developed for high-speed operation with low temperature rise. Suitable for ultra high precision machining applications, and ultra high-speed applications.

› Contact angles: 18° (BNR), 25° (BER)
› Ball material: steel (S type), ceramic (H and X type)
› Cage design: phenolic (T), polyamide (TYN), depending on application requirements
› ROBUST series also can be used for ultra high speed applications of over 3 million $d_m n$.


ROBUST Standard Series

Ultra High-Speed Single Row Cylindrical Roller Bearings

High performance cylindrical bearings designed for ultra high-speed applications, such as machining centre spindles.

› Cage material: brass (MR)[1], PEEK resin (TP)
› Roller material: steel, SHX, ceramic
› Ultra high-speed ROBUST RXH design can be used up to 3 million $d_m n$.

[1] MR cage is used in the standard series

Super Precision Bearings – Product Range

ROBUSTSHOT Series

High Precision Angular Contact Ball Bearings - RobustShot Series

Direct oil-air lubrication in order to achieve highest speeds.

› Direct air-oil Lubrication via a through-hole in the outer ring
› Contact angles: 18° (BNR), 25° (BER)
› Lubrication groove with O-rings in the outer ring
› Hybrid bearings - steel rings, ceramic balls

Special Series
for Machine Tool Applications

NSKHPS Angular Contact Thrust Ball Bearings for Ball Screw Support

High rigidity thrust bearings designed specifically for ball screw support applications in machine tools.

› Contact angle: 60°
› Can be universally matched to any required rigidity specification or life cycle
› A pre-greased line using special grease is also available
› Can be supplied with contact seals and waterproof grease

Special Series
for Injection Molding Machines

Angular Contact Thrust Ball Bearings for heavy duty Ball Screw Support

The high load capacity design delivers five times the life expectancy compared to ball screw support bearings for machine tool applications of a similar size. The number of rows can also be reduced.

› Easier handling than tapered roller bearings or thrust spherical roller bearings as a result of non-separable configuration
› Optimum ball bearing design results in lower rotational torque
› Can be universally matched to any required rigidity specification or life cycle

BSN & BSF Series

NSKHPS BSBD Ball Screw Support Bearings

The double row configuration, enables the bearings to support large axial forces in both directions.

› BSN series withouth flange, BSF series with flange
› Paired types also available
› Contact lip seal - provides good sealing at high speeds

Super Precision Bearings – Nomenclatures

Angular Contact Ball Bearing

Conventional Type 72, 70, 79 Series

70	16	A5		TR	V1V	DU	L	P3

Bearing Series

Bore Number

Contact Angle
A = 30°
A5 = 25°
C = 15°

Material
Blank Symbol: Bearing Steel (SUJ2)
SN24: Ceramic Balls

Retainer
TR: Phenolic Cage
TYN: Polyamide Cage

Seal
No symbol: Open type
V1V: Non contact rubber seal

Mounting Configuration
SU: Single Universal
DU: Duplex Universal
DB, DF, DT: Duplex Arrangement
DBD, DFD, DTD, DUD: Triplex Arrangement
DBB, DFF, DBT, DFT, DTT, QU: Quad Arrangement

Preload
L: Light
M: Medium
H: Heavy
Gxx: Preload in Kgf (G5=5 Kgf)
CPxx: Median Preload in Microns (CP10=10µm)
CAxx: Median Axial Clearance in Microns (CA15=15µm)

Precision Class
P4: ISO Class 4 (ABEC7)
P3: Dimensions - ISO Class 4
Running Accuracy - ISO Class 2
P2: ISO Class 2 (ABEC9)

ROBUST Series, High-Speed Type

80	BER	10	S	T	V1V	SU	EL	P3

Nominal Bore Diameter

Bearing Type
BNR: 18° Contact Angle
BER: 25° Contact Angle
BSR: 15° Contact Angle

Dimension Series
10: Same bore diameter, outside diameter & width as the 70 series
19: Same bore diameter, outside diameter & width as the 79 series

Material
S: Steel Ball
H: Ceramic Ball
X: SHX rings, ceramic balls

Retainer
T: Phenolic Cage
TYN: Polyamide Cage
T42: PEEK Cage

Seal
No Symbol: Open type
V1V: Non contact rubber seal

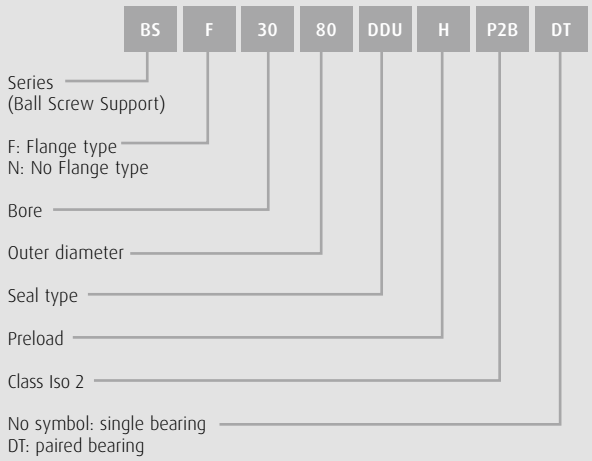
Mounting Configuration
SU: Single Universal
DU: Duplex Universal
DB, DF, DT: Duplex Arrangement
DBD, DFD, DTD, DUD: Triplex Arrangement
DBB, DFF, DBT, DFT, DTT, QU: Quad Arrangement

Preload
EL: Extra Light
L: Light
Gxx: Preload in Kgf (G5=5 Kgf)
CPxx: Median Preload in Microns (CP10=10µm)
CAxx: Median Axial Clearance in Microns (CA15=15µm)

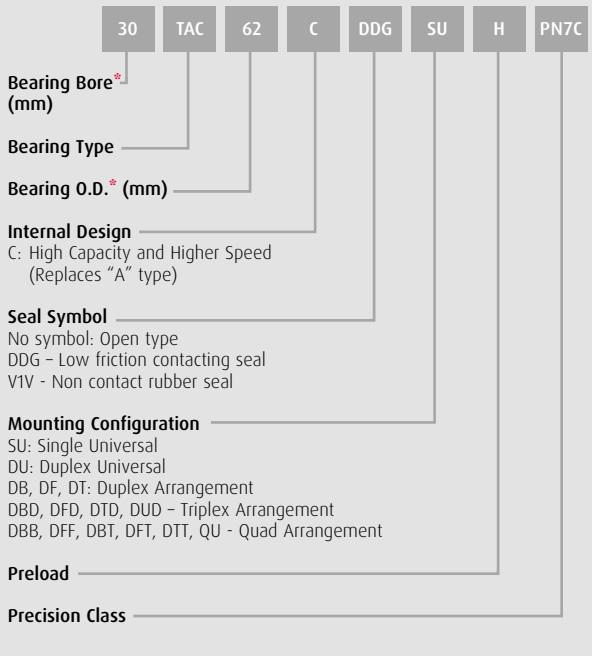
Precision Class
P4: ISO Class 4 (ABEC7)
P3: Dimensions - ISO Class 4 Running Accuracy - ISO Class 2
P2: ISO Class 2 (ABEC9)

Super Precision Bearings – Nomenclatures

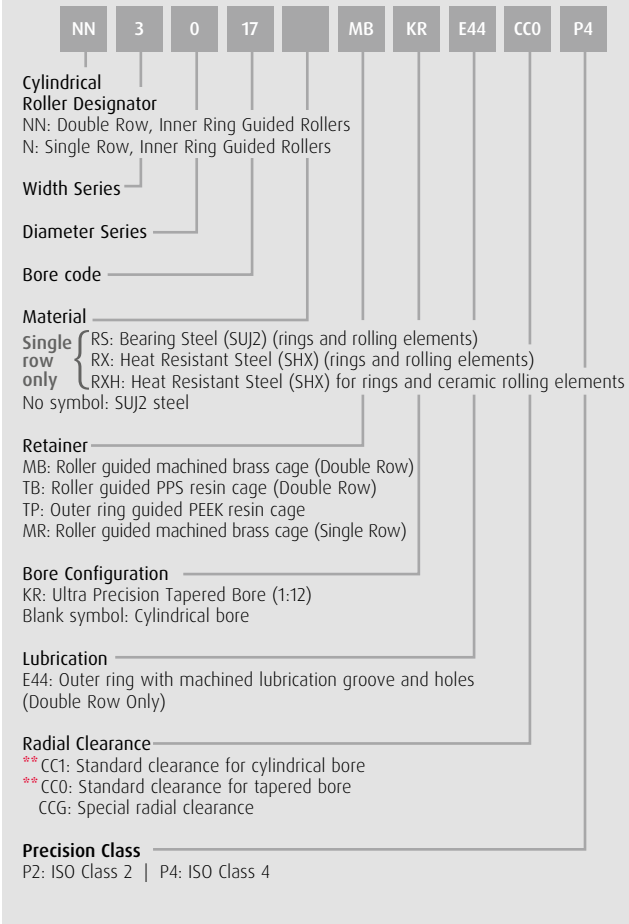
Ball Screw Support Bearings



Ball Screw Support Bearings



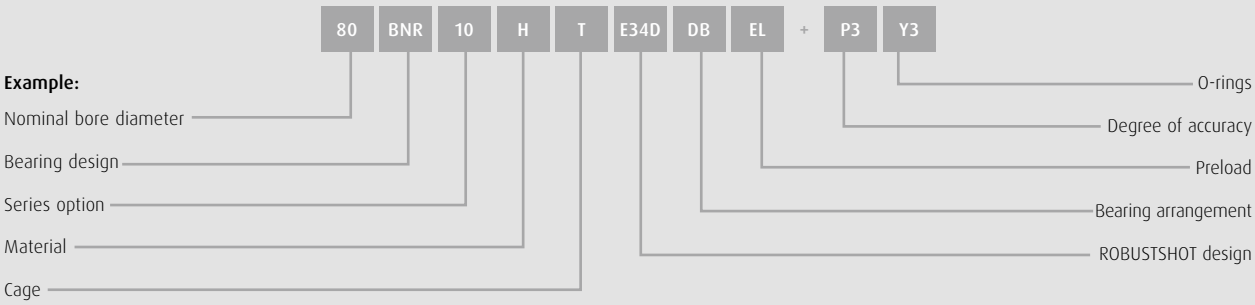
Cylindrical Roller Bearings



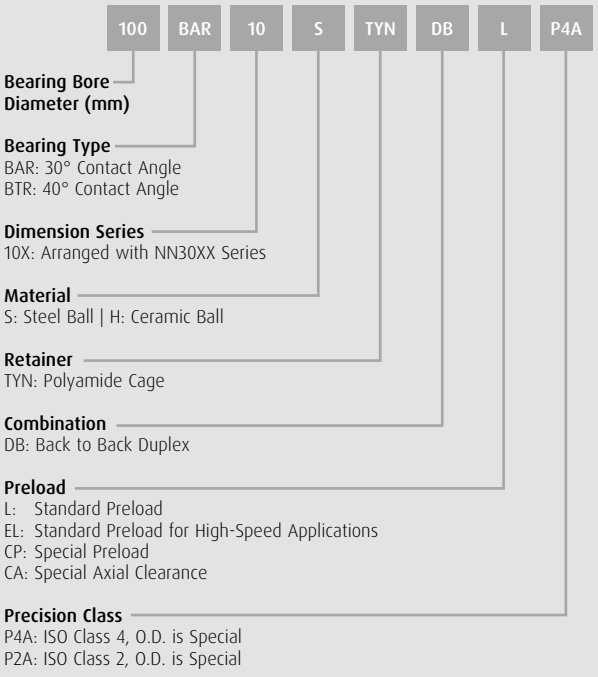
* For inch series bearings, the fractional portion of the size is omitted.

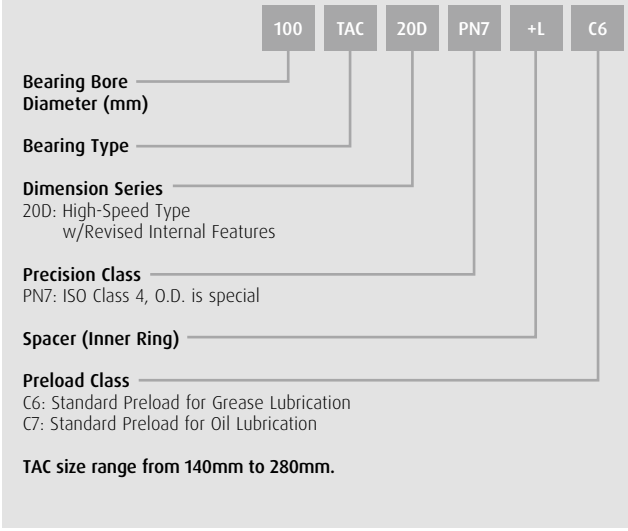
** **CC0 clearance (NSK's recommended clearance):** CC0 clearance range less than CC1. This range overlaps with the upper values of CC9 and lower values of CC1. As this clearance is easy for customers to target this range, it is the preferred clearance offered for CRB with taper bore.
CC1 clearance: Matched clearance range greater than CC0. While not the standard, this clearance is most popular in the field.

RobustShot Series



Thrust Angular Contact Ball Bearing





Super Precision Angular Contact Bearings for Machine Tools

NSK offers “universal” bearings, SU or DU, that can be used to create various angular contact ball bearing arrangements. A universal angular contact ball bearing is one with the same offset ground on both front and back faces. Reference Fig. 1, (f=b). This offset relates directly to the bearing’s stringent preload control and enables universal bearings to be combined or form back to back (DB, DBD, DBB) or face to face (DF, DFD, DFF) sets.

Features

- State-of-the art preload control
- High point of eccentricity marked on inner and outer rings
- Bearing and box marked with actual bore, OD, and width deviation from nominal (units are microns µm), see **figures 3a** and **3b**
- High performance phenolic cage

High Point of Radial Runout

The high point of radial runout is indicated by a small circle or burnished spot on the inner ring face (**Fig. 2a**) and by a ‘V’ line on the outside diameter of the outer ring (**Fig. 2b**). The bearings can then be mounted with these marks axially aligned with each other and opposed to the shaft or housing eccentricities in order to minimise assembled runout.

Fig. 1

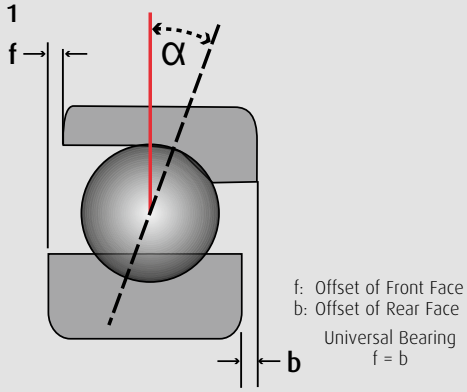


Fig. 2a

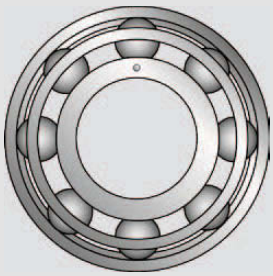


Fig. 2b

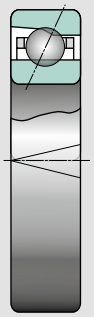


Fig. 3a

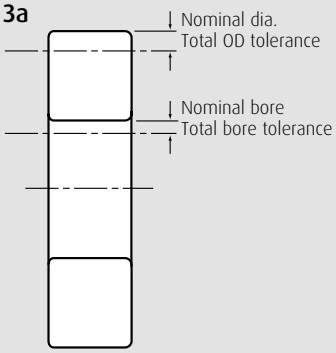


Fig. 3b

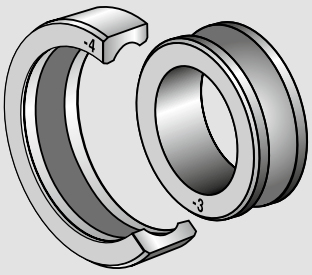
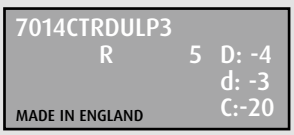
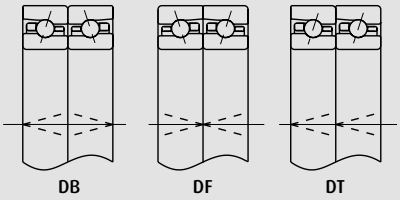
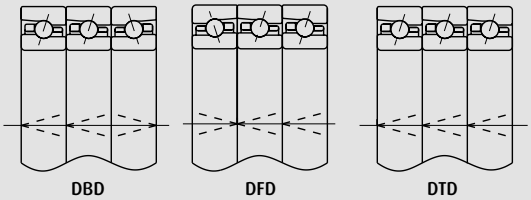


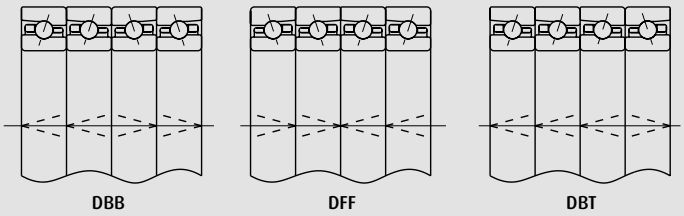
Fig. 3c

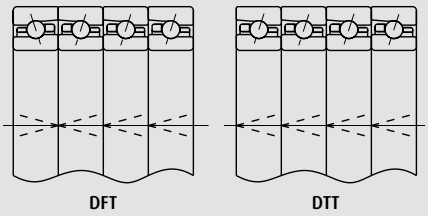


Combination mark & matching method for universal combination bearings









Angular Contact Ball Bearings combinations available

	DB	DF	DT	DBD	DBB
Load stiffness	⇦⇨	⇦⇨	⇨	⇦⇨	⇦⇨
Moment stiffness	◎	○	△	◎	●
Speed capability	◎	◎	●	△	○
Heat generation	◎	◎	●	△	○
Stiffness	○	○	△	◎	●

● Excellent ◎ Very good ○ Good △ Fair ⇨ One direction only ⇦⇨ Two directions

Fitting on Shaft and Housing

It is of utmost importance that shafts and housings are accurately and precisely mated in order to take full advantage of the precision bearings' capabilities, which include rotational accuracy, high speed performance, and low heat generation.

When the inner ring or outer ring is mounted onto a shaft or into a housing with some interference, the shape of shaft or housing (out of roundness) is transferred to the bearing raceway surfaces and affects running accuracy. When different arrange-ments of angular contact ball bearings are used, cylindricity affects the distribution of preload for each bearing. Therefore, the mating parts should be as accurate as possible. Inaccurate mating of parts can cause the formation of peaks or ridges along the shaft of a precision lathe, which can affect the quality of finished work.

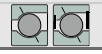
Bearing type[3]		Shaft outer diameter (mm)		Tolerance of shaft[2] outer diameter (mm)		Target interference[2,4] (mm)	
		over	incl.	minimum	maximum	minimum	maximum
Fits[1] on shafts	Machine tool spindle bearing	10	18	-0.003	0	0	0.002 T
		18	50	-0.004	0	0	0.0025 T
		50	80	-0.005	0	0	0.003 T
		80	120	-0.003	0.003	0	0.004 T
		120	180	-0.004	0.004	0	0.004 T
		180	250	-0.005	0.005	0	0.005 T
	Angular contact thrust ball bearing for ball screw support	10	18	-0.008	0	–	–
		18	30	-0.009	0	–	–
		30	50	-0.011	0	–	–
		50	80	-0.013	0	–	–
		80	120	-0.015	0	–	–
Bearing type[3]		Housing bore diameter (mm)		Tolerance of housing[2] bore diameter (mm)		Target clearance[2,4] (mm)	
		over	incl.	minimum	maximum	minimum	maximum
Fits[1] in housing	Angular contact ball bearing (fixed side)	18	50	-0.002	0.002	0.002 L	0.006 L
		50	80	-0.0025	0.0025	0.002 L	0.006 L
		80	120	-0.003	0.003	0.003 L	0.008 L
		120	180	-0.004	0.004	0.003 L	0.008 L
		180	250	-0.005	0.005	0.005 L	0.010 L
	Angular contact ball bearing (free side)	18	50	0	0.004	0.006 L	0.011 L
		50	80	0	0.005	0.006 L	0.011 L
		80	120	0	0.006	0.009 L	0.015 L
		120	180	0	0.008	0.009 L	0.015 L
		180	250	0	0.010	0.015 L	0.022 L
	Cylindrical roller bearing	18	50	-0.006	0	0.002 L	0.002 T
		50	80	-0.007	0	0.002 L	0.002 T
		80	120	-0.008	0	0.002 L	0.002 T
		120	180	-0.009	0	0.002 L	0.002 T
		180	250	-0.011	0	0.002 L	0.002 T
	Angular contact thrust ball bearing for ball screw support	10	18	–	–	–	–
		18	30	–	–	–	–
		30	50	0	0.016	–	–
		50	80	0	0.019	–	–
		80	120	0	0.022	–	–

1. The fitting data above provides general recommendations for machine tool spindles operating under normal conditions and for dmn values of less than 800,000. For high speeds, heavy loads, or outer ring rotation, please contact NSK for assistance.
2. Use the target interference when the bearings can be matched to the shaft or housing. Otherwise use the shaft outer diameter and housing bore min and max for random matching.
3. Applies to angular contact ball bearings: 70XX, 79XX, 72XX, BNR and BER Angular contact thrust ball bearings: BAR, BTR and TAC. Cylindrical roller bearings: N10XX, NN30XX, NN39XX, NN49XX and NNU49XX
4. T=Interference or tight fit, L=Clearance or loose fit

Super Precision Bearings Interchange Guide

Interchange Guide for Precision Angular Contact Bearings (Example of 25 degrees contact angle)

Standard design	ISO series	NSK	SKF	SNFA	Fafnir	FAG
	19	79xxA5(V1V)	719xxACD	SEBxxxxx3	3xx93xxWI	B719xxE.(2RSD)
	10	70xxA5(V1V)	70xxACD	SEBxxxxx3	3xx91xxWI	B70xxE.(2RSD)
	02	72xxA5	72xxACD	EBxxxxx3	3xx21xxWI	B72xxE.(2RSD)
	19	79xxA5SN24(V1V)	791xxACD/HC	SEBxx/NSxxx3	3xxC93xxWI	HCB719xxE.(2RSD)
	10	70xxA5SN24(V1V)	70xxACD/HC	EXxx/NSxxx3	3xxC91xxWI	HCB70xxE.(2RSD)

High speed design	ISO series	NSK	SKF	SNFA	Fafnir	FAG
	19	xxBER19(V1V)S	719xxACE	VEBxxxxx3	3xx93xxHX(VV)	HS(S)719xxE
	10	xxBER19(V1V)S	70xxACE	VEXxx(/S)xxx3	3xx91xxHX(VV)	HS(S)70xxE
	19	xxBER19(V1V)H	719xxACE/HC	VEBxx/NSxxx3	3xxC93xxHX(VV)	HC(S)719xxE
	10	xxBER10(V1V)H	70xxACE/HC	VEXxx(/S)/NSxxx3	3xxC91xxHX(VV)	HC(S)70xxE
	19	xxBER19(V1V)X	–	VEBxxXNxxx3	–	XC(S)719xxE
	10	xxBER10(V1V)X	–	VEXxx(/S)/XNxxx3	–	XC(S)70xxE

Interchange Guide for Ball Screw Support Bearings

Series		NSK	INA	SKF	TIMKEN
	No flange single	BSNxxxxDDUHP2B	ZLKNxxxx-(2Z/2RS)	BEAM0xxxx-(2RZ/2RS)	MMN5xxBSxxPP DM
	No flange single	BSFxxxxDDUHP2B	ZLKFxxxx-(2Z/2RS)	BEAS0xxxx-(2RZ/2RS)	MMF5xxBSxxPP DM
	No flange pair	BSNxxxxDDUHP2BDT	ZLKNxxxx-(2Z/2RS)-2AP	-	MMN5xxBSxxPP QM
	No flange pair	BSFxxxxDDUHP2BDT	ZLKFxxxx-(2Z/2RS)-2AP	-	MMF5xxBSxxPP QM

Interchange Guide for Precision Thrust Bearings

Thrust bearings for spindle applications – contact angle	NSK	SKF	SNFA	Fafnir	FAG
30 degrees	xxBAR	BTMxx A/DB	–	–	–
40 degrees	xxBTR	BTMxx B/DB	–	–	–
60 degrees	xxTAC	2344xx	–	–	2344xx

Interchange Guide for Precision Ball Screw Support Bearings

Series	NSK	SKF	SNFA	Fafnir	FAG
Non-ISO-metric (30 bore, 62 OD, 15 w)	30TAC62B	BSD3062C	BS3062	MM30BS62	BSB030062
ISO-metric (30 bore, 62 OD, 16 w)	BSB2030	BSA206C	BS230	–	760230
INCH (23.838 bore, 62 OD, 15.875 w)	BSB093	BDAB634201C	–	MM9308WI2H	–

Interchange Guide for Precision Cylindrical Roller Bearings

		NSK	SKF	FAG
Standard design construction		NN39xx(KR)	–	–
		NN30xx(KR)	NN30xx(K)	NN30xx(K)
		NN49xx(KR)	–	–
		NNU49xx(KR)	NNU49xx(K)	NNU49xx(K)
		N10xx(KR)	N10xx(K)	N10xx(K)
High speed design construction		N10xxRS(KR)	–	–
		N10xxRXH(KR)	N10xxHC5(K)(*)	HCN10xx(K)(*)
		N10xxRX(KR)	–	–

Caption
Symbols in **(brackets)** show seal designation when available.
Items in **red** are the manufacturers identifiers of particular parameters.

- Steel balls
- Ceramic balls
- Steel balls sealed
- Ceramic balls sealed
- Special material rings/ Ceramic balls (sealed)
- Steel rollers & rings
- Ceramic rollers & Special steel rings
- Special steel rollers & rings

(*) Normal steel rings
This interchange should be used as a guideline only, as manufacturers' designations may change without notice.

Recommended Grease Quantities for High-Speed Spindle Bearings

Unit: cc/brg

Bore number	Bore diameter	Angular contact ball bearings: 15 % of internal free space				Ball screw support bearings 50 %	Cylindrical roller bearings: 10 % of internal free space			
	(mm)	BNR19, BGR19 BER19, 79XX X-quantity	BGR10 70XX X-quantity	BGR02 72XX X-quantity	BNR10, BAR10 BER10, BTR10 X-quantity	TAC L-quantity	NN49 X-quantity	NN39 X-quantity	NN30 X-quantity	N10 X-quantity
5	5	–	–	0.03	–	–	–	–	–	–
6	6	–	0.04	0.07	–	–	–	–	–	–
7	7	–	0.07	–	–	–	–	–	–	–
8	8	–	0.12	0.10	–	–	–	–	–	–
00	10	0.06	0.13	0.16	–	–	–	–	–	–
01	12	0.06	0.14	0.23	–	–	–	–	–	–
02	15	0.11	0.18	0.29	–	2.20	–	–	–	–
03	17	0.13	0.24	0.41	–	2.20	–	–	–	–
04	20	0.23	0.44	0.68	–	2.20	–	–	–	–
05	25	0.27	0.52	0.85	–	3.00	–	–	0.40	–
06	30	0.31	0.69	1.20	0.58	3.20	–	–	0.60	0.40
07	35	0.48	0.98	1.70	0.78	3.80	–	–	0.80	0.60
08	40	0.75	1.20	2.10	0.92	3.90/8.80*	–	–	1.00	0.70
09	45	0.83	1.50	2.60	1.20	4.20/9.70**	–	–	1.30	1.00
10	50	0.91	1.60	3.00	1.20	10.20	–	–	1.40	1.10
11	55	1.10	2.40	3.90	1.70	10.20/12.00***	–	–	2.00	1.50
12	60	1.20	2.60	4.80	1.80	12.00	–	–	2.10	1.60
13	65	1.30	2.60	5.70	1.90	–	–	–	2.20	1.60
14	70	2.10	3.60	6.50	2.80	–	–	–	3.20	2.40
15	75	2.30	3.60	7.00	2.90	–	–	–	3.50	2.50
16	80	2.40	5.10	8.70	3.80	–	–	–	4.70	3.50
17	85	3.50	5.30	11.00	4.00	–	–	–	4.90	3.70
18	90	3.60	6.60	13.00	5.50	–	–	–	6.50	4.50
19	95	3.60	6.80	16.00	5.70	–	–	–	6.60	4.70
20	100	4.90	7.20	19.00	6.10	–	5.40	4.50	6.80	4.90
21	105	5.10	9.00	23.00	7.60	–	5.60	4.60	9.30	5.90
22	110	5.20	12.00	27.00	9.10	–	5.70	4.80	11.00	7.50
24	120	7.90	12.00	31.00	9.80	–	8.40	6.50	12.50	8.10
26	130	9.00	18.00	34.00	15.00	–	11.00	8.50	18.00	12.40
28	140	9.90	20.00	42.00	17.00	–	12.00	9.30	20.00	12.90
30	150	14.0	25.00	53.00	22.00	–	24.00	14.00	23.00	–
32	160	16.0	34.00	–	26.00	–	20.00	15.00	29.00	–

Do not operate bearings at full spindle speed when bearings are first installed. It is necessary to break the grease in, contact NSK for assistance. The grease quantity of "xxTAC20(29)X(D)" should be the same as the double row cylindrical roller bearings, which is assembled with this bearing together.

* 40TAC72 and 40TAC90
** 45TAC75 and 45TAC100
*** 55TAC100 and 55TAC120

Grease Brand Names and Properties

Brand names	Manufacturers	Thickeners	Base oils	Base oils viscosity mm (40˚C)	Dropping point (˚C)	Working temperature range (˚C)	Main application
MTE	NSK	Barium complex	Ester oil	20	200	-30~+120	Bearings for high speed spindles, high speed cylindrical roller bearings
MTS	NSK	Urea	Ester + Synthetic hydro carbon oil	22	220	-40~+130	Bearings for high speed spindles
Isoflex NBU15	Klüber	Barium complex	Diester oil + Mineral oil	20	250	-30~+120	Bearings for main spindles
Isoflex NCA15	Klüber	Special Ca	Ester oil	23	180	-40~+130	Bearings for main spindles
Mobilux 2	Mobil	Lithium	Mineral oil	26	190	-10~+110	Bearings for boring heads, live centres
Multemp LRL3	Kyodo Yushi	Lithium	Tetraester oil	37	208	-30~+130	Bearings for main spindles
Stabragus NBU8EP	Klüber	Barium complex	Mineral oil	105	220	-30~+130	Heavy load cylindrical roller bearings
Alvania 2	Shell	Lithium	Mineral oil	130	182	-10~+110	Ball screw support bearings
ENS	NSK	Diurea	Tetraester oil	32	260	-40~+160	Bearings for motors
WPH	NSK	Diurea	Polyalphaolefin	95.8	260	-40~+150	Ball screw support bearings

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NSK

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