(6) NSKHPS angular contact thrust ball bearings for ball screw support

1. Features

This is highly rigid and accurate ball screw support bearing often used for the machine tools driving mechanism.

NSKHPS:Reliability has been improved by focusing on material cleanliness, which has the biggest impact on bearing life, by employing NSK's proprietary material evaluation technology. The dynamic load rating has been improved by 5% compared with that of conventional bearings.

The NSKTAC C Series features high axial rigidity and is suitable for machine tool feeding mechanisms, while the NSKTAC 03 Series with its high axial load capacity is well suited for the support of large ball screws in high-load drive applications such as electric injection molding machines. With these series users can achieve much lower torque and higher accuracy than with roller bearings.

(a) High axial rigidity

The axial rigidity is high because of a higher contact angle of 60°

(b) Low starting torque

Compared with tapered roller bearings or cylindrical roller bearings, this type has lower starting torque; so smoother rotation is possible with driving force.

(c) Easy Installation

The clearance in each indivisual bearing in a combination is adjusted to obtain the optimum preload. With universal combination bearings (combination symbol SU), a specific preload is obtained when used with others having the same bearing number in any combination (DB, DF, and others).

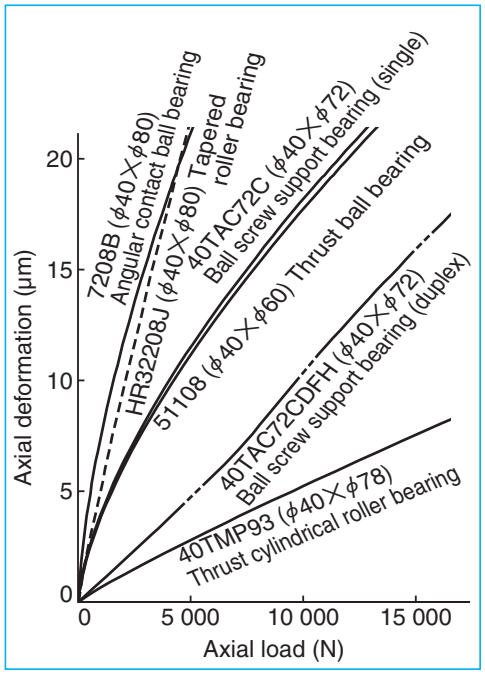


Fig. 1 Axial rigidity of various bearings

(d) Structural simplicity

Since this type can sustain both axial and radial loads, the surrounding structure is simpler and more compact than when using a combination of radial and thrust bearings.

(e) Easy handling

Since the Inner and outer rings are inseparable, handling is easy.

Table 2 Comparison with other types of bearings

Bearing type	Bearing rigidity (See Fig. 1)	Starting torque	Preload adjustment	Installation structure
Ball screw support bearings	High	Low	Not required	Simple
Combined angular contact ball bearing	Low	Low	Not required	Simple
Tapered roller bearing	Low	High	Complicated	Simple
Thrust ball bearing and radial bearing	High	Low	Complicated	Complicated
Thrust cylindrical roller bearing and radial bearing	Extremely high	Extremely high	Complicated	Complicated

Note: Consult NSK when you use these bearings other than the purpose of ball screw support.

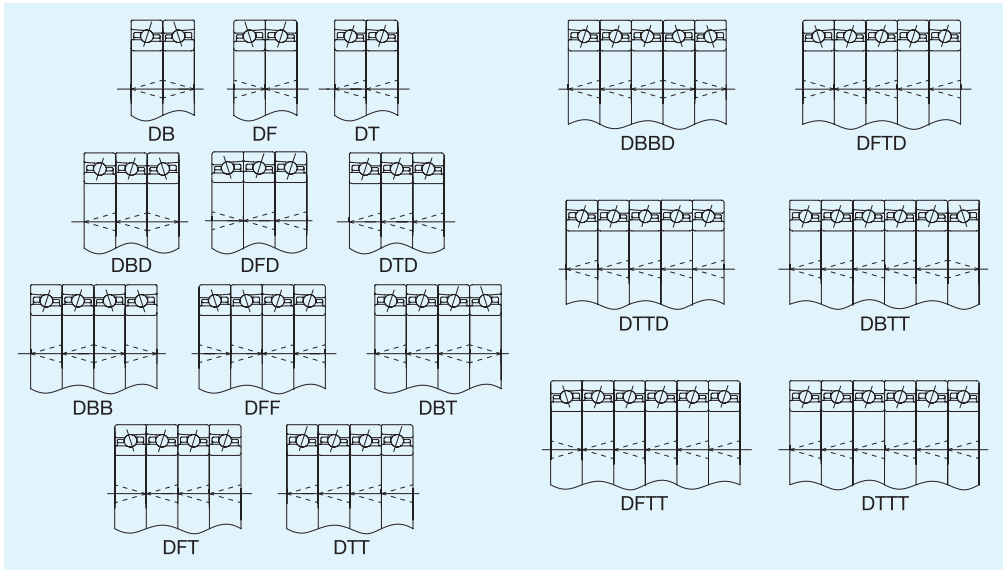
2. Bearing combinations

Angular contact thrust ball bearings for ball screw support are generally used in two or more rows with preload applied.

Universal Combination Bearings

NSK manufactures universal combination bearings which have been controlled to have the same amount of stand-out (offset) on their front and back faces. That way, for bearings with the same bearing number, users will achieve the specified amount for each standard preload, regardless of which combination they chose. Each universal combination bearing comes with a V-shaped mark on the surface of the outer ring to simplify identification of the correct direction when mounting and to ensure that the correct combination is achieved. The V-shaped mark points to the direction of the axial load that the inner ring supports (contact angle).

Combination Mark and Matching Method for Universal Combination Bearings



3. Permissible Axial Load for Angular Contact Ball Bearings

NSK has defined the limiting static axial load as the smaller of the two values listed below:

(1) Limiting axial load that produces shoulder override
The limiting load at which the contact ellipse generated between the ball and the raceway overrides the shoulder of the raceway groove (Fig. 2)

(2) Limiting axial load in terms of surface pressure
The limiting load at which the contact stress at the center of the contact area between the ball and the raceway groove reaches a level that leaves an indentation as defined in the basic static load rating (Fig. 3)

To maintain optimal bearing performance, NSK has defined permissible static axial load values by applying a safety factor to the limiting axial load based on many years of experience.
The formula for calculating the basic static axial load rating C_{0a} does not take the shoulder height of the raceway groove into account. Therefore, in some cases the C_{0a} value may exceed the limiting axial load that produces shoulder override.
In such cases, the maximum load that the bearing can sustain is lower than the C_{0a} value, making the C_{0a} value unsuitable (Fig. 4). Therefore, instead of C_{0a} values, we have listed limiting axial load values in the bearing tables where necessary, particularly for angular contact thrust ball bearings as they are usually used to support heavy axial loads.

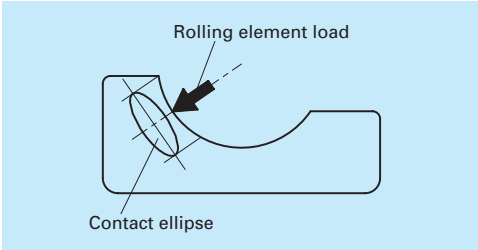


Fig. 2 Ride-over limit axial load

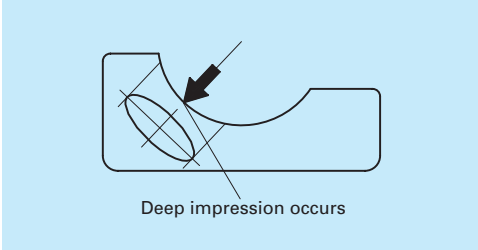


Fig. 3 Contact pressure limit axial load

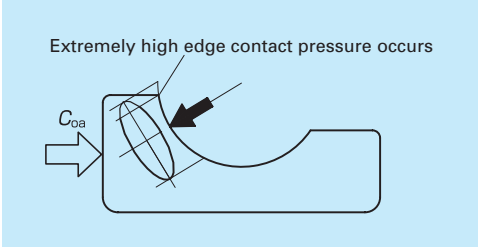


Fig. 4 C_{oa} and limit axial load

4. Rolling contact fatigue life

The relationship between basic load rating, bearing load, and basic rating life for the rolling bearing is presented in the following formula.

$$L_h = \frac{10^6}{60n}\left(\frac{C_a}{P}\right)^3$$

Where, L_h: Basic rating life (h)
C_a: Basic dynamic load rating (N)
P : Dynamic equivalent load (N)
n : Rotational speed (min^{-1})
See the right table for dynamic equivalent load in each combination.

Dynamic equivalent load $P_a = XF_r + YF_a$

Bearing configuration / Combination code / Number of the row that receives axial load		Duplex		Triplex			Quadruplet		
		DF	DT	DFD		DTD	DFT	DFF	DFT
		One row	Two rows	One row	Two rows	Three rows	One row	Two rows	Three rows
$e = 2.17$									
$F_a/F_r \leqq e$	X	1.9	–	1.43	2.33	–	1.17	1.9	2.53
	Y	0.55	–	0.77	0.35	–	0.89	0.55	0.26
$F_a/F_r > e$	X	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
	Y	1	1	1	1	1	1	1	1

5. Fits

Recommended interference values for standard operating conditions of ball screws are listed in Tables 3. When using angular contact thrust ball bearings for high-load drive ball screw support, in cases where a single end is supported and moment loads are high, it is advisable to increase shaft interference, for example by choosing k5 etc. as required.

Table 3 Tolerances for Shaft and Housing Bore Diameters Unit: μm

Shaft Outer Diameter, Housing Bore Diameter (mm)		Tolerance of shaft outer diameter						Tolerance of housing bore diameter		
		Angular contact thrust ball bearings for high-rigidity applications			Angular contact thrust ball bearings for high-load drive applications					
Over	Incl.		Min.	Max.		Min.	Max.		Min.	Max.
10	18	h5	–8	0	js5	–4	4	H6	–	–
18	30		–9	0		–4.5	4.5		–	–
30	50		–10	0		–5.5	5.5		0	16
50	80		–13	0		–6.5	6.5		0	19
80	120		–	–		–7.5	7.5		0	22
120	180		–	–		–9.0	9.0		0	25
180	250		–	–		–	–		0	29
250	315		–	–		–	–		0	32
315	400		–	–		–	–		0	36

6. Bearing Accuracy

Table 4 to 6 shows accuracy for angular contact thrust ball bearings for ball screw support.

Table 4 Tolerances for angular contact thrust ball bearings NSKTAC C for high-rigidity ball screw support (Class PN7C [1]) Unit: μm

Nominal Bore (or outer diameter) (mm)		Single Plane Mean Bore Diameter Deviation Δdmp		Deviation of Single Bore Diameter Δds		Single Plane Mean Outside Diameter Deviation ΔDmp		Deviation of Single Outside Diameter ΔDs		Deviation of Single Inner Ring Width ΔBs		Inner ring (Outer Ring) Face Runout with Raceway *Sia* (*Sea*)
Over	Incl.	High	Low	High	Low	High	Low	High	Low	High	Low	Max.
10	18	0	–4	0	–4	–	–	–	–	0	–120	2.5
18	30	0	–5	0	–5	–	–	–	–	0	–120	2.5
30	50	0	–6	0	–6	0	–6	0	–6	0	–120	2.5
50	80	0	–7	0	–7	0	–7	0	–7	0	–150	2.5
80	120	–	–	–	–	0	–8	0	–8	–	–	2.5

Note: 1. NSK specification

Table 5 Tolerances for angular contact thrust ball bearings NSKTAC 03 for high-load drive applications ball screw support (Class PN5D [2]) Unit: μm

Nominal Bore (or outer diameter) (mm)		Single Plane Mean Bore Diameter Deviation Δdmp		Single Plane Mean Outside Diameter Deviation ΔDmp		Deviation of Single Inner Ring Width ΔBs		Inner ring (Outer Ring) Face Runout with Raceway *Sia* (*Sea*)
Over	Incl.	High	Low	High	Low	High	Low	Max.
10	18	0	–5	–	–	0	–80	5
18	30	0	–6	–	–	0	–120	5
30	50	0	–8	0	–7	0	–120	5
50	80	0	–9	0	–9	0	–150	8
80	120	0	–10	0	–10	0	–200	8
120	150	0	–13	0	–11	0	–250	10
150	180	0	–13	0	–13	0	–250	10
180	250	–	–	0	–15	–	–	10
250	315	–	–	0	–18	–	–	11
315	400	–	–	0	–20	–	–	13

Note: 2. NSK specification

Table 6 Tolerances for BSBD Series double-row bearings (Class P2B [3]) of BSF and BSN series) Unit: μm

Nominal Bore Diameter (mm)		Single Plane Mean Bore Diameter Deviation Δdmp		Single Plane Mean Outside Diameter Deviation ΔDmp		Inner Ring Face Runout with Raceway *Sia*	Radial Runout of Inner Ring *Kia*	Width Tolerance	
Over	Incl.	High	Low	High	Low	Max.	Max.	High	Low
10	18	0	–5	0	–10	1.5	1.5	0	–250
18	30	0	–5	0	–10	2.5	2.5	0	–250
30	50	0	–5	0	–10	2.5	2.5	0	–250
50	80	0	–8	0	–15	2.5	2.5	0	–250

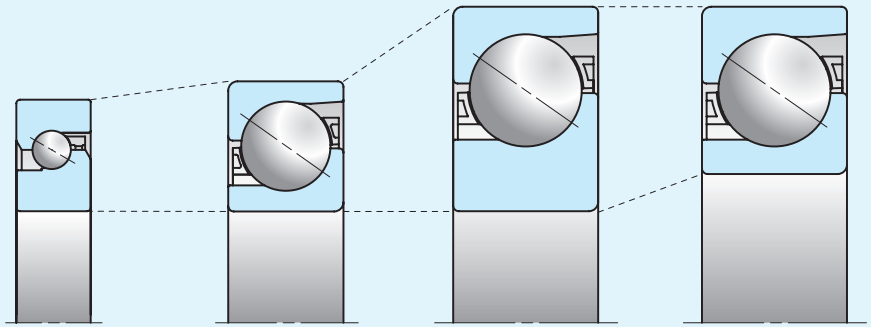
Note: 3. NSK specification

NSKTAC C Angular Contact Thrust Ball Bearings for Ball Screw Support in High-Rigidity Applications

A larger number of balls and a 60° contact angle provide high axial rigidity and make these bearings ideally suited for machine tool feeding mechanisms.
The "DDG" seals used for the sealed bearings of this series are light-contact seals for high-speed capability; a strong sealing effect is achieved by a labyrinth between the seal lip and the seal groove of the inner ring. This ensures that no foreign particles can get into the bearing and no grease can leak out, thus helping to keep the surrounding area clean. Some bearings from this series are also available as non-contact sealed bearings for even lower torque and lower heat generation.
For ease of handling and increased efficiency, NSKTAC C bearings come prepacked with "WPH" grease that resists high temperatures and is less likely to soften and leak.

NSKTAC 03 Angular Contact Thrust Ball Bearings for Ball Screw Support in High-Load Drive Applications

Optimized internal design has led to a higher limiting axial load. The number of rows may be reduced, contributing to smaller sized devices. We also offer bearings with special bore diameters. That way, bearings with higher load capacity may be employed without any need to modify the shaft diameter, allowing for more compact screw shaft ends.
For the validity of this series for industries except Injection molding machines and machine tools, please ask NSK.



60TAC120C (NSK TAC C)	60TAC03D (NSK TAC 03)	TAC60-3 (NSK TAC 03 with special bore diameter)	80TAC03D (NSK TAC 03)
For high-rigidity applications	For high-load drive applications		

Numbering System of NSKTAC C Angular Contact Thrust Ball Bearings for Ball Screw Support in High-Rigidity Applications

Bearing number example:	30	TAC	62	C		SU	H	PN7C
Nominal bore diameter								Accuracy
Bearing type								Preload
Nominal outer diameter								Arrangement
Internal design								Seal

30	Nominal bore diameter	Bore diameter (mm)
TAC	Bearing type	Angular contact thrust ball bearing
62	Nominal outer diameter	Outer diameter (mm)
C	Internal design	Contact angle 60°
	Seal	No symbol: Open type DDG: Contact rubber seal V1V: Non-contact rubber seal
SU	Arrangement	SU: Universal arrangement (single-row)
H	Preload	H: Heavy preload (standard in the HPS Series)
PN7C	Accuracy	PN7C: NES Class 7C (axial runout equivalent to P2)

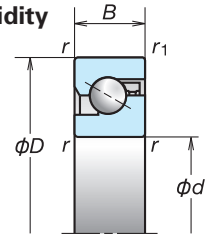
Numbering System of NSKTAC 03 Angular Contact Thrust Ball Bearings for Ball Screw Support in High-Load Drive Applications

Bearing number example:	60	TAC	03	D	T85	SU	M	PN5D
Nominal bore diameter								Accuracy
Bearing type								Preload
Dimension series								Arrangement
Internal design								Cage

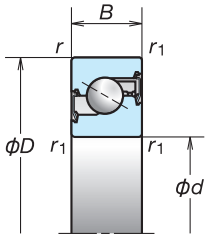
60	Nominal bore diameter	Bore diameter (mm)
TAC	Bearing type	Angular contact thrust ball bearing
03	Dimension series	02: 02 Series 03: 03 Series
D	Internal design	Contact angle 55°
T85	Cage	T85: Polyamide cage M:Brass Cage
SU	Arrangement	SU: Universal arrangement (single-row)
M	Preload	M: Medium preload EL: Extra light preload
PN5D	Accuracy	PN5D: Standard accuracy (equivalent to ISO Class 5)

NSKHPS is not applicable for TAC160-3 and 180TAC03D.

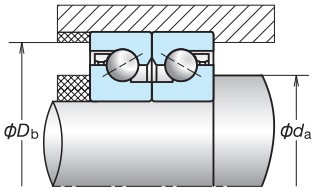
for High-Rigidity

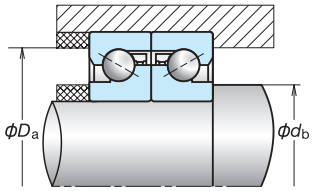


Open type



Sealed type DDG





Calculation of preload, axial rigidity and starting torque for bearing arrangements
Multiply by factors in table B.

Table B

	DFD ⊘Ø⊘	DFF ⊘⊘Ø⊘	DFT ⊘Ø⊘Ø
	DBD Ø⊘Ø	DBB Ø⊘⊘Ø	DBT Ø⊘Ø⊘
Preload factor	1.36	2.00	1.57
Axial rigidity	1.49	2.00	1.89
Starting torque	1.35	2.00	1.55

(Open type)

Bearing Numbers	Boundary Dimensions (mm)					Abutment and Fillet Dimensions (mm)				Recommended Grease Quantities (cc)	Contact angle (degree)	Limiting Speeds[2] (min^{-1})		Mass (kg) (approx.)
	d	D	B	r (Min.)	r_1 (Min.)	D_b (Max.)	d_a (Min.)	D_a (Max.)	d_b (Min.)			Grease	Oil	
15TAC47C	15	47	15	1	0.6	42	19.5	41	19.5	2.2	60	6 900	9 200	0.146
17TAC47C	17	47	15	1	0.6	42	23	41	23	2.2	60	6 900	9 200	0.140
20TAC47C	20	47	15	1	0.6	42	25	41	25	2.2	60	6 900	9 200	0.135
25TAC62C	25	62	15	1	0.6	57	31	56	31	3.0	60	5 200	6 900	0.252
30TAC62C	30	62	15	1	0.6	57	36	56	36	3.2	60	4 900	6 400	0.224
35TAC72C	35	72	15	1	0.6	67	42	66	42	3.8	60	4 100	5 800	0.310
40TAC72C	40	72	15	1	0.6	67	47	66	47	3.9	60	4 100	5 500	0.275
40TAC90C	40	90	20	1	0.6	85	48	84	48	8.8	60	3 500	4 600	0.674
45TAC75C	45	75	15	1	0.6	68	54	67	54	4.2	60	3 700	4 900	0.270
45TAC100C	45	100	20	1	0.6	93	55	92	55	9.7	60	3 000	4 100	0.842
50TAC100C	50	100	20	1	0.6	92	60	91	60	10.2	60	3 000	3 900	0.778
55TAC100C	55	100	20	1	0.6	92	63	91	63	10.2	60	3 000	3 900	0.714
55TAC120C	55	120	20	1	0.6	112	63	111	63	12	60	2 500	3 500	1.23
60TAC120C	60	120	20	1	0.6	112	70	111	70	12	60	2 500	3 500	1.16

Preload (DB and DF Arrangement) (N)	Axial Rigidity (DB and DF Arrangement) (N/μm)	Starting Torque (DB and DF Arrangement)[4] (N·m)(reference)	Basic dynamic load rating Ca by number of rows sustaining Fa			Limiting axial load by number of rows sustaining Fa[3]		
H	H	H	1 row (kN)	2 rows (kN)	3 rows (kN)	1 row (kN)	2 rows (kN)	3 rows (kN)
1 450	630	0.09	23.0	37.5	49.5	26.6	53.0	79.5
1 450	630	0.09	23.0	37.5	49.5	26.6	53.0	79.5
1 450	630	0.09	23.0	37.5	49.5	26.6	53.0	79.5
2 280	850	0.15	29.9	48.5	64.5	40.5	81.5	122
2 400	890	0.16	30.5	50.0	66.0	43.0	86.0	129
2 750	1 030	0.18	32.5	53.0	70.5	50.0	100	150
2 860	1 080	0.19	33.5	54.0	72.0	52.0	104	157
3 450	1 150	0.29	62.0	101	134	89.5	179	269
3 100	1 170	0.20	34.5	56.0	74.5	57.0	114	170
4 440	1 340	0.40	64.5	105	140	99.0	198	298
4 650	1 410	0.42	66.0	107	142	104	208	310
4 650	1 410	0.42	66.0	107	142	104	208	310
5 450	1 660	0.49	70.5	115	153	123	246	370
5 450	1 660	0.49	70.5	115	153	123	246	370

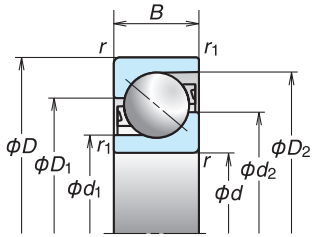
(Sealed Type)

Bearing Numbers[1]	Boundary Dimensions (mm)					Abutment and Fillet Dimensions (mm)				Contact angle (degree)	Limiting Speeds[2] (min^{-1})	Mass (kg) (approx.)
	d	D	B	r (Min.)	r_1 (Min.)	D_b (Max.)	d_a (Min.)	D_a (Max.)	d_b (Min.)		Grease	
* **15TAC47CDDG**	15	47	15	1	0.6	42	19.5	41	19.5	60	6 900	0.146
* **17TAC47CDDG**	17	47	15	1	0.6	42	22	41	22	60	6 900	0.140
* **20TAC47CDDG**	20	47	15	1	0.6	42	25	41	25	60	6 900	0.135
* **25TAC62CDDG**	25	62	15	1	0.6	57	30	56	30	60	5 200	0.252
30TAC62CDDG	30	62	15	1	0.6	57	36	56	36	60	4 900	0.224
35TAC72CDDG	35	72	15	1	0.6	67	41	66	41	60	4 100	0.310
40TAC72CDDG	40	72	15	1	0.6	67	46	66	46	60	4 100	0.275
40TAC90CDDG	40	90	20	1	0.6	85	47	84	47	60	3 500	0.674
45TAC100CDDG	45	100	20	1	0.6	93	54	92	54	60	3 000	0.842
50TAC100CDDG	50	100	20	1	0.6	92	59	91	59	60	3 000	0.778
55TAC100CDDG	55	100	20	1	0.6	92	63	91	63	60	3 000	0.714

Preload (DB and DF Arrangement) (N)	Axial Rigidity (DB and DF Arrangement) (N/μm)	Starting Torque (DB and DF Arrangement)[4] (N·m) (reference)	Basic dynamic load rating Ca by number of rows sustaining Fa			Limiting axial load by number of rows sustaining Fa[3]		
H	H	H	1 row (kN)	2 rows (kN)	3 rows (kN)	1 row (kN)	2 rows (kN)	3 rows (kN)
1 450	630	0.09	23.0	37.5	49.5	26.6	53.0	79.5
1 450	630	0.09	23.0	37.5	49.5	26.6	53.0	79.5
1 450	630	0.09	23.0	37.5	49.5	26.6	53.0	79.5
2 280	850	0.15	29.9	48.5	64.5	40.5	81.5	122
2 400	890	0.16	30.5	50.0	66.0	43.0	86.0	129
2 750	1 030	0.18	32.5	53.0	70.5	50.0	100	150
2 860	1 080	0.19	33.5	54.0	72.0	52.0	104	157
3 450	1 150	0.29	62.0	101	134	89.5	179	269
4 440	1 340	0.40	64.5	105	140	99.0	198	298
4 650	1 410	0.42	66.0	107	142	104	208	310
4 650	1 410	0.42	66.0	107	142	104	208	310

Note: 1. An asterisk (*) indicates bearings that are also available as non-contact sealed bearings.
2. Limiting speeds are based on high preload (H). The values shown are valid for all types of bearing arrangement.
3. To calculate permissible axial load, multiply limiting axial load by 0.7.
4. The starting torque values in the table apply to grease lubricated bearings. Contact seal torque is not included. For oil lubricated bearings, multiply by 1.4.
5. Abutment and fillet dimensions are recommendable values for the use of standard Machine tool applications. For heavy load applications, please ask NSK

for High-Load Drive Applications



Bearing Numbers[1]	Boundary Dimensions (mm)					Reference Dimensions (mm)				Recommended Grease Quantities (cc/row)	Contact angle (degree)	Limiting Speeds[2] (min^{-1})		Mass (kg) (approx.)
	d	D	B	r (Min.)	r_1 (Min.)	d_1	d_2	D_1	D_2			Grease	Oil	
15TAC02D	15	35	11	0.6	0.3	19.1	24.5	26	31.9	1	55	12 000	14 800	0.047
20TAC03D	20	52	15	1.1	0.6	27.2	35.3	37.5	46.1	2.7	55	8 300	10 300	0.155
25TAC02D	25	52	15	1	0.6	30.8	38.1	39.6	47.3	3	55	7 700	9 700	0.137
TAC35-3	35	90	23	1.5	1	50.4	64.2	67.1	81.7	14	55	4 600	6 000	0.712
40TAC03D	40	90	23	1.5	1	50.4	64.2	67.1	81.7	14	55	4 600	5 700	0.659
TAC40-3	40	110	27	2	1	62	79.1	82.4	100.6	25	55	3 700	5 000	1.28
45TAC03D	45	100	25	1.5	1	56.5	71.7	74.7	90.8	18	55	4 100	5 200	0.877
TAC45-3	45	110	27	2	1	62	79.1	82.4	100.6	25	55	3 700	4 800	1.21
50TAC03D	50	110	27	2	1	62	79.1	82.4	100.6	25	55	3 700	4 700	1.14
TAC50-3	50	130	31	2.1	1.1	73.9	93.8	98	119	40	55	3 100	4 200	2.00
55TAC03D	55	120	29	2	1	68	86.4	90.2	109.7	32	55	3 400	4 300	1.44
60TAC03D	60	130	31	2.1	1.1	73.9	93.8	98	119	40	55	3 100	3 900	1.80
TAC60-3	60	170	39	2.1	1.1	98.5	123.6	128.7	157.5	85	55	2 400	3 300	4.47
70TAC03D	70	150	35	2.1	1.1	86.3	108.6	113.4	137.8	59	55	2 700	3 400	2.67
75TAC03D	75	160	37	2.1	1.1	92.4	116.2	121	146.2	67	55	2 500	3 200	3.20
80TAC03D	80	170	39	2.1	1.1	98.5	123.6	128.7	157.5	85	55	2 400	3 000	3.80
TAC80-3	80	215	47	3	1.1	124	154.9	160.4	194.5	156	55	1 900	2 600	8.66
100TAC03D	100	215	47	3	1.1	124	154.9	160.4	194.5	156	55	1 900	2 400	7.54
TAC100-3	100	260	55	3	1.1	150.5	186.9	193.4	231.7	254	55	1 500	2 100	14.8
120TAC03D	120	260	55	3	1.1	150.5	186.9	193.4	231.7	254	55	1 500	2 000	13.3
* **TAC120-3M**	120	300	62	4	1.5	170.8	215.3	224.1	265.7	336	55	1 300	1 800	24.5
* **140TAC03DM**	140	300	62	4	1.5	170.8	215.3	224.1	265.7	336	55	1 300	1 700	22.5
* **TAC140-3M**	140	340	68	4	1.5	197.5	246.2	254.3	298.8	442	55	1 200	1 600	34.5
* **160TAC03DM**	160	340	68	4	1.5	197.5	246.2	254.3	298.8	442	55	1 200	1 500	32.0
* **TAC160-3M**	160	380	75	4	1.5	221.1	275.6	284.9	334.9	624	55	1 000	1 400	46.8
* **180TAC03DM**	180	380	75	4	1.5	221.1	275.6	284.9	334.9	624	55	1 000	1 400	43.7

Note: 1. An asterisk (*) indicates bearings that are also available equipped with screw holes for mounting bolts.
2. Limiting speeds are based on the standard preload of each bearing. The values shown are valid for all types of bearing arrangement.
3. Preload values for bearings with a bore diameter of 100mm or more as well as for TAC80-3 are based on EL preload.

Multi-row combination calculations

Calculation of preload, axial rigidity and starting torque for bearing arrangements
Multiply by factors in table B.

Table B

Number of load-sustaining rows	2 rows		3 rows			4 rows		5 rows
	DFD	DFF	DFT	DFFD	DFFF	DFTD	DFFT	DFTT
	DBD	DBB	DBT	DBBD	DBBB	DBTD	DBBT	DBTT
Preload factor	1.36	2.00	1.57	2.42	3.00	1.72	2.72	1.83
Axial rigidity	1.49	2.00	1.89	2.51	3.00	2.24	2.97	2.57
Starting torque	1.35	2.00	1.55	2.41	3.00	1.68	2.71	1.77

Preload[3] (DB and DF Arrangement) (N)	Axial Rigidity[3] (DB and DF Arrangement) (N/μm)	Starting Torque[4] (DB and DF Arrangement) (N·m)	Basic dynamic load rating Ca by number of rows sustaining Fa					Limiting axial load by number of rows sustaining Fa[5]				
			1 row (kN)	2 rows (kN)	3 rows (kN)	4 rows (kN)	5 rows (kN)	1 row (kN)	2 rows (kN)	3 rows (kN)	4 rows (kN)	5 rows (kN)
400	290	0.017	21.0	34.0	45.0	55.5	64.5	18.6	37.5	56.0	74.5	93.0
830	430	0.026	42.5	69.5	92.0	113	132	38.5	77.0	116	154	193
690	430	0.036	37.0	60.0	79.5	97.5	114	36.0	72.5	109	145	181
2 500	780	0.26	113	184	244	299	350	118	235	355	470	590
2 500	780	0.26	113	184	244	299	350	118	235	355	470	590
3 900	970	0.50	166	270	360	440	515	181	360	540	720	905
2 800	830	0.31	133	216	287	350	410	142	283	425	565	710
3 900	970	0.50	166	270	360	440	515	181	360	540	720	905
3 900	970	0.50	166	270	360	440	515	181	360	540	720	905
5 200	1 120	0.78	218	355	470	575	670	242	485	725	965	1 210
4 280	1 060	0.68	190	310	410	500	585	210	420	630	840	1 050
5 200	1 120	0.78	218	355	470	575	670	242	485	725	965	1 210
8 050	1 400	1.5	305	495	660	805	940	390	775	1 170	1 550	1 940
6 400	1 250	1.1	262	425	565	690	810	305	615	920	1 230	1 530
7 230	1 330	1.3	283	460	610	750	875	345	690	1 040	1 380	1 730
8 050	1 400	1.5	305	495	660	805	940	390	775	1 170	1 550	1 940
1 240	880	0.15	420	685	910	1 110	1 300	510	1 020	1 530	2 040	2 550
1 240	880	0.15	420	685	910	1 110	1 300	510	1 020	1 530	2 040	2 550
1 620	1 050	0.21	520	850	1 130	1 380	1 610	680	1 360	2 040	2 720	3 400
1 620	1 050	0.21	520	850	1 130	1 380	1 610	680	1 360	2 040	2 720	3 400
1 710	1 130	0.24	640	1 040	1 380	1 680	1 970	794	1 590	2 380	3 200	3 950
1 710	1 130	0.24	640	1 040	1 380	1 680	1 970	794	1 590	2 380	3 200	3 950
1 850	1 240	0.27	725	1 180	1 570	1 920	2 240	1 040	2 080	3 100	4 150	5 200
1 850	1 240	0.27	725	1 180	1 570	1 920	2 240	1 040	2 080	3 100	4 150	5 200
1 940	1 310	0.30	815	1 330	1 760	2 150	2 520	1 360	2 720	4 100	5 450	6 800
1 940	1 310	0.30	815	1 330	1 760	2 150	2 520	1 360	2 720	4 100	5 450	6 800

4. The starting torque values in the table apply to grease lubrication.
5. To calculate permissible axial load, multiply limiting axial load by 0.7.