Miniature and Extra Small Ball Bearings

Miniature and Extra Small Ball Bearings



Open type



Shielded type



Open type with flange

Shielded type with flange

The main variations of these bearings are as shown in Table 2.

In addition to the types given in the dimensional table, thrust and pivot ball bearings are also manufactured. For details on these two types, please refer to catalog No. 3013/J.

Unlike open type bearings, most of the sealed and shielded bearings generally require a wider width dimension. The standard of these bearings are (Type ZZA and Type ZZ) shielded. Among the non-contact seals shown in Fig. 1, there are type, LLB with rubber seals and Type SSA with resin seals. Type LLU with rubber seals are included in the contact seal design.

Table	2 I	Main types ar	nd constructions							
	Ţ	уре	Constru	ction		т	уре	Constru	ction	
Stand	С)pen type				C	Open type			
	(Dne side shielded	ZA	Z			One side shielded	ZA	Z	
	B	oth sides shielded	ZZA ZZ		Flange att	Both sides shielded		ZZA	ZZ	
ird type		Open type			ached type		Open type			
	Wide inner ri	One side shielded	ZA			Wide inner rir	One side shielded	ZA		
	ÐL	Both sides shielded	ZZ	ZZA			Both sides shielded	ZZ	A	

The dimensional range of miniature and extra small ball bearings are given in Table 1. Boundary dimensions for both metric and inch systems are in accordance with the internationally specified ISO and ANSI/AFBMA standards.

Table 1 Dimensional range

Item of bearing	Dimensional range
Miniature ball bearings	Nominal outer diameter <i>D</i> <9 mm
Extra small ball bearings	Nominal bore diameter <i>d</i> <10 mm Nominal outer diameter <i>D</i> ≥9 mm





Pressed cages are standard for these bearings. However, resin cages are used for some bearings depending on the applications.

Applications and the selection standards based on accuracy grade are given in Table 3.

Regarding the accuracy of bearings, the JIS Standard described in Table 4.3 (page A-26 and A-27) of Clause 4 is used. The "accuracy of bearings" mentioned above shall be applied for general use bearings. For bearings used in instrument or measuring gauge use, the standard of instrument precision bearings of ISO shall be applied. Also, the accuracy of flanges are given in Table 5.

Bearings for low noise and low friction torque use and bearings conforming to AFBMA standards are manufactured special by NTN; so, please refer to NTN.

Radial clearance values should be applied as described in the above mentioned Table 8.3 (page A-66) of Clause 8, "bearing clearance and preload". However, for the bearings, the values of radial clearance for high precision bearings given in Table 6 are applied in many cases.

The selection guidelines for radial clearance are given in Table 7 and the fitting of high precision bearings in Table 8.

Table 3 Application portions and selection standards by accuracy grade

Application portions	Accuracy grade
Small motors, gears, cam mechanisms, instrumentation, pinch rollers, low sensitivity synchro and servo motors, paper feed roller of copying machines, etc.	ISO, Class 0, Class 6
Precision motors, high sensitivity synchro and servo motors, resolvers, potentiometers, gyro gimbals and rotors, dental hand pieces, magnetic disk spindles, mirror spindles, encoders, high frequency spindles, VTR cylinders and capstans, etc.	ISO, Class 5, 4 ISO, Class 5A, 4A NTN Class PS5, Class PS4 ¹⁾

1) Class PS5 and PS4 are NTN's standards specifying low noise and low friction torque. For the specified values of accuracy or other values, please refer to NTN.

Table 4	Accuracy of instrument precision bearings of ISO
Table 4 (1)	Inner rings

Tolerance	Δ_{dmp}		Δ_{ds}		V _{dp}	V _{dmp} K _{ia}		<i>S</i> _{d1}	S_{ia}	$\Delta_{B_{S}}$		$V_{B_{\rm S}}$
class	high	low	high	low	max	max	max	max	max	high	low	max
class 5A class 4A	0 0	-5 -5	0 0	-5 -5	3 2.5	3.5 2.5	3.5 2.5	7 3	7 3	0 0	-25 -25	5 2.5

Note: Symbol: see page A-23, A-24

Table 4 (2) Outer rings

Tolerance	D (mm)		D (mm)		D (mm)		$\Delta_{\mathcal{L}}$	mp	0000		Ds			V _{Dmp}	K _{ea}	S_{D}	$S_{ m ea}$	$\Delta_{C_{\sf S}}$	$V_{C_{\rm S}}$
class	over	incl.	high	low	high	low	high	low	max	seal type max	max	max	max	high low	max				
class 5A	2	18	0	-5	0	-5	+1	-6	3	5	5	8	8	Identical to)				
	18	30	0	-6	0	-6	+1	-7	3	5	6	8	8	Δ_{Rs} and V_{Rs}					
class 4A	2	18	0	-5	0	-5	+1	-5	2.5	5	3.5	4	5	of inner ring					
	18	30	0	-5	0	-5	+1	-6	2.5	5	4	4	5	of same be	earing				

Note:1. The bearing by this standard specifies the start-up friction torque. For further detail please refer to NTN.

2. Symbol: see page A-23, A-24.

Unit: µm

I Init: um

Tolerance	class	$arDelta_{D1 ext{s}}$ high	$arDelta_{D2s}$ low	S _{D1} max	S _{ea1} max	Δ_{C2s} low	$arDelta_{ extsf{C2s}}$ low	$V_{C1s \text{ or }} V_{C2s}$		
	class 0				_			Identical to <i>V_{Bs}of</i> inner ring of same bearing		
	class 6			_	—	Identica	al to A of			
	class 5	js	12	8	8	inner rin	g of same	5		
ISO standard	class 4			4	5	Dea	anng	2.5		
otandara	class 2			1.5	1.5 ¹⁾ 2.5		·	1.5		
	class 5A	0	-25	—	10	0	-50	5		
	class 4A	0	-25	_	8	0	-50	2.5		

Table 5Accuracy of outer ring flanges

Table 6Radial clearance of high precision bearings

			,											
MIL standard		Tię	ght				Star	tandard Loose Extra		Extra	Loose			
Symbol	C2	2S	CI	٧S	CN	M	CI	NL	C	3S	C3	BM	C	3L
Clearance	min	max	min	max	min	max	min	max	min	max	min	max	min	max
	0	5	3	8	5	10	8	13	10	15	13	20	20	28

Note:
 This standard is specified in accordance with MIL-B 23063. However, the symbols are NTN's.
 Increased value due to the load of measurement is not included in each clearance value.

Table 7 Selection guidelines for radial clearance

Requested items	Main application	Clearance	Attention items
When minimizing the angle deflection or when especially requesting the prevention of fretting or in case of low speed operation.	Shafts of precision gears, stepping motors VTR capstans	C2 C2S	The torque becomes larger when axial force is loaded. Axial loading capacity and Axial rigidity are low.
When requesting high rotation accuracy, or in case of ordinary temperature under low or medium speed condition.	Small motors, VTR cylinders, capstans, mirror spindles, magnetic disk spindles	Regular CNS, CNM, CNL	Axial clearance adjustment is required (give a pre-load by spring, etc.).
In case of high speed and high temperature, or when considering to decrease the clearance by interference of press fitting.	Gyro-rotors, high frequency spindles, cleaner motors spindles, cleaner motors	C3 C3S, C3M, C3L	Axial clearance adjustment is required (give a pre-load by spring, etc.).

Unit *m*m

Unit: um

Table 8 Fitting practice of high precision bearings Table 8 (1) Fitting on shafts

Table 8 (1) Fitting on shafts								
Operating	aanditiona	Main applications	Acourcov	Interference ¹⁾				
Operating	conditions		Accuracy	Range	Target			
Inner ring rotation load	Medium-high speed and	Gyro-rotors, cleaner motors, high frequency spindles	Light interference fitting	Equivalent	5T~3L	3T~0 2T~3L		
	light-medium load	Small motors, VTR cylinders capstans, mirror spindles, magnetic disk spindles		of ISO	_	0~2L ²⁾		
	Low speed and light load	Stepping motors, shafts of precision gears	Slight clearance fitting	Equivalent to Class 4	3T~7L	0~5L		
Outer ring rotation load	Low to high speed and light load	Gyro-rotors		or Class 5 of ISO	3T~7L	0~5L		

1) Suffix "T" shows interference and "L" clearance.

2) Sometimes, the bearings are used by fixing with an adhesive.

Table 8 (2) Fitting on housing

Interference¹⁾ Accuracy **Operating conditions** Main applications Fitting Range Target Equivalent Gyro-rotors, cleaner motors, Clearance 0~10L 2L~7L2) to Class 4 Medium-high high frequency spindles fitting of ISO speed and light-medium Small motors, VTR cylinders Light Inner ring load capstans, mirror spindles, interference 2T~3L²⁾ rotation load magnetic disk spindles fitting Equivalent Low speed Stepping motors, shafts of to Class 4 2T~8L and light 0~5L precision gears or Class 5 Slight load of ISO clearance Low to high fitting Outer ring speed and Gyro-rotors 2T~8L 0~5L rotation load light load

1) Suffix "T" shows interference and "L" clearance.

2) Sometimes, the bearings are used by fixing with an adhesive.

Unit: µm