

Miniature and Extra Small Ball Bearings

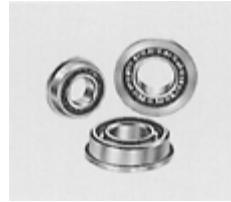
Miniature and Extra Small Ball Bearings



Open type



Shielded type



Open type with flange



Shielded type with flange

The 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 $D < 9$ mm
Extra small ball bearings	Nominal bore diameter $d < 10$ mm Nominal outer diameter $D \geq 9$ mm

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 Main types and constructions

Type		Construction		Type	Construction			
Standard type	Open type			Open type				
	One side shielded			One side shielded				
					Both sides shielded			
	Wide inner ring	Open type			Flange attached type	Wide inner ring	Open type	
		One side shielded					One side shielded	
		Both sides shielded					Both sides shielded	

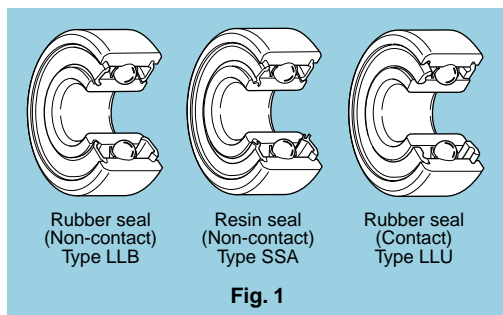


Fig. 1

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.

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

Unit: μm

Tolerance class	Δ_{dmp}		Δ_{ds}		V_{dp}	V_{dmp}	K_{ia}	S_{d1}	S_{ia}	Δ_{Bs}		V_{Bs}
	high	low	high	low	max	max	max	max	max	high	low	max
class 5A	0	-5	0	-5	3	3.5	3.5	7	7	0	-25	5
class 4A	0	-5	0	-5	2.5	2.5	2.5	3	3	0	-25	2.5

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

Table 4 (2) Outer rings

Unit: μm

Tolerance class	D (mm)		Δ_{Dmp}		Δ_{Ds}				V_{Dp} or V_{Dmp}		K_{ea}	S_D	S_{ea}	Δ_{Cs}		V_{Cs}
	over	incl.	high	low	open type		high	low	open type	shield type and seal type	max	max	max	high	low	max
class 5A	2	18	0	-5	0	-5	+1	-6	3	5	5	8	8	Identical to Δ_{Bs} and V_{Bs} of inner ring of same bearing		
	18	30	0	-6	0	-6	+1	-7	3	5	6	8	8			
class 4A	2	18	0	-5	0	-5	+1	-5	2.5	5	3.5	4	5			
	18	30	0	-5	0	-5	+1	-6	2.5	5	4	4	5			

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.

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Table 5 Accuracy of outer ring flanges

Unit: μm

Tolerance class	Δ_{D1s}	Δ_{D2s}	S_{D1}	S_{ea1}	Δ_{C2s}	Δ_{C2s}	V_{C1s} or V_{C2s}
	high	low	max	max	low	low	
ISO standard	class 0	js 12	—	—	Identical to Δ_{Bs} of inner ring of same bearing	Identical to V_{Bs} of inner ring of same bearing	
	class 6		—	—			
	class 5		8	8			
	class 4		4	5			
	class 2		1.5	1.5 ¹⁾ 2.5			
	class 5A	0	-25	—	10	0	-50
	class 4A	0	-25	—	8	0	-50

Table 6 Radial clearance of high precision bearings

Unit: mm

MIL standard	Tight				Standard						Loose		Extra Loose	
Symbol	C2S		CNS		CNM		CNL		C3S		C3M		C3L	
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

Note: 1. This standard is specified in accordance with MIL-B 23063. However, the symbols are NTN's.
2. 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.).

Table 8 Fitting practice of high precision bearings

Table 8 (1) Fitting on shafts

Unit: μm

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

Unit: μm

Operating conditions		Main applications	Fitting	Accuracy	Interference ¹⁾	
					Range	Target
Inner ring rotation load	Medium-high speed and light-medium load	Gyro-rotors, cleaner motors, high frequency spindles	Clearance fitting	Equivalent to Class 4 of ISO	0~10L	2L~7L ²⁾
		Small motors, VTR cylinders capstans, mirror spindles, magnetic disk spindles	Light interference fitting		—	2T~3L ²⁾
	Low speed and light load	Stepping motors, shafts of precision gears	Slight clearance fitting	Equivalent to Class 4 or Class 5 of ISO	2T~8L	0~5L
Outer ring rotation load	Low to high speed and light load	Gyro-rotors			2T~8L	0~5L

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

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