



Bearing Clearances (including Miniature)

The bearing clearance is how much movement there is if you hold the outer ring still and move the inner ring up and down towards the outer ring.

A more technical definition: *The radial play of a bearing is equal to the total radial displacement, in the median plane perpendicular to the bearing axis of the inner ring in relation to the outer ring, under the effect of a small measuring force.*

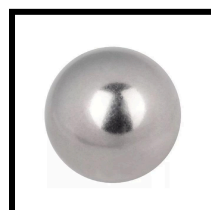
Two things to keep in mind with regards to clearance:

1. [The clearance is a range](#). It specifies what amount of play is acceptable for any bearing with the clearance classification.
2. [Clearance ranges overlap](#). This means that a bearing classified as C3, might also meet the criteria to be classified as CN. Another bearing classified as C3 might also meet the criteria to be classified as C4.

The Clearance is a Range



A single bearing does not have a *range of clearance*. A single bearing has a clearance that is *within the range*. The range is the permitted tolerance for the clearance. To understand this, consider it like this. If you move the inner ring towards the outer ring in any given bearing, it will move as far as it can and then stop moving. Let's say the bearing moved by 0.013mm. Now repeat the experiment on the same bearing using the same amount of force. The bearing will again move by 0.013mm. Nothing inside the bearing has changed to allow it to move any more or any less.





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Clearance Ranges Overlap

A miniature bearing (under 10mm bore size) with 0.013mm movement could be classed correctly as either MC4 or MC5. It matches both ranges. Compare the ranges in the charts further down this document to see how clearance ranges overlap.

Tolerances in Simple Terms:

A tolerance is the amount of variation allowed. If I require a box of 1000 screws +/- 5, this means I can accept a box containing anything from 995 to 1005 screws. If a supplier states they can supply a box of 1000 +/- 2, this means their box contains anything from 998 to 1002 screws. The higher accuracy still meets my requirement of +/- 5. The same principle applies for tolerances of size, clearance, hardness or anything else.

Other Factors Affecting Clearance

There are other factors that will affect the clearance of the bearing, including temperature and fit. These factors should be taken into consideration when specifying the clearance required for an application.



Miniature Bearings in C3

Sometimes a customer will request a miniature bearing with a C3 clearance. This situation requires some investigative work to find out why the customer is asking for C3. Some possibilities are below...

1. The customer has a bearing with a part number ending in "MC3" and doesn't know about miniature clearances. In larger bearings, the letter "M" is often used to mean "Brass Cage". So in this scenario, a customer has mistaken the MC3 suffix for M (Brass Cage) C3 (C3 Clearance).





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2. The customer feels that they need a bearing with increased clearance, and doesn't realise that miniature bearings have their own clearance classification system. In these cases, the customer should be looking for something in the range MC5 or MC6. Both MC3 and MC4 are considered "standard" clearance for miniature bearings.
3. The customer has a miniature bearing labelled with C3. Yes, it happens.
 - a. The bearing may have been produced by a manufacturer that doesn't specialise in miniature bearings. They can't accurately manufacture specific miniature clearances, so they label the bearing as C3. C3 actually only applies to bearings over 10mm bore size, so if we use the smallest C3 range, for a 10mm bearing, it would indicate that the bearing could have a clearance anywhere between 0.008mm and 0.023mm. Basically, a C3 designation used for a miniature bearing means that the internal clearance is not precisely calibrated. If measured, the bearing labelled as C3 could fall into any category from the higher end MC3 to the lower end MC6. It's the bearing to use when clearance doesn't matter.
 - b. The bearing was labelled as C3 by a manufacturer to satisfy an insistent customer. A miniature bearing manufacturer knows that any bearing in their standard range higher than MC2, will fall somewhere within the C3 range. They will all be somewhere between 0.008 and 0.023 mm clearance. Rather than attempt to explain this, some manufacturers will opt for the simple solution and just provide a bearing labelled as C3.

Miniature Bearings with No Clearance Designation

A miniature bearing with no clearance designation can be considered akin to a miniature bearing being labelled as C3. Basically, the bearing is for general use in situations where clearance doesn't matter.





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Clearance and Quality

Clearance (play) is not a criterion of bearing quality, but if badly chosen or unfavourably influenced during mounting, the clearance can adversely affect operation and reduce the bearing's life.

For most everyday applications, the clearance won't matter. A miniature bearing with no clearance designation, or one that has been labelled as C3 will suffice. Remember, the individual bearing does not necessarily have a large clearance. The clearance of the individual bearing is somewhere within a large range. This means simply that the clearance is not important, not that the bearing is poor quality.

Additional MBA Gradings

Precision miniature bearing clearances are grouped very precisely. MC3 and MC4 can both be considered "standard". MC3 clearance range is 5 to 10 microns and MC4 is 8 to 13 microns. In precision applications selecting the correct clearance can be critical, but in everyday applications both MC3 and MC4 bearings can be used as standard. They are both within the specifications of "standard clearance", just more accurately graded.



MBA uses additional designations MC12, MC34 and MC56 to indicate that a bearing falls within a wider clearance range. For example MC34 falls within the range of MC3 to MC4, 5 to 13 microns. It's just a broader designation that still falls within the definition of "standard".

See the following pages for Miniature Clearance Ranges and Large Diameter Clearance Ranges.





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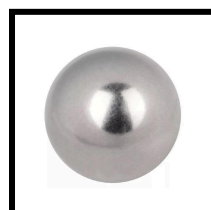
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Miniature Bearings (Less than 10mm bore size)

This table shows the basic radial clearances available for miniature bearings and applications for these clearances. Dimensions shown in microns μm 0.001mm and (1/10th's thou 0.0001").

MBA/ISO Code	Description	Minimum	Maximum	Applications
MC1	Tight	0 (0)	5 (2)	Radially loaded low backlash gear systems. Very low speed.
MC12		0 (0)	8 (3)	
MC2		3 (1)	8 (3)	
MC3	Standard	5 (2)	10 (4)	Tape Guides, Synchros, Servo Motors, Low Speed Electric Motors and Gear Trains. Gyro Gimbals (Horizontal Axis).
MC34		5 (2)	13 (5)	
MC4		8 (3)	13 (5)	
MC5	Loose	13 (5)	20 (8)	High speed Electric Motors and Tape Guides. Provides some compensation for axial loading. Gyro Gimbals (Vertical Axis).
MC56		13 (5)	28 (11)	
MC6		20 (8)	28 (11)	





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Bearings 10mm Bore Size & Over

This table shows the basic radial clearances available for bearings over and including 10mm bore size. Dimensions shown in microns μm 0.001mm.

		Clearance (Minimum / Maximum)					
		Bore Size Range					
MBA/ISO Code	Description	10mm	Over 10mm to 18mm	Over 18mm to 24mm	Over 24mm to 30mm	Over 30mm to 40mm	Over 40mm to 50mm
C2	Tight	0 / 7	0 / 9	0 / 10	1 / 11	1 / 11	1 / 11
CN (standard)	Standard	2 / 13	3 / 18	5 / 20	5 / 20	6 / 20	6 / 23
C3	Loose	8 / 23	11 / 25	13 / 28	13 / 28	15 / 33	18 / 36
C4		14 / 29	18 / 33	20 / 36	23 / 41	28 / 46	30 / 51
C5		20 / 37	25 / 45	28 / 48	30 / 53	40 / 64	45 / 73

