



Radial and Axial Play, Raceway Curvature, Contact Angle

When a ball bearing is running under a load, force is transmitted from one bearing ring to the other through the balls. Since the contact area between each ball and the rings is relatively small, moderate loads can produce stresses of tens, even hundreds of thousands of pounds per square inch. These internal stresses have a significant impact on bearing life and performance. Thus the internal geometry of a bearing—its radial play, raceway curvature and contact angle—must be carefully chosen so loads can be distributed for optimal performance.

Radial and Axial Play

Most ball bearings are assembled in such a way that a slight amount of looseness exists between the balls and the raceways. This looseness is referred to as radial play and axial play. Radial play is the maximum distance that one bearing ring can be displaced with respect to the other, in a direction perpendicular to the bearing axis when the bearing is in an unmounted state. Axial play, or end play, is the maximum relative displacement, in a direction parallel to the bearing axis, between the two rings of an unmounted ball bearing.

Since radial play and axial play are both consequences of the same degree of looseness between the components, they bear a mutual dependence. Yet their values are usually quite different in magnitude. Radial play can often vary between .0002 and .0020, while axial play may range from .001 to .010. The suggested radial play ranges for typical applications should always be consulted when a device is in the initial design phase.

Suggested Radial Play

Typical Application	Suggested Radial Play*
Small Precision High Speed Electric Motors	.0005 to .0008
Tape Guides, Belt Guides, Low Speed	.0002 to .0005
Tape Guides, Belt Guides, High Speed	.0005 to .0008
Gyro Gimbals, Horizontal Axis	.0002 to .0005
Gyro Gimbals, Vertical Axis	.0005 to .0008
Precision Gear Trains, Low Speed Electric Motors, Synchros and Servos	.0002 to .0005
Gyro Spin Bearings, Ultra-High Speed Turbines and Spindles	Consult factory

*Measurement in inches.

In most ball bearing applications, radial play is functionally more critical than axial play. While radial play has become the standard purchasing specification, you may also specify axial play requirements. Keep in mind, however, the values of radial play and axial play for any given bearing design are mathematically interdependent, and that radial play is affected by any interference fit between the shaft and bearing I.D. or between the housing and bearing O.D., as shown on page 53. Since the important condition is the actual radial play remaining after assembly of the complete device, the radial play specification for the bearing must be modified in accordance with the discussion in the mounting and coding section on page 51.

Standard Radial Play Ranges

Description	Radial Play Range*	NHBB Code
Tight	.0001 to .0003	P13
Normal	.0002 to .0005	P25
Loose	.0005 to .0008	P58
Extra Loose	.0008 to .0011	P811

*Measurement in inches.

Non-standard ranges may be specified.

