A BARDEN Precision Bulletin

Emerson Bearing
Service. Inventory. Solutions.

Number 11

PRELOADING BEARINGS

What is preload? Preloading is the removal of internal clearance in a bearing by applying a permanent thrust load to it.

Why preload bearings? Preloading is used to:

- Eliminate radial and axial play.
- Increase system rigidity.
- Reduce nonrepetitive runout.
- Lessen the difference in contact angles between the balls and both inner and outer rings at very high speeds.
- Prevent ball skidding under very high acceleration.

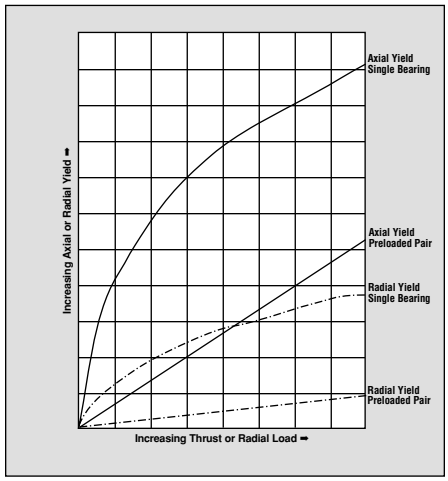


Table 1. *Axial and Radial Yield Characteristics.*

Bearings should be preloaded as lightly as is necessary to achieve the desired results. This avoids excessive heat generation, which reduces speed capability and bearing life. (Table 1).

How are bearings preloaded? There are three basic methods of preloading — spring preloading, axial adjustment and duplex bearings.

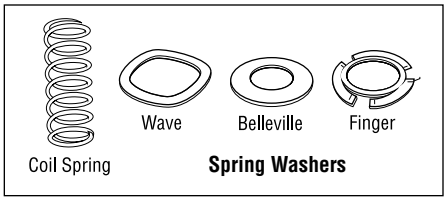
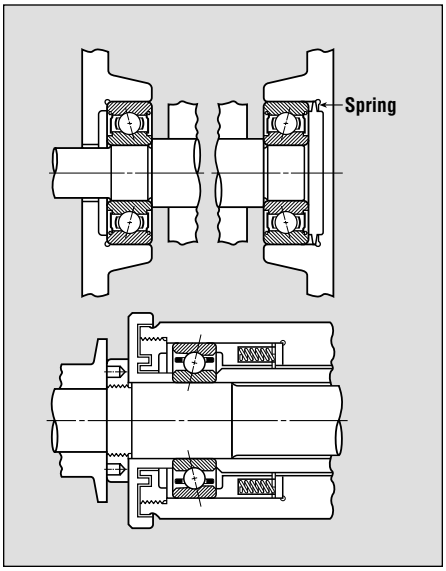


Fig. 1. *Typical Springs Used for Preloading.*

Spring Preloading

This is often the simplest method and should be considered first. Spring preloading provides a relatively constant preload because it is less sensitive to differential thermal expansion than rigid preloading and accommodates minor misalignment better. Also, it is possible to use bearings which have not been preload ground. Many types of springs may be used, among them coil springs and belleville, wave or finger spring washers. (Fig. 1). Usually the spring is applied to the nonrotating part of the bearing — typically the outer ring. (Figs. 2a and 2b). This ring must have a slip fit in the housing at all temperatures.



Figs. 2a and 2b. *Spring Preloading.*

A disadvantage of this method is that spring preloading cannot accept reversing thrust loads. Space must also be provided to accommodate both the springs and spring travel, and springs may tend to misalign the ring being loaded.

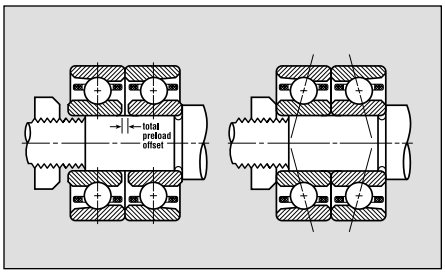
Duplex Bearings

Duplex bearings are matched pairs of bearings with built-in means of preloading. (Photo 1). The inner or outer ring faces of these bearings have been selectively relieved by grinding faces a precise amount called the preload offset.

Photo 1.
Duplex Bearings Available in Various Configurations.

When the bearings are clamped together during installation, the offset faces abut, establishing a permanent preload in the bearing set. Duplex bearings are usually speed-limited due to heat generated by this rigid preload. Duplexing is used to greatly increase radial and axial rigidity. Duplex bearings can withstand bidirectional thrust loads (DB and DF mounting) or heavy unidirectional thrust loads (DT mounting). Other advantages include their ease of assembly and minimum runout.

The Barden Corporation
FAG Aerospace and Super Precision Bearings Division
200 Park Ave., Danbury, CT 06813 • 203-744-2211 • www.bardenbearings.com

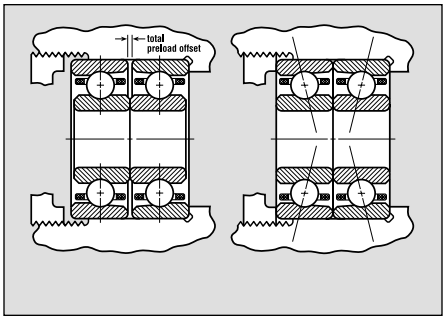


Figs. 3a and 3b. *DB Mounting (back-to-back).*

DB Mounting (back-to-back)

This configuration is suited for most applications having good alignment of bearing housings and shafts. It is also preferable where high moment rigidity is required, and where the shaft runs warmer than the housing. (Figs. 3a and 3b).

Inner ring abutting faces of DB duplex bearings are relief ground. When they are mounted and the inner rings clamped together, the load lines (lines through points of ball contact) converge outside the bearings, resulting in increased moment rigidity.



Figs. 4a and 4b. *DF Mounting (face-to-face).*

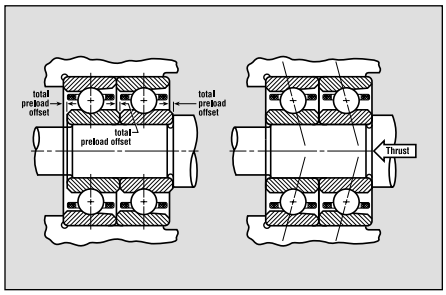
DF Mounting (face-to-face)

DF mounting is used in few applications — mainly where misalignment must be accommodated. Speed capability is usually lower than for a DB pair of identical preload.

Outer ring abutting faces of DF duplex bearings are relief ground. When the bearings are mounted and the outer rings clamped together, the loadlines converge toward the bore. (Figs. 4a and 4b).

DT Mounting (tandem)

DT pairs offer greater capacity without increasing bearing size, through load sharing. They can counter heavy thrust loads from one direction, but they cannot take reversing loads as DB and DF pairs can. However, DT pairs are usually opposed by another DT pair or a single bearing. (Figs. 5a and 5b).



Figs. 5a and 5b. *DT Mounting (tandem).*

Duplex Bearing Preload Specifications

Most Barden angular contact duplex bearings in spindle and turbine sizes are universally ground, for mounting either DB, DF or DT. They are available with light, medium and heavy preloads; values for each change with the bearing size.

For a given Barden duplex pair, bore and O.D. are matched within 0.0001", therefore, duplex sets should not be separated or intermixed. High points of eccentricity are marked on both inner and outer rings. The high points should be aligned during assembly (inner to inner, outer to outer) to get a smoother, cooler and more accurate running spindle.

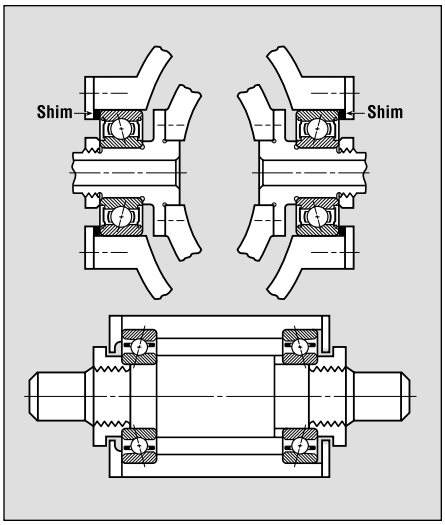
Barden deep groove bearings are also available in duplex sets. They are not universally ground, but are furnished in specific DB, DF or DT configurations. Spindle and turbine sizes (Series 1900, 100 and 200) are available with light, medium and heavy preloads.

When closures are needed, they can be installed on the outer sides of Barden deep groove bearings.

Special configurations such as flanged/non-flanged pairs, sets (3 or more bearings), and sets with different contact angles within the set are available. Consult your Barden representative.

Axial Adjustment

Axial adjustment calls for mounting at least two bearings in opposition so that the inner and outer rings of each bearing are offset axially. Threaded members, shims and spacers are typical means of providing rigid preloads through axial adjustment. (Figs. 6a and 6b). This technique requires great care and accuracy to avoid excessive preloading, which might occur during setup by overloading the bearings, or during operation due to thermal expansion. Precision lapped shims are usually preferable to threaded members, because helical threads can lead to misalignment.



Figs. 6a and 6b. *Axial Adjustment.*

For low torque applications such as gyro gimbals, an ideal axial adjustment removes all play, both radial and axial, but puts no preload on either bearing under any operating condition.The shims should be manufactured to parallelism tolerances equal to those of the bearings, because they must be capable of spacing the bearings to accuracies of one ten-thousandth of an inch or better. Bearing ring faces must be well aligned and solidly seated, and there must be extreme cleanliness during assembly.