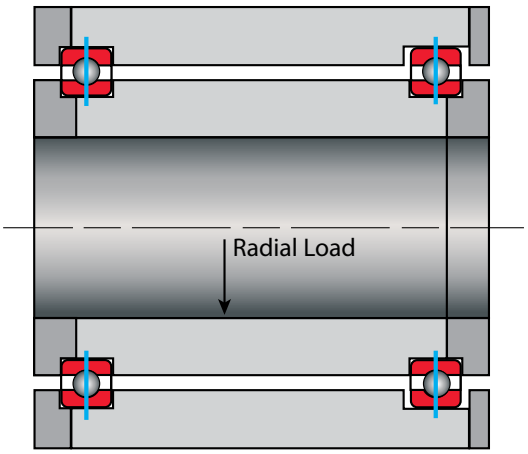
Mounting

Introduction: Reali-Slim thin section ball bearings have a cross-section thickness that is much thinner than standard bearings of the same diameter, and are therefore more sensitive to shaft and housing fits. Proper mounting is essential to make sure that the bearing functions as intended. There are a number of factors to consider when mounting a bearing, including: bearing style and orientation, the direction and magnitude of the applied loads, allowable free play in the bearing, the maximum allowable torque, shaft and housing materials, operating temperature, and which ring is rotating.

Radial (Type C) Bearings: Radial bearings are typically used when the applied loads are predominantly in the radial direction. If two bearings are used on opposite ends of a long shaft, then one of the bearings should be allowed to float in the axial direction (see Figure 5-1). This is done so that thermal expansion of the shaft or housing does not induce an axial (thrust) force into the radial bearing.

Figure 5-1

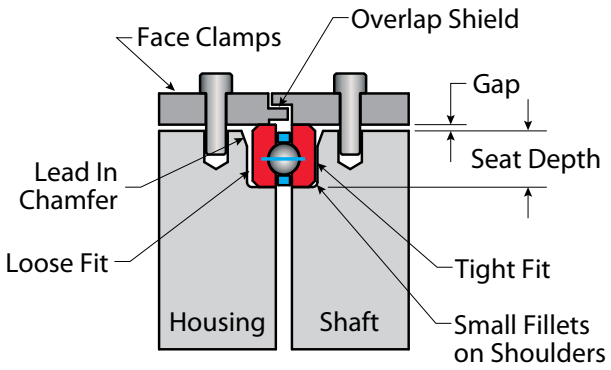


The recommended shaft and housing sizes for radial bearings are found in the tolerance tables. Kaydon generally recommends a light press fit between the bearing and either the shaft or housing, whichever side is rotating. A slight amount of clearance is recommended for the non-rotating (stationary) side. Most radial bearings are supplied with an internal diametral clearance. Using the recommended fits assures that the bearings will not become radially tight after installation, which could affect bearing life and performance.

Please note that the recommended fits apply only to bearings with "standard" clearance, which is also shown in the tolerance tables. They also apply only to steel shafts and housings, or room temperature applications. If dissimilar metals are used, then the fits will change with temperature. This could cause the bearing to become radially tight, leading to excessive friction torque. When bearings are supplied with a diametral preload, a slight clearance is recommended for both the shaft and housing.

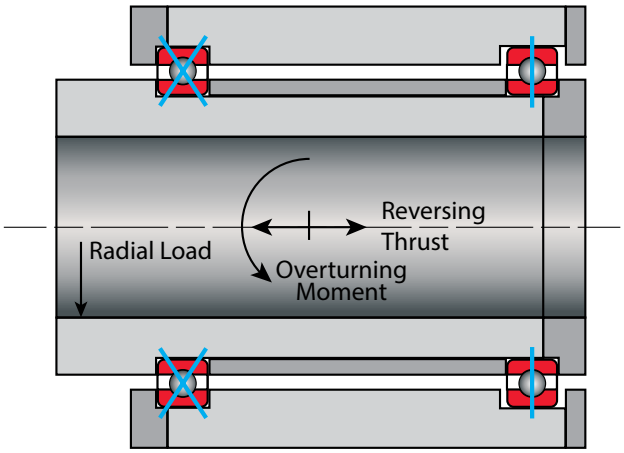
Kaydon also recommends that face clamps (See Figure 5-2) be used with all bearings. The user should not rely solely on a press fit to hold the bearing in place.

Figure 5-2



Four-Point Contact (Type X) Bearings: Four-point contact bearings are used when there is an axial (thrust) applied load or some combination of radial, thrust and moment loads. If two bearings are used on the opposite ends of a long shaft, the second bearing should be a radial (Type C) bearing, and it should be allowed to float as shown in Figure 5-3. Kaydon does not recommend using two four-point contact bearings on the same shaft.

Figure 5-3



Mounting (continued)

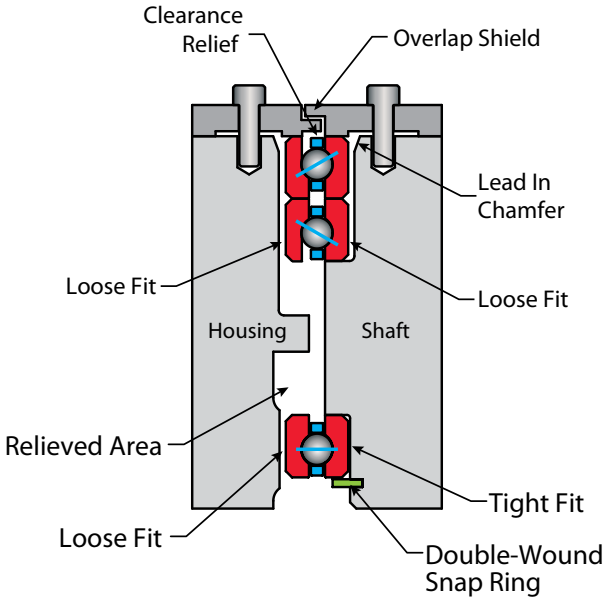
Recommended shaft and housing sizes for four-point contact bearings can be found in the tolerance tables. As with radial bearings, these fits only apply to bearings supplied with the standard clearance, and to steel shafts and housings or room temperature applications. Four-point contact bearings can also be supplied with a diametral preload. Where preloaded bearings are used, there should be a slight clearance to both the shaft and housing.

A single four-point contact bearing is capable of taking an axial (thrust) load in both directions. It is also capable of taking radial and moment loads. However, this type of bearing typically has higher friction than a radial (Type C) or an angular contact (Type A) bearing of the same size. Therefore, for torque-sensitive and high-speed applications, duplex pairs of angular contact bearings are generally used in place of a single four-point contact bearing.

Angular Contact (Type A) Bearings: Angular contact ball bearings can take an axial (thrust) load in only one direction, and therefore are almost always used in pairs. They can be used in either a back-to-back (DB) arrangement or a face-to-face (DF) arrangement, as described in the Bearing Selection section on page 91. Angular contact pairs are normally used with some amount of axial preload to remove all free play and increase stiffness. Angular contact bearings can be purchased as matched pairs where the axial preload is set by the factory, or as individual bearings where the axial preload is set during installation.

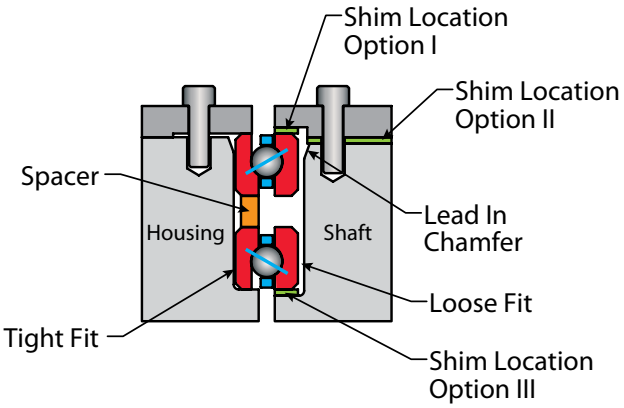
When angular contact bearings are purchased as a matched pair — called a "duplex pair" — the inner and outer rings simply need to be clamped in place as shown in Figure 5-4. For bearings with an axial preload, there should be a slight clearance between the bearing and both the shaft and housing. If a third bearing is used on the opposite end of a long shaft, it should be either a single radial or a face-to-face (DF) pair. It should also be free to float in the axial direction, (see Figure 5-4). Kaydon does not normally recommend using two back-to-back (DB) bearing pairs on the same shaft.

Figure 5-4



Back-To-Back (DB) Mounting: If angular contact bearings are purchased as individual bearings, the axial preload needs to be set during installation. If the bearings are used in a back-to-back (DB) arrangement, the preload is set by pressing the inner rings of the two bearings toward each other. The axial preload is set using shims, as shown in Figure 5-5.

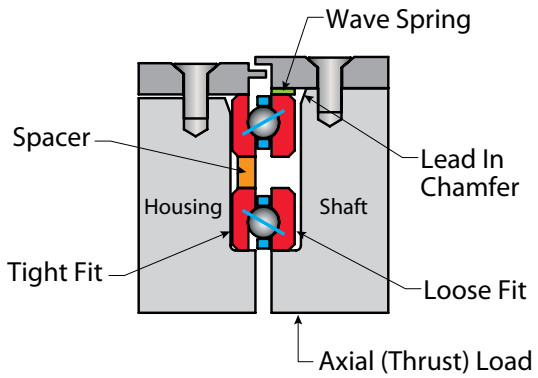
Figure 5-5



Mounting (continued)

If the thrust load is applied in only one direction, then the bearings can also be preloaded using a wave spring, as shown in Figure 5-6.

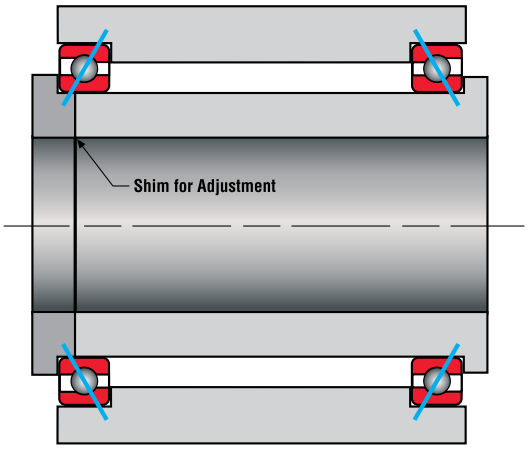
Figure 5-6



For a back-to-back (DB) mounting, Kaydon typically recommends using a slight press fit between the bearing OD and the housing. A clearance fit is required between bearing and shaft so the inner rings are free to move in the axial direction. The recommended shaft and housing sizes are shown in the tolerance tables. Please note that these fits are for steel shafts and housings or for room temperature applications. If dissimilar metals are used, then the fits will change with temperature. In that case looser fits may be advisable to prevent excessive friction torque at high and low temperatures.

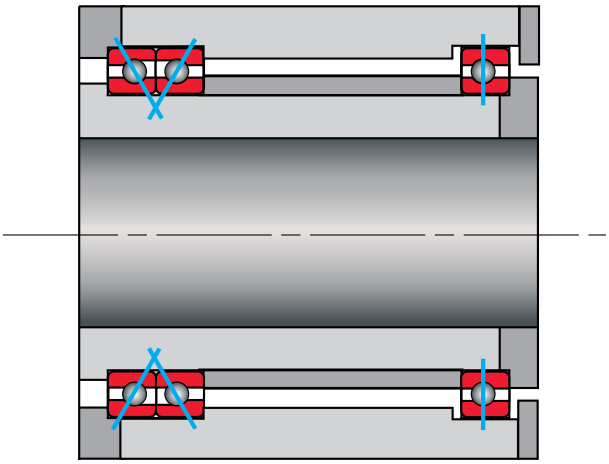
The life and load-carrying capacity of a pair of angular contact bearings under an applied moment load can be increased by spacing the bearings further apart (Fig. 5-7). The angular deflection (tilt) of the shaft under an applied moment also decreases as the spacing increases. However, the bearings can become more sensitive to differential thermal expansion if the shaft and housing are different materials or if they operate at different temperatures.

Figure 5-7



Face-To-Face (DF) Mounting: In a face-to-face (DF) mounting, the preload is set by pressing the outer rings toward each other (Fig. 5-8). The preload can also be set with shims or wave springs. For this type of mounting a slight press fit is used between the bearing I.D. and the shaft. A slight clearance is required between the bearing O.D. and housing. The recommended shaft and housing sizes for DF mounting can be found in the tolerance tables. As with the DB mounting, if dissimilar metals are used then looser fits may be necessary to prevent excessive friction torque at high and low temperatures.

Figure 5-8 - Face to Face

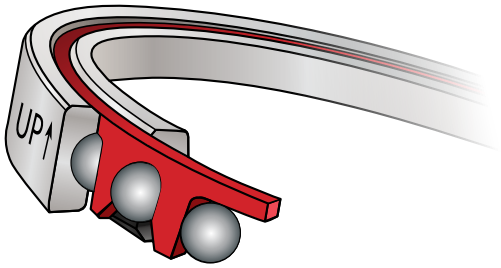


Mounting (continued)

General Recommendations

Orientation: Kaydon recommends that radial (Type C) and four-point contact (Type X) bearings that use a "snap-over" or "crown" type ball separator be mounted with the solid side of the separator facing up and the pocket openings facing down if the shaft orientation is within 45° of vertical. These bearings are marked with an "UP" arrow to show proper orientation. For horizontal shafts, there is no preferred orientation.

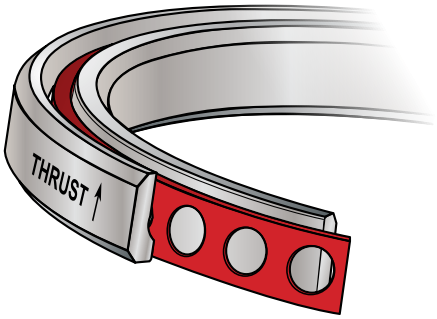
Figure 5-9



Single angular contact (Type A) bearings can only take an axial (thrust) load in one direction. The outside diameter of these bearings is marked with an arrow and the word "THRUST" to indicate the direction that a thrust load can be applied to the outer ring.

When these bearings are mounted in a back-to-back (DB) arrangement, the arrows should point away from each other. In a face-to-face (DF) arrangement, the arrows should point toward each other.

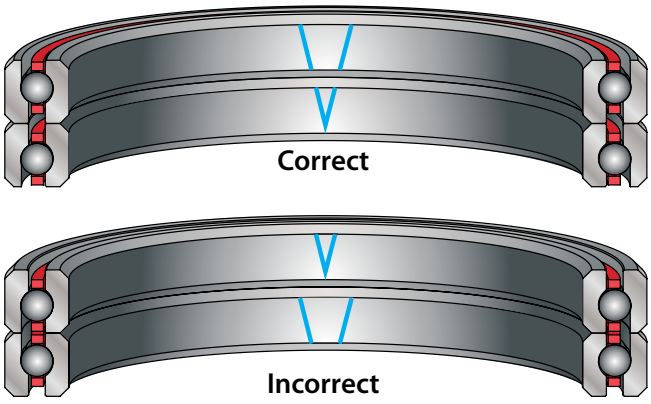
Figure 5-10



Angular contact bearings purchased as a matched (duplex) set will have a "V" marked across the O.D. and I.D. of both bearings.

During installation these "V" marks should be aligned with each other. (For vertical shafts it does not matter whether the "V" is facing up or down.) The "V" marks are located at the high point of radial runout. These can be matched to the low point on the shaft and housing to reduce the assembled runout.

Figure 5-11



Mounting (continued)

Shaft and Housing Tolerances: Since their cross-sections are much thinner than standard bearings of the same diameter, Reali-Slim thin section ball bearings are very sensitive to shaft and housing geometry. After installation the bearing tends to take the shape of shaft and housing, so the roundness of the shaft and housing is very important, as is the flatness of the bearing seats. Therefore, Kaydon recommends the following:

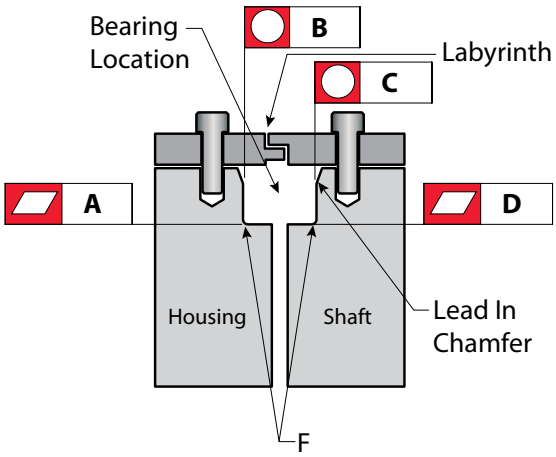
A) The flatness tolerance for the bearing seat in the outer housing should be the same as the axial runout of the outer ring of the bearing.

B) The roundness tolerance for the outer housing should be the same as the radial runout of the outer ring of the bearing.

C) The roundness tolerance for the shaft should be the same as the radial runout of the inner ring.

D) The flatness tolerance for the bearing seat on the shaft should be the same as the axial runout tolerance of the inner ring.

Figure 5-12

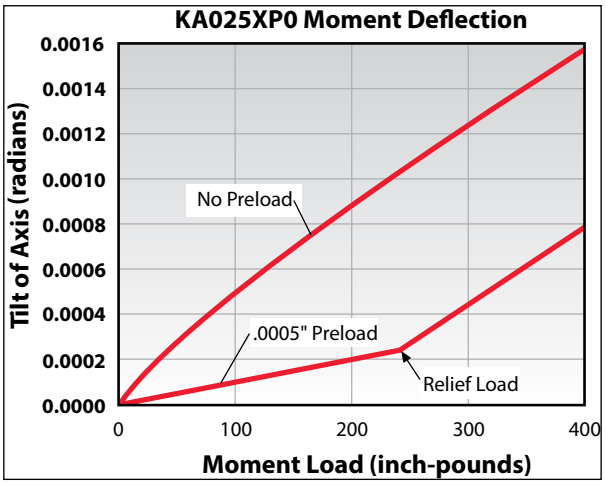


Both the shaft and the housing should have a shallow lead-in chamfer for ease of assembly. The fillet radii at the corner of the bearing seats should be smaller than the chamfer on the bearing (dimension "F" in the bearing tables). Where interference fits are used, heat or cold should be used to increase clearance and ease assembly. Allow the assembly to return to room temperature before tightening any fasteners.

If a press fit must be used, then Kaydon recommends applying uniform pressure over the entire face of the bearing. **Always press on the ring with the interference fit.** For example, if a press fit is used between the bearing and the shaft, then press on the inner ring, not the outer. **WARNING – Never press across the races, as this can damage the bearing.**

Preload: The optimal preload for any bearing depends on the application. As the preload increases, the amount of deflection under load is reduced (see Figure 5-13) and the bearing stiffness and natural frequency increase. However, increased preload also leads to higher friction torque. Kaydon's free Reali-Design software can be used to calculate the amount of deflection under an applied load for various amounts of preload. This tool can also be used to calculate the amount of preload needed for any given application.

Figure 5-13



Clamp Rings: Kaydon recommends that face clamps be used with all bearings. The user should not rely solely on a press fit to hold the bearing in place. Overlapping the clamp rings to form a labyrinth shield, as shown in Figure 5-2, is recommended. This helps keep lubricant in the bearing and contamination out. For bearings used in harsh environments, external seals are recommended.

To provide a uniform clamping force, a large number of small fasteners is preferable to a few large ones. The fasteners should be tightened in a "star" pattern to evenly distribute the clamping force.

Lubrication: Standard open bearings are shipped with preservative oil that is not intended to be a working lubricant. Prior to installation, the bearings should be cleaned and then lubricated with an oil or grease suitable for the loads, speed, temperature, and environment.