For the precision ball and roller bearings supplied by MRC Bearings, skill and cleanliness while handling, mounting and dismounting are necessary to ensure satisfactory bearing performance. As precision components, rolling bearings must be handled with appropriate care during transportation, storage, mounting and dismounting. For example, it is well known that minute dents, and small amounts of contact surface corrosion and contaminants will seriously shorten bearing endurance.

Such damages can be caused by improper handling.

Bearing Storage and Transportation

Before packaging, MRC precision bearings are treated with a high-grade preservative and they should be stored in the original, unbroken package. **The relative humidity in the storage room should not exceed 60%.** When transporting bearings into and out of the storage room, care must be exercised not to drop the bearings nor apply heavy or even moderate impact loading of any kind to prevent damage to, or dislodging of, any of the bearing components. Also care must be exercised to assure the package remains unbroken to prevent contaminants from being introduced into the bearings.

Preparations for Bearing Mounting

Mounting should be carried out in a dry, dust free room away from metal-working or other machines producing swarf and dust and operating with contaminating agents. Before mounting the bearings, all the necessary parts, tools and equipment should be at hand. It is also important that any drawings or instructions be studied to determine the correct order in which the various components are to be mounted.

All components of the bearing arrangement (housings, shafts, etc.) must be carefully cleaned and any burrs removed; unmachined internal surfaces of cast housings must be free of core grit. The dimensional and form accuracy of all components in contact with the bearings must be checked. The bearings will only perform satisfactorily if the prescribed tolerances of the mounting structures are adhered to. The bearings should be left in their original packages until immediately before mounting.

There is usually no need to remove preservative protecting the bearings. If, however, the bearings are to be grease-lubricated and used at very high or very low temperatures, or when the grease has been determined to be incompatible with the preservative, it is necessary to wash the bearings in a suitable, non-contaminated fluid and carefully dry the bearings prior to mounting. This is to prevent any detrimental effect on the lubricating properties of the grease.

Bearings which have become contaminated because of improper handling (damaged package, etc.) must be carefully washed and dried before mounting.

Bearings which are supplied ready-greased and which have seals, shields or polymerized lubricant must never be washed before mounting.

Bearing Mounting

The method (mechanical, hydraulic or thermal) used to mount a bearing depends on the type and size of the bearing and complexity of the application assembly.

In all cases, it is extremely important that neither the bearing, nor any of its components (rings, cage or rolling elements), receive any impact loading (hammer blows, etc.) as this would damage the bearing and could dislodge components. Also, under no circumstances must pressure be applied to one ring in order to mount the other ring.

With non-separable bearings, the ring which is to have the tighter fit is generally mounted first. The seating surface should be lightly oiled before mounting. Pressure may be uniformly applied against a sleeve abutting the bearing ring face; the use of a mounting dolly instead of a sleeve, as shown in Figure 1, permits a mounting force to be applied centrally.

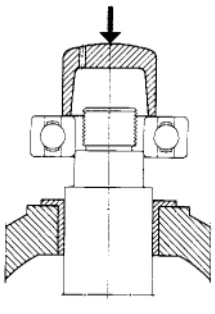


Figure 1

If a non-separable bearing is to be pressed onto the shaft and into the housing simultaneously, the tool set shown by Figure 2, in which a mounting ring is inserted between the dolly and the bearing to simultaneously abut the side faces of the inner and outer rings, may be used. For the mounting forces to be applied equally to both rings, the abutment surfaces of the mounting ring must lie in the same plane.

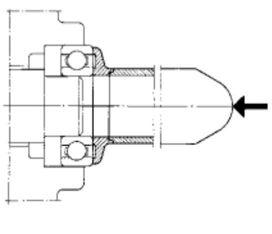


Figure 2

Bearing Mounting

Most split inner ring ball bearings, cylindrical roller bearings and tapered roller bearings are designed as separable bearings. In the case of split inner ring ball bearings and cylindrical roller bearings, this means that the outer ring, cage and rolling elements comprise a non-separable unit when the inner ring is removed. Sometimes the inner ring, cage and rolling elements comprise the non-separable unit; this is usually the case for tapered roller bearings.

With separable bearings, the inner ring can be mounted independently of the outer ring. This simplifies mounting, particularly where each ring is to have an interference fit. When inserting the shaft, with the inner ring already mounted, into the housing containing the outer ring, care must be taken that the shaft is correctly aligned with the housing to prevent scoring the raceways and damaging the rolling elements.

For a cylindrical roller bearing, should either part of the bearing be mounted askew, damage may easily be caused to the rings or rollers especially if the rollers and raceways are not oiled or if the parts are rotated during fitting.

It is generally not possible to mount larger bearings in the cold state, as the force required to mount a bearing increases very considerably with bearing size. The bearings, the inner rings or the housings are heated prior to mounting. The required difference in temperature between the bearing ring and shaft or housing depends on the degree of interference and the diameter of the bearing seating. Guideline values for the temperature differences required for some of the most commonly employed fits of bearings may be found in the accompanying diagram (Figure 3).

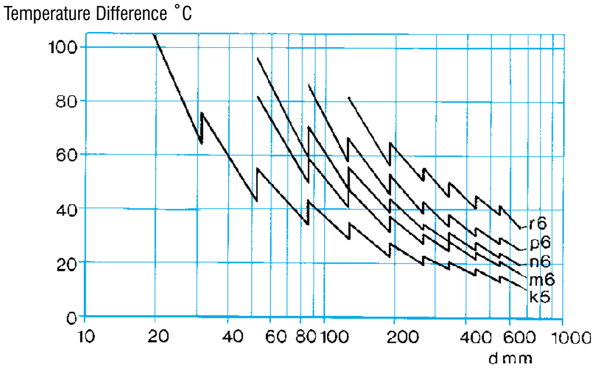


Figure 3

Bearings fabricated from AISI 52100 steel, or other steels suitable for normal operating temperatures (for example, 150°C [*300°F*] should not be heated to more than 125°C [*250°F*] since dimensional changes caused by alterations in the material structure may occur.

Bearings fabricated from steels capable of operation at higher temperatures may be heated to somewhat higher temperatures; e.g., 205°C [*400°F*] for mounting purposes. The indicated temperature is more dictated by the preserving lubricant temperature limit than by the steel. Ready-greased bearings fitted with seals and/or shields should not be heated.

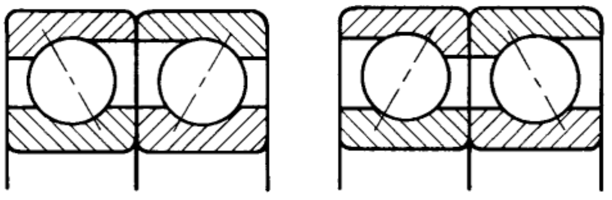
Local overheating must be avoided when heating bearings. Uniform, risk-free heating can be achieved using electric heaters, heating cabinets and oil baths. If hotplates are used, the bearing must be turned over a number of times. The inner rings of medium and large cylindrical roller bearings which have no flange or an integral flange on one side only may be heated using an induction heating tool or heating ring.

Bearing Adjustment

The internal clearance of single row, angular contact ball bearings is only established, in contrast to other radial bearings, when one bearing is adjusted against a second bearing. Usually these bearings are arranged in face-to-face or back-to-back pairs, and one bearing ring is axially displaced until a given clearance or preload is attained (Figure 4).

Bearings are placed so that the unmarked (low shoulder side) of the outer rings are together. Contact angle lines of two bearings converge inwardly toward the bore of the bearing.

Bearings are placed so that the marked backs (high shoulder side) of the outer rings are together. Contact angle lines of the bearings converge outwardly, away from the bearing bores.



Face-to-face ***Back-to-back***

Figure 4 Angular contact ball bearings pair mounting arrangements.

The appropriate value for the clearance to be obtained when mounting is determined by the conditions when the bearing is under load and at the operating temperature. Depending on the size and arrangement of the bearings, the materials from which the shaft and housing are fabricated and the distance between the two bearings, the initial clearance obtained on mounting may be smaller or larger in actual operation. If, for example, differential thermal expansion will cause a reduction in clearance, the initial clearance must be sufficiently large so that distortion of the bearings and resultant detrimental effects are avoided.

Since there is a definite relationship between radial and axial internal clearance of angular contact ball bearings, it is sufficient to specify a single value, generally the axial internal clearance. This specified value is then obtained, starting from a condition of zero clearance, by loosening or tightening a nut on the shaft or a threaded ring in the housing bore, or by inserting calibrated shims between one of the bearing rings and its abutment. The actual methods used to adjust the clearance and measure the set clearance are determined by whether a few or many bearings are to be mounted.

Dismounting of Bearings

If bearings are to be reused after removal from the application, the force used to dismount them must never be applied through the rolling elements. With separable bearings, the ring with the rolling element and cage assembly can be removed independently of the other ring. With non-separable bearings, the ring having the looser fit should be removed from its seating first. To dismount a bearing ring having an interference fit, the tools and accessories described in the following may be used depending on bearing type and size.

Bearing Ring Puller

Small bearings may be removed from their seatings by using a puller as illustrated in Figure 5.

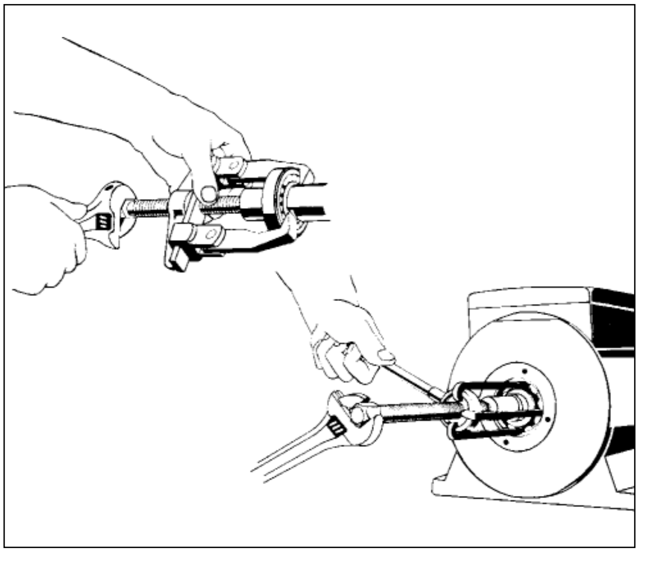
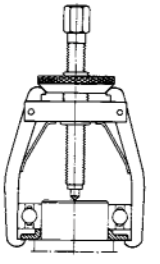
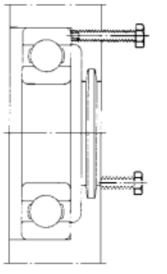


Figure 5

The claws of the puller should be placed against the side face of the ring to be removed or an adjacent component; e.g., a labyrinth ring, etc. Dismounting is made easier if, when designing the bearing arrangement, slots are provided in the shaft and housing shoulders to accommodate the claws of the puller. Outer rings can be removed more easily from their housings if tapped holes are provided in the shoulders to take withdrawal screws (Figure 6).



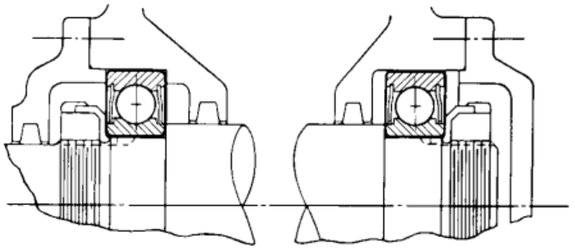
Puller acting on labyrinth ring



Housing with tapped holes for withdrawal screws

Figure 6

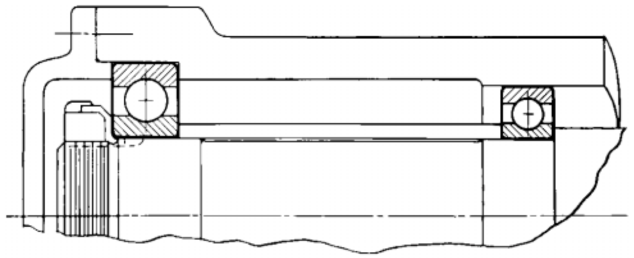
Typical Horizontal Mountings For Single-Row Radial and Double-Row Bearings



STANDARD MOUNTING

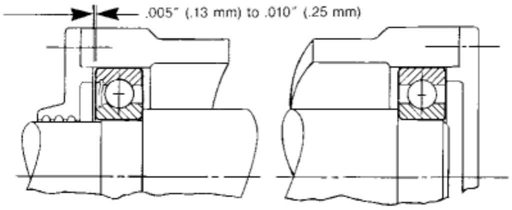
This is the ideal mounting for a shaft supported by two ball bearings, and has these advantages:

1. It permits one bearing to take thrust in either direction.
2. Axial shaft expansion is provided for by the ''floating'' of the unclamped bearing.
3. The bearings cannot be axially preloaded through improper adjustment of the lock nuts. The lock nuts serve to clamp the bearing inner rings against the shaft shoulder.
4. This mounting arrangement is suitable for a wide range of speed and temperature conditions.



STANDARD MOUNTING (WITH SPACER)

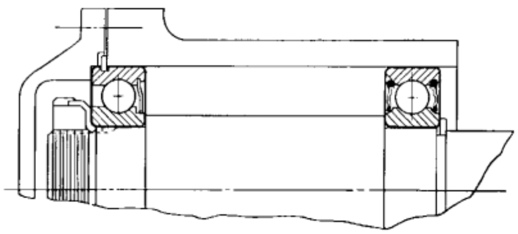
This is an alternate mounting with that shown above, and should be used where the bearings are assembled from one end of the shaft. Note that the inner rings of both bearings, together with the spacer which separates them, are clamped against the shaft shoulder by means of one lock nut at the end of the shaft. (Compare mounting above which requires two lock nuts.) This construction has the same advantages as those enumerated above.



MOUNTING WITH NO LOCK NUT OR SNAP-RINGS

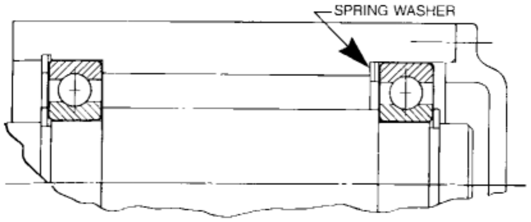
The mounting shown above employs no lock nuts on the shaft and permits through bore in the housing. Due to tolerance build-up of the various components, it is difficult to control the axial play of the shaft unless shims are used. These shims are usually mounted between the face of the bearing outer ring and the end cover shoulder. Axial play of the shaft should be sufficiently large to eliminate any possibility of preloading due to thermal expansions, yet small enough to eliminate excessive chucking under reversing thrust load.

This means of mounting may be effectively employed where there is no rapid alternation in the direction of the thrust load. It is also adaptable for locations where shaft length is short.



MOUNTING WITH LOCK NUT AND SNAP-RING

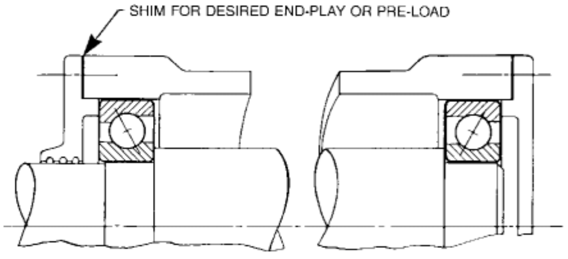
This type of mounting differs from that shown in the top sketch on the opposite page in that the bearing on the right end is held on the shaft by a snap-ring which eliminates the lock nut and the necessity of threading the shaft. Use of a snap-ring bearing (as shown on the left) makes use of a through bore housing possible, thereby allowing economies in manufacture.



MOUNTING WITH SNAP-RINGS AND SPRING WASHER

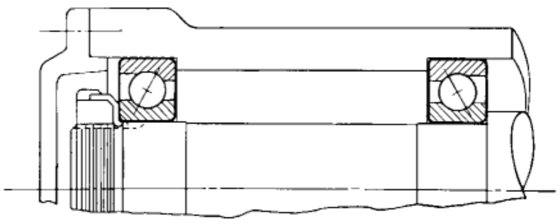
The above mounting can be used where both shaft and housing have shoulders, and where thrust is not excessive. The commercially available spring washer provides a small preload to the bearings. This eliminates shaft end play and enhances quiet bearing operation.

Pair of Angular-Contact bearings mounted opposed to take thrust in either direction.



This construction requires a shoulder on the shaft, and a clamping member of the outer ring, with shim adjustment.

Lock nuts on the shaft can in general be dispensed with, but should be used where the inner ring must be very firmly secured to resist shock or vibratory loads.



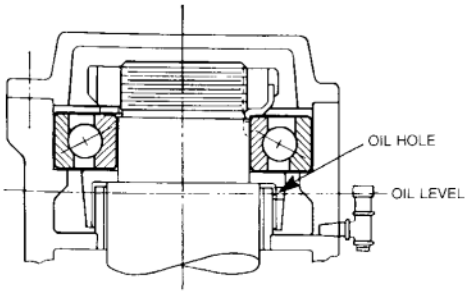
This construction requires housing shoulders, and a lock nut on the shaft. Adjustment is made by means of the lock nut. The left hand bearing should have a sliding fit on the shaft.

Owing to the difficulty of accurate adjustment and danger of excessive tightening, this mounting is not often recommended.

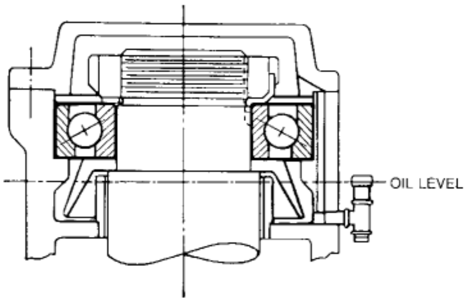
If the thrust in one direction is substantially less than in the opposite direction, the bearings can be of different sizes so as to give approximately equal safety factors. Also the reverse thrust can, if desired, be taken care of by a smaller angular-contact bearing, or by a radial bearing.

Typical Vertical Mountings For Angular-Contact Bearings

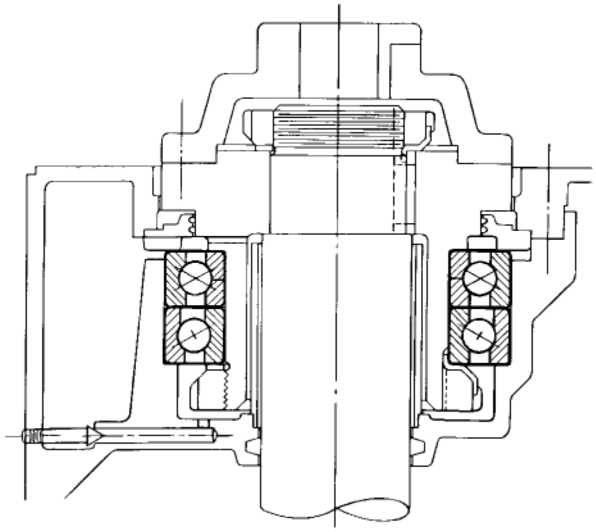
Vertical mountings are frequently used with oil lubrication. This requires a means for lifting the oil into contact with the bearings. The sketches below show three approved mounting arrangements.



The design above is suited for uni-directional thrust. If reversing thrust is present, it must be taken by an opposed bearing mounted at the bottom of the shaft. Note that the oil is lifted into the bearing by means of the inverted rotating cone. Attention is called to the drilled hole which prevents possible siphoning out of the oil when the shaft is stationary.



The sketch above shows the conventional method of circulating oil in a vertical application. Note that the dish-shaped oil thrower pumps the oil up through the drilled hole in the housing from which the oil flows downward through the bearing by gravity. Reverse thrust loads must be carried by an opposed bearing.



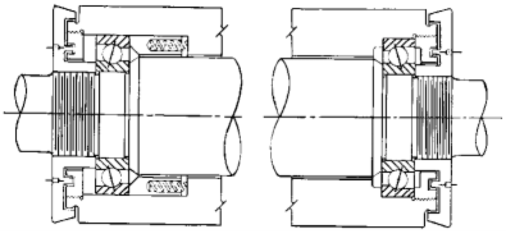
Application of MRC 97000 Series

The bearing arrangement above is capable of supporting extremely heavy thrust in the downward direction as well as substantially heavy thrust loads in the upward direction. The radial support bearing at the bottom of the shaft need not be shimmed to carry the up-thrust. The 9000-UD bearing may be mounted above (as shown) or below, the 7000-D, but maintaining the same orientation of bearing faces.

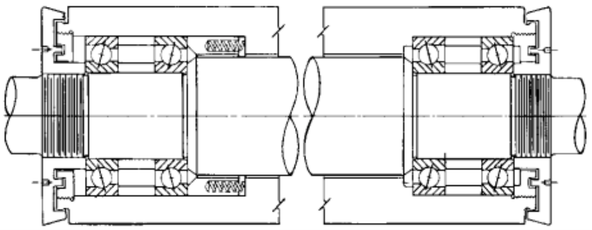
In the lubricating arrangement shown, the bearings serve as a pump to elevate the oil from the chamber immediately below the bearings to a passageway at the top of the bearings. From this point the oil returns by gravity to the reservoir shown at the left. Oil flow into the chamber below the bearings is adjusted by means of a metering pin. This system has a unique advantage in that the bearings may be completely covered by the oil level during shut-down, thereby protecting them against damage through corrosion.

Typical Methods of Mounting Bearings For High Speed Operation

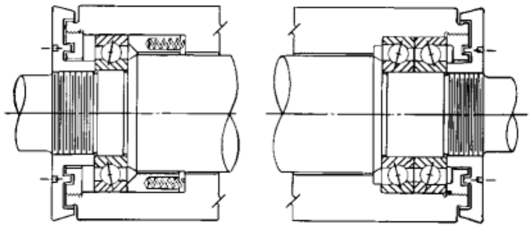
The drawings here illustrate proven designs for high speed service, primarily for machine tool spindles. Note the rugged sections for minimizing deflection and the labyrinth flinger seals for protecting the bearings against the entrance of foreign material. Additional sealing protection is often provided by introducing air-oil mist in the chamber between the two bearings. This not only lubricates the bearings, but also assures a positive outward flow of air through the labyrinth passage. The radial clearances in the labyrinth should be .005″ (.13mm) to .010″ (.25mm) and the axial clearances should be approximately 1/32″ (.080mm) to 1/16″ (1.59mm).



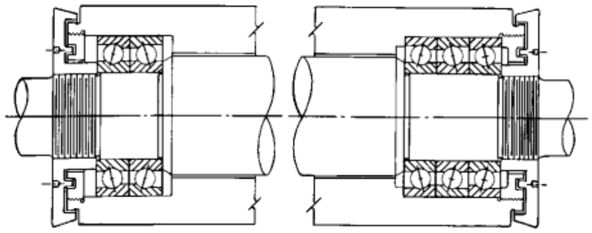
This is the simplest high speed mounting arrangement and is used for a wide variety of applications involving extremely high speeds. The spring pack bears against the face of the outer ring on the bearing at the left in order to preload the two bearings. Bearing on left end of shaft must be free to float in housing for preload to be effective. For extremely high speeds, the floating bearing is sometimes mounted in a cartridge in order to improve the length-to-diameter ratio of the sliding member.



In this arrangement, the duplex tandem pair on the left end of the shaft is spring preloaded against another duplex tandem pair on the right. The pairs at either end are separated by equal length spacers between bearing outer rings and inner rings. This arrangement produces good shaft rigidity due to the multiple shaft support.



In this arrangement the shaft is supported at the right end by a duplex pair mounted in the back-to-back relationship. These bearings may be supplied as a preloaded set if operating conditions require that deflections be minimized. The bearing on the left end of the shaft is a single-row deep-groove bearing which floats axially in the housing and is lightly spring loaded to remove residual clearances.



The shaft is located axially by the arrangement on the right end of the shaft which consists of a pair of tandem bearings opposed back-to-back against a single bearing. The duplex back-to-back pair on the left end of the shaft is free to move axially in the housing. This mounting arrangement has great rigidity.