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Technical Update 43

All about Bearings, Part 1

For further information on tolerance rings see Technical Update 5. *For information on identifying bearings see* Technical Update 15. *For further information on proper care and maintenance of bearings, ask your WAI salesperson for our Bearing-Care Instructions, literature #87-389-98.*

Anti-friction bearings seem to be very simple parts, but after you read this, you may think otherwise. They consist of two hardened steel rings (races), several hardened balls or rollers, and a separator (*Figure 1*). Some types of bearings, such as needle-roller bearings, may be used without a separate inner race because the rollers fit directly onto a hardened shaft. Many things can shorten the life of a bearing, and we would like to cover some of them in this issue.

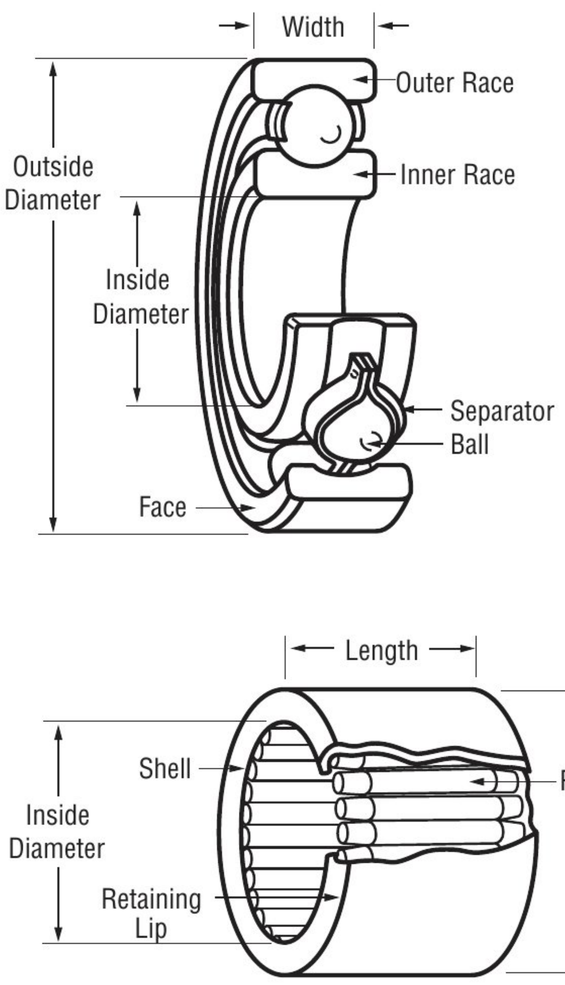

Figure 1. Ball bearings (top) have an inner and outer race. Needle-roller bearings (below) may use the rotor shaft as the inner race.

Selecting the proper bearing

Knowing the environment where the alternator or starter is going to operate is extremely important. What type of end thrust or side thrust will the bearing be subjected to? Is the application a passenger car or is it heavy-duty equipment or a truck? Is it being used in a dirty environment that would require a bearing with a seal rather than a shield? What is the temperature range in which the unit will be operating and can the seals and the grease withstand these temperatures?

***Caution*:** A bearing is packed with a certain amount and type of grease. Adding extra grease can cause some disastrous problems. Too much grease can blow out the seals when the grease expands with heat. If the added grease is not compatible with the grease already there, it can liquefy or coagulate and this can be as bad as having no grease at all.

Installing, removing and cleaning bearings

Installing

You need to abide by two simple rules when installing bearings. **Number one**: When installing a bearing into a housing, press only on the outer race (*Figure 2*). **Number two:** When installing a bearing onto a shaft, press only on the inner race (*Figure 3*).

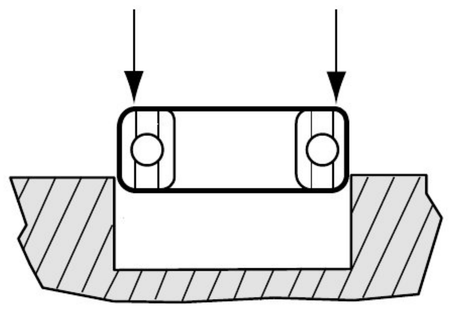

Figure 2. When installing a bearing into a housing press only on the outer race.

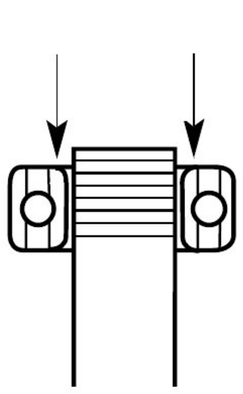

Figure 3. When installing a bearing onto a shaft, press only on the inner race.

These two rules sound very simple but can be easily confused when, for example, you support the bearing and press on the shaft or housing, instead of on the bearing. In these circumstances, the rule of thumb is to support the bearing where you'd otherwise be pressing on it. In other words, if you're pressing a housing onto a bearing, support the bearing on the outer race. If you're pressing a shaft into

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the bearing, support the bearing on the inner race. The important thing to remember is to always try to support the bearing, if it's at all physically possible.

You must also make sure that you are not pressing from one race through the balls to the other race. This will put a mark on the races and the balls, compromising the bearing's longevity. How much life has been removed from the bearing will depend upon the amount of pressure that was exerted during the pressing process.

Removing

If you are salvaging bearings, the removal process becomes very important. The point to remember here is that you hold or press only on the inner race when removing it from a shaft and you hold or press only on the outer race when removing it from a housing. (Note: Removing bearings undamaged from late-style housings can be very difficult, if not impossible.)

Sometimes a bearing will come apart during disassembly of the alternator. We have found a few tricks for removing the races when this happens.

To remove an inner race from a rotor shaft, first select a spot and grind the inner race almost down to the shaft. (***Caution****:* Do not touch the shaft with the grinder.) You will notice that the bearing race has changed color because of the heat generated during the grinding. This indicates that the hardness has been removed from the race.

Now support the race 180 degrees from the grind spot and, with a hammer and chisel, break the race at the grind spot. (***Caution:*** Never use a chisel on a bearing race that has not had the hardness removed by heating.)

To remove an outer race that is stuck in a housing where you cannot get to it, first select a bearing with the same outside diameter and lay it on the outside face of the housing, centering it as well as possible. Draw a line on the housing around the bearing race. Using this line as the outside diameter of the race, mark two spots 180 degrees apart and drill a small hole at each mark. Using a hammer and a small punch, alternate between the holes and tap out the old bearing race. Be sure to reseal those holes with silicone sealant to prevent future contamination.

Cleaning

If a bearing has become contaminated, it must be cleaned. To do this, first carefully remove the seals or shields from both sides of the bearing. Then remove all the old grease and any particles that are present. After the bearing has been washed, blow out all the cleaning solvent so it will not contaminate the new grease. (***Caution*:** Never spin a bearing using compressed air -- it will destroy the bearing and can cause it to fly apart.)

Inspection of housings and shaft

After the bearings have been removed, the D.E. and S.R.E. housings, as well as the shaft, must be inspected for imperfections. Even the smallest gouge or raised area in the housing or on the shaft will translate into a gouge or raised area on the bearing race and shorten the new bearing's life.

Slip fit vs interference (press) fit

When a bearing can be slipped into a housing or onto a shaft without pressing, this is called a slip fit. Just the opposite, as the name implies, is a press fit, which is when pressure is required to install the bearing. A bearing should never require a press fit on both the inner and outer races. Nor should both races be a slip fit.

If both races are a press fit, you will lose the clearance between the balls and the races as the bearing heats and expands. If both races are a slip fit, the excessive clearance will allow the races to move, causing possible misalignment. Both these conditions will shorten the life of the bearing, shaft and housing. Also remember that knurling a shaft or housing may create a press fit where a slip fit is required.

Figure 4. "Brakes" for bearings include "O" rings, wave washers, "C" rings and tolerance rings.

Tolerance rings and other "brakes"

Alternators with needle bearings don't need brakes

Most early automotive alternators had a ball bearing in the drive end and a needle bearing in the slip-ring end. The most common exceptions were Motorola and Prestolite, which had ball bearings at both ends. In alternators with a needle bearing, the D.E. bearing is secured into the D.E. frame with a retainer and the rotor is allowed to expand and contract by moving in and out of the needle bearing about .007 of an inch. This movement is caused by the difference in expansion rates between the aluminum end frames and the steel rotor.

With this type of set-up, the slip-ring end of the rotor shaft usually serves as the inner race of the S.R.E. bearing,

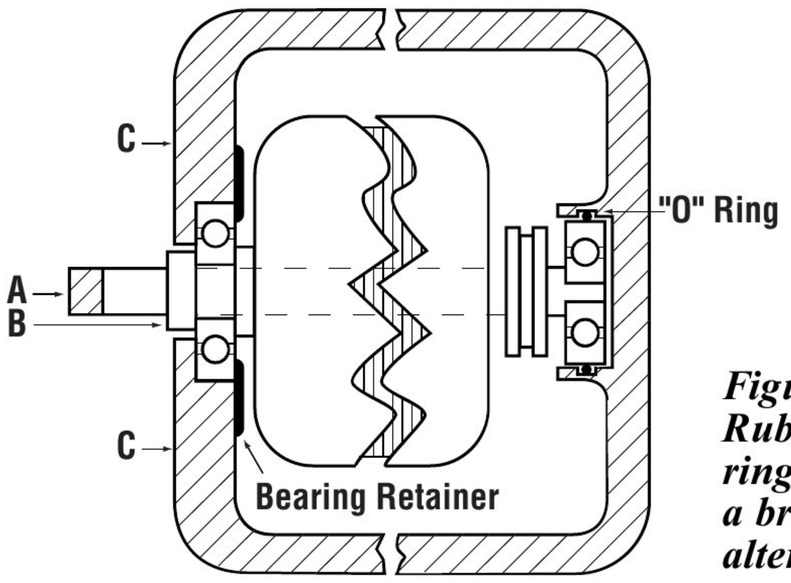

Figure 5. Rubber "O" rings are used as a brake in some alternators.

although some heavy-duty alternators have a replaceable inner race that is pressed onto the rotor shaft. In either case, you must give this race the same care that you would give any other bearing race.

Alternators with ball bearings in S.R.E. need brakes

When manufacturers began installing a ball bearing in the slip-ring end, this created some new problems. The rotor still expanded at a different rate than the end frames, so there had to be some method that would allow for this expansion without destroying the bearings. The solution to this problem was to allow the S.R.E. bearing to move in and out of the S.R.E. frame, and install a brake on the outer

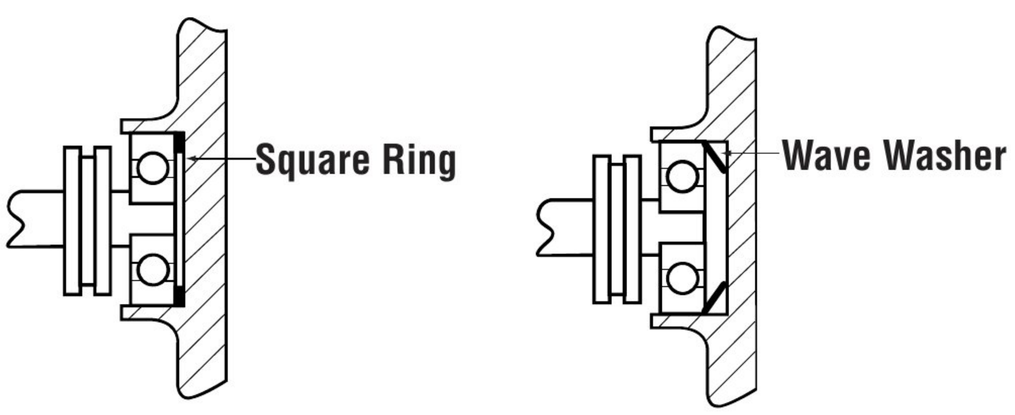

Figure 6. Some alternators use a wave washer or a rubber ring (either "O" or square) in the bottom of the S.R.E. bearing cavity to serve as a brake.

race to keep it from turning. This brake has taken many forms (*Figure 4*).

"O" rings

One type of brake is a rubber "O" ring, located in a groove at about the midway point of the S.R.E. bearing cavity. The "O" ring rocks back and forth the necessary .007" while holding the outer race in place (*Figure 5*). To keep the "O" ring from interfering with bearing installation, some type of lubrication is required, but it must disappear so that the braking effect will not be inhibited. We have found that a small amount of water on the tip of the finger works well as a lubricant. The water evaporates quickly, leaving the "O" ring's braking action unaffected.

Rings or wave washers

Some manufacturers place a rubber ring -- either "O" or square -- or a spring-type wave washer at the bottom of the S.R.E. bearing cavity. This ring or washer is squeezed as the rotor expands and relaxed as the rotor contracts. It holds onto the end of the S.R.E. bearing's outer race, but still allows the rotor to expand and contract. Any type of lubrication between this type of brake and the bearing race negates the brake effect of this setup (*Figure 6*).

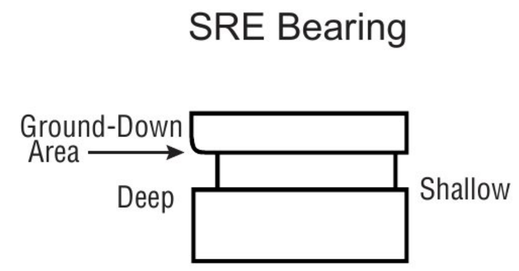

Figure 7. For a "C" ring to be installed properly, the curved part must be in the deepest part of the groove in the S.R.E. bearing.

"C" rings

A third type of brake, used on some import alternators, is a metal "C" ring. This "C" ring fits in a groove around the S.R.E. bearing's outer race to keep it from spinning. Note that this groove is ground off-center. One side is deeper than the other, so as the bearing attempts to turn, it wedges the "C" ring into the smallest part of the groove. This prevents any further spinning of the outer race.

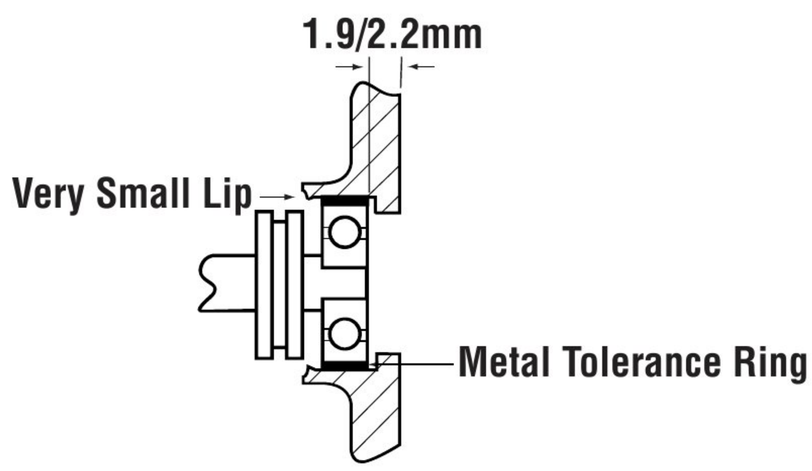

Figure 8. Early Delco alternators use metal tolerance rings as a brake. These tolerance rings and early-style plastic tolerance rings both must be recessed.

In order for this bearing to be installed properly, the curved part of the "C" ring must be in the deepest part of the groove. An easy way to locate the deepest part of the groove is to look at the edge of the groove. Turn the bearing until you see an area just above the upper edge of the groove that is slightly ground down and/or discolored. This is where the deepest part of the groove is located (*Figure 7*). See *Technical Update 5* for additional details.

Plastic tolerance rings

A fourth type of brake is a pair of plastic tolerance rings around the S.R.E. bearing's outer race (*Figure 4*). Once these bearings have been in service for a while, the plastic rings will take a "seat." However, if the alternator is then disassembled for service, this type of bearing must be

replaced because the plastic tolerance rings will not reseat and the braking effect will disappear.

Metal tolerance rings

In late-model alternators, plastic tolerance rings have become the most popular type of brake. Early Delco CS130 alternators, however, have metal tolerance rings (*Figures 4 & 8*).

These metal tolerance rings, as well as first-style plastic tolerance rings, both require a very important last step during the assembly of the alternator. The S.R.E. bearing must be recessed 1.9 to 2.2 mm away from the lip that is either on the S.R.E. frame or on the tolerance ring itself (*Figure 8*). Many tool companies have a tool that makes this procedure very easy. Without this clearance, as the rotor expands it will push the inner races against the balls, which will then push tightly into the bearing separator and against the outer race. This will cause the bearings to overheat and be destroyed (*Figure 9*).

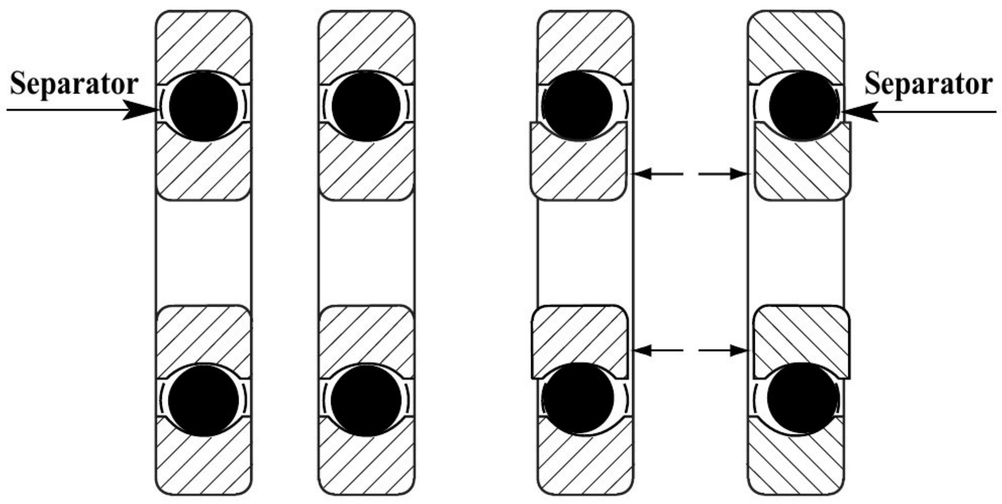

Figure 9. If the S.R.E. bearing is not recessed in alternators using metal or first-style plastic tolerance rings, it will be destroyed when the rotor heats up and expands.

As a side note, rebuilders have reported that they are adding heat-transfer compound to fill the grooves in both sides of the metal tolerance rings. This helps transfer the heat away from the bearing, increasing its life.

Metal tolerance rings should be replaced each time an alternator is rebuilt because the ribs in a small area become flat. This is caused by the belt tension pulling sideways on the rotor.

Late-style CS130 tolerance rings

The latest-style tolerance ring for the CS130 is straight through, without a lip, and does not require this last step. A short time after the latest plastic tolerance ring was introduced, a wide 10mm bearing was also introduced.

We have heard that sometimes, during assembly, this wide 10mm bearing slides too far onto the rotor shaft and grounds the slip ring. This can be prevented by installing a small washer on the shaft between the bearing and the slip ring. This will prevent the bearing from sliding too far on the shaft. WAI's 85-7503 fiber washer works well here.

Update old S.R.E. frames

As the S.R.E. frames for earlier style CS130 alternators get older, the thin lip on the outside of the bearing bore is breaking (*Figure 10*). This can allow the metal tolerance ring to come out of the S.R.E. frame. With the following procedure these S.R.E. frames can be converted to accept the latest-style plastic tolerance ring.

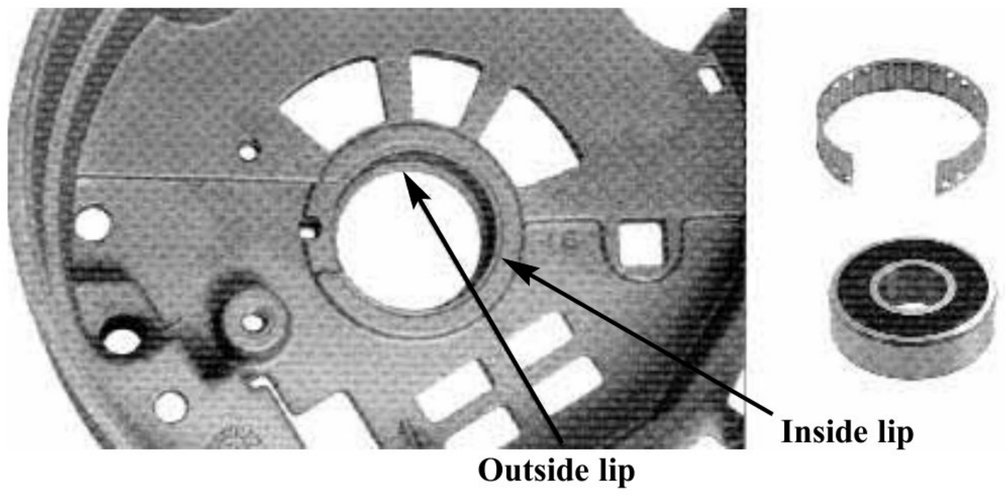

Figure 10. Early-style S.R.E. frames for CS130 have a thin lip on the outside of the bearing bore that tends to break. The inside lip prevents the metal tolerance ring from walking inward and grounding out the slip ring.

Step 1: Using a tapered reamer, round file or other suitable tool, remove the thin lip on the outside of the bearing bore. There is also a very very small lip on the inside of the bearing bore that must be removed (*Figures 8 & 10*). This inside lip was created by Delco to prevent the metal tolerance ring from walking inward and grounding the slip ring.

Step 2: Center punch a mark approximately 180 degrees from the brush-pin hole. Drill an 1/8" hole as close to the bearing bore as possible. This is to accommodate the lock tab on the tolerance ring. It may be necessary to break out the small area between the hole and the bearing bore to make room for this lock tab.

Step 3: As mentioned above, install a small spacer (85-7503 fiber washer) onto the rotor. This spacer will prevent the bearing from being pressed on too far and grounding the slip ring.

How to install CS130 S.R.E. bearing

First install the tolerance ring into the S.R.E. frame, then install the bearing into the tolerance ring, pressing only on the outer race. Assemble the balance of the components into the S.R.E. frame. Now invert the assembly and press on the inner race to install it on the rotor. During this process, the drive end of the alternator must be supported on the end of the rotor and not on the D.E. housing (*Figure 5, support on point A or B, not point C*).