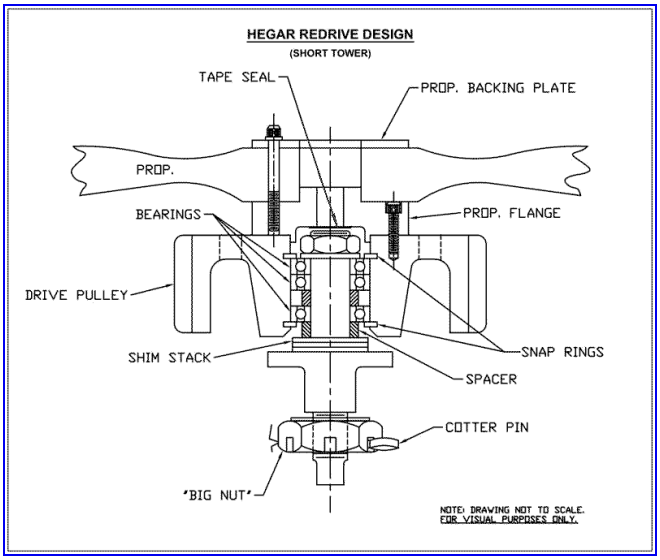
Redrive - Bearing Replacement

By: Ralph Shultz

Has your Challenger redrive been bothering you lately? Perhaps you are wondering if the bearings may be failing or are about to fail? You have tried to determine if they are running rough but cannot decide either way if they are still good or not. You really would like to answer that question but the only way you see to do that is to open up the drive, remove the bearings and do a hands-on inspection. But the problem is you don't exactly know what is inside the drive or what to expect in doing that.

This article will explain what you need to know to handle the bearing change with ease. The following diagrams depict the two different redrives that are in service on Challengers today and should go a long way in relieving any uncertain feelings you might have about tackling a bearing replacement job.

HEGAR REDRIVE



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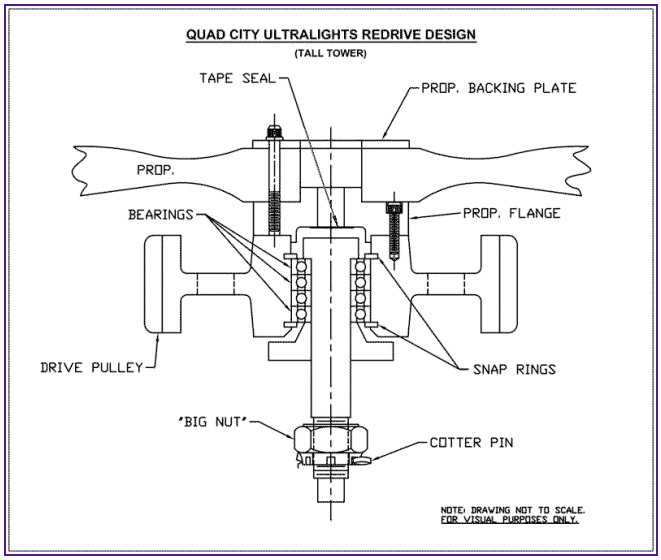
QCU REDRIVE



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Description of the Redrive Interior Components:

By referring to the diagrams above, you will see that the two designs are very similar. Note that the prop mounting flange is directly below the propeller. This flange is attached to the upper "driven" pulley by six socket head cap screws and up to this point the drives are identical. In the Hegar drive, you find the bearing shaft, a nut & washer and a snap ring. In the QCU set-up you see the bearing mounting shaft end and a snap ring. In both drives the bearing stack shows up next and is the real focus of this article. The Hegar stack consists of three ball bearings and a bearing spacer followed by another snap ring. A bearing spacer and a couple of shims complete the stack. The drive is mounted to the tower and held in place by the "Big Bad Nut" with a cotter pin locking the nut in place. In the QCU drive you find four ball bearings with no bearing spacer. Another snap ring holds the stack in. A shaft collar is mounted nesting against the inner race of the stack. This collar and the washer and the dreaded "BIG BAD NUT" end up mounting the drive in the mounting plate (tower). A cotter pin then locks and holds everything together.

Disassembly:

1. **Prior to disassembly note the alignment of your cogged belt and the forward and aft edges of the driven pulley. If this alignment is not to your liking note and record how much you would like to change the alignment. Adding or possibly removing shims on the bearing shaft assembly at installation of the new bearings may accomplish this.**
2. **Disassembly is started by removing the propeller and prop mounting flange from the driven pulley assembly. Some repairmen prefer to remove the propeller mounting flange after the driven pulley assembly has been removed from the tower.**
3. **Next comes the removal of that "BIG BAD NUT". Start by removing the cotter pin, then the big nut. Here are two ways to accomplish this:**
    - **Using two wrenches, of the appropriate sizes, place one on the big nut and one on the flats at the end of the prop shaft. By holding opposite tension on the prop shaft flats with one wrench, break the nut loose with the other wrench.**
    - **Bring to bear a large socket and cheater bar to break the Big Nut, while taking care not to damage the engine vibration mounts. This can be done by using the method shown in the article located at: www.challengers101.com/MountVibration.html After breaking the high torque on the Big Nut remove the socket and continue removing the nut with a wrench while holding the shaft with a second wrench.**
4. **Then remove the cog belt from the pulley being sure to loosen the belt tensioning assembly first. Marking the direction of rotation (travel) directly on the belt will ensure it will be remounted operating in the same direction.**
5. **Remove the pulley and propeller shaft assembly from the redrive tower.**
6. **Remove the bearing shaft retaining nut and washer.**
7. **Removal of the shaft and bearings from the pulley requires a press or a heavy duty bearing puller.**
8. **On the Hegar drive the shaft must be pressed out of the bearing stack from the prop flange end. Once the shaft is out, the snap rings are accessible and should be removed. The bearings can then be pressed out of the pulley from either end.**
9. **On the QCU drive the snap rings are accessible at both ends of the bearing stack and both should be removed. The bearings and shaft may then be pressed out from either end of the unit. Once out, the pulley and the bearings can then be pressed off the shaft.**
10. **Bearings are pressed out of either unit's pulley using a cylinder having an I.D. and O.D. matching the bearing outer race. Take care to collect all bearings, spacers and shims, noting the order in which they were assembled in the assembly.**
11. **Clean and store all components.**
12. **While the cog belt is off, it might be a good idea to inspect it and replace it if necessary.**

Be sure to note and record the bearing numbers on your removed bearings. They will probably be marked with something like "IKS 9R-16, R-16 2RS, 2RS 16" or some similar numbers. The bearing's basic dimensions are 2.0000" O.D. X 1.0000" I.D. X .4985" width. These bearings are considered light duty bearings, but believe me, the service loads they see are anything but light duty. Supporting a working airplane propeller is a very tough job for shafts and bearings! Bottom line is that you should use good, well lubricated and sealed bearings.

While talking about the bearings you need to be forewarned that the Chinese manufactured bearings of this size have been reported by some as not holding up very well in our redrives. Use them if you must but keep a keen eye on the installation and future operations.

Taking notice of the used bearing numbers, you will probably see the sequence of -RS or -2RS included. For most manufacturers these designations refer to bearings, which have integral internal rubber seals, on one side only or on both sides respectively.

If a bearing shows a -D or -2D, the seals are made of metal. The letter Z stands for metal shields. It may be possible to find "-2RS2Z" bearings, but they are rare. The sealed bearing types are lubed and sealed at the factory, thus ensuring maximum cleanliness and lubrication throughout its service life.

Do not try to clean the interiors of these bearings in hopes of returning them to service. If a bearing checks out OK and you believe it is indeed serviceable, just wipe off the outer surfaces and reinstall it. As a matter of fact, trying to clean any bearing with a solvent is a bad idea unless you happen to have a special sonic solvent vibration tank in which to suspend the bearing in. Otherwise, it's better just to push out the old lubricant by machine packing with clean lubricant. This however is not possible on sealed bearings. A precautionary note is in order here: It is a fact that it is not good practice to mix new with used bearings. Doing this usually results in premature bearing failures.

I would think the ideal bearings for our drive application would be two -2RSZ bearings in the outer positions with the shields facing outward and one or two -2RS bearing(s) in between these bearings. However, good luck finding those -2RSZ bearings! If these are not available, try to match what was previously installed in your unit.

The following bearings will probably work as well:

NSK R16DDUPA1
R16SS, R16RS
9R-16
2RS16
R-16 2RS

In any case, try to find self-greased and sealed bearings, as they will keep the dirt and grime out of the bearing and the grease in. If sealed bearings cannot be found, applying a piece of tape over the hole in the propeller mounting flange can create somewhat of a better seal to the cavity where the bearings live. The tape might be a good idea in any case. Also, if non-sealed bearings are used, be sure they are properly "packed" with bearing grease and add some grease to the bearing cavity as well.

Re-assembly and Installation:

The following apply to both the Hegar and QCU drives:

1. **Read all installation instructions to get comfortable in your mind with the steps and procedures.**
2. **Set out all needed components and tools in a clean work area.**
3. **Take care to keep all components CLEAN. This includes your hands and tools. You don't want to carry dirt and grime on to the bearings or their surrounding and mounting surfaces. This could affect bearing fits and possibly work its way inside the bearings, any of which can reduce the service life of a bearing. I cannot tell you how important cleanliness is!**

To assemble the Hegar drive proceed as follows:

1. **Install the snap ring in the bore of the drive pulley at the end away from the prop.**
2. **Prior to installing the bearings, inspect, clean and lightly oil the pulley bore; it must be free from any foreign material. Keeping in mind the assembly stacking order add the spacer between the bearings at the proper location. Install the new bearings into the pulley bore one at a time, pressing the outer race into the pulley bore using the same cylinder used for removing the old bearings. This should be done from the prop end until the bearing stack has been seated against the snap ring. Be careful here not to damage the snap ring groove.**
3. **Assemble the shim stack and the lower spacer onto the shaft. This would be the time to add or subtract shims to change the belt to pulley alignment if needed!**
4. **After the bearings are safely seated, install a snap ring in the pulley bore at the prop end of the bearing stack.**
5. **From the side away from the prop, carefully start the shaft into the installed bearings. Press the shaft into the bearing bores using another cylinder sized and fitted to seat on the inner bearing race of the last (upper) bearing. Never press a bearing on or off through the balls of the bearing! In a heavy press this most assuredly will reduce the life of the bearing!**
6. **Place the washer and nut on the shaft end nearest the prop and torque to 66 ± 7 ft/lbs. Use a drop or two of blue Loctite on the nut threads. The shaft must be held with a wrench on the flats on the shaft.**

9. **Test the installation for smoothness of operation by spinning the pulley. If no roughness is detected... you're good to go!**

Note: I see no reason why a fourth bearing or two bearing spacers seated against the inner and outer bearing races, could not be used in place of the single inner bearing spacer. If this were to be done it should simplify the installation of the bearings by making it possible to press them onto the shaft and then press the bearing/shaft assembly into the pulley bore.

To assemble the QCU drive proceed as follows:

1. **Install a snap ring in the lower (farthest from the prop) groove in the pulley.**
2. **Lightly oil the shaft and install the bearings being sure that they seat against the shaft's shoulder.**
3. **Lightly oil the pulley bore and press the shaft/bearing assembly into the pulley from the prop mounting side bore using the same cylinder used for removing the old bearings.**
4. **Install the upper snap ring in its groove in the pulley.**
   Test the unit for bearing smoothness of operation by spinning the pulley.

A few words of caution are in order at this point in the bearing(s) installation. The bearing(s) are difficult to start straight and squarely in the bore. If they enter being cocked they will bind and if pressed farther in like that they may be damaged and in all probability they WILL damage the bore beyond the acceptable tolerances for the bearing bore. At the very first indication that they may be cocked STOP and investigate. If things do not look right, turn around and press the bearing back out. Be very careful getting the remaining bearings pressed in because if they get cocked they are very difficult to press back out as another bearing may be blocking access to the side necessary for their removal. Working through a bearing's I.D. (bore) is not fun or easy!

This is what a few Challenger owners have had to say about the removal and installation of the redrive bearings.

I use a hammer and a wooden block to start it slightly, and then use the hammer around the circumference of the bearing a bit at a time until the bearing is into the bore somewhat and is straight. Takes a bit of tapping and looking and tapping and looking. I then carefully press it on in.

George Hurt

Hey guys-here is a little trick to make those bearings come out much easier. Put the whole unit in the deep freeze (or just outside overnight in South Dakota this time of year). Then warm up the hub (careful not too hot) with a propane torch. This method makes the bearings smaller (cold) and the hub larger (warm). You will be surprised what a difference it makes. First time I did this was in a press. The second time I did it with the cold/warm method I didn't even need a press. I just tapped 'em out with a hammer on the shaft.

Brad Stiefvater

Be careful when you press them out of the aluminum redrive hub so as to not damage the snap ring groove. It takes a lot of pressure as you are pressing all four bearings through the hub at once. The aluminum prop hub must be supported equally all the way around at the center or the pressure can collapse the snap ring groove that holds the bearings in place. I would not support the aluminum hub on the perimeter as you might run the risk of warping it. I would suggest that you shop for replacement bearings at a bearings specialty house such as Motion Industries or Bearing Chain Supply, depending on where you are. You might ask them the difference between the SS vs RS designation. I WOULD NOT replace them with any bearings that say "Made in China or Made In USSR!

Jim Harvey

Another way the bearing installation might be approached is to place the bearings in a box and heat them overnight with a 100-watt light bulb. While this is happening the shaft could be chilling down in a freezer. After removing the bearings and the shaft, lightly oil the shaft and install the bearings on it. This should take very little force; however check that the bearings are seated against each other. After this has been

accomplished return the bearing/shaft assembly to the freezer and place the pulley in an oven set to 150 degrees F for about 2 hrs. Retrieve the shaft/bearing assembly and pulley, lightly oil the pulley bore and install the shaft assembly into the pulley seating the bearings against the snap ring. This also should take very little force.

The following finishing steps apply to both the Hegar and QCU units:

1. **Place the propeller mounting flange on the pulley face. Apply a drop or two of blue Loctite on the threads of each of the six socket head cap screws then install and torque each screw to 18 ± 2 ft./lbs (216 ± 24 in/lbs) using a cross opposing tightening pattern.**
2. **Install the pulley shaft and the belt tension adjuster into the drive tower (on the Hegar drive the tensioner goes on to the tower from the side away from the prop). Slide the big nut washer on to the shaft and screw on the Big Nut so that it slightly tightens the squeeze on the tower to the point where whole pulley/shaft assembly is snug but can still be slid (moved up or down). On the QCU drive it would be at this time you would add or subtract shims to change the belt to pulley alignment!**
3. **Install the cog belt over the engine pulley and the large belt driven redrive pulley, checking that the belt alignment is satisfactory and does not ride against or over either pulley's edges.**
4. **Adjust the belt tensioning assembly by turning its top bolt to a position that tightens the belt on the Hegar drive so that it can be moved slightly back and forth across the pulley cogs by pushing fairly hard with your fingers. In the case of the QCU drive the belt should feel somewhat tighter and harder to slide when tested by pushing with your fingers. If reusing the same belt you had been running be sure to install it so that it will be rotating in the same direction as it did before.**
5. **Tighten the Big Nut (by using one of the methods stated in the disassembly section above), torque it to 135 ± 15 ft/lbs.**
6. **Install the 1/8" diameter cotter pin remembering to bend fully open its legs.**
7. **Tighten the belt tensioning bolt lock nut.**

At this point you will have completed the bearing replacement. All that is left is to install the propeller and check its tracking. Cross torque the mounting bolts to 12 - 15 ft/lbs (144 - 180 in/lbs) and safety wire them together in pairs. You may want to read the prop article located at: www.challengers101.com/PropBal.html Give yourself a pat on the back - you did it! This is now a job you know all about and hopefully do not fear. If or when there is a next time it will go faster and easier and you can take the savings to the bank.

A final thought on the service and life expectancy of the bearings. Bearing life is usually rated by expressing that life in terms of millions of rotations at a given effective bearing load among other factors. Just as an exercise let's assume the life is rated at 100 million. At our cruising flight prop speed of roughly 2700 RPM that equates to about 100,000,000 / (2700 X 60) which renders about 617 hrs. It should be noted that this would represent a bearing operating ideally. Which is probably not what our drive bearings are subjected to considering the props dynamic flight loads and varying RPMs. Taking it one step further, my guess is that a duty cycle on the (short) Hager (three bearings) drive is actually between 2 to 3 times as harsh as this and should be applied, thus reducing the expected life to say 617 / 2.5 = 247 hrs! The four bearing QCU (tall) drive is probably in the area of 1.7 and therefore might be expected to provide 617 / 1.7 = 363 hours.

These are just my personal estimates of course. Real world bearing life calculations are much more complicated than the simplified analysis presented above. However, these results do give you a sense of what might be an expected service life from our bearings.