



TR250/TR6 Clutch Release Bearing Woes

It seems that at least once a week someone on the Triumph or 6PACK email lists mentions having TR250/TR6 clutch release bearing problems. My kids and I have put over two hundred thousand miles on TRs over the last 20 years and we've never had a release bearing failure. I've also taken apart or observed others take apart about ten clutch systems, none of which had defective release bearings. So ---- what's the problem? Apparently, during the mid 1990s some bad RHP release bearings made it into the supply chain. There apparently was no way to tell a good bearing from a bad bearing. [I believe part of this problem was caused by the introduction of release bearing sleeves that required a greater force to press the bearing onto the sleeve. This sleeve design necessitated special procedures to avoid damaging the bearing during the pressing operation.] According to TRF, the current RHP bearing is different than that supplied originally.

Dick Taylor replaced six of the bearings with less than 1,000 miles each going back to 1995. More recently he replaced one than had about 4,000 miles on it. The bearing, while costing less than \$50, requires removal of the gearbox to replace, a 4 to 8 hour job. So, after replacing the bearing a couple times, many go to great lengths to avoid another premature failure. Unfortunately, in my opinion, the alternatives have drawbacks that significantly degrade the clutch or release system.

The Original Design: The original equipment release system is shown in the adjacent photos. The upper photo shows the front of the gearbox as viewed from the left side. The splined shaft is the gearbox input shaft. The splines fit into the clutch disk that drives the shaft. The thick disk in the center is the release bearing. The shaft across the bottom is the clutch operating shaft. When the clutch pedal is pressed, the shaft rotates such that the forked shaped casting, called the clutch fork, rotates and pushes the release bearing towards the front of the gearbox against the clutch pressure plate, not shown.



The next photo shows the standard (RHP) release bearing and the release bearing sleeve.

The sleeve slides over the gearbox front cover. The little pin in the groove at the bottom on the sleeve in the photo rests against one of the pins on the clutch fork and keeps the sleeve from rotating. The front of the bearing, at the top in the photo rotates with the clutch pressure plate. The inside of the bearing is pressed onto sleeve that doesn't rotate.



The act of pressing the bearing on the sleeve I think can damage the bearing. I use a two-pronged approach. First, I cool the sleeve in the freezer to shrink the sleeve outside diameter and heat the bearing in a ~ 200 degree oven to increase the bearing inside diameter. Next I use a tool sold by TRF that rotates the bearing as it is pressed on the sleeve. See photo on right.

The head of the bolt is secured in a vice, the (cold) sleeve and then the (hot) release bearing are placed over the bolt and the nut with washer screwed down. Since the large washer is welded to the nut, the bearing is forced to rotate as it is pressed on the sleeve, thus distributing the force over the bearing surfaces. Note, I much prefer to press the bearing onto the sleeve myself rather than buying the combined unit since I have no idea how the bearing was pressed on the sleeve. Also, I smooth and polish the sleeve as describe in the "Sticky Clutch" note before pressing on the bearing.



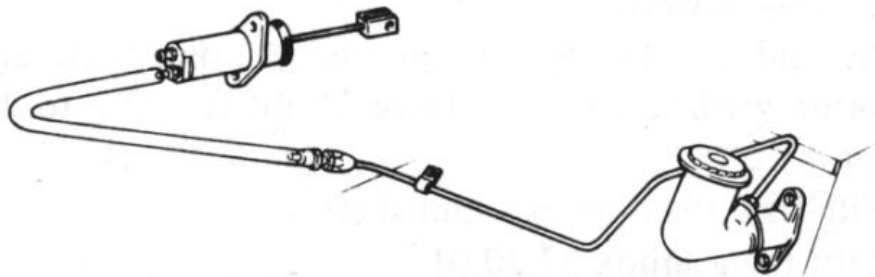
The photo shows a clutch pressure plate mounted to a flywheel. A release bearing is positioned against the pressure plate spring fingers, as it would be in normal operation. The pressure plate is a Laycock brand used as original equipment in the later TR6s.

The next photo shows the under side of the Laycock pressure plate on the left and the clutch disk on the right. The clutch disk is sandwiched between the pressure plate and the flywheel. There is stiff diaphragm spring in the pressure plate that normally holds the disk tightly against the flywheel so that the disk turns with the flywheel. As mentioned earlier, the splines on the disk mate with the splines on the gearbox input shaft hence coupling the flywheel to the gearbox. Applying force to the pressure plate spring fingers via the release bearing lifts the pressure plate away from the clutch disk allowing the disk to rotate independent of the flywheel --- in other words, disengage the clutch.



The release bearing and clutch pressure plate as viewed through a hole cut in the top left side of the gearbox bell housing is shown on the right. In normal operation with the clutch engaged, the release bearing is next to or against the pressure plate spring fingers and in some cases the bearing turns with the flywheel.

The clutch pedal is connected to the release system via the hydraulics shown in the sketch below. The unit on the right side is the master cylinder. The clutch pedal (not shown) is linked to the piston in the master cylinder. The slave cylinder is on the left side. The rod extending from the slave cylinder is connected to an arm that turns the clutch operating shaft. The operation is as follows; when the clutch pedal is pressed, the piston in the master cylinder is pushed into the cylinder forcing hydraulic fluid out of the master cylinder through the tube and then hose into the slave cylinder. The additional fluid in the slave cylinder forces the slave cylinder piston towards the rear in turn pushing the push rod.

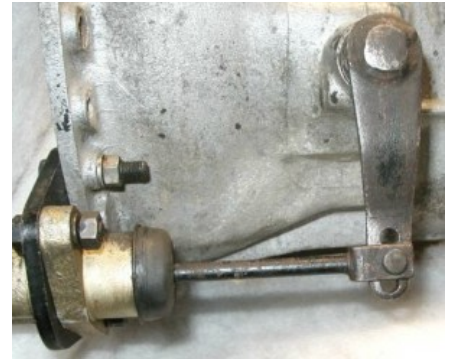


The push rod forces the lever on the clutch operating shaft towards the rear, in turn rotating the operating shaft and via the clutch fork forces the release bearing to press against the spring fingers on the pressure plate. The slave cylinder, push rod and operating shaft lever are shown in the next photo. (This is a bench setup. In a working system, the engine rear plate is sandwiched between the plate holding the slave cylinder and the gearbox. I didn't want to go dig out one of those greasy old plates just for the photo.) More information on the hydraulic system is contained in the "Clutch Hydraulics Overhaul" article.

The release bearing must move the pressure plate spring fingers about 1/4 inch to transition the clutch from engaged to release. The force required to move the pressure plate spring is between 250 and 325 pounds,

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depending on the specific pressure plate. These data are from measurements made by Dick Taylor and also measurements in the accompanying "Clutch Measurements" note.



The operating shaft arm length to the center hole is 3.36 inches and the fork length to the center of the pins is 2.44 inches. Therefore, the clevis pin in the center hole of the operating shaft arm moves 3.36/2.44 or 137% of the distance that the sleeve and release bearing moves. Since the release bearing must move about 1/4 of an inch to release the clutch, the clevis pin must move about 3/8 inch. The maximum movement available for a new system is about 0.6 inches for the 0.75 inch master cylinder system, about 0.5 inches for the later 0.70 inch master cylinder system. As wear (especially in the linkage between the clutch pedal and the master cylinder) introduces slack into the system, there is little if any margin in the system.

As the clutch disk wears, it gets thinner. This causes the position of the pressure plate spring fingers when the clutch is engaged to move to the rear and the operating shaft arm to move toward the front. Earlier systems had an adjustment in the link between the slave cylinder and the operating shaft arm. The TR250 & TR6 use a self adjustment feature. I don't know when this feature was introduced, the TR4 doesn't have it, so it was introduced either with the TR4A, the IRS, or with the TR250. There is a small spring behind the piston in the slave cylinder. When the clutch pedal is released, the pressure plate spring (that 250-325 pound force) pushes the release bearing back and in turn via the fork, operating shaft and arm pushes the slave cylinder piston into the cylinder. When the pressure plate spring reaches the relaxed position, there is no longer a force exerted on the release bearing. However, the spring in slave cylinder piston exerts a very small force (a few ounces) on the piston. The force is so small that it has no practical effect on the system except possibly keeping vibrations from moving the bearing away from the pressure plate. With this arrangement, all slack is removed from the system between the slave cylinder and the pressure plate.

The original equipment RHP release bearing turns rather freely. I don't know whether the bearing turns when the clutch is released. If the force exerted by the little spring is sufficient, it probably turns. If there is an uneven spot on the pressure plate springs, then the bearing is probably kicked back far enough so that it doesn't turn. There seems to be no ill effect if the bearing turns all the time probably because the forces are so small.

As mentioned previously, I've never experienced a bearing failure.

Reports for others indicate that the first symptoms of a bad release bearing is a screeching or squeal from the clutch area, in some cases all the time and in others just when the clutch pedal is pressed. The noise level increases as the deterioration progresses. At some point the bearing disintegrates and the clutch release function becomes inoperative.

The Bad Bearings: There probably has always been release bearing failures. However, the incidence of premature failures increased significantly in the mid 1990s. Some folks had repeated failures after less than a thousand miles. Apparently one or more of the big three acknowledged that there were some bad bearings produced. These things have no lot number etc, and there was no information as to how long the problem existed, etc. As mentioned earlier, I've never had the problem, but wonder if the bearing I buy now is one of the bad ones that has been on the back of some shelf for the last five years.

Another possible cause of bearing problems is damage during the operation to press the bearing on the sleeve as discussed earlier. While I suspect this caused some of the problems, I doubt that it is the principal cause of the problems.

Others have speculated that the Borg & Beck pressure plate currently offered as the standard replacement is part of the cause. This clutch is very similar to the Borg & Beck clutch that was original equipment on the TR250 and early TR6s. The later TR6s were equipped with a Laycock clutch. The Borg & Beck reputation is that it is much stiffer than the Laycock. Some feel that the Borg & Beck is so stiff that it overloads the release bearing resulting in early failure. I've always used the Borg & Beck pressure plates and have had no trouble. Some have noted that the Borg & Beck is so stiff that their wives an/or girlfriends are unwilling or unable to drive the car. (Some consider this a worthwhile benefit.) The measurements of a new Borg & Beck and a used original equipment Laycock pressure plates documented in the "Clutch Measurements" note show the difference between these two samples to be insignificant.

The Fix - The Koyo Bearing: If you can't be assured that the standard bearing is of good quality, then the natural reaction is to try to find a substitute. One substitute is the Koyo bearing used in the 1975-1986 Toyota Land Cruiser. It has the same inside diameter so it can be pressed on the standard sleeve. The Koyo bearing is shown on the left with the RHP standard bearing on the right in the following two photos. The RHP bearing in the first photo is sitting on the sleeve and had not been pressed into position. The Koyo bearing is much more rugged than the standard bearing, has a much greater mass and is much stiffer. This bearing is clearly a confidence builder. Unfortunately, it is not without problems. This bearing is used in the TRF "Magic Clutch" along with a Sachs pressure plate, new clutch disk, operating shaft, fork & bushings.



The adjacent photo shows a Sachs pressure plate after less than 5,000 miles service. (This clutch is in Murry Mercier's '73 TR6 and was discovered while repairing a sticky clutch --- see article on "Sticky Clutch".) It is pretty clear that the bearing is wearing the pressure plate spring fingers. At the present rate, one would expect the spring fingers to start breaking off in less than 20,000 miles.

The problem is clearly that the forces holding the bearing against the slave cylinder is insufficient to transfer enough torque to turn the stiffer bearing. As a result, the system works like a lathe, with the release bearing the tool --- a rather blunt one with little force, but like nagging, will wear things down over a long period. The external symptom is a constant chirp or squeal that stops when slight pressure was applied to the pedal.

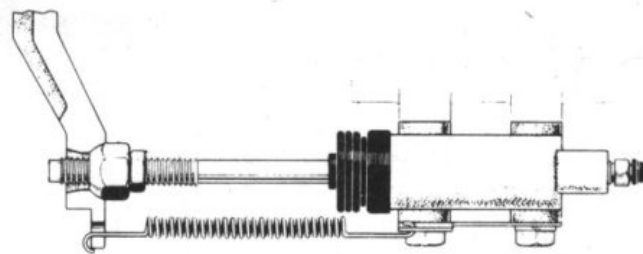
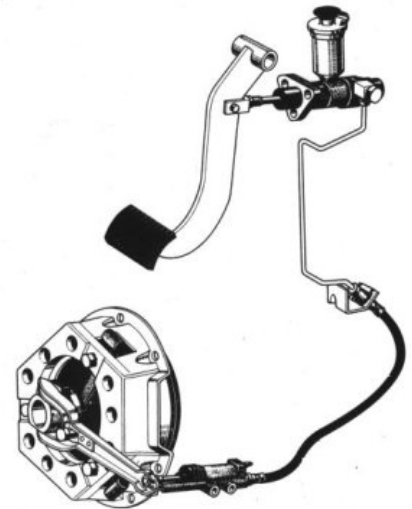
I recently inquired of the Triumph and 6PACK email lists whether others had encountered the bearing squeal. Many responded and a large percentage had had the problem. Some gave up and took the system apart again and installed the standard bearing. Others had modified the linkage between the slave cylinder and operating shaft arm to pull the release bearing away from the pressure plate.



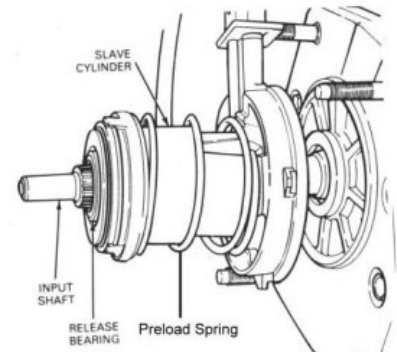
The Fix For The Fix: I spend many years in communication system development. Development of fixes was routine and sometimes a fix caused other problems that requires a second fix. A long time associate referred to these fixes for the fixes rather distastefully as "**second order bug killers**".

Remember, I've never had the problem, but want to decide what to do the next time I open a clutch. I've communicated with many over the last few weeks on this subject. I was fortunate that Dick Taylor (DT) responded to the list enquiry mentioned earlier. Dick has been working this problem for months. He offered many suggestions and measurements of the clutch system. One of our first questions was "how is the bearing configured in the Land Cruiser?" DT inquired of the technical experts at TRF. They were unable to tell him anything about the use in the Land Cruiser.

I finally purchased a Haynes manual for the 1968 through 1982 Land Cruiser. The sketches on right and below show the release bearing arrangement. Note that a lever type fork arrangement is used to push the release bearing. The sketch below shows the linkage between the slave cylinder and the fork in more detail. Note that there is a spring that pulls the lever (and bearing) back and an adjustment to push the bearing close to the pressure plate. The specified play at the adjustment nut is 0.12 to .016 inches. This is very similar to the TR3 & TR4 arrangement that is described in more detail later.



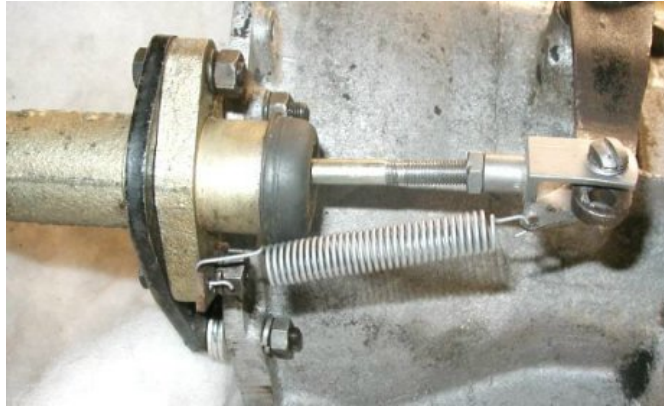
While thinking about this I checked out my son's 94 Ranger. I figured I could check out the slave cylinder and see if there is a return spring. It's a 4WD that sets pretty high and he had parked it on the grass, so I slid under and looked for the slave cylinder. There wasn't any. Further investigation revealed that the hydraulic pipe went from the master cylinder through a hole in the side of the transmission. I then pulled out an old Haynes manual covering the 1983 through 1992 Ranger. Apparently the slave cylinder was moved into the bell housing in 1985. The sketch on right shows a representative slave cylinder. Note that it is concentric to the gearbox input shaft. Also note that there is a preload spring that holds the release bearing against the pressure plate. **I understand that Triumph was the first to use disk brakes in passenger autos -- maybe they were also one of the first users of the self adjusting clutch.**



Koyo -- Alternative #1 -- Pull the bearing away from the pressure plate: One alternative that many have used is to pull the release bearing away from the pressure plate as is done in the TR3/TR4 and the Land Cruiser. The TR3/TR4 linkage hardware can be used except for the pushrod that is too short. The configuration is shown in the next photo (note the use of washers between the gearbox and slave cylinder in place of the engine rear plate). The push rod is 5.5 inches long and made from 5/16 steel rod threaded 24 TPI. Threaded rod can also be used. The push rod end is I think from a TR4. The push rod that came with the end was 4.75 inches, too short for the TR250/TR6 application. The spring is the same as used on the TR6 accelerator, somewhat weaker than the spring used on

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the TR3/TR4. A small flat bracket with a 5/16 inch mounting hole and a 1/8 inch hole to secure the front of the spring as show in the photo was fabricated. The TR3/TR4 slack adjustment is 0.10 inches. One way to achieve this adjustment is to remove the spring, loosen the nut, back the rod out of the end to the point where the slack disappears, then screw the rod back into the end 2.4 turns. The slack can be adjusted to less, such as 0.040 inches (one turn) and readjust it more frequently. In this case, the need for adjustment will be noted when the release bearing develops a constant squeal. Of course, if you wait long enough the squeal will stop as the clutch wears enough to give a constant preload -- just like using the clutch pedal for a foot rest.



The good point with this arrangement is that there is no wear on the pressure plate or the release bearing when the pedal is not pressed.

There are however negative points with this solution:

1. The Koyo bearing has significant mass. When the stationary bearing is pushed against the rotating pressure plate, it slips for a short period, wearing the pressure plate spring. Many using this fix report a short squeal every time the clutch pedal is pressed.
2. This fix introduces slack into a system that has little margin.
3. This fix requires readjustment as the clutch disk wears. There is a trade off between frequency of adjustment and the amount of slack introduced into the system when it is adjusted. A small amount of slack requires more frequent adjustment whereas a larger amount of slack may prevent normal clutch operation.

Koyo -- Alternative #2 -- remove all the springs: Dick Taylor has tried a second approach of just removing the spring in the slave cylinder. The theory here is that the run out of the pressure plate should kick the bearing back enough so that it is next to but doesn't touch the pressure plate. The good point is that no adjustment is required and little or no slack is introduced into the system. It still has the problem of getting the bearing up to speed when the pedal is pressed (#1 above). One concern I have with this arrangement is that vibrations could cause the bearing to move away from the pressure plate necessitating that the clutch pedal be pumped. On the other hand, this is similar to the front brake pads and vibrations don't seem to cause the pads to move away from the rotors. Some folks have suggested that the TR4A used this arrangement -- neither a return nor a preload spring. I've been unable to confirm or refute this. Apparently some current replacement slave cylinders are not equipped with springs.

Koyo -- Alternative #3 -- stiffer preload spring: This alternative is to use a bigger preload spring. The first question is "Will the bearing take the constant rotation?" I don't think that will be a problem. Dick Taylor tested the bearing under loads from 15 to 100 pounds for 15 minute periods at 1000 RPM found it didn't get hot. He also found that a force of about 30 pounds is required to keep the bearing turning. Because of the different lever lengths, this translates to about 20 pounds additional at the slave cylinder. Dick has added a second spring to his slave cylinder and the system seems to work perfectly. This restores the original configuration. I described this to Ryan Miles, my 17 year old Triumph enthusiast neighbor. He asked how would the additional load on the pressure plate affect the crankshaft thrust bearing? Ouch! Hadn't thought about that. The thrust bearing is a weak link in the engine. While the 30 pound force is miniscule compared to the 250 to 350 pounds force necessary to release the clutch, it's constant. I just don't know whether it's a problem or not.

Dick has promised to keep us posted as to performance of this preloaded system.

Find a good standard bearing: As I mentioned earlier, I've never had a standard bearing fail nor have seen one that has failed. Although the Koyo bearing seems to be a much more rugged bearing, it doesn't match well with the TR6 design. In my opinion, the best choice is to use a good quality standard bearing. The data from Dick Taylor and others suggest that the bad bearings fail quickly, in most cases in less than 1,000 miles. So, how about if I test each bearing for the equivalent of a thousand miles use and, if it still good, then I should feel safe using it.

I counted the number of clutch operations on a trip to a couple stores in town and counted 67 operations for the 10.4 mile trip. That's about 6 operations per mile or 6,000 operations per 1,000 miles. The clutch is in for about 1/2 second for the shifting and maybe a second for startups and a bit longer when backing out of garage, parallel parking, etc. If we assume an average of 1 second per operation, that means the the release bearing is under full load for 6000 seconds or 100 minutes per 1,000 miles. A drill press could be used as a test vehicle. My drill press has speeds of 750, 1250, 2400 and 4700. A good test might be to run under a 400 pound load for 10 minutes at 1250 then with a 20 pound load for 10 minutes at 4700 rpm. This could then be repeated until a total of 100 minutes under load and 100 minutes under the light load are logged. I could do this while working on other projects in the workshop. The major concern would be whether the bearing overheated. After each 10 minute period the bearing would be inspected to see if still tight and smooth. I postponed this test after talking to TRF as described next.

TRF HP122 Long life high-performance bearing: I just received TRF's TR250 & TR6 Quick Reference Catalogue Volume 1 and noticed that they are offering a long life high performance bearing under part number HP122. I called technical support at TRF and chatted with Dave about the specifics. He said it was the same Koyo bearing used in the Magic Clutch Kit. I commented that it had problems because it ate into the pressure plate spring fingers. He said it wouldn't eat into the proper plate. I mentioned the Sachs plate and he said that would work fine. (For what it's worth, Murry's pressure plate pictured earlier is a Sachs.) During the ensuing discussion Dave made the following observations based on his 30 years experience.

- The current RHP bearing is different than the original design, of poor quality and he wouldn't use it.
- When questioned about the small preload spring in the slave cylinder he said "what spring?" After I described it he said that the spring was only used in the very early TR250/TR6 and is not in replacement cylinders. He also said a spring should not be used. (I told him both the '76TR6s I purchased in the early '80s had the springs. Others have commented that the current replacement cylinders don't have the spring. However, Dick Taylor found a spring in the slave cylinder he purchased from Moss this past spring.)
- He said the best arrangement is to pull the bearing away from the pressure plate by about 1/8 inch. I commented that there isn't much slack in the system. He said the system has 3/4 inch motion and the 1/8 inch won't be noticed. (I assume these distances are at the center pin of the operating arm.)
- He said there is information on the Internet that suggest adding external springs to the system. He said this is bad information and shouldn't be used. (I assume he was referring an to external preload spring. I can't imagine how one can pull the release bearing away from the pressure plate the preferred 1/8 inch without using a spring.)

Summary: Well, I still don't know what I'll use the next time I open a clutch.

I guess at this point my first choice will be to use the Koyo bearing and pull the bearing aware from the pressure plate and put up with the squeal every time the clutch pedal is pressed as the bearing gets up to speed. The 3/4 inch motion that Dave from TRF suggests is available is a little high. The geometry suggests that the

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maximum one can expect for the 0.75 inch master cylinder is 0.6 inches and a little over 0.5 inches for the 0.70 inch master cylinder --- if everything is in good shape. Wear around the pin between the pedal and master cylinder push rod degrades the available motion to 1/2 inch or less for the 0.70 inch master cylinder. The 1/8 inch slack Dave suggests translates to 1 inch pedal motion. Both my '76 TR6 (0.70 MC) and my TR250 (0.75MC) have several inches spare pedal when the clutches are disengaged, so that would not be a problem for me (at the moment). As mentioned earlier, the slack need not be that great if one checks the adjustment more frequently.

My opinion is that the best choice is to use the Koyo bearing and preload system as the original design except with an increased spring pressure to keep the stiffer bearing moving when the clutch is engaged. This matches modern systems. However, I'm reluctant to subject the trust bearing to the constant load. If I can find some sort of an upgraded high-performance thrust bearing, I'll go to this solution.

At this point I'm reluctant to use a new RHP bearing.

If it ain't broke..... Conventional wisdom is that whenever you remove the gearbox, all clutch components should be replaced. Similarly, if you dismantle a gearbox, replace all the bearings, etc. I put less than 5K miles per year on each of my TRs. The normal life of these components is well over 50K miles. There are more than a few examples of replacement parts lasting 1000 miles or less. Therefore, in the future I will probably not replace any working clutch component unless it shows excessive wear. Ditto for the gearbox. As a matter of fact, I have a bunch of dirty rusty old bearings, clutches etc that I think I'll clean up and oil. They're probably worth five times the price of the shiny new inferior products.