

Disclaimer:

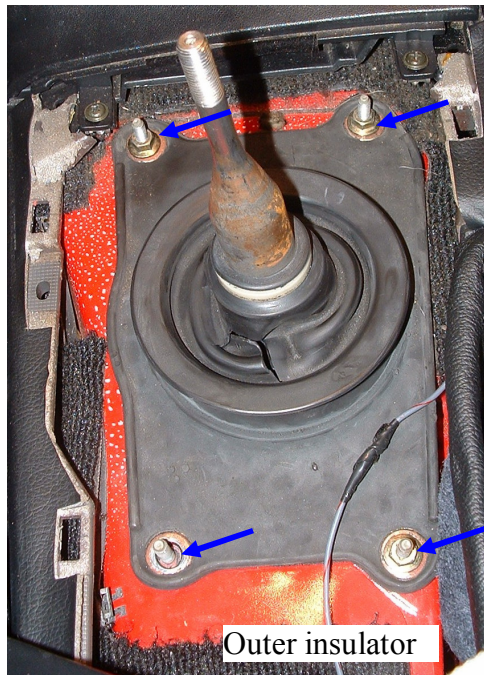
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Getting started:

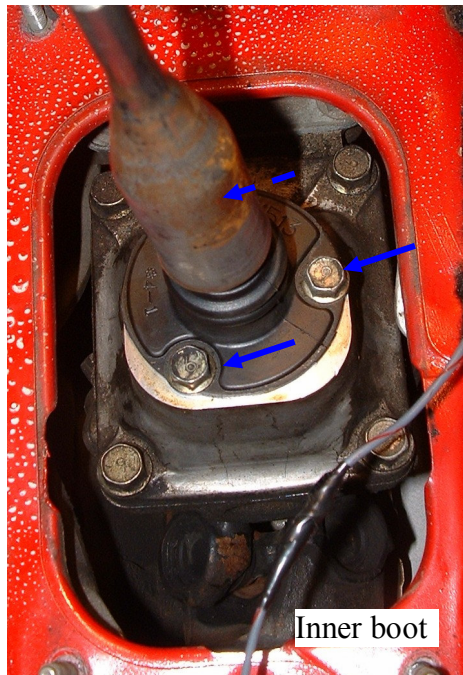
- Jack the car up and level. As high as you can while still being stable. A lift would be fantastic, but most of us will not have that option. The bellhousing measures 18-1/2" tall, and you'll want additional height for the jack that you're lowering the transmission onto. If you question the safety of your jackstand setup, definitely sort this out before continuing. I had the lowest point of my car at 20", and during reassembly it wasn't tall enough to wheel the transmission under the car while on the transmission jack.
- Relieve fuel pressure if you're planning to change the fuel filter. Disconnect the battery.
- Wear leather gloves and safety glasses at all times while under the car. Dirt and oil has a funny way of falling and blinding you. With a new (unscratched) set of safety glasses on, I find I work faster.
- Remove one or all of the wheels. This made it much faster for me to get under the car with the creeper.



1. Unscrew the shift knob.
2. Lift out the console panel. Don't lose any metal clips, and don't let the sharp edges underneath the panel scratch other interior parts. Put it into Neutral.



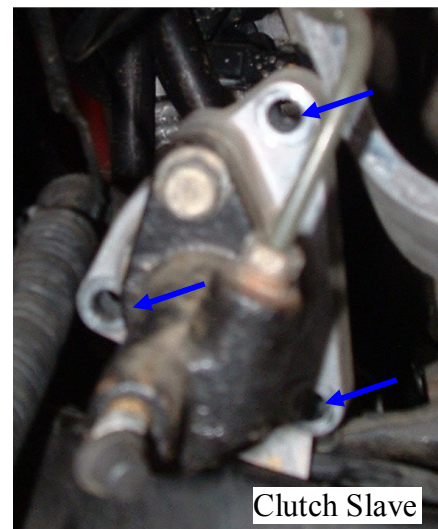
3. Insulators. Remove the felt pad, then the 2 rubber insulators. Then remove the (4) 10mm nuts and the outer boot.



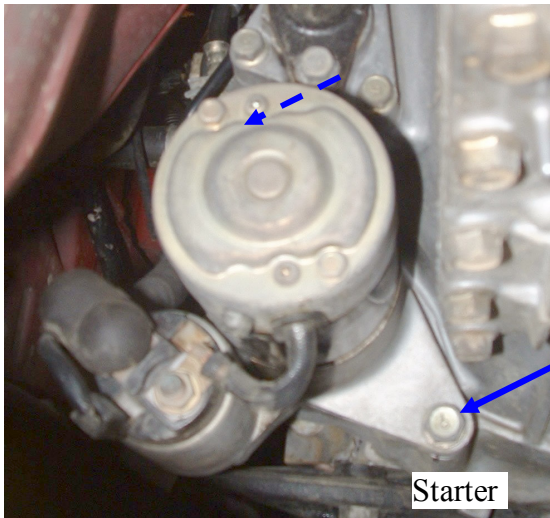
- (3) 10mm nuts
Replace the inner boot if it's torn. It will tighten up shifter feel.



4. Remove the shifter, wave washer, and bushings. Replace the bushings and wave washers if any are damaged.
5. Remove the transmission cover. (10mm). Spray the fasteners on the catalytic converter with PB Blaster now. Also spray the powerplant frame nuts with PB. Remove the drain plug, and drain the transmission oil.
6. Remove the right undercover. (10mm)
7. Remove the left undercover. (10mm)



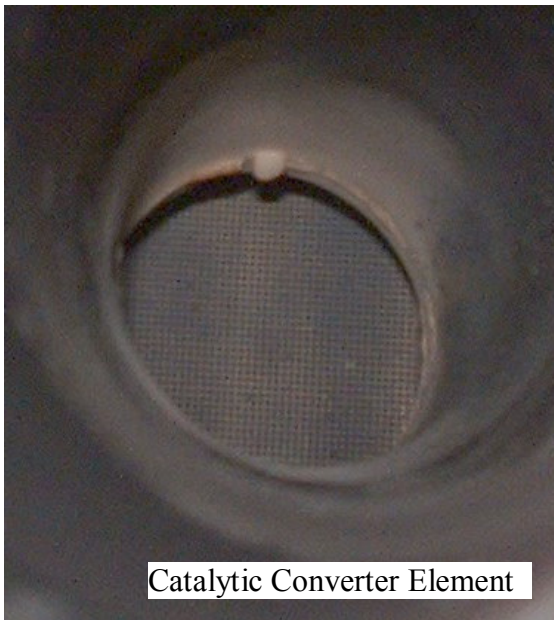
8. Remove the clutch slave. I removed the slave (3 12mm bolts) with the bracket attached.



9. Disconnect the battery, then remove the terminals on the starter motor. Now remove the Starter. Note that there is a nut on the engine side of the upper bolt that must be held still.

10. Remove the tunnel reinforcement.

11. Remove the secondary air pipe. Don't damage or loose the gasket.

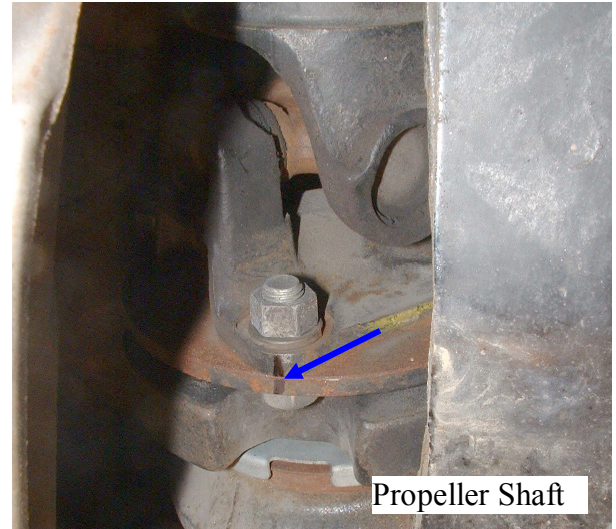


12. Remove the catalytic converter. I find the garage jack directly under the center of the cat helps greatly. A shot of PB Blaster on the rubber hangers makes them easy. Take a good look down inside with a flashlight, and shake it out to see if the catalytic element has begun to break down. This one looks good.

13. Remove the tunnel reinforcement.

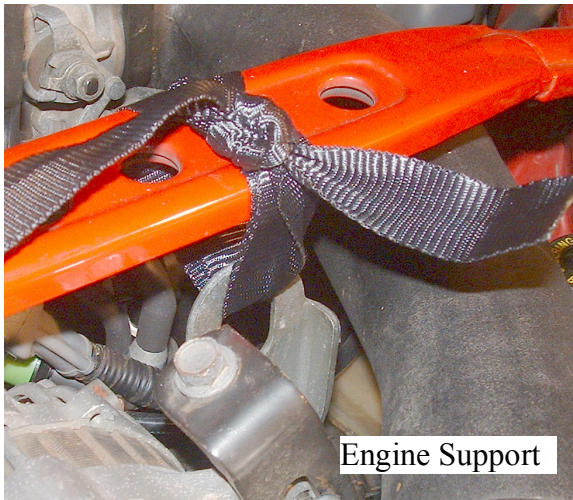
14. Remove the tunnel reinforcement.

15. Remove the cover on the front of the PPF.



16. Mark the propeller shaft at the rear end, then remove the (4) 14mm bolts, nuts, and lockwashers. Use either a scribe or paint marker – the Sharpie marker I used here rubbed off. Fortunately the yellow paint marks were still visible. Lower the rear end of the shaft, and slide the front out of the extension housing. Have a big rag handy to stuff in the housing before oil comes drooling out. Some people claim they've used a plastic cap to fit into the oil seal, but I didn't find anything that would work.

17. Powerplant frame Removal – don't unbolt it yet – it's a key structural member and things will move when it's taken out.



Start by bracing the engine. When the transmission is removed the engine will tip forward and overstress the engine mounts. I used my strut tower brace to tie off the lifting eye. Then put a jack underneath the transmission – center it about even with the big drain plug, but put a thin block of wood there to support it evenly and not break the ribs in the casting. Technically, the engine won't tip until the transmission is detached, but I did it early.

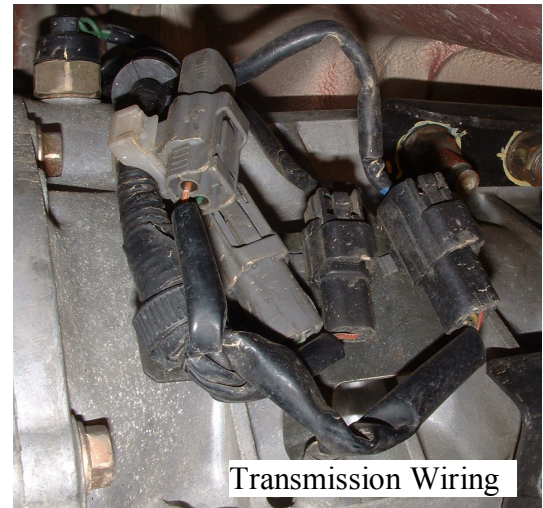
There are (8) 21mm nuts and one bolt.



Without an air impact wrench, this is what it took to loosen the bolts – my 4' jack handle over the 18" breaker bar, and a 12" extension to reach the upper ppf nuts.

Jackstands are very stable, but if there is a situation that could tip them, this might be it. I put my feet only against the underside of the car to push, this does not apply any tipping forces like if you push off the wall or a jackstand base.

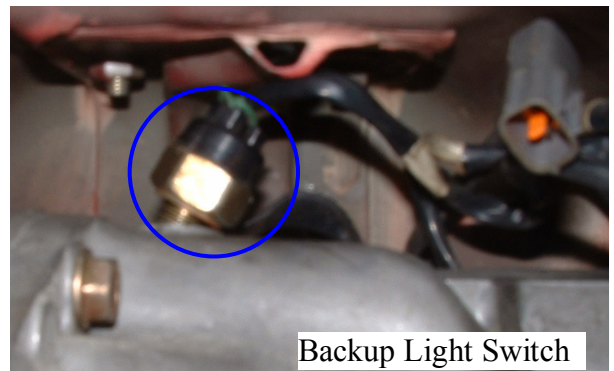
I think it's easier to remove the front PPF nuts first, so that you can use the PPF to rotate the differential and support the diff with a wooden block or beam.



18. Remove the electrical switch connectors. Be careful – the wiring is often brittle and ready to break off. As you'll later see, I replaced all three of these sensors on the extension housing due to broken wiring.

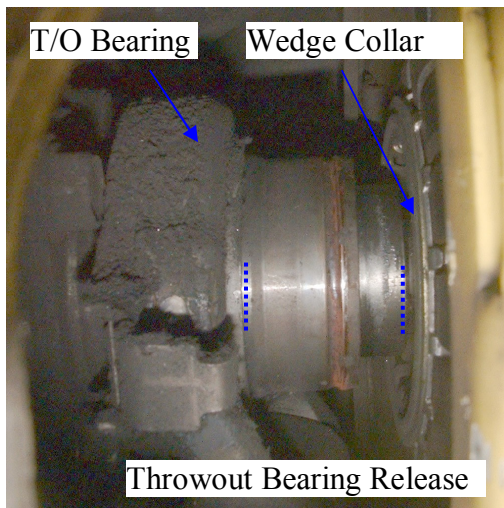
19. Remove the cover (10mm)

20. Remove the cover (10mm)



21. Remove the backup light switch. It is 15/16" size, but either a large vise-grip to loosen it, or an adjustable wrench will work. The wiring is very brittle, so when untwisting it, make sure you don't allow the unshielded wire by the sensor get damaged. Secure it safely out of the way and save the copper seal washer.

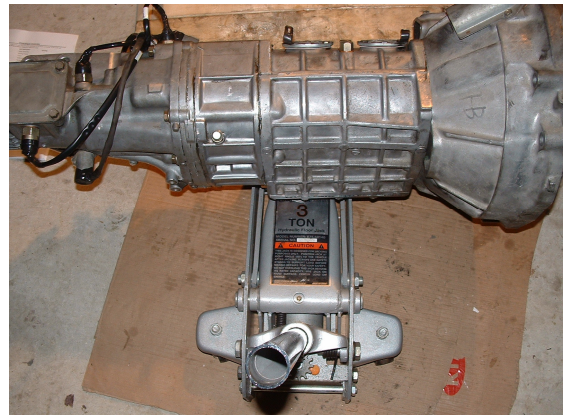
22. Transmission Removal



Using a long, bladed screwdriver, insert it between the wedge collar and the throwout bearing. The two dashed lines will be about ¼” apart; pry and twist between them and the throwout bearing will pop loose like the picture above. The trick is to pry in a way that holds the wedge collar tight against the pressure plate.

Loosen the 14mm bolts surrounding the transmission. Using a 24” long extension with a jointed adapter and a short 14mm socket, accessing them all was a piece of cake from underneath the car. Thanks to Zach Keller for that tip.

I found that even with the bolts loosened, the transmission wouldn’t budge. It took some careful prying and work with the dead-blow mallet to get it loose – apparently the last person who installed the Bonez clutch put sealant between the bellhousing and engine block. Do not manhandle the tranny at this point – the input shaft and pilot bearing are susceptible to damage now – so keep patient and be careful using any force to make things move. Also be careful that you don’t damage the sensor wires at the tail end of the tranny – they are prone to damage from pressing against the tranny tunnel.



If you’re not using a transmission jack to support and lower the transmission, be careful, work slowly, and don’t drop it. Extra hands help a lot. This picture shows about where to balance the transmission on a single jack point.

Congratulations, the transmission is finally free of its hiding place.



Some notes about handling the tranny:

- always wear leather gloves when handling the housings. The casting has many tiny sharp edges that will cut your fingers before you realize it.
- Take a moment now to brush off all loose dirt, spray it with degreaser, and clean the housing. Then sweep your workspace clean. You don't want dirt around when you get into the tranny internals.
- be very careful with the sensor wires. Right now you should wrap the uncovered section of wire at both the plug and sensor ends to prevent damage. I didn't, and ended up needing to replace them since the broken wires couldn't be resoldered. I used Silicone self-fusing tape from McMaster-Carr, and tightly wrapped them like this:

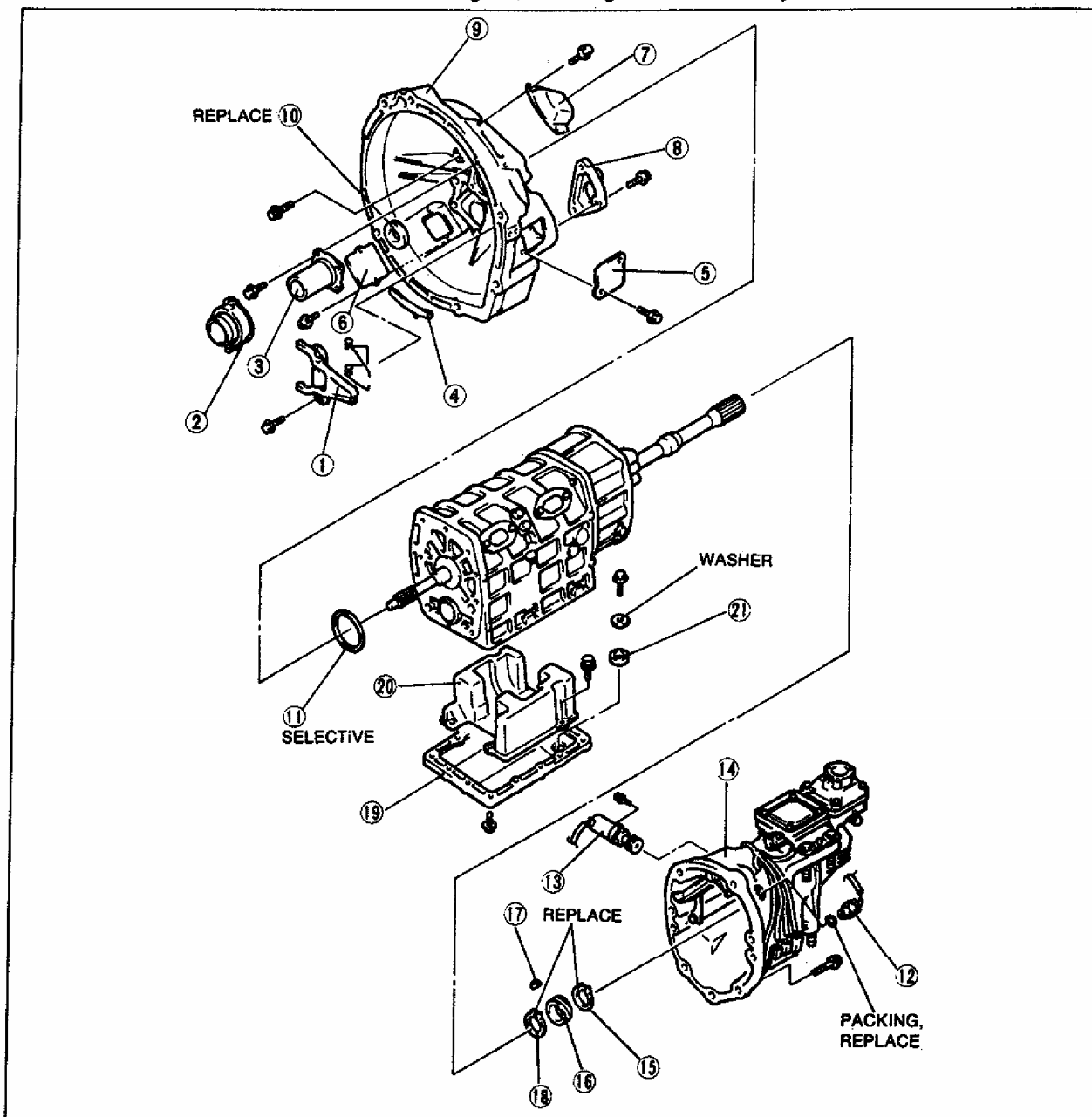


Clutch Housing and Extension Housing Components

Note

- The front and rear oil seals do not need to be removed unless you are replacing them.

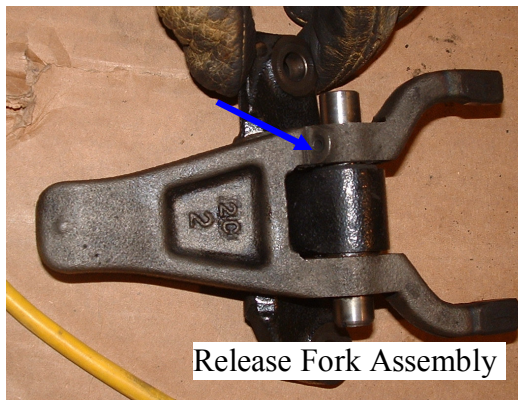
Disassemble in the order shown in the figure, referring to **Disassembly Note**.



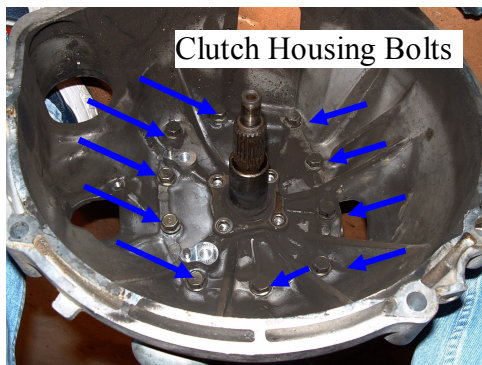
1. Release fork assembly
2. Release collar
3. Front cover
4. Dust cover
5. Service hole A cover
6. Service hole B cover
7. Vent cover
8. Release cylinder support
9. Clutch housing

10. Oil seal (clutch housing)
11. Adjustment shim
- ★ 12. Back-up light switch
- ★ 13. Speedometer sensor
(Speedometer driven gear)
- ★ 14. Extension housing
- Disassembly Note
- page J-15
- ★ 15. Snap ring

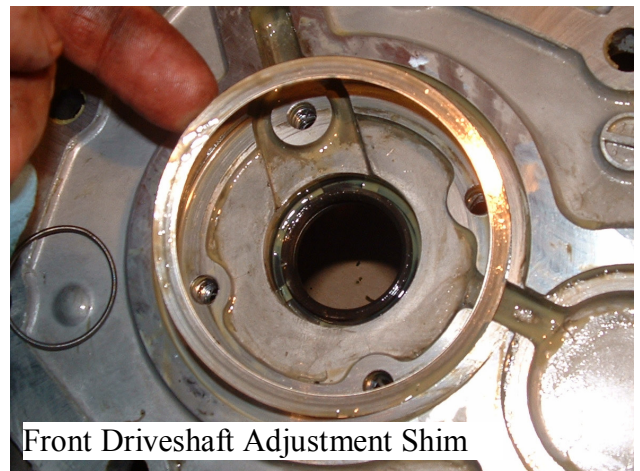
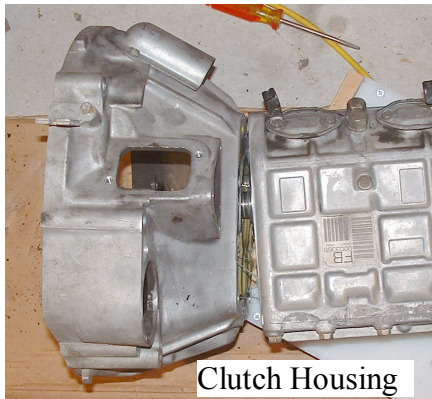
- ★ 16. Speedometer drive gear
- ★ 17. Key
- ★ 18. Snap ring
19. Undercover
20. Oil baffle
21. Magnet



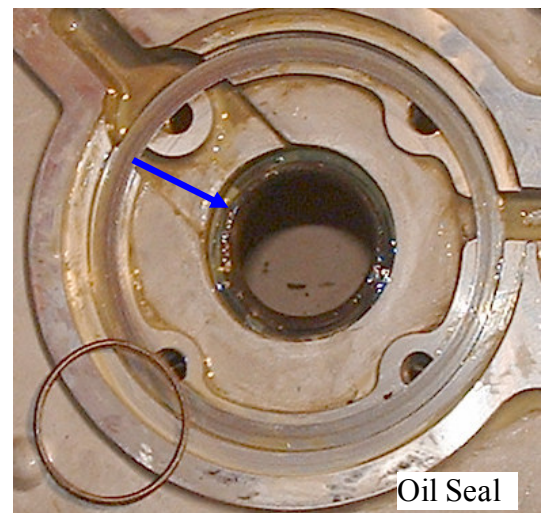
1. Release fork. Take note of how the spring is captured, then loosen the 14mm bolts holding it in place. Inspect the area around the roll pin for cracking. Mazda has a reinforced release fork that you may choose to replace the original.
2. Release Collar (Throwout Bearing). Inspect per the FSM, or replace it to be safe.
3. Front Cover – Remove the (4) 14mm bolts and remove it.
4. Dust cover – I didn't remove it, or it was missing to begin with.
- 5-8. Covers and bracket were already removed.



9. Clutch Housing. Remove the 14mm(?) bolts holding it to the gearbox, and use a dead-blow or plastic mallet to break the sealant loose.



11. Remove the adjustment shim before removing the oil seal. You don't want to lose this.



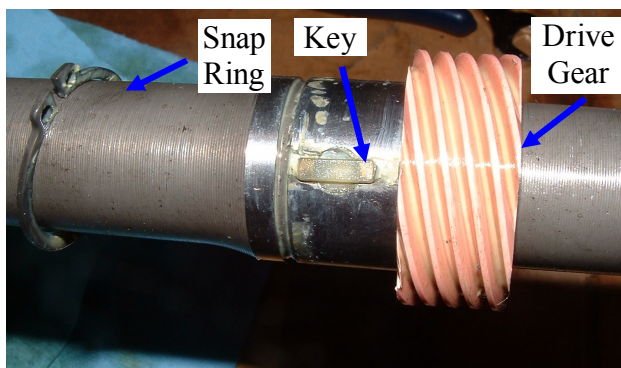
10. Now pry out the oil seal. The is a ring-shaped spring that's part of the seal, but remove the whole rubber piece without damaging the aluminum housing.
12. Backup Light switch – don't damage the wiring!
13. Speedometer sensor – don't damage the wiring or pinion gear – this is expensive to replace.



Extension Housing

14. Extension Housing. Note that the shift control rod is hooked into the shift rod ends. Twist the housing clockwise as you pull to avoid catching on the rod ends. Do not damage the plastic speedometer drive gear.

By now you may have noticed my gear oil is mustard-yellow color. This is the color of the Redline Lightweight Shockproof gear oil – I don't particularly recommend using it. I have since been pleased with the Neo 75W-90 HD oil that I refilled with. Always work over old towels or cardboard – there was significantly more oil left in the case than I expected, and it stinks and has a tendency to form puddles when you walk away.

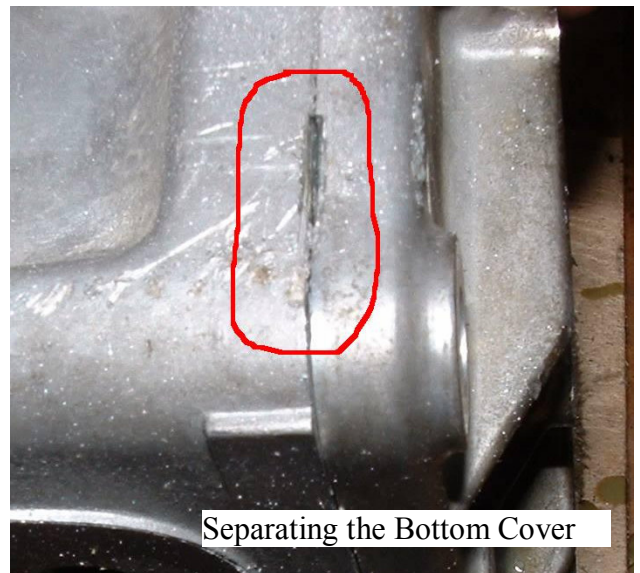


Snap Ring

Key

Drive Gear

- 15-18. Speedometer drive gear assembly. There are snap rings on each end, and a key underneath the gear. Gently tap off the gear using a punch or similar smooth-ended tool.



Separating the Bottom Cover

19. Undercover. Remove the bolts holding on the bottom cover. I chose to cut a shallow (1/8" deep) slit with a Dremel disc cutter along the seam, insert a screwdriver, and twist to pry it free. Much more oil mess.

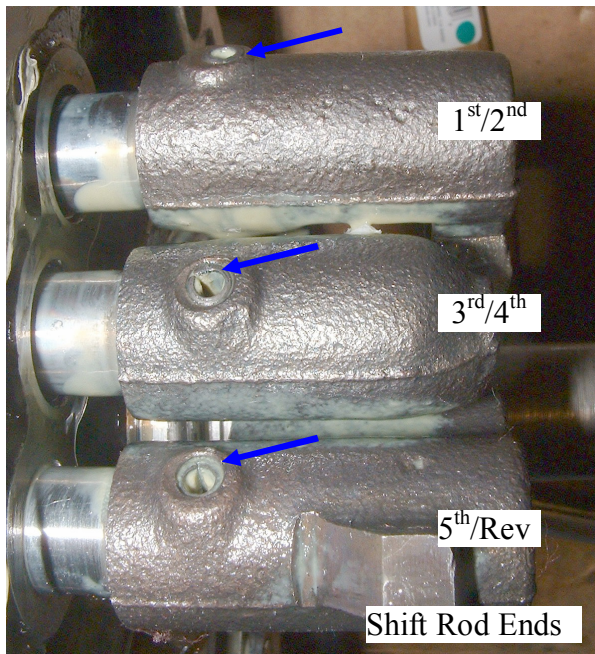


Bottom Cover

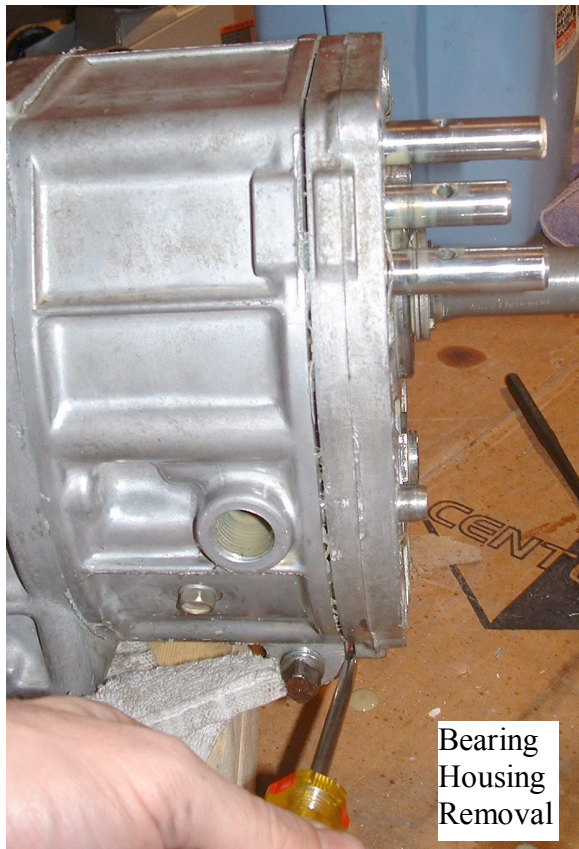
- 20-21. Remove the oil baffle and magnet from the undercover, wipe them all clean.

Disassemble in the order shown in the figure, referring to **Disassembly Note**.





1-3. Shift Rod Ends. Drive out the roll pins holding them in place. It may require some light tapping to slide them off the rods.

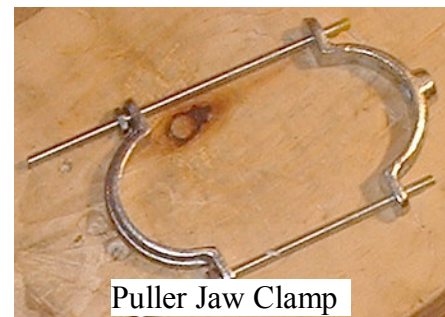
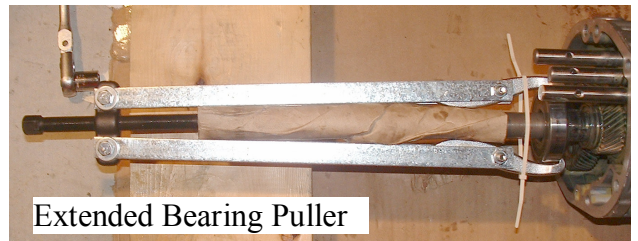


4. Bearing Housing
Pry off the bearing housing. Work around it, keeping it square to the rods.

Guess what? More oil drool.



5-8. Snap Ring, Thrust Washer, C-Washers, and C-Washer Retaining Ring. They are shown here in order – top part was removed first.



9. Mainshaft Rear Bearing Removal. I used an AutoZone #25914 gear puller and a set of metal extensions. The holes in the extensions are spaced 11-1/2" apart. Notice the zip-ties used to hold the jaws together. The pipe clamp and threaded rod device I made later was much more effective, and very cheap. Make sure the puller arms don't scratch the shaft. Discard this bearing because it was pulled by its outer race.



10. C-Washers and Retaining Ring. Don't get them mixed up with the first set.



Thrust Lock Washer and Ball

Next, remove the Thrust Lock Washer and Steel Ball so they don't get lost. The FSM does this later, but I recommend doing it now.



Countershaft Locknut Removal

11. Countershaft Lock Nut. I covered the housing with a paper towel and used the dremel again to cut into the retaining tab. Once I got it partly cut, I use a screwdriver and hammer to chisel the bent part out.



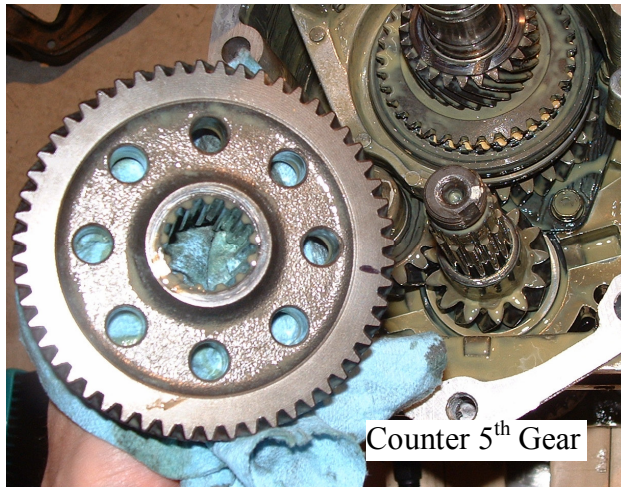
Countershaft Locknut Removal

Now use a 1-1/4" deep socket and breaker bar to loosen the nut. I placed a rag between the 5th and counter-5th gears to keep things from moving.



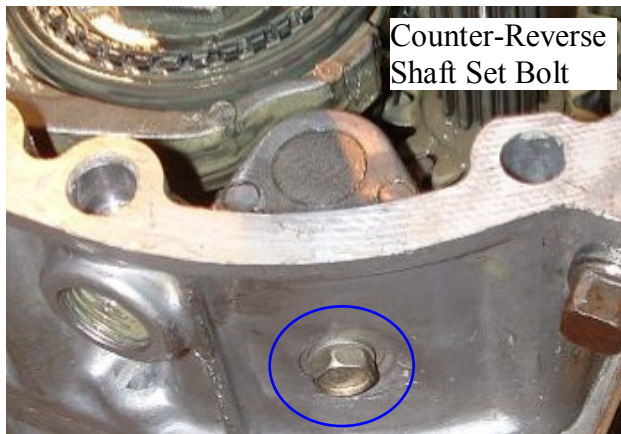
Countershaft Rear Bearing Removal

12. Countershaft Rear Bearing. Using the gear puller, remove the bearing. The white plastic plate is to keep the puller from rubbing directly against the mainshaft. I needed to grind the ends of the puller down so the hooks would fit behind the bearing. Discard this bearing.

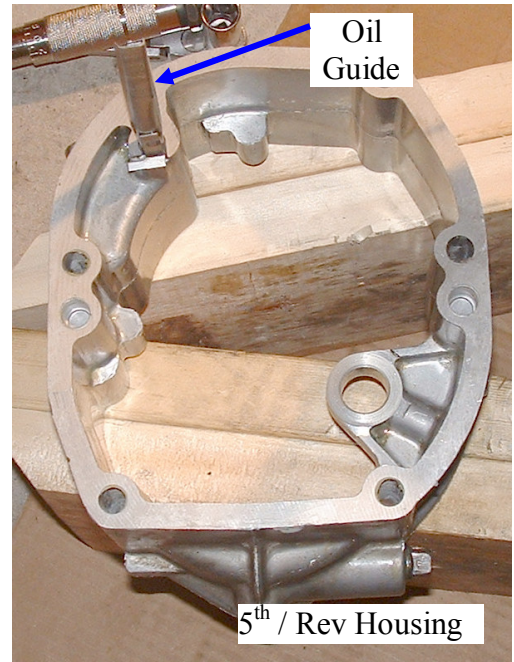


13. Counter 5th Gear slides off. Note the marking on the countershaft – I could not find a matching alignment mark on the gear, and by the end of the job I ignored the marks. The FSM mentions nothing about this. I'm still not sure if that was a mistake, but the car is running fine.

14. Spacer. This is under Counter 5th gear.



15. Set bolt and seal washer. This 12mm bolt holds the counter-reverse shaft in place.



16. The 5th – Rev housing can now be removed. Gently pry it loose to break the sealant, and don't damage the metal oil guide that comes out with it. (This picture is from reassembly)

17. Pull out the oil guide and set it aside.



18. Remove the shift rod covers. Be careful if you intend to reuse the paper gaskets. Mine were stuck to the housing and broke. You can probably make a good replacement out of any similar gasket material.

19. Shifter cap plug, washer, spring, and detent balls. Use a small magnetic pick-up to reach in and remove the ball.

20-21. Thrust lock washer and ball (we already removed these)



5th Gear and Bearing

22-24. 5th Gear and bearing and retaining ring. The ring is on the inside of the 5th gear and does not need to be removed.

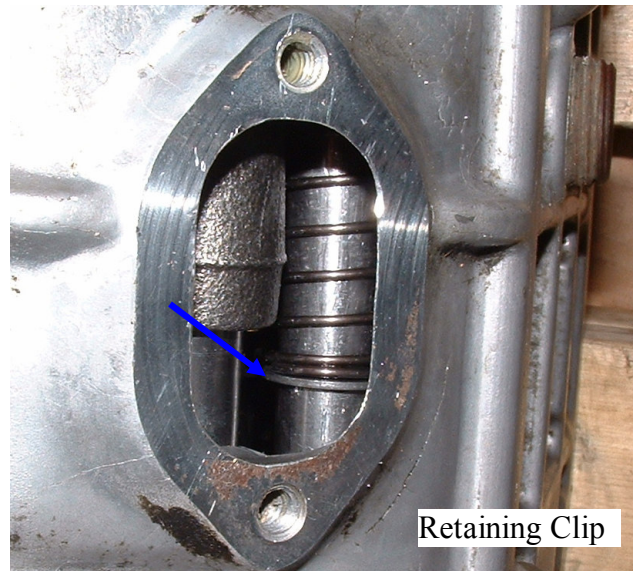


5th Synchro
(old on top)

25. 5th Gear Synchro. Notice a how one side of all the teeth is bent toward the camera, and notice the lighter color of the new synchro. Damaged synchros are bent like this and the edges are sharp to the touch. Worn synchros are rounded on the other side. If in doubt, compare it to the tooth shape on a new synchro – if there is more than a tiny bit of wear you should replace it.

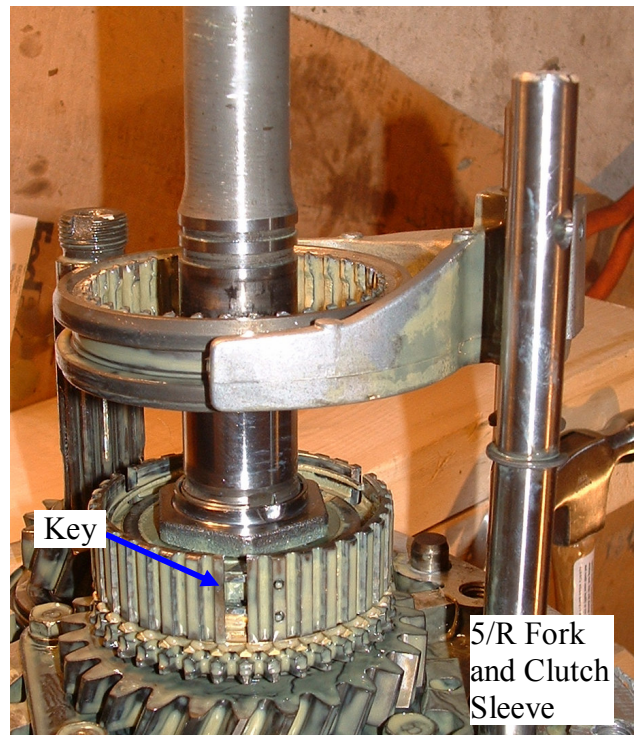
If you're only doing 5th synchro, congratulations, you're done. Just inspect the teeth on both sides of the 5/R clutch sleeve

(mark its alignment to the hub before taking it off), and replace it if necessary. Then start reassembling.



Retaining Clip

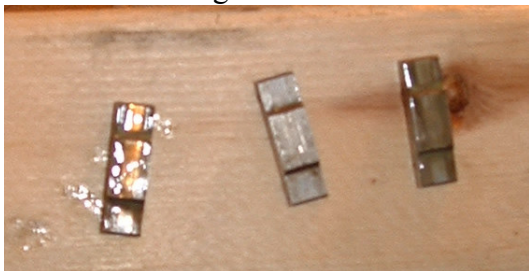
26. Retaining clip. This one was a bugger. It will help to have either a friend to hold a couple of long, thin screwdrivers at each side of the c-clip so that your hands are free to hammer-tap the screwdrivers to drive the clip off. Or, use some very grippy long needle-nose pliers to pull it off. The presence of the spring on one side makes it more aggravating – if you can find a way to compress it and keep it out of the way, do so.



Key

5/R Fork
and Clutch
Sleeve

27-29, 41. Shift Rod. First, drive out the roll pin holding the shift fork to the rod. Then mark the alignment of the 5/R clutch sleeve and remove it together with the shift fork.



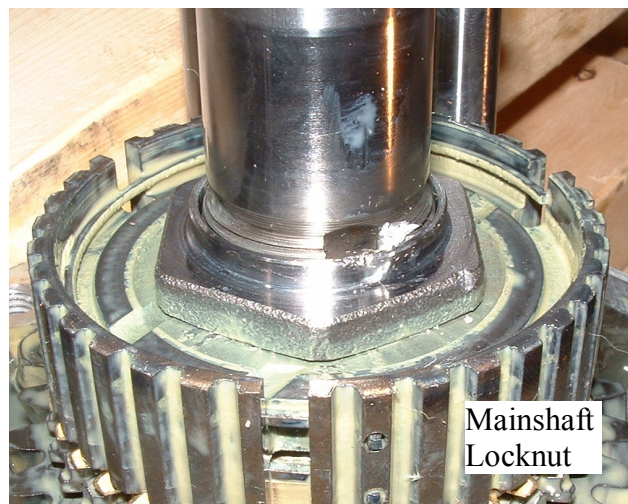
Do not lose the 3 clutch keys which are now freed. Now you can pull the 5th/Reverse shift rod and spring from the housing. The FSM does this differently by holding the fork in place and sliding the rod out through the housing and fork at the same time – it doesn't really matter.

30-34. 1st/2nd shift rod, 3rd/4th shift rod, and interlocks. Through the windows, drive out the roll pins holding the shift rods to the shift forks. Remove the interlock plug bolt, spring, and ball. These parts are unlabeled in the FSM, but have a blue arrow in my copy of page J-16 above. Use the magnet pick-up to capture the interlock pieces. Alternate removing shift rods and interlock pieces as necessary. There is no wrong order as long as nothing is lost or damaged.

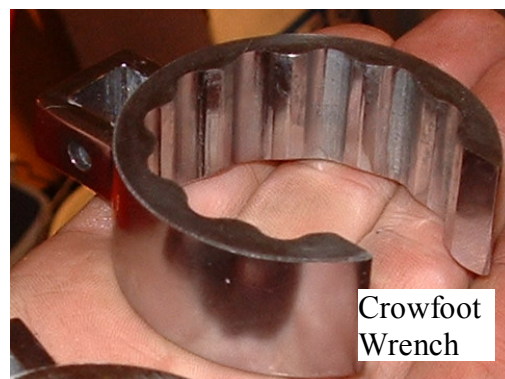
Once the shift rods are out, be careful to not let the shift forks get wedged against the inside of the housing. It's a good idea to reinsert the shift rods to keep them in position until it's time to remove the shafts from the housing.

35-38. Reverse idler gear, shaft, and thrust washers. These slide directly out.

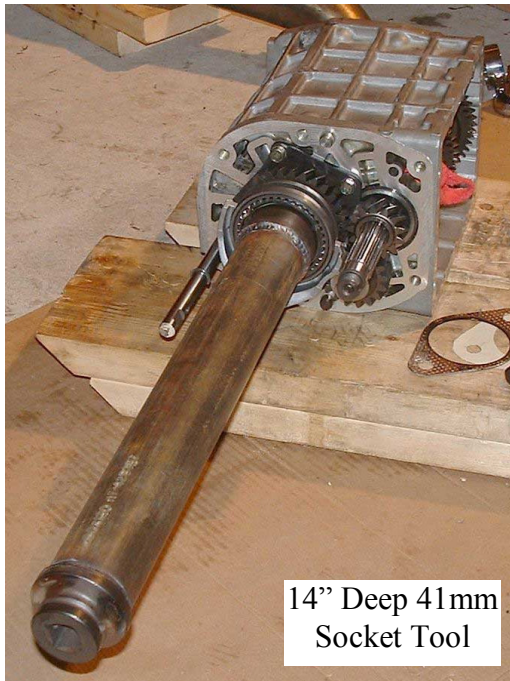
39. Counter-Reverse gear. It slides off.



40. Mainshaft locknut. This (little bastard) is a 41mm low profile locknut. First, slide the 1st/2nd and 3rd/4th forks into gear. Then, bend or cut out the staked portion of the nut. Open-ended or crescent wrenches will not work since the nut is recessed by the outer flange of the clutch hub. Although others have had success using a chisel to hammer a corner of the nut to get it loose, it did not work for me.



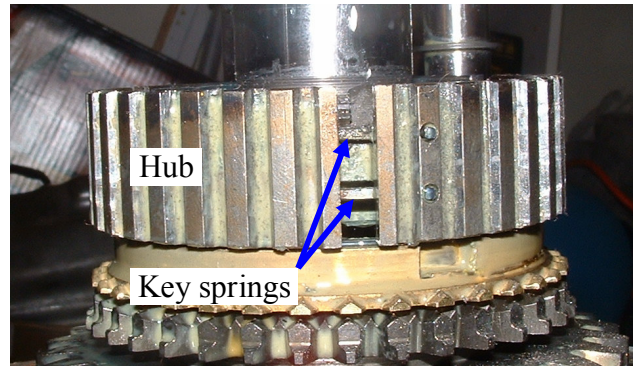
I first tried using a deep crow foot wrench from McMaster-Carr, but it would stretch open and pop loose. Don't bother trying this, unless you also weld a bar across the open side.



The best answer is the SST (\$95) or similar: a special deep socket that fits over the entire shaft. You'll need this or something like it to tighten the replacement nut, so just get it now. I'm told that another effective tool can be made by cutting the drive end off of an impact socket and welding a bar to the socket to serve as a handle or just turn the socket with a pipe wrench.



For disassembly, I didn't yet have this tool (made from a 41mm impact socket and piece of pipe), so through tedious and creative use of the Dremel I cut it off. It was difficult to not nick the shaft or clutch hub, and the shavings made a mess. Be absolutely sure to clean every last shaving and bit of grit from these parts.



41. 5th/Reverse Clutch Hub Assembly. It slid off for me, but may require a puller. Remove and clean the key springs.



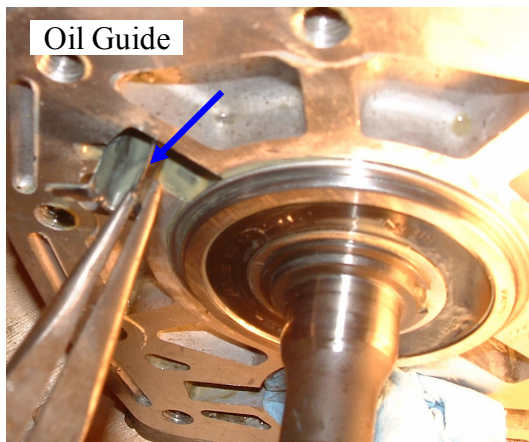
42. Reverse synchro. It slides off.



20-21. Reverse gear, bearing, bearing race, and washer. These slide off.



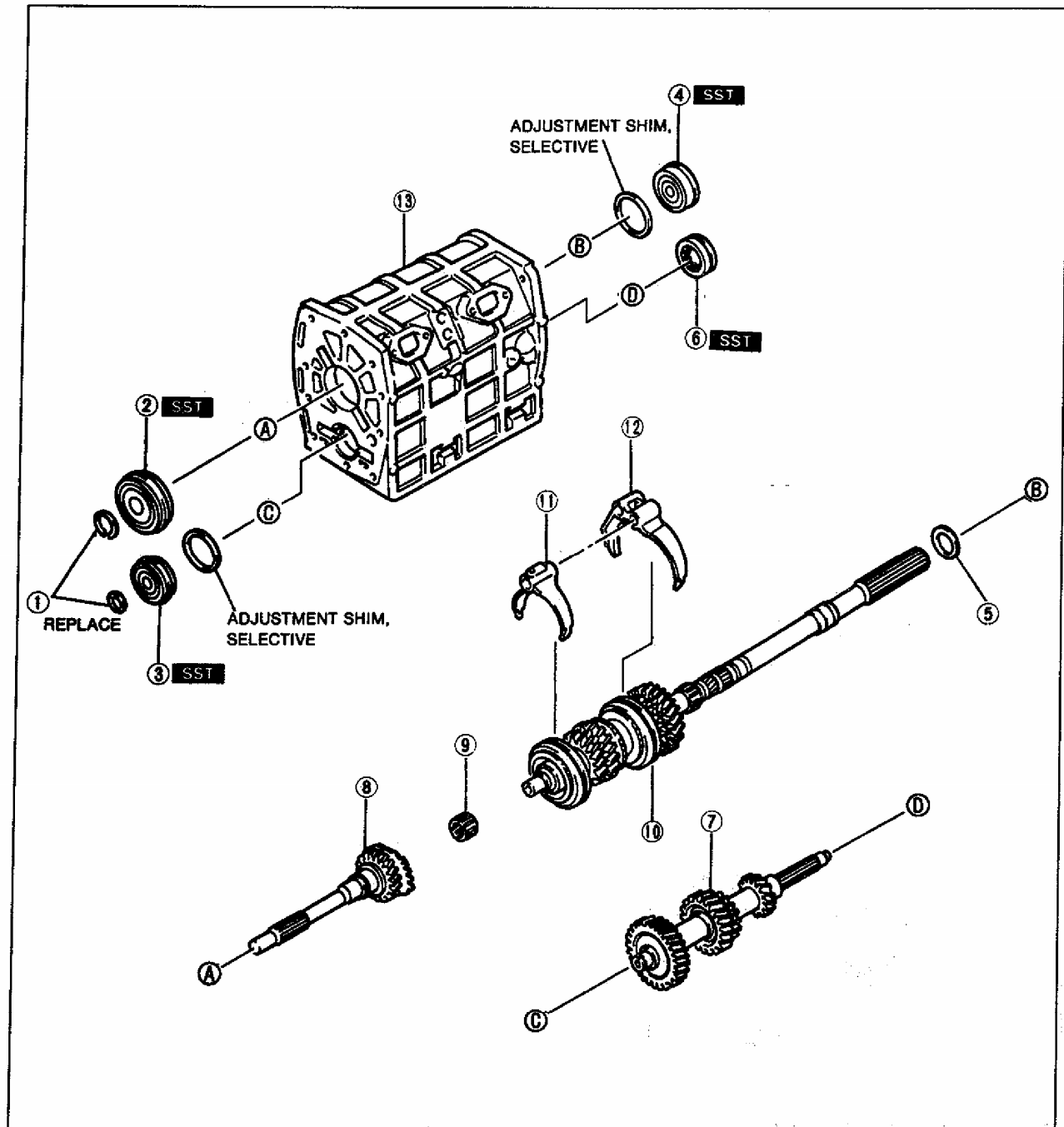
47. Bearing Cover plate. (4) 14mm bolts with lock washers.



48. Oil Guide. It's been sitting in the front of the gearbox for a while; the FSM suggests we finally remove it. It just gets cleaned and reinstalled later.

Transmission Case Components

Disassemble in the order shown in the figure, referring to **Disassembly Note**.



- | | | |
|--|--|--|
| 1. Snap rings
Disassembly Note
..... page J-21 | 4. Mainshaft front bearing
Disassembly Note
..... page J-22 | 8. Main drive gear
Inspection page J-29 |
| 2. Main drive gear bearing
Disassembly Note
..... page J-21 | 5. Thrust washer
Inspect for damage | 9. Bearing |
| 3. Countershaft front bearing
Disassembly Note
..... page J-21 | 6. Countershaft center
bearing
Disassembly Note
..... page J-22 | 10. Mainshaft gear assembly
Disassembly Note
..... page J-22 |
| Inspect for damage | 7. Countershaft assembly
Inspect for damage | 11. 3rd/4th shift fork |
| Inspect for damage | | 12. 1st/2nd shift fork |
| | | 13. Transmission case |

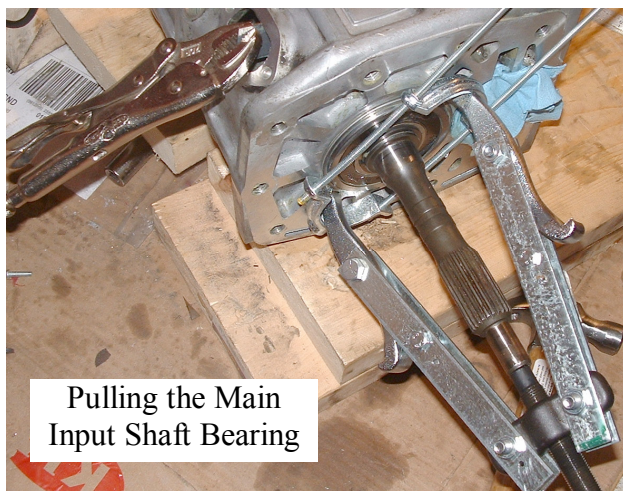
1. Snap Rings. Remove the snap rings on the front of the input shaft and countershaft.



Main Input Shaft Bearing

2. Main Input Shaft Bearing. Rotate the collar snap ring so that the end are 90° from the housing openings. (See red arrow above). Also, insert a plate between the 4th synchro and 4th gear. I used a machinist scale and used the weight of the Vise-Grip to hold in place.

There are two ways to pull the bearings from the case. 1) use a bearing puller or 2) use a pair of pry bars. I only learned about the pry bar method after doing the job, but I expect the pry bars may work better and faster.



Pulling the Main Input Shaft Bearing

Using 6" extensions in the puller, put the jaws in the housing slots and pull the bearing out by the collar. It is very important to keep the puller jaws squeezed tight against the outer diameter of the bearing, or else the jaws will slip off the collar ring. The collar only comes with a new bearing.



Front Countershaft Bearing

3. Front Countershaft Bearing. Same as before, don't damage the outer ring, but be extra careful as there is a thin shim behind the collar. Also be very careful that it does not come apart – there is nothing holding the inner race in place. If you always hold it with the front facing up (as in the picture above), it will not come apart.



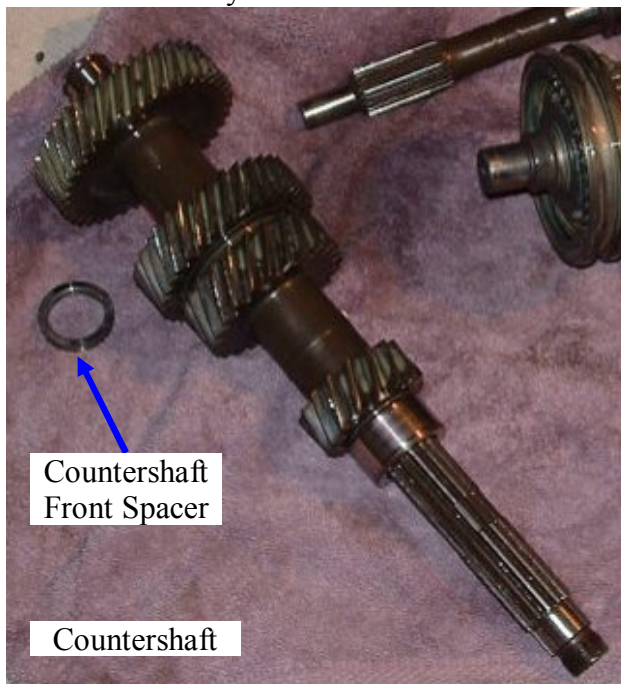
Pulling the Rear Mainshaft Bearing

4. Mainshaft Front Bearing. This is the same arrangement as the front countershaft bearing, with a collar and shim behind it, but larger. Don't damage the shaft with your

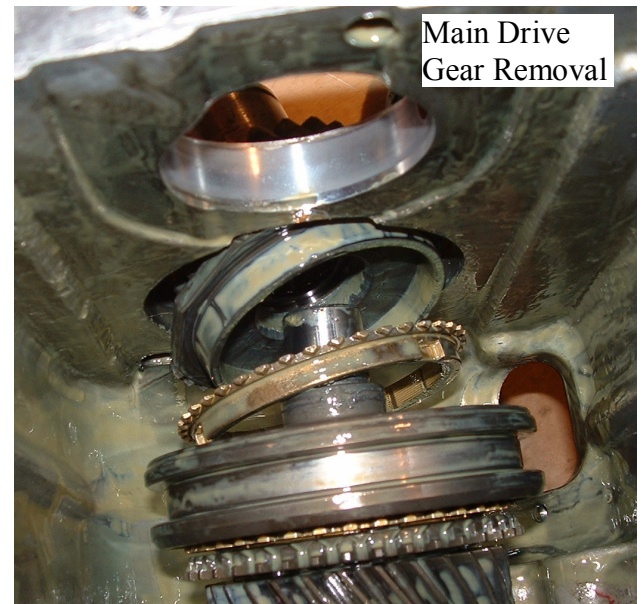
tools. This required 16" extensions. Be careful to not allow the shafts to bang against the transmission case – I wrapped each shaft with a rag when I removed a bearing.



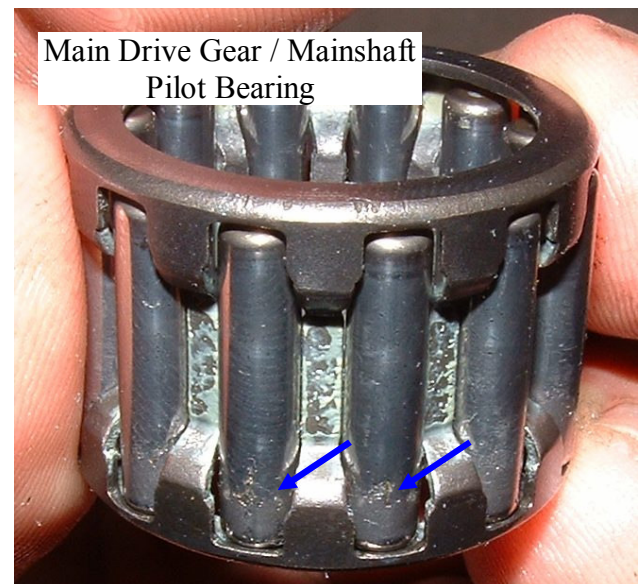
5. Thrust washer. On my transmission, the rounded edge faced the gearbox.
6. Countershaft center bearing. By now you're getting good with the bearing puller, and it should be easy.



7. Countershaft removal. Now flip the case upside-down, and remove the rags. Slip the spacer (unlabeled in the FSM) off the front of the countershaft. Turn the shafts carefully until you can remove the countershaft from the case.



8. Main drive gear removal. (Input Shaft). Pull it off the nose of the mainshaft, and turn the gear so that the teeth face left and right. Carefully angle the main gear and slide it out the front of the housing. As the picture shows, 4th gear synchro will come out also. I suggest setting it aside now.



9. There is a second pilot bearing inside the Main drive gear. It is known for making noise or failing in FDs. Mine showed spalling wear, although the camera flash makes it hard to see in the picture. As I hoped, the groaning noise

the car made when cold and in neutral has died down considerably. If you see bearing wear, study both faces it rolls against very carefully for wear.

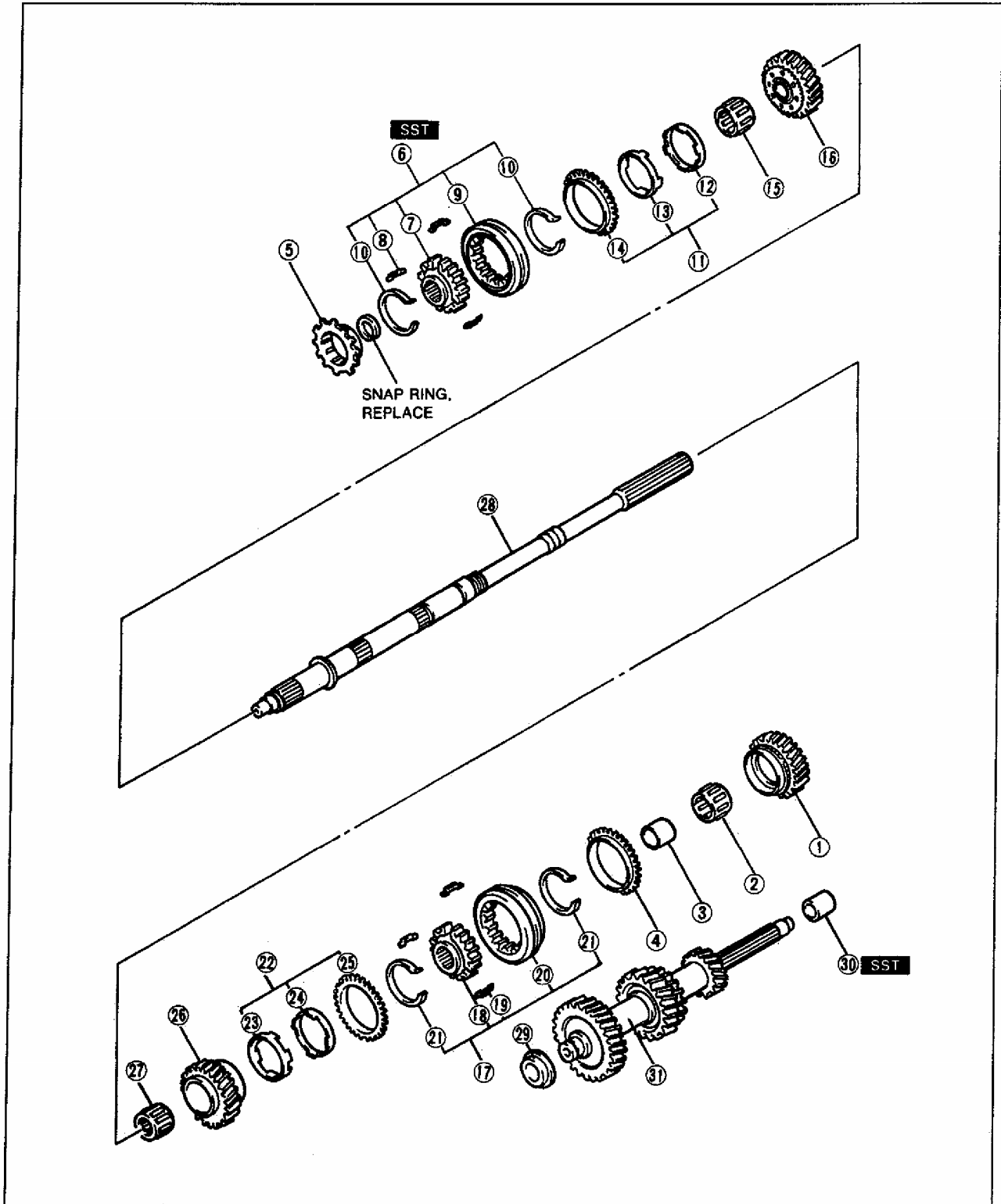


10. The mainshaft can now be removed. This pilot bearing inner race is in acceptable but not great condition.
11. The 3-4 shift fork comes out.
12. The 1-2 shift fork comes out.
13. The tranny case comes out. Now might be a good time to use a deburring tool to remove the sharp edges from the case openings and clean it out.

Mainshaft and Countershaft Components**Note**

- The countershaft center bearing race does not need to be removed unless you are replacing it.

Disassemble in the order shown, referring to **Disassembly Note**.

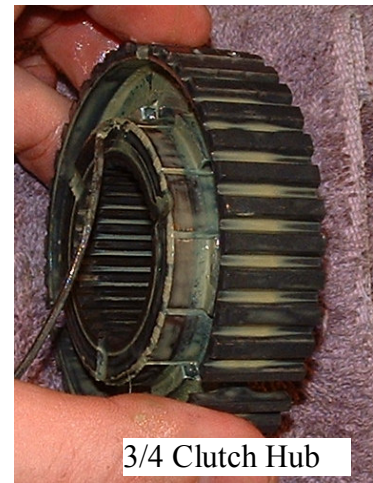




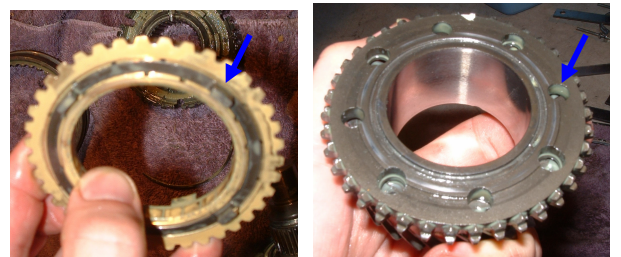
- 1-4. 1st Gear slides right off the rear of the mainshaft. The roller bearing, 1st synchro, and inner bearing race slide off also.
5. 4th synchro came off with the main drive gear, but the FSM mentions it here.



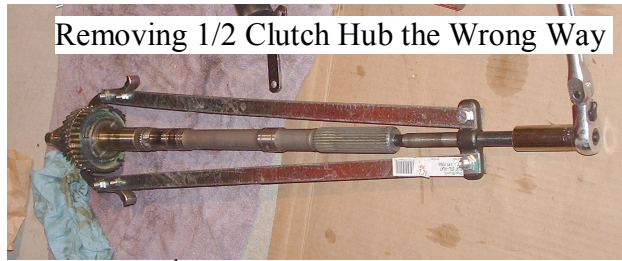
6-10. 3/4 Clutch hub assembly. First slide off the clutch sleeve and keys. This is where to use the press. The clutch hubs on the mainshaft are a tight splined fit. Removing the hub doesn't require much force, but using a press makes it very easy and minimal risk to damaging a part. I used a gear puller for disassembly – the puller marred the gear surfaces it was pulling on, although the marking was mild and the surfaces are unimportant. I don't recommend it.



Disassemble 3rd/4th clutch hub and clean the parts.



11-16. Now slide off 3rd synchro, 3rd gear roller bearing, and 3rd gear. 3rd is a double-cone synchro – notice how the tabs on the inner brass ring fit the slots on the clutch hub, and the tabs on the middle steel ring fit the holes in 3rd gear.



17-21. 1st/2nd Clutch Hub Assembly. Here again I used my gear puller, and again I recommend you use a press. Unless you have a bearing splitter tool, use the puller for bearings, but not clutch hubs.

22-27. The 2nd synchro assembly, 2nd gear, and 2nd gear bearing can now be removed. Mazda put out a TSB covering updated 2nd synchro and clutch hub assembly parts – supposedly an issue with early 94s and all 93s. I have a 94 that should have the newer parts, according to the TSB, but the new synchro was different – it had narrower slots to fit over the clutch keys. I have no more information, but wonder if my clutch hub assembly is the old or new style. After the rebuild, 2nd is still a little clunky if I shift slow. It's your choice to replace them all – the updated clutch hub assembly and 2nd synchro total \$250.

28. Mainshaft.

29. Countershaft front bearing spacer. I had removed this earlier to give myself more room to get the countershaft out of the gearbox.

30. Countershaft center bearing race – don't remove or replace it unless you see wear.

31. Countershaft.



A few suggestions about the Extension housing:

- Don't take it all apart. I did, and there was nothing inside that I couldn't be evaluated from outside.
- Replace the rear oil seal, select spindle, and reinforce the wires on the 1-2 switch and neutral switch.
- Dig around under the control rod end and fish out any broken wave washer or bushing pieces that may be in there.

11. Shift Select Spindle. This is the piece that you push against when shifting to reverse or 5th. The updated part is stiffer to avoid ramming against 5th when aiming for 3rd. Do yourself a favor and install the newer spindle, although it looks like it can be done with the transmission still in the car.
15. Control Rod. Using a micrometer, measure the thickness of the rod end. (ref. page J-30) Don't remove it unless your measurements suggest there is too much play between it and the shift rod ends.



19. Rear oil seal. I used a wood chisel and mallet to work it out, going little by little around the outer lip. Tap in the new one, making sure to keep the end labeled 'up' in the right direction.

Next section: Inspection and Miscellaneous other parts.