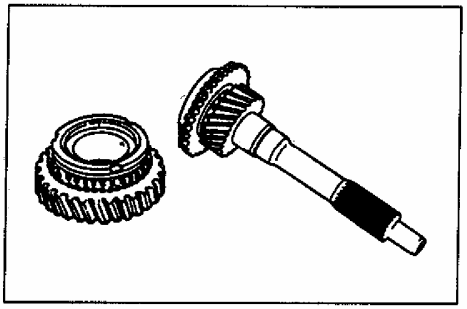
FD Transmission Rebuild: Parts Inspection

Now that everything is disassembled, cleaned, and bagged in labeled Zip-Locs, it's time to decide what to replace. Warning: I'm not a transmission specialist. If in doubt, consult a pro or just replace the part.

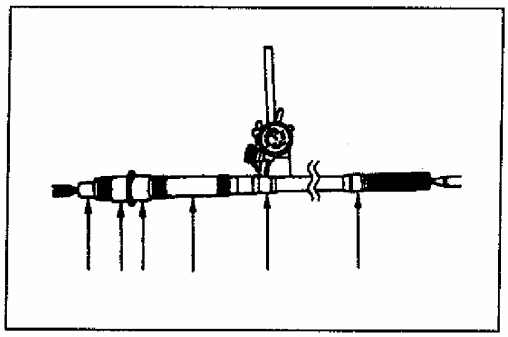


Each Gear and Main Drive Gear
1. Inspect synchronizer cones for wear.
2. Inspect individual gear teeth for damage, wear, and cracks.
3. Inspect synchronizer ring matching teeth for damage and wear.
4. Inspect main drive gear splines for damage and wear.

Carefully inspect all gears and the main drive gear. Check the inside faces for signs of wear or light pits, especially if the bearing that was removed had any wear. Inspect the bearing face on the drive gear at each end. A good bearing face is shiny and free of scratches. A mildly worn face is smooth to the touch but a slightly dull grey due to the very fine surface pitting. If the wear is rough enough to be felt by a fingernail discard the part.

Gear teeth should be shiny across the full face of each tooth. The very root and very tip are not as important, so a chip at the corner of a tooth can be acceptable. But any scratches, pits, or gouges in the rolling face of the tooth is reason for rejection.

The gear dog teeth are the small teeth that engage the clutch slider. These teeth should be fairly pointy – I'd say if the dog teeth points are any duller than the edge of a butter knife you should consider replacing the gear and clutch hub assembly. If these points are dull the gear will be more likely to make clunky shifts. It's your choice – replacing hard parts gets expensive fast.

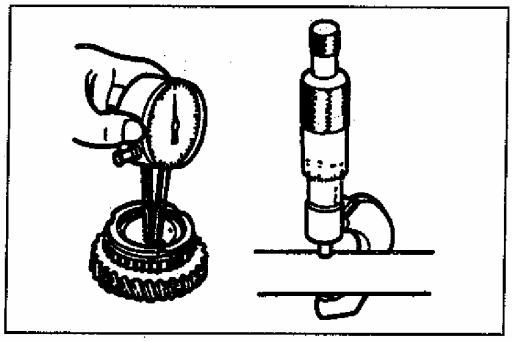


Mainshaft
1. Measure the mainshaft runout.

   Runout: 0.03 mm {0.0012 in} max.

2. Inspect splines for damage and wear.

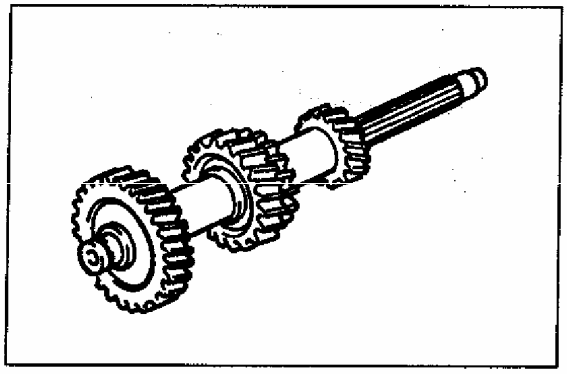
I did not perform this inspection because I didn't have the appropriate v-blocks and dial indicator setup. If you have access to a machine shop with these tools, you should do it. I simply did visual inspection of the bearing surfaces on the shaft. Again, verify the condition of the bearing face at the nose of the mainshaft.



3. Measure the clearance between mainshaft and gear (or bushing).

Clearance: 0.15 mm {0.006 in} max.

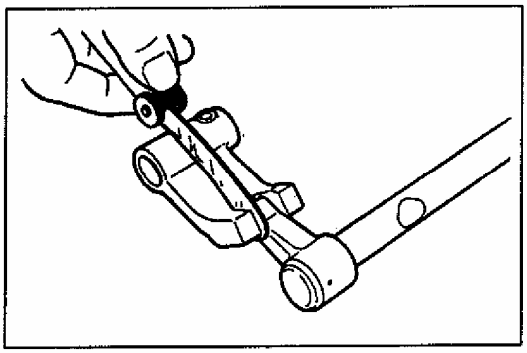
I'm honestly not sure what this measures. All of the gears have a roller bearing between the gear and shaft that is much thicker than .003", and measuring the ID with the bearing in place doesn't sound easy to do. I don't think the inside tips of my dial calipers would get a good reading. Maybe a transmission guru could explain this one. I just relied on visual inspection of the bearings and gears instead – to appreciably change the clearance on any of these parts, they would also show a lot of visible face wear.



Countershaft

1. Inspect gear teeth for damage, wear, and cracks.
2. Inspect splines for damage and wear.

Fairly straightforward – inspect the key surfaces of the countershaft. If you are replacing a gear then you should replace the countershaft as well if it has high mileage.

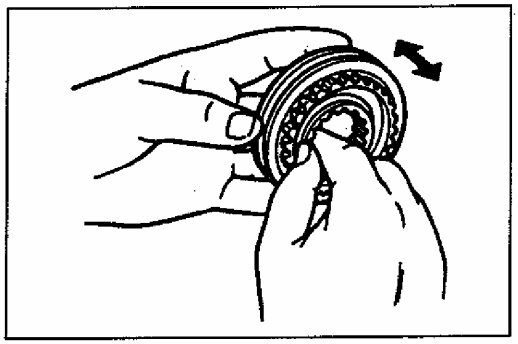


Control Rod Lever and Shift Rod

Measure the clearance between the control rod lever and the shift rod gate.

Clearance: 0.8 mm {0.031 in} max.

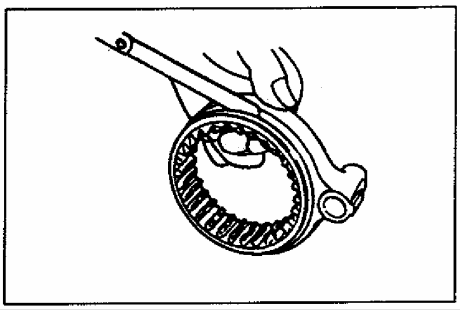
You can use a feeler gauge to measure this, or use a good dial caliper to check the difference between the insides of the shift rod slot and the outside of the control rod lever end. The latter method allows you to leave it in place. Mine had minimal wear even at 60k: only .012 to .014 clearance. In my experience, out-of-tolerance shift gates usually have visible damage from being jammed into gear.



Each Clutch Hub Assembly
1. Inspect clutch hub sleeve and hub operation.
2. Inspect individual gear teeth for damage, wear, and cracks.
3. Inspect synchronizer keys for damage, wear, and cracks.

The clutch hub assemblies should not have any sharp edges on the gear teeth, and the keys should not show more than light surface wear. I replaced my 5th/Rev clutch sleeve because one side of each tooth was rounded and sharp to the touch. Fortunately, Mazda sells the 5/R sleeve separate from the rest of the clutch hub assembly.

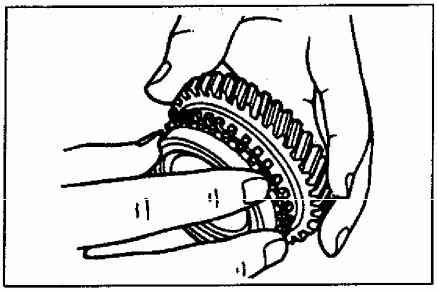
If you want to dress up your clutch hub assemblies, use some valve lapping compound and work them back and forth for a while (like 20min) to improve the fit. Wash these parts thoroughly to get every trace of lapping compound out.



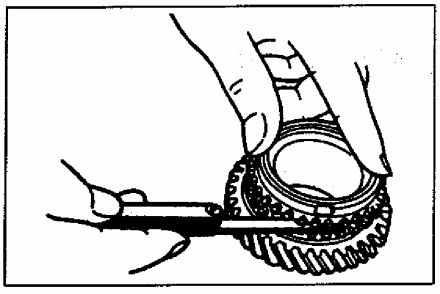
4. Measure the clearance between the hub sleeve groove and shift fork.

Clearance:
0.2–0.3 mm {0.008–0.012 in}
Maximum: 0.5 mm {0.020 in}

I replaced all three of my shift forks because the originals were between .017 and .020 clearance, and because I figured the aluminum would continue to wear quickly. When the new ones arrived, I was disappointed to find that the surfaces of the fork that make up the clearance fit were slightly rough cast surfaces, and the surfaces weren't very square. The new forks were only .005-.006 thicker than the old ones. So I've concluded that this measurement just isn't as picky as it first sounded. I suggest only replacing the forks if the clearance was a solid .020 or greater. I think in this case the rubbing wear on the fork will be apparent.



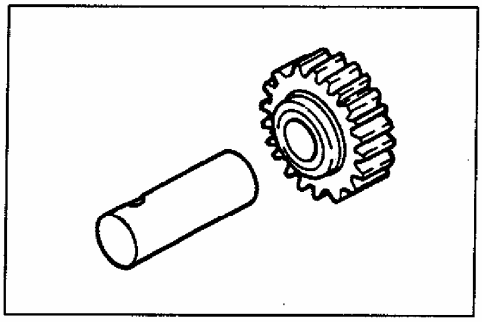
1st, 4th, 5th, Reverse Synchronizer Rings
1. Inspect individual synchronizer ring teeth for damage, wear, and cracks.
2. Inspect taper surface for wear and cracks.



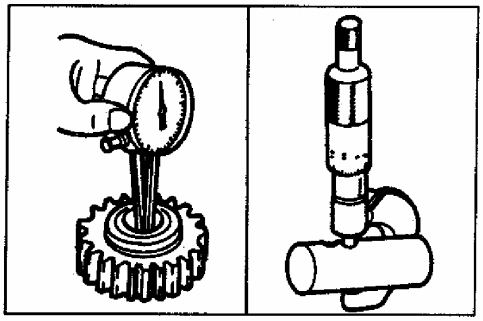
3. Set the synchronizer ring squarely in the gear.
4. Measure the clearance between the synchronizer ring and flank surface of gear all around the circumference.

Clearance: 1.5 mm {0.059 in}
Minimum: 0.8 mm {0.031 in}

I replaced all of the synchros except reverse. Only 5th had any visible problem (deformed teeth). Measuring the clearances, I found the new synchros had only slightly more clearance than the old ones. For 2nd and 3rd synchros, inspect all the pieces if you're considering reusing them.



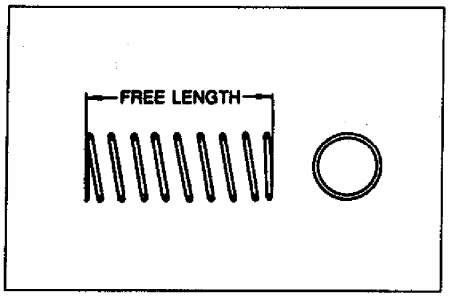
Reverse Idler Gear and Shaft
1. Inspect gear teeth for damage, wear, and cracks.



2. Measure the clearance between the reverse idler gear bushing and shaft.

Clearance:
0.02–0.05 mm {0.0008–0.0020 in}
Maximum: 0.15 mm {0.006 in}

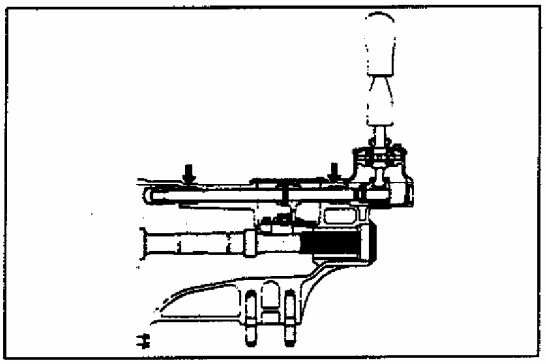
I saw no evidence of wear on these parts, and I measured .001 clearance. I suspect it's uncommon to replace them unless for some reason you hammer on reverse gear.



Spring
Measure the free length of the spring.

Standard free length
Detent ball spring: 22.5 mm {0.886 in}
5th/Reverse retaining spring: 73.00 mm {2.874 in}
Select lock spindle spring: 43.25 mm {1.703 in}

I skipped this step. Measure them if you want, but all of the spring-loaded components in my tranny seemed to be nice and snappy. It might make more sense just to replace all of them since they are cheap.



Extension Housing
1. Inspect the indicated bearings for damage.
2. Replace the extension housing if necessary.

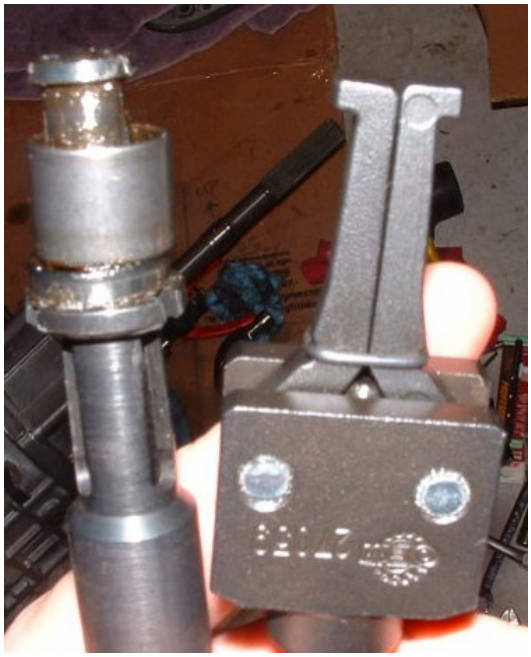
My extension housing rods moved smoothly. Be careful to not scratch any of the sleeve bearings that hold the driveshaft, or roller bearings that hold the control rod.

Miscellaneous

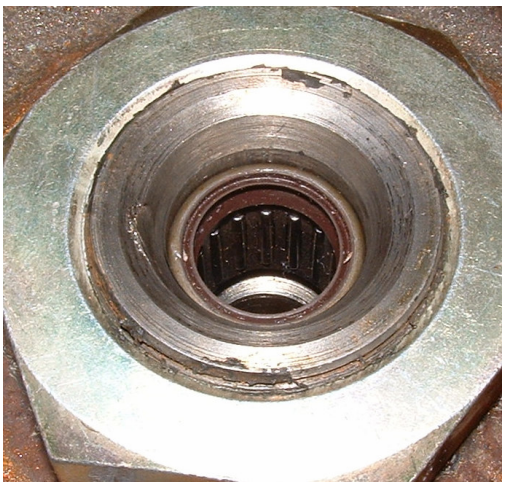
There were several side jobs I tackled while 'in there'. Here are some notes on them.

Pilot Bearing

Here you can see the old bearing. I wasn't sure which bearing was responsible for the groaning, so I planned on replacing it. Zach Keller had the Mazda puller tool, which works just wonderfully. If you can beg, borrow, or steal one it's worth it at least for the cool factor.



I also rented the AutoZone pilot puller, which is clearly not as well made and designed for larger bearings. The jaws of the AutoZone puller don't even fit inside the bearing without grinding off the corners. I'm sure I could make it work, but I didn't need to. I've heard from others that the AutoZone "Blind hole puller" does work.


Using an M10 bolt and matching washers, I found that the right sized stack would let me tap the pilot bearing into the end of the E-shaft to the proper depth (ref the FSM). I used a block of wood over the bolt head to ensure I didn't drive it any further than that. I checked this depth with a nifty depth micrometer, but the tolerance isn't tight at all.

Fuel Filter

Mine was getting on 20 months / 10k old, but I hadn't relieved the fuel line pressure before tearing everything apart. Rather than receive an extreme shower of gasoline in subfreezing temperatures, I skipped it and will do it again when the weather is warmer. I think replacing it now will help if you intend to change some of the fuel lines or haven't done the filter before since it's more visible, but the bolts that hold it aren't more accessible. See picture below.

Differential Bushings

After hearing about how differential bushings can pop and make the rear end handle loosely, and again recalling my car's history of autocross, I chose to change them.

My pictures of this are not as good as Damian Dela Huerta's, so I suggest you see this thread for better instructions: http://www.rx7club.com/showthread.php?t=294744

Old vs. New: I didn't see any difference when installing them, and I don't see any difference driving the car. Well, chalk it up to preventative maintenance.

My only comments are to be prepared to loosen the bolts in the bushings and diff mount casting with a minimal amount of space to turn the wrenches. Also, when the differential is unhooked it will want to tip further forward and hang on the parking brake cables. So disconnect the cable bracket that is in the tunnel to avoid damage to it, and use something to prop up the diff.