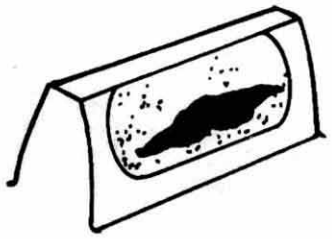

Figure 1

Taking A Standard Transmission To The Doctor, Part II

By Mike Weinberg
Rockland Standard Gear Inc.

When we left off in March, we had a standard transmission on the bench. It had been examined externally, we measured the endplay and disassembled, and it was thoroughly cleaned. Now we can evaluate the damage and try to determine the CAUSE of failure.

During disassembly we had to remove the bearings. In many cases, these will be the initial cause of failure. A careful examination of the bearings can tell you a lot. One of the most common failures on ball bearings is cage failure. The retainer that holds the balls evenly in place has broken and allowed the balls to collect in one area, and the shaft that the bearing supports runs off-center. If this is the case, we must carefully check all the gears for damage. Pieces of the cage or the balls themselves will have a chance to get caught between the gears and cause breakage or a bent tooth. If you find a broken gear, always replace the opposing gear it meshes with. If one gear underwent enough force to fracture, then the opposite gear had to absorb the same force. The fact that it didn't break doesn't mean it is not damaged. It may have a hair-line crack which is hard to see, or an internal stress riser that will cause it to fail later under warranty. If there is the slightest doubt about a part, sell your customer a new one. Don't gamble with your profits and your reputation. A gear that gives up later can and will cause damage to the whole gear train.

After examining the gears for breakage or cracks and finding none, we still are not out of the woods. Look carefully at the surface of the gears' contact area. When a failed bearing lets a shaft run off-center, in many cases the gears will wear abnormally. This sometimes shows up as a "thin gear," one in which enough material has been removed to actually sharpen the gear. A series of lines or chatter marks on the teeth where the metal has been removed by abnormal contact and pressure also is common. Replace these gears as they will be noisy or fail prematurely. (See Figure 1.)

Now it is time to check the coupling or "shift" teeth on the speed gears (see Figures 2, 3, and 4). Chipped or broken and rounded points on these teeth are an indication of gear clash caused by a worn or misadjusted clutch, or excessive endplay, and will grind on shifting. Look at the sides of the coupling teeth that lock the synchro sleeve onto the gear under changing torque loads. This kind of damage causes gear jump-out. Examine the thrust surface of the gears to make sure there is no wear that will cause excessive endplay. Check the bore to make sure there is no galling from lack of lube or from metal contamination. Examine the journals on the mainshaft that the gear rides on, and test fit the gear to the shaft to ensure a tight fit with no

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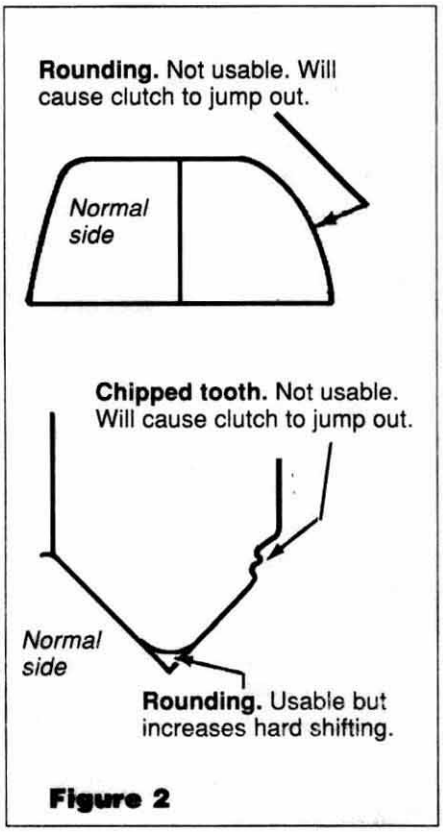


Figure 2

side play or wobble.

Now it is time to check the synchronizers. Before disassembly, mark both the slider and the hub so that it can be reassembled in the original manner. Failure to do so will result in notchy, hard shifts. Look at the hub to make sure there are no cracks, nicks, burrs or excess wear on the splines. Check the inside of the slider and make sure there is no damage to the points that engage the shift teeth. Look at the grooves that the synchro keys ride in and make sure they aren't worn or distorted. Examine the keys for wear and metallic contamination. See that the springs are not broken or distorted and that they have good tension. Fit the shift fork into the slider, measure the clearance and make sure it is up to spec. Make sure there is no excessive wear or cracks on the forks. Look at the shift rails, detents, interlocks and springs for wear, pitting, burrs or contamination. Make sure that the case bores for the rails and detents are smooth and free from debris. Check all washers for metal impregnation, wear and galling. Check the pocket in the input gear for roller damage, make sure the clutch splines are true, and that the journal for the pilot bearing is not worn undersize. Examine the nose on the main shaft, the journals and synchro splines, snap-ring grooves and output splines for wear and damage.

As you may have noticed, I said nothing about the bearings or synchro rings. You should check them for damage to help understand why the unit failed and then discard them. They are the "soft parts" for a stick rebuild. A minimum overhaul on a standard unit would include: New main bearings, new synchro rings, gaskets and seals and a small-parts kit. Bearings are rated for a certain number of revolutions under load and nobody can foresee how much life they have left in them. A new set of bearings will stop a lot of noise complaints and ensure good endplay. Synchro rings also will be subjected to heavy wear and contamination. Please don't give me any fancy talk about the difference between a repair and an overhaul. Once you take money for the job, YOU own it. Neither the customer nor the courts will understand the distinction.

Figure 3

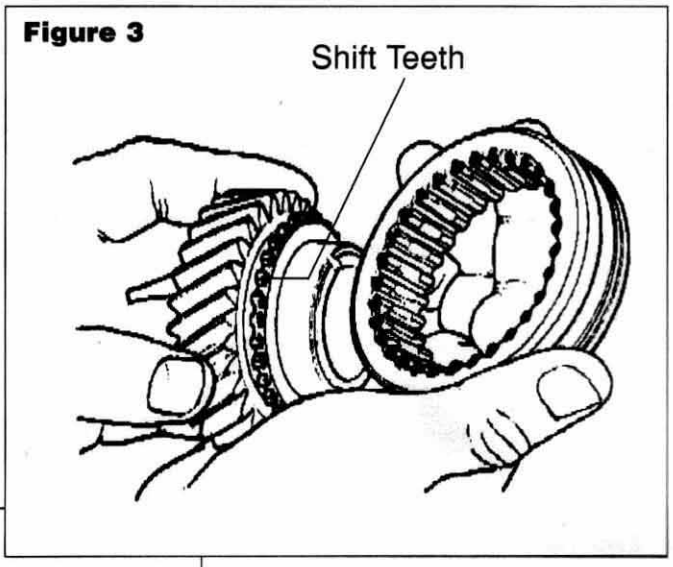
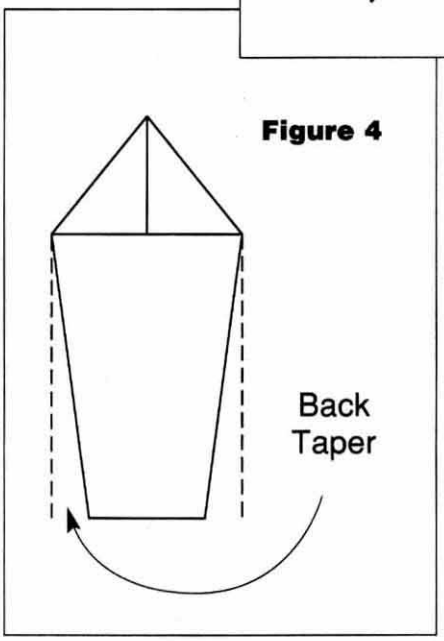


Figure 4



Occasionally, you will find a unit that was run dry and the gears are blue. Be prepared to find a core or buy a new assembly. It takes about 850° Fahrenheit to start the metal changing colors. You are betting on a long-shot if you think you can repair such a unit successfully. At the very least it will be noisy, and at worst the gears will have lost some of their temper and will wear quickly.

Reassembly is simple enough, but some rules must be followed.

- Always prelube every part of the unit as it goes together. Stick transmissions are splash-lubricated and if you put one together dry, it can seize up on the road test.
- Use only petroleum jelly or TransGel to aid in assembly; no white lithium grease or wheel-bearing grease. These are high temperature lubes and will block oil flow through lube holes in the gears.
- Fit each NEW synchro ring on its gear cone and measure the clearance to make sure it is in spec. That's right, we measure new brass to make sure it isn't egg shaped and properly fits the cone.
- Use a feeler gauge and measure all gear clearances to spec, making adjustments with selective washers or snap rings until all components have the proper endplay.
- Set the overall endplay to spec. Don't let a unit go unless it is right. The few minutes spent finding the correct setup will save hours of comeback labor.

Just like football is a game of inches, this is a game of details. Putting a cause to the failure gives

you a logical step-by-step approach to the repair. Careful appraisal of the damage and wear patterns gives you an idea about the events that led to the failure.

Example: Countershaft front bearing failed, countershaft ran off-center damaging input and cluster, all synchro rings show heavy metal contamination. If one bearing failed, the others are not far behind.

Example: Mainshaft rear bearing failed, mainshaft now can move backwards under torque, hard shifts, hops out of 4th, 3-4 synchro and input gear damaged.

You have been building units successfully and the point of this article is to give you food for thought. Consistent methods of damage analysis and repair will help to ensure high-quality production. We all have comebacks on occasion. The worst nightmare any rebuild faces is noise. You can't see it and sometimes you can't locate it. A methodical analysis is the only chance to cure the problem.

1. It is assumed that all the previous work was done to spec, as we discussed earlier in the article.

2. Isolate the problem. When does the noise occur? What is it related to (engine rpm, road speed, etc.)? Is it in the trans?

3. Was it there before, or did we build it into the unit?

4. What type of noise is it? Contact noise caused by interference between parts, noise from improper fit, out-of-round conditions, damaged contact teeth, bearing noise? Noise that migrates through the connecting parts, such as a driveshaft, rear end, clutch, motor. Inherent noise from design defects such as gear rattle in diesel motors, or neutral rollover noise. Lube-related noises, such as wrong lube, no lube.

5. Occurrence, one gear or all gears, under load or on coast, at idle or at speed, clutch in, clutch out?

Assume nothing. Work from a constant set of conditions, examine each detail, determine its significance. Is it a cause or is it an effect?

What you already know about the powerflow in the trans, the parts you replaced, the correctness of your specs, and proper lube fill are your only defense against noise. If you always replace the bearings and synchro rings, and have all clearances within spec, you have a constant to work with. If you only replaced one bearing and the others "looked good," you are working with the unknown. This is a Russian roulette, hit-or-miss approach. The reality of the marketplace dictates that we must produce quality units with a minimum of comebacks. The first time we do the overhaul, the customer pays. The second time, we pay. Need I say more? ■