

Subject:

Identifying sources of manual-transmission noises

Essential Reading:

- ✓ Rebuilder
- Shop Owner
- Center Manager
- ✓ Diagnostician
- ✓ R & R

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Diagnosing Noises in Manual Transmissions

Continuing with our third article in the series on manual-transmission diagnosis, we now concentrate on noise. Noise is a difficult and time-consuming problem if you do not follow a prescribed step-by-step diagnostic process. Every rotating or moving part in a vehicle creates some noise. The vehicle itself moving through the air creates noise. Tires, exhaust, and suspension parts create noise as part of their normal operation.

Customers' sensitivity to noise varies, and the carmakers spend a tremendous amount of time refining components to reduce NVH (noise, vibration and harshness) to acceptable levels. Along with the engineering and design that go into manufacturing the vehicle, there's a lot of research aimed at creating individual components that work as quietly as possible, sealing and insulating the passenger compartment to prevent noise intrusion, and insulating the cabin from normal road and wind noises present whenever the vehicle is operating.

Noise is also the most-subjective issue to be resolved with customers. This means that you need to be thorough in your evaluation of the problem, with as much customer involvement as possible. The first step is to spend the time with the customer to identify *exactly* what their concern is. This means taking a road test, with the customer driving, to determine when the noise occurs and what they are doing with the vehicle at the time it occurs. Then you should drive the vehicle with the customer along and

shut down every auxiliary piece of equipment that is operating, such as radios, climate control etc., to see whether there are any differences in the noise complaint.

Now is the time to evaluate your customer. Did they just have snow tires installed? Did they just pay thousands of dollars for a transmission repair and shut off the radio so that they can listen to the transmission, making wind noise that has always been there more noticeable now? Make sure that you identify exactly what the customer is concerned about. Some concerns will be valid, others will be caused by ignorance of vehicle operation, some will be related to issues you are not involved with. The start of wasted time happens when you are not on the same page as the customer.

The learning curve involved in diagnosing noise is no different from that of other diagnostic routines. We must know and understand how the various vehicle systems function and how they react to each other. We must understand the basics of noise. Sound travels about 705 mph at sea level through air. Noise travels much more quickly through water, and even quicker through solid objects such as metals. Loudness of noise can be measured in decibels, and frequency of the vibrations is measured in hertz (hz).

Some pretty sophisticated electronic noise-locating devices are available, sold through tool distributors and essential-tools suppliers to the car dealers. They are expensive and capable of solving some difficult problems, but

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common sense and a step-by-step approach to locating the noise will solve all but the most-arcane problems.

Note: Resist at all cost the urge to pull out a unit until you have confirmed that it is the cause of the noise. The ability to drive and operate the car is paramount to finding the source of the noise. Once you have pulled out a unit you will no longer be able to locate the noise if it is not inside the unit, and since noises are not visible you have just wasted labor dollars. Noise, because sound travels much faster in solid objects, will “walk” from its source to appear to emanate from another component.

Example 1: Noise appears to be coming from the transfer case. The common reaction is to pull out the transfer case, which in most situations will not be the problem. Differential noise will flow through the driveshaft and resonate into the driver area, seemingly from the transfer case. At least 50% of noise issues with transfer cases will be found to originate in the rear through failed bearings or a bad ring-and-pinion set.

Example 2: You build a manual transmission over the counter for someone; they install it and come back with noise complaints. Upon road testing you discover that they failed to replace the insulation between the floorboard and the transmission, and the normal transmission and road noise is now filling the cabin.

To help define when and where noise occurs, a diagnostic routine has been developed to break it into throttle-related sequences. This gives you a way to describe the noise in relation to throttle position and engine operation.

Drive – Acceleration with defined, steady throttle pressure

Cruise – Steady, constant-speed operation with enough steady throttle pressure to maintain same road speed.

Coast – Deceleration from road speed with full lift-off from throttle

Float – Controlled deceleration by partial lift-off to allow engine braking

Sources of noise must be identified by working from the outside in, which means that we are examining the whole vehicle, starting with external components such as tires, exhaust system, U-joints and suspension and moving inward to the engine, transmission and differential. Always look to the cheaper, less-labor-intensive sources before committing to higher-dollar R&R work. Outside sources include loose or worn powertrain mounts, U-joints and driveshaft; exhaust components and shields; vibrations caused by worn or incorrect tires; incorrect driveline angles; and loose or worn wheel bearings.

Pay close attention to make sure that there are no “grounded” components. An incorrectly routed speedometer cable that is touching other components such as a driveshaft or exhaust-system compo-

nent will cause noise to migrate into the cabin. Shifters or shifter cables, discarded balance weights and mounts from previous repairs, or slipping, chattering posi rears all will appear to be transmission issues.

Terminology

Clunking – usually caused by harsh metal-to-metal contact. Bad or worn powertrain mounts, loose or worn U-joints, broken or worn suspension bushings or components, or excess endplay in the transmission or differential will create clunks.

Chuckle – described as the noise generated by a stick held on the moving spokes of a bicycle wheel. Usually found on coast conditions and remaining until full vehicle stop.

Knocking – similar to chuckle except that it can be present in all four drive phases. Can result from damaged gear teeth, loose ring-gear bolts striking carrier, or any unwanted contact between rotating components.

Chatter – noise and felt vibration due to alternating slip and grab of clutch components. Common to acceleration with a bad clutch, chatter induced by clutch-driven transfer cases, and chatter around turns from limited-slip differentials. Limited-slip-differential chatter results in a huge number of transfer cases being torn down for nothing.

Gear noise – howl or whine that increases with driveline rotation speed; usually caused by worn ring and pinion, transmission gear damage, incorrect preload in transmission or differential. Be extremely careful to separate differential and transmission noises, as connecting driveshafts will make noise travel.

Bearing noise – whine or growl that intensifies as driveline rotation speed increases. Does not

have to occur in all gears. Countershaft bearings will be quieter in fourth gear, which is direct drive in most units, because of the lack of power flow through the countershaft.

Lubrication – Lack of lubricant or too much lube will create noise. Incorrect lube will cause shift complaints as well as synchro-ring chatter or squeaks, even in neutral.

Transaxles will exhibit some different types of noise because of their construction.

Low-speed knock – Worn drive-axle CV joints or worn side-gear-hub counterbores

Straight-line noise – Defective wheel bearings. Sharp turns at speed will cause noise to lessen or disappear as the bearings get loaded in the turns. Always replace wheel bearings in pairs, as the good one will not have much life left.

Clunk on acceleration or deceleration – loose, broken or worn powertrain mounts. Worn differential pinion shaft or side-gear-hub counterbore in case. Worn or damaged drive-axle inner CV joints, or worn axle splines.

Clunking on turns – worn or damaged outer CV joints or failed suspension components

Once you have established that none of the external sources could create the noise and that the only possibility is the transmission, you have to make sure what is causing the noise before you pull the unit. When is a noise not a noise? As all components of the vehicle are working together, vibrations from one component can show up in another. Neutral-gear rollover noise and gear rattle fall into this category.

All engines produce harmonic vibrations caused by cylinder firing order and crankshaft deflection on the power stroke. The clutch disc has damping that is supposed

to filter this out before the harmonics are transferred to the input shaft of the transmission. Certain vehicles use dual-mass flywheels to further damp these vibrations and prevent the driver from noticing them. Diesel engines are highly prone to this type of noise.

It is vital that you identify neutral-rollover noise or gear rattle before opening a unit. The noise is not in the unit and you cannot repair it. The noise comes from engine harmonics vibrating or rattling the gears. To test this, place the vehicle in neutral with the engine running and the clutch engaged, and slowly rev the engine to about 2,500-3,000 rpm. If the noise goes away at higher speed it is NOT in the transmission. Look for an out-of-tune engine or a diesel with a mistimed injection pump, worn clutch-disc dampers, worn dual-mass flywheel, or a bad crankshaft-vibration damper. The good news is that although it sounds ugly, gear rattle will not damage the transmission; the bad news is, how do you sell that to the customer?

Noises also can be caused by the best of intentions during a rebuild. For example, you have a customer who comes in with an older vehicle. You've known the guy for years, and he is a great guy who just doesn't ever have a lot of money to spend. You determine that his differential or transmission is noisy because of failed bearings and quote him on replacing only the bearings. You, of course, have no idea how long he has been driving like this, but the noise is now so great his radio can't drown it out and he has come to you.

You go ahead with the repair, and the transmission or differential works just fine but is still noisy. Consider this as "No good deed goes unpunished." The gear train, either ring and pinion or transmission, has been running on failed bearings for an unknown length of

time. The gear sets now have worn to a new pattern because of incorrect positioning due to the bearing wear. By replacing the bearings you have reset the gear set into its correct position, but the gears will never again operate quietly because they are worn to an incorrect pattern.

During any teardown, you must inspect for not only broken or worn parts but also parts that have been damaged by improper position. This is also a frequent problem caused by replacing one broken gear without replacing the opposing meshed gear. One is trashed and the other looks fine, except that whatever force it took to break one gear also was shared by the opposing gear, and now the fix is on you. Good rebuilding techniques will prevent these types of problems.

The soft parts of any unit are the seals, gaskets, bearings and synchro rings. This equates to the paper, rubber and ring kit on an automatic, and these parts should be replaced on every unit. You are now working from a constant and have eliminated possible premature failures and eliminated one source for leaks, noises and shift complaints. A detailed inspection of the unit once it's apart and cleaned will give you a heads-up on gears and shafts that need to be replaced.

Noise diagnosis is time consuming, for sure. It is attention to detail without preconceived notions that will lead you to solving the problem. You can try other ways, but there is no substitute for a patient, complete examination. It comes down to your dollars; you make them when you do it right the first time, and you lose them when you are wrong and have to do it over without being able to charge for your time. **ID**