MODULE CONTENT

| Unit of Competency | **DIAGNOSE AND OVERHAUL MANUAL TRANSMISSION/TRANSAXLE** |
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| Module Title | **DIAGNOSING AND OVERHAULING MANUAL TRANSMISSION/TRANSAXLE** |
| Module Descriptor | This unit identifies the competence required to diagnose, overhaul and assemble the manual transmission/transaxle. Overhaul includes knowledge, skills and attitude in disassembly and replacement of components of manual transmission/transaxle. |
| Nominal Duration | **hours** |
| Summary of the Learning Outcomes: | |
| Upon completion of this module the student must be able to: | |
| LO1. Prepare to diagnose and overhaul manual transmission/ transaxle | |
| LO2. Diagnose manual transmission/ transaxle | |
| LO3. Disassemble and evaluate manual transmission/ transaxle and components | |
| LO4. Complete work processes | |

**LEARNING EXPERIENCES**

**LEARNING OUTCOMES NO. 2**

**DIAGNOSE MANUAL TRANSMISSION/ TRANSAXLE**

| **Learning Activities** | **Special Instructions** |
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| Read Information Sheet 3.1-1 Diagnose manual transmission/ transaxle | If you have some problem with the content of the information sheet don’t hesitate to approach your Trainer.  If you feel that you are now knowledgeable on the content of the information sheet, you can now answer the self-check provided in the module. |
| Answer Self-Check 3.1-1 on Diagnose manual transmission/ transaxle | Try to answer the Self-check without looking at the Answer Key  Compare your answer to Answer Key 3.1-1 |
| Observe Trainer’s demonstration on Task Sheet 3.1-1 on Diagnose manual transmission/ transaxle | Listen carefully and attentively so that you may be able to perform a task correctly  Ask questions if are in doubt for clarification |
| Perform the Task Sheet 3.1-1 on Diagnose manual transmission/ transaxle | Remember the step-by-step procedure the Diagnose manual transmission/ transaxle |
| Evaluate the performance using the Performance Criteria Checklist 3.1-1 | Repeat the task in case fail to meet the criteria |

**INFORMATION SHEET 1.1-1**

**DIAGNOSE MANUAL TRANSMISSION/ TRANSAXLE**

**Learning Objectives:**

After reading this **Information Sheet**, you must be able to:

1. Analyzed symptoms.
2. Performed diagnostic tests.
3. Carried out inspection.
4. Compared inspection results.
5. Identified faults and determined causes of faults.
6. Reported findings and recommendations.
7. Applied safety practices.

**Diagnose manual transmission failure**

**When properly operated and maintain, a manual transmission/transaxle normally lasts the life of the vehicle without a major breakdown. All units are designed so the internal parts operate in a bath of oil circulated by the motion of the gears and shafts. Some units also use a pump to circulate oil to critical wear areas that require more lubrication than the natural circulation provides.**

**Maintaining good internal lubrication is the key to long transmission/transaxle life. If the amount of oil falls below minimum levels, or if the oil becomes too dirty, problem result.**

**S H O P T A L K**

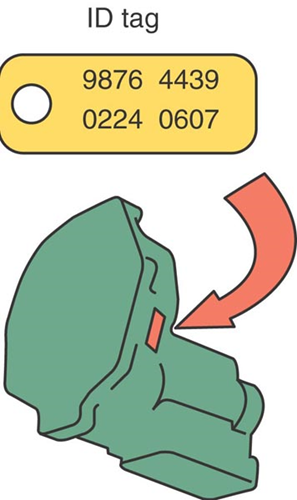
**Whenever you are diagnosing or repairing a transaxle**

**or transmission, make sure you refer first to the**

**appropriate service manual before you begin.**

**Prior to beginning any service or repair work, be sure you know exactly which transmission you are working on. This will ensure that you are following the correct procedures and specifications and are installing the correct parts. Proper identification can be difficult because transmissions cannot be accurately identified by the way they look. The only positive way to identify the exact design of the transmission is by its identification numbers.**

**Transmission identification number are found either as numbers stamped on the case or on metal tag held by a bolt head. Use a service manual to decipher the identification number. Most identification numbers include the model, gear ratios, manufacturer, and assembly date (Figure 37-1). Whenever you work with a transmission with a metal ID tag, make sure the tag is put back on the transmission so that the next technician will be able to properly identify the transmission.**

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**Figure 37-1 A typical transmission ID tag.**

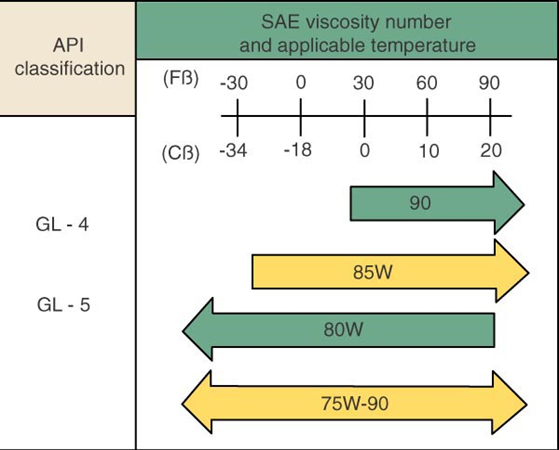
**If the transmission does not have an ID tag, the transmission must be identified by comparing it with those in the vehicle’s service manual.**

**LUBRICANT CHECK**

**The transmission/transaxle gear oil level should be checked at the interval specified in the service manual. Normally, these range from every 7,500 to 30,000 miles (12,000 to 48,00 km). For service convenience, many units are now designed with a dipstick and filter tube accessible from beneath the hood. Check the oil with the engine off and the vehicle resting in a level position. If the engine has been running, wait 2 to 3 minutes before checking the gear oil level.**

**Some vehicles have no dipstick. Instead, the vehicle must be placed on lift, and the oil level checked through the fill plug opening on the side of the unit. Clean the area around the plug before loosening and removing it. Lubricant should be level with, or not more than ½ inch (12.7 mm) below the fill hole. Add the proper grade lubricant as needed using filler pump.**

**Manual transmission/transaxle lubricants in use today include single and multiple-viscosity gear oils, engine oils, special hydraulic fluids, and automatic transmission fluid. Always refer to the service manual to determine the correct lubricant and viscosity range for the vehicle and operation conditions (Figure 37-2).**



**Figure 37-2** Typical transmission/transaxle gear oil classification and viscosity range data.

**Lubricant Leaks**

Normally, the location and cause of a transmission fluid leak can be quickly identified by a visual inspection. The following are common causes for fluid leakage:

1. An excessive amount of lubricant in the transmission or transaxle.

2. The use of the wrong type of fluid; it will foam excessively and leave through the vent.

3. A loose or broken input shaft bearing retainer.

4. A damage input shaft bearing retainer O-ring and/or lip seal.

5. Loose or missing case bolts.

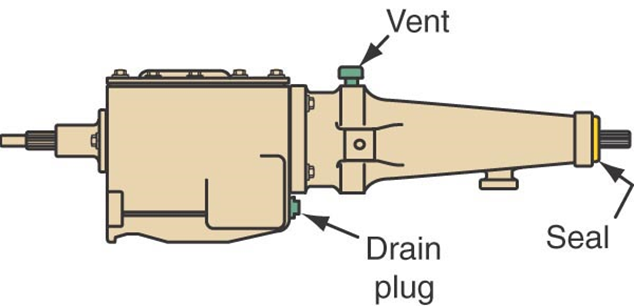
6. Case is cracked or has a porosity problem.

7. A leaking shift lever seal.

8. Gaskets or seals are damaged or missing.

9. The drain plug is loose.

Fluid leaks from the seal of the extension housing can be corrected with the transmission in the car. Often, the cause for the leakage is a worn extension housing bushing, which supports the sliding yoke. When the drive shaft is installed, the clearance between the sliding yoke and the bushing should be minimal. If the clearance is satisfactory, a new oil seal will correct the leak. If the clearance is excessive, the repairs required that a new seal and a new bushing be installed. If the seal is faulty, the transmission vent should be checked for blockage. If the vent is plugged, the oil will be under high pressure when the transmission is hot, and this pressure can cause seal leakage **(Figure 37-3)**.



**Figure 37-3** Possible sources of fluid leaks.

An oil leak at the speedometer cable can be corrected by replacing the O-ring seal. An oil leaks stemming from the mating surfaces of the extension housing and the transmission case may be caused by loose bolts. To correct this problem, tighten the bolts to the specified torque.

**Lubricant Replacement**

Transmission/transaxle lubricant should be changed at the manufacturer’s specified intervals. Typical intervals are 24,000 or 30,000 miles (39,000 or 48,000 km) or every two years. Vehicles used for towing trailers, offroad operation, or continuous stop-and-go driving may require shorter change intervals.

During the vehicle to warm the lubricant before placing the vehicle on the hoist. Clean and remove the drain plug and allow the lubricant to drain into a clean catch pan. Inspect the lubricant for metal particles, which may appear as a shiny, metallic color in the lubricant. Large amounts of metal particles indicate severe bearing, synchronizer, gear, or housing wear.

Once all lubricant has drained, replace the washer or apply a recommended sealant to the threads on the drain plug and replace it. Tighten the drain plug to the recommended torque. Fill the transmission or transaxle with the proper lubricant.

**Fluid Changes**

The manufacturers of most transmission do not recommend that the fluid be changed at any scheduled time. Older transmissions typically had 20,000-mile (32,000 km) fluid changes intervals. When a car has been operated under severe conditions, such as in high heat or dusty road conditions, the fluid may need to be periodically changed. Check the service manual for the manufacturer’s recommendations.

To change the transmission fluid, raise the car and safely support it on jack stands. Locate the oil drain plug in the bottom of the transmission case or extension housing. Make sure the car is level so that all of the fluid can drain out. Remove the drain plug with a catch pan positioned below the hole, and let the oil drain into the pan. Let the transmission drain completely. The fluid is normally very thick and it takes some time to drain it all out.

Inspect the drained fluid for gold-color metallic and other particles. The gold-color particles come from the brass blocking rings of the synchronizers. Metal shavings are typically from the wearing of gears. After the fluid has drained hole, then sweep it around the inside to remove all metal particles. Because brass is not magnetic, it will not show on the magnet. An excess of iron or brass shavings indicates severe wear in the transmission.

Before refilling the transmission, reinstall the drain plug. Remove the filler plug, which is normally located above the drain plug. Check your service manual to identify the location of the filter plug and the proper type and quantity of fluid for the transmission. Fill the transmission case until the oil just starts to run out the filter hole or until it is at the bottom of the bore. Reinstall the plug. You should check the case’s vent to make sure it is not blocked with dirt. If the case is not properly vented, the fluid can easily break down.

**IN-VEHICLE SERVICE**

Much service and maintenance work can be done to transmissions while they are in the car. Only when a complete overhaul or clutch service is necessary does the transmission need to be removed from the car. The following are procedures for common service operations: the replacement of a rear oil seal and bushing, linkage adjustments, and replacement of the back-up light switch and the speedometer cable retainer and drive gear.

**Rear Oil Seal and Bushing Replacement**

Procedures for the replacement of the rear oil seal and bushing on a transmission vary little with each car model. Typically, to replace the rear bushing and seal follow these steps:

**PROCEDURE**

**Replacement of Rear Oil Seal**

**and Bushing**

**STEP 1** *Remove the drive shaft*

**STEP 2** *Remove the old seal from the extension housing*

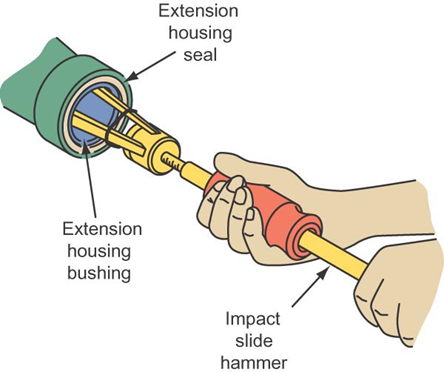
**STEP 3** *Insert the appropriate puller tool into the extension housing until it grips the front side of the bushing.*

**STEP 4** *Pull the bushing from the housing* ***(Figure 37-4)****.*

**STEP 5** *Drive a new bushing into the extension housing.*

**STEP 6** *Lubricate the lip of the seal, then install the new seal in the extension* ***(Figure 37-5)****.*

**STEP 7** *Install the drive shaft*.



**Figure 37-4** Removing the extension housing’s seal and bushing.



**Figure 37-5** Drive the new seal into place with hammer and seal driver.

**Linkage Adjustment**

Transmissions with internal linkage have no provision for adjustments. However, external linkages, both floor and column mounted, can be adjusted. Linkages are adjusted at the factory, but worn parts may make adjustments necessary. Also, after a transmission has been disassembled, the shift lever and other controls may need adjustment.

Only externally controlled gearshift levers and linkages can be adjusted. To begin the adjustment procedure, raise the car and support it on jack stands. Then follow the procedure given in your service manual.

**Backup Light Switch Service**

To replace the back-up light switch, disconnect the electrical lead to the switch. Put the transmission into reverse gear and remove the switch. Never shift the transmission until a new switch has been installed. To prevent fluid leaks, wrap the threads of the new back-up light switch with Teflon tape in a clockwise direction before installing it. Tighten the switch to the current torque and reconnect the electrical wire to it.

**Speedometer Drive Gear Service**

Begin to remove speedometer cable retainer and drive gear by cleaning off the top of the speedometer cable retainer. Then remove the hold-down screw that keeps the retainer in its bore. Carefully pull up on the speedometer cable, pulling the speedometer retainer and drive gear assembly from its bore. Unscrew the speedometer cable from the retainer.

To reinstall the retainer, lightly grease the O-ring on the retainer and gently tap the retainer and gear assembly into its bore while lining the groove in the retainer with the screw hole in the side of the clutch housing case. Install the hold-down screw and tighten in place.

**INFORMATION SHEET 1.2-1**

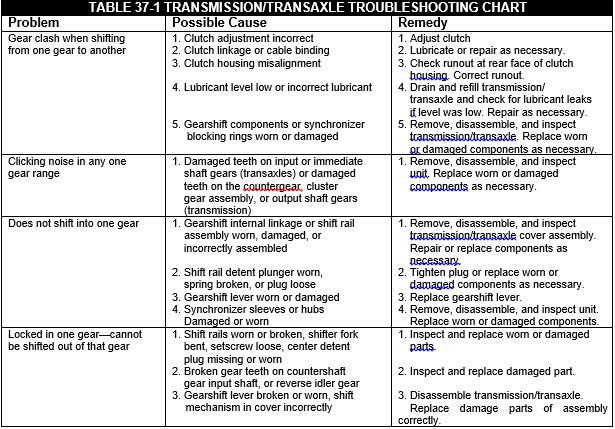
**DIAGNOSE MANUAL TRANSMISSION/ TRANSAXLE**

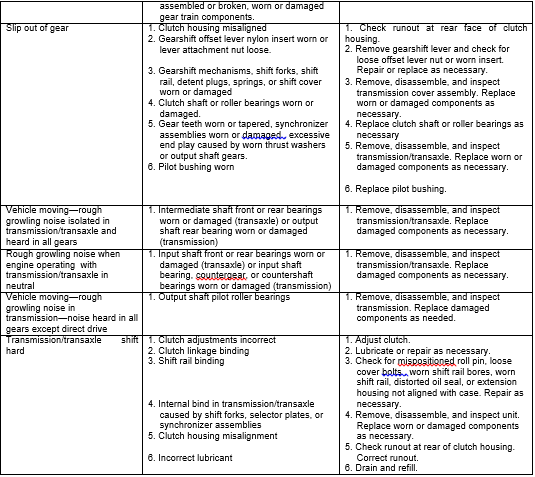
**Diagnose manual transmission failure**

**DIAGNOSING PROBLEMS**

**Service manuals list the most common problems associated with manual transmissions and transaxles. Proper diagnosis involves locating the exact source of the problem. Many problems that seen transmission/transaxle related may actually be caused by problems in the clutch driveline or differential. Check these areas along with the transmission/transaxle, particularly if you are considering removing the transmission/transaxle for service.**

**Table 37-1 a troubleshooting chart for common transmission and transaxle problems.**





**Visual Inspection**

Visually inspect the transmission/transaxle at regular intervals. Perform the following checks:

1. Check for lubricant leaks at all gaskets and seals. The transmission rear seal at the driveline is particularly prone to leakage.

2. Check the case body for signs of porosity that show up as leakage or seepage of lubricant.

3. Push up and down on the unit. Watch the transmission mounts to see if the rubber separates from the metal plate. If the case moves up, but not down, the mounts require replacement.

4. Move the clutch and shift linkages around and check for loose or missing components. Cable linkages should have no kinks or sharp bends, and all movement should be smooth.

5. Transaxle drive axle boots should be checked for cracked, deformation, or damage.

6. The constant velocity joints on transaxle drive axles should be thoroughly inspected.

**Transmission Noise**

Most manual transmission/transaxle complaints center around noise in the unit. Once again, be certain the noise is not coming from other components in the drivetrain. Unusual noises may also be a sign of trouble in the engine or transmission mounting system. Improperly aligned engines, improperly torqued mounting bolts, damaged or missing rubber mounts, cracked brackets, or even a stone rattling around inside the engine compartment can create noises that appear to be transmission/transaxle related.

| **S H O P T A L K**  If during the test drive you hear a noise you suspect  is coming from inside the transmission/transaxle,  bring the vehicle to a stop. Disengage the clutch. If  the noise stops with the engine at idle and the clutch  disengaged, the noise is probably inside the unit. |
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Once you have eliminated all other possible sources of noise, concentrate on the transmission/transaxle unit. Noises from the inside the transmission/transaxle may indicate worn or damaged bearings, gear teeth, or synchronizers. A noise that changes or disappears in different gears can indicate a specific problem area in the transmission.

| ***C A U T I O N !*** |
| --- |

| *When the transmission/transaxle is in gear and the engine is running, the driving wheels and related parts turn. Avoid touching moving parts. Severe physical injury can result from contact with spinning drive axles and wheels.* |
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The type of noise detected may also help indicate the problem.

**Rough, Growling Noise** This noise can be a sign of several problems in a transaxle or transmission depending on when it occurs. If the noise occurs when the transaxle is in neutral and the engine running, the problem may be the input shaft roller bearings. The input shaft is supported on either end by tapered roller bearings, and these are the only bearings in operation when the transaxle is in neutral. In its early stages, the problem should not cause operational difficulties; but left uncorrected, it grows worse until the bearing race or rolling element fractures. Solving the problem involves transaxle disassembly and bearing replacement.

When the vehicle is moving, both the input and mainshaft (output shaft) are turning in the transaxle. If the noise occurs in forward and reverse gears, but not in neutral, the output or mainshaft bearings are the likely failed component. Replacement is the solution.

In transmissions, the problem is also bearing related. If the rough growling noise occurs when the engine is running, the clutch engaged, and the transmission in neutral, the front input shaft bearing is likely at fault. Rough growling when the vehicle is moving in all gears indicates faulty countergear bearings or countershaft –to-cluster assembly needle bearings. If the problem occurs in all gears except direct drive, the bearing at the rear of the transmission input shaft may be at fault. This bearing supports the pilot journal at the front of the transmission output shaft. In all forward gears except direct drive, the input shaft and output shaft turn at two different speeds. In reverse, the two shafts turn in opposite directions. In direct drive, the two shafts are locked together and this bearing does not turn. If the growling noises stop during direct drive operation, the rear input shaft bearing may be at fault. Disassembly, inspection, and replacement of damaged parts is needed.

**Clicking or Knocking Noise** Normally, the helical gears used in modern transmission/transaxle are quiet because the gear teeth are constantly in contact. (When spur cut gear teeth are found in the reverse gearing, clicking or a certain amount of **gear whine** is normal, particularly when backing up at faster speeds.)

Clicking or whine in forward gear ranges may indicate worn helical gear teeth. This problem may not require immediate attention.

Chipped or broken teeth are dangerous because the loose parts can cause severe damage in other areas of the transmission/transaxle. Broken parts are usually indicated by a rhythmical knocking sound, even at low speeds. Complete disassembly, inspection, and replacement of damaged parts is the solution to this problem.

**Gear Clash**

**Gear clash** is indicated by a grinding noise during shifting. The noise is the result of one gearset remaining partly engaged while another gearset attempts to turn the mainshaft. Gear clash can be caused by incorrect clutch adjustment of binding of clutch or gearshift linkage. Damaged, worn, or defective synchronizer blocking rings can cause gear clash, as can use of an improper gear lubricant.

**Hard Shifting**

If the shift lever is difficult to move from one gear to another, check the clutch linkage adjustment. Hard shifting may also be caused by damage inside the transmission/transaxle, or by a lubricant that is too thick. Common hard shifting includes badly worn bearings and damaged clutch gears, control rods, shift rails, shift forks, and synchronizers.

**Jumping Out of Gear**

If the car jumps out of gear into neutral, particularly when decelerating or going hills, first check the shift lever and internal gearshift. Excessive clearance between gears and the input shaft or badly worn bearings can cause jumping out of gear. Other internal transmission/transaxle parts to inspect are the clutch pilot bearing, gear teeth, shift forks, shift rails, and springs or detents.

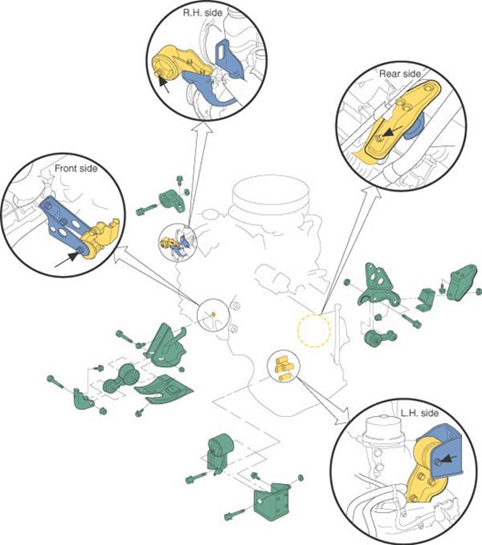
**Locked in Gear**

If a transmission or transaxle locks in one gear and cannot be shifted, check the gearshift lever linkage for mis-adjustments or damage. Low lubricant level can also cause needle bearings, gears, and synchronizer to seize and lock up the transmission.

If these checks do not resolve the problem, the transmission or transaxle must be removed from the vehicle and disassembled. After disassembly, inspect the internal countergear, clutch shaft, reverse idler, shift rails, shift forks, and spring or detents for damage. Also, check for worn support bearings.

If the problem seems to be in the clutch assembly, make sure the transmission/transaxle is out of gear, set the parking brake, and start the engine. Increase the engine speed to about 1,500—2,000 rpm and gradually apply the clutch until the engine torque causes tension at the drive train mounts. Watch the torque reaction of the engine. If the engine’s reaction to the torque appears to be excessive, broken or worn drive train mounts may be the cause and not the clutch.

The engine mount on FWD cars are important to the operation of the clutch and transaxle **(Figure 37-6)**. Any engine movement may change the effective length of the shift and clutch control cables and therefore may affect the engagement of the clutch and/or gears. A clutch may slip due to clutch linkage changes and the engine pivots on its mounts. To check the condition of the transaxle mounts, pull up and push down on the transaxle case while watching the mount. If the mount’s rubber separate from the metal plate or if the case moves up but not down, replace the mount. If there is movement between the metal plate and its attaching point on the frame, tighten the attaching bolts to an appropriate torque.



**Figure 37-6** Typical engine and transaxle mounts.

If it is necessary to replace the transaxle mount, make sure you follow the procedure for maintaining the alignment of the drive line. Some manufacturers recommend that a holding fixture or special bolt be used to keep the unit in its proper location. A broken clutch cable may be caused by mounts and improper cable routing. Inspect all clutch and transaxle linkages and cables for kinks or stretching. Often transaxle problems can be corrected by replacing or repairing the clutch or gearshift cables and linkage.

**Shift Linkage**

Check the shift linkage for smooth gear changes and full travel. If the linkage cannot move enough to fully engage a gear, the transmission/transaxle will jump out of gear while it is under a load. Some FWD cars have experienced the problem of jumping out of second or fourth gear. Two causes have been identified with this problem: the upshift light interferes with the shifter or there are improper shifter-to-shifter boot clearances. Both conditions prevent the transaxle’s shift forks from moving enough to fully engage the synchronizer collar to their mating gears. If correcting these problems does not solve the complaint, the cause may be the engine mounts or an internal problem in the transaxle.

| **USING SERVICE MANUALS**  A service manual is absolutely necessary when performing  any type of transmission/transaxle disassembly work.  Not only does the manual clearly  illustrated all components and their disassembly  procedure, it also lists many vital specifications, such as  shaft and gear thrust (side) clearances, synchronizer  ring and cone clearances, and bolt torque values.  Special service tools, such as transmission service  stands, oil seal presses, bearing replacers, shaft removers,  pullers, and installing tools are also illustrated  and explained. |
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