



Up To Standards

Shortcuts to Analyzing ZF S5-42 Transmissions

**By Mike Weinberg
Contributing Editor**

Manufactured by ZF Transmissions and used in large quantities in Ford trucks, the S5-42 5-speed trans is by now a common unit. This is a well-engineered trans that is capable of the heavy-duty use it gets in Ford pickups and Stripped Chassis. This unit also is responsible for a large volume of tech calls. Most complaints about this unit come from noise, shift concerns and PTO problems. We will devote this space to learning to solve these problems quickly and profitably.

Noise in neutral with the vehicle stopped falls into several areas. If the

noise is present with the clutch depressed, it will be caused by the clutch-release hub and/or the release bearing having failed, failure of the pilot bearing or a misaligned transmission. Check for a cracked bellhousing or missing alignment dowels on the engine block.

Noise that occurs in neutral at idle with the clutch released should be checked carefully as follows: Steadily increase the idle speed by 100 rpm at a time until you are at 1,500 rpm, or about double the idle speed. If the noise disappears, it is NOT in the transmission, and nothing you do inside the gearbox will change it. Noise that disappears as the idle speed is increased in neutral is generated by the engine or a worn-out dual-mass flywheel or damaged clutch-disc damper. This is known as

neutral rollover noise and is caused by harmonic engine vibrations making the geartrain rattle. This can be caused by a worn or out-of-time diesel injection pump or by clogged or worn fuel injectors.


On 7.5L engines, neutral gear rattle is an option that comes with the truck. In many high-mileage vehicles the dual-mass flywheel is just worn out with too much travel on the damper springs. The high cost of the replacement usually means that the customer has had this problem on a previous clutch repair but didn't commit to buying a new flywheel. LuK Automotive has released a new clutch set with special damping and a solid flywheel that saves the customer big bucks. NEVER use a will-fit clutch in one of these vehicles, and do not promise the customer that you will fix this noise by going inside the gearbox.

If you have a hard-to-convince truck owner on your hands, set the truck up on a lift, drain the transmission oil, remove a PTO cover and let the truck idle. You now can see the gears do a tango until the idle speed is increased sufficiently to get rid of the engine vibration. The good news here is that this problem, while unpleasant to listen to, will do no harm to the unit and will not affect the proper operation of the trans. By all means get the engine timed and tuned, and repair any clutch and flywheel concerns, but don't take the trans apart.

If the noise in neutral does not leave with an increase in the idle speed and is present at road-speed operation in some or all of the gears, the problem is internal. Check for proper lube levels and confirm that the unit is filled with Mercon ATF. Synthetic Mercon is even better, as it will take 40-50° more heat. If the lube is correct and in good condition, the noise will be due to worn or

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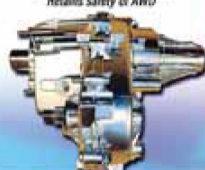
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Up To Standards

Figure 1

Condition	Possible Cause	Action
Noise is present in all or several gears. Noise occurs at high and low engine speeds and may vary with engine speed.	<ul style="list-style-type: none"> • Worn or rough mainshaft rear bearing. • Needle bearing under mainshaft gears damaged. • Wrong preload on main or cluster-shaft bearing. • PTO installed incorrectly. 	<ul style="list-style-type: none"> • Disassemble transmission and install new output at high shaft rear bearing on mainshaft. • Replace needle bearing and gear. • Disassemble transmission and correct preload. • Check PTO installation.
Rattle noise when taking off from a stop and driving at less than 1,000 rpm	<ul style="list-style-type: none"> • Lugging rattle. 	<ul style="list-style-type: none"> • Operate truck without lugging. Condition will shorten the life of the transmission.
Clunking noise when shifting or speeding up or slowing down. Condition is worse on bumpy surface.	<ul style="list-style-type: none"> • Freeplay in the system (clutch through axle and fuel-injector shutoff timing). Some clunk is normal with the 4.9L & 5.8L engines. • Loose yoke nut. 	<ul style="list-style-type: none"> • Check for excessive axle backlash. Clunk cannot be corrected by repairing transmission unless a transmission defect is evident. • Install a new Spiral Locknut. No staking required. Tighten to 270 N-m or 200 ft./lbs.
Whining noise at high engine rpm in 3rd and 5th gears.	<ul style="list-style-type: none"> • Worn input-shaft gear and countershaft drive gear. 	<ul style="list-style-type: none"> • Check noise level in 4th gear under same engine conditions. If noise level is less, replace the input shaft and countershaft. Inspect and replace other gears as required.
Shift-lever buzz present while driving, not present during a neutral engine runup while parked.	<ul style="list-style-type: none"> • Upper shift lever damaged or loose. • Lower shift lever defective. 	<ul style="list-style-type: none"> • Change shift lever. If buzz is still present, see in which gear buzz occurs. Disassemble and inspect specific gear. Inspect and replace other gears as required. • Replace lower shift lever. Shift lever E9TZ-7210-G is less sensitive to vibration than earlier design.
Shifter-lever rattle in neutral engine runup, primarily diesel 4X4.	<ul style="list-style-type: none"> • Transfer-case shift lever may not have plastic bushing at the pivot. • Transmission-lever boot incorrectly installed. 	<ul style="list-style-type: none"> • Check by temporarily removing the transfer-case shift lever. Replace if the noise is gone. • Lever boot must make airtight seal to shift lever. Replace boot if stretched or if sealing surface is damaged.

damaged tapered bearings, bad needle bearings or scuffed or broken gear teeth. The noise-diagnosis chart in Figure 1 will help you diagnose other noise complaints in the trans.

Do not ignore two other possibilities – PTO problems and incorrect unit exchanges. If you believe the PTO is a source of noise, remove it, put a spare cover plate on the unit and road test. If the noise is gone, the problem will be the PTO, incorrect backlash or an incorrect PTO ratio. On the S5-42 trans the PTO backlash should be set at 0.006-0.012 in. The PTO gaskets will crush

by about 0.004 in. when the PTO is torqued to spec properly (30-35 ft./lbs. on 6-bolt and 45-50 ft./lbs. on 8-bolt models). Gaskets come in 0.010-in. and 0.020-in. sizes. On the crush these will yield 0.006 in. to 0.012 in., respectively (See Figure 2).

As for making sure you are working on a unit that matches the truck it is in, all ZF transmissions are identified by a tag that contains both Ford and ZF part numbers. Any ZF distributor can confirm for you whether the gearbox is correct for the application. The S5-42 comes in

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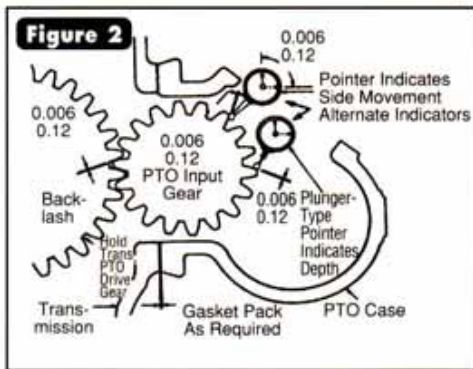
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wide-ratio and close-ratio versions (See Figure 3), and every town has at least one wizard who will throw any old junkyard unit into a vehicle to get the truck out the door and quick cash in his pocket, regardless of drivability or operating concerns. You all know these guys. They work quick and dirty, ruin the reputation of our industry and don't give a damn about the customer.

In solving shift problems it is very important to do some careful road testing to identify when and where the problem occurs.

Notchy shifts – These units normally have a slight notchy feeling to the shifts, especially on the 2-3 shift. The concern, if severe, almost always will be synchronizer related.

Grinding on a shift usually will start with worn synchronizer rings and if allowed to continue will result in worn or chipped coupling teeth on the speed gears and sliders. Do five hard shifts at high rpm. If the grind still is present, make a series of shifts double-clutching to match the shaft speeds. If the grind goes away in a particular gear using a double-clutch, the blocking ring and synchronizer will be worn out. If no change is noticed, inspect the trans internally for damage or end-play concerns.

For difficult or grinding shifts in first, second and reverse, check the clutch-release system and the hydraulics. Inspect the firewall at the master cylinder for flex or cracking, confirm that the slave cylinder and

pedal travel are correct, make sure the system has no air in it, and inspect the routing of the hydraulic lines to make sure they are not too close to a heat-producing component.

Gear jump-out after a shift also will demand careful road testing. Does the hop-out occur under load or on coast? Does the hop-out occur on smooth roads, bumpy roads or both? Gear jump-out is caused by worn-out back taper on the sides of the coupling teeth on the speed gear and slider; excess endplay on the shafts or the speed gears, or worn forks, shifter mechanism, broken detents and any problem that prevents a complete shift from happening. External problems that cause jump-out are a misaligned transmission, worn or broken engine or trans mounts, or a heavy extension on the shifter.

There are some crazy noises associated with these vehicles at higher road speeds – 50 mph and up. This usually shows up as a moan or



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	1st	2nd	3rd	4th	5th	Reverse
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Wide Ratio (Gasoline/Diesel)	5.72	2.94	1.61	1.0	0.76	5.24

Figure 3

vibration at highway speeds on the F Super Duty models. Usually the noise at this speed will be due to some type of custom modifications to the frame or driveshaft. Many of these vehicles start life as a stripped chassis and wind up being converted into tow trucks or other work vehicles. Many times non-OEM driveshafts are used and must be carefully inspected and balanced. A shaft less than 51 inches in length can be a 3-in. tube. From 51 to 55 inches, the shaft must be 3.5 inches in diameter, and over 55 inches a 4-in. tube should be used. U-joint working angles should be 0.5° to less than 3°. Driveshaft vibration, balance problems and incorrect U-joint working angles can, in some cases, crack the transmission bellhousing.

You also will see broken transmission-mount ears on the extension housing because of broken engine mounts, driveline imbalance, broken or loose trans mounts, and mounting surfaces that are not flat because of corrosion buildup.

Be very careful when towing any vehicle equipped with this series of transmissions. Make sure that the vehicle is towed with the front wheels on the ground or, if this is not practical, disconnect the driveshaft. When one of these vehicles is towed for any distance at speeds over 35 mph, internal damage due to lack of lube can occur. The first part to fail will be the mainshaft pocket bearing that rides inside the input. Remember that when the rear wheels are on the ground, the driveshaft is

turning the transmission mainshaft. The pocket bearing is the last place to get adequate lube when the truck is being driven normally, and when it is being towed there is not enough splash lubrication to take care of the nose of the mainshaft. This can make for a very expensive lesson in proper tow technique.

We could continue this discussion for many more pages, but the main point here is not to tear into any of these units unless you first have confirmed all the symptoms and removed all problems external to the trans. Nothing is a greater waste of time and money than tearing down a unit that has nothing wrong with it. On the other hand, the best-built unit will not live through the warranty if all other systems related to it are not in correct working order.

I wish all of you a happy, healthy, and prosperous New Year. **TD**

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