Thinking OUTSIDE the Box

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Opening a unit before you know what's wrong is like throwing money away.

The level of complexity and sophistication in later model transmissions, both automatic and standard, has increased tremendously in the last 10 years. The trend to more computer control, 5 and 6-speed units, and the addition of systems such as ABS, stability control, rear-wheel steering, dynamic skid control, and electronic shock damping, have added many more electronic systems and components that involve the gearbox.

What many people fail to realize is that all of these items also affect the transfer case on 4WD vehicles. Most of the late-model transfer cases in the ever-growing SUV market are *active transfer cases*. This means they're controlled electronically, using vehicle inputs to a computer. And when set to the automatic mode, they have the ability to split torque between the front and rear driveshafts, based on system requirements. Here's what that means:

During normal driving conditions, most 4WD systems in automatic mode split the torque so that 95% of the load is handled by the rear driveshaft, and 5% goes to the front driveshaft. If the computer receives input that indicates

one of the axles is slipping, it applies a clutch pack electronically to send power (torque) to the other axle. When the shaft speeds equalize, the computer returns the unit to the normal torque split.

This generates a number of diagnostic problems in the field, especially for shops that are quick to pull the transfer case and disassemble it before diagnosing the external control systems properly. Older mechanical units create similar problems, caused by improper function of external systems such as vacuum- or electrically-operated front axle connects. These problems generate a number of calls to the HelpLine, most of which start with "we took the transfer case apart and now we can't find anything wrong with it, but this is what it is doing…"

A three pound difference in air pressure between the tires can set a code.

As with any type of drivetrain problem, it's always best to diagnose the problem before you attempt to fix it. There will be plenty of time to pull the unit after you've cleared every possible external problem. Make yourself a checklist of detailed steps to begin your diagnosis, and leave the unit alone until you know for sure that the problem is internal. If you're not sure where to begin, call the HelpLine *before* you take the unit out of the vehicle.

Always begin your diagnosis of a transfer case complaint with the tires: Make sure all tire pressures are equal, and all four tires are the same size. This doesn't mean just checking the sidewall label: You need to measure the tires' diameters with a stagger gauge, or measure the circumference of each tire at the centerline, using a tape measure. That way you know you're working from a constant. If one or more of the tires has a smaller diameter than the others, correct that before going any further.

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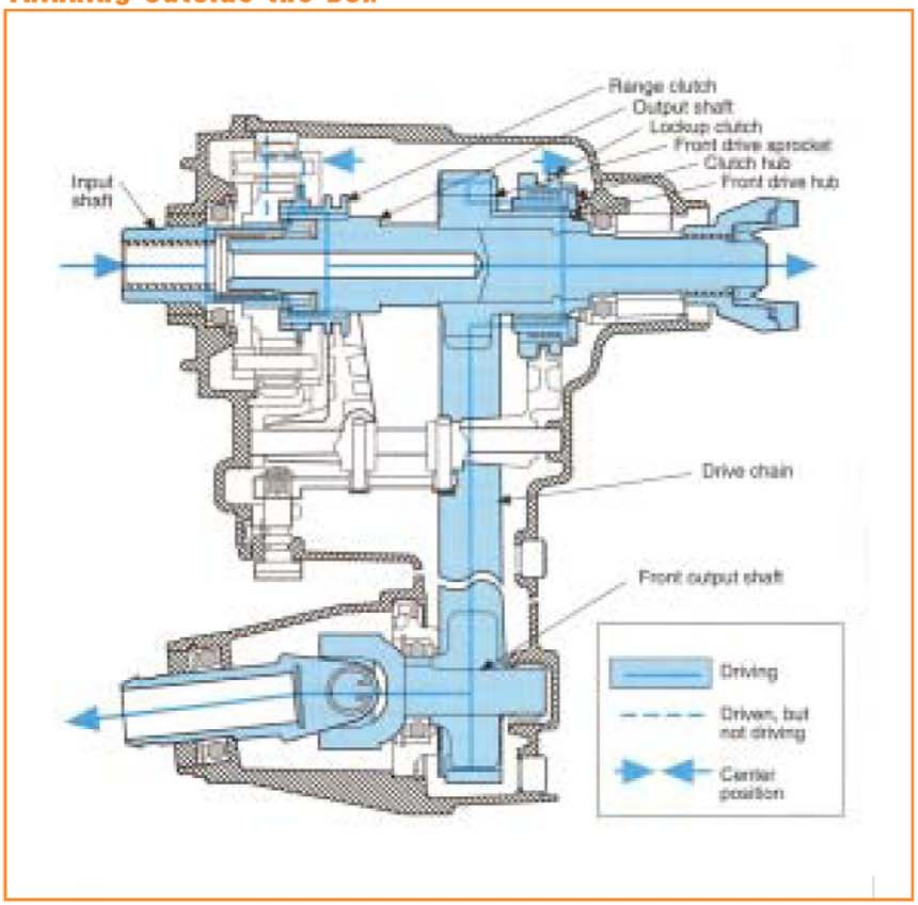
Mismatched tires cause electronic and other faults in half the problem vehicles. On the late-model, active units, the computer will interpret a tire size variation as a difference in axle speed, and set codes or create internal damage in short order. On the late-model, electronic GM transfer cases, a 15 RPM difference in driveshaft speed will set a code. 15 RPM translates into 1/16 of an inch variation in tread wear.

This applies to older, mechanical units, too. For example, an NP242 in a Jeep will remain in 4-wheel drive, even when shifted back into two-wheel drive, because of a 3-pound difference in tire pressure. The giveaway is the unit will work properly with all four wheels off the ground.

On units equipped with viscous couplings, it's ever so common to have a shop replace a bad viscous coupling, only to have a new one fail because no one corrected the mismatched tires or pressures that caused the failure. This expensive mistake is easily prevented by fixing the cause of the failure at the same time as replacing the parts that went bad.

Mismatched or out-of-pressure tires will also wreak havoc with differentials, as the difference in rolling radius forces the side and pinion gears to operate even while the vehicle is driving straight ahead. Ever have a front-wheel drive car that kept eating up differentials, and contaminating the



transaxle with fine metallic debris that jammed up valve bodies and solenoids?

Full size GM pickups, 1987 to present, are equipped with a two-wire front axle connect servo. These solenoids have been updated to quicker, three-wire, gas-charged units. When you shift the transfer case into 4WD, the servo moves a sliding sleeve in the front differential, to connect the front wheel to the differential. When you have to replace one of the older, 2-wire units, the new part comes with three wires - and, curiously, no directions or schematics. The common tech call is to locate where to put the longer third wire.

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Locate the electric switch on the transfer case; find the side that's hot when you turn the key on, engine off. That's where you splice the 3rd wire. Connect it to the ignition side of the switch; not the switched power side. IMPORTANT! - Never try to test the newer, three-wire solenoid unless it's assembled correctly into the front differential. If you apply 12 volts to the assembly with the solenoid dismounted, it may blow the piston across the shop violently! (Go ahead: ask me how I know!)

4WD S10s, 1983 and up, will sometimes make a ratcheting noise in the front differential while driving. This can be caused by a vacuum problem. The vacuum canister with a cable to engage the locking sleeve in the front differential will probably have clogged, broken, pinched or misrouted hoses. Or it could have a bad vacuum switch or clogged system vent. A poor vacuum supply will cause the differential locking sleeve to lock and unlock in response to throttle opening, creating a nasty ratcheting sound.

On GM NV233 or 243 transfer cases, you may have complaints of no 4WD High range; only 2WD and 4WD Low range. This problem may set several different codes, and will continue after you've cleared the codes. This is usually a problem with the encoder motor, the transfer case control module (computer), and the harness that runs between them. These problems are usually caused by a resistance change in the harness that creates an improper signal to the control module. This may cause the encoder motor to click, begin to sweep, and then return to the original position.

The only sure repair we've found

Ford uses a GEM module to control many body funtions including the transfer case.

is to replace the control module, harness, and encoder motor as a set. The latest harness has improved wiring and connectors, and the latest control module has improved software. The encoder motor operates on a 5-volt signal, and any short in the harness to battery voltage will damage the encoder motor. Never test the encoder with 12 volts unless you plan to buy a new one.

There have been many mechanical and design problems with the BW4405 transfer case, found in the Explorers and Mountaineers. There are also a host of electrical faults you may have encountered that seem mysterious until you look at a wiring schematic. One example is where the transfer case isn't operating properly, and the system sets a number of codes… including a code for *rear defrost*. This turned out to be a bad MLP switch. What does that have to do with other body components, such as rear defrost, door chimes, wiper relays, etc.? Look at the schematics and see how many accessories run through those same circuits.

An equally-common problem can occur after replacing electrical components or the whole transfer case. Any time you disconnect one of the input sensors or the motor with the battery connected, you'll create a code in the GEM (Generic Electronic Module). Even if you use your scan tool to clear the codes in the system, you may still have to clear the GEM. Unplug the GEM for 30 seconds, reconnect it, and drive the vehicle for several miles for the GEM to go through its relearn procedure. After a number of disconnects, you may have to reflash the GEM; refer to TSB 97-21-15 to learn more.

A bindup in 2WD or automatic 4WD that's usually more noticeable in reverse may also be cured by clearing the GEM.

Next, we have the unauthorized shift (without driver input) into 4WD Low range. This is usually caused by a short in the electric shift motor wiring harness to the main harness under the driver's seat. This harness goes bad often enough that many shops keep one in stock. When the harness shorts, it sends a false resistance value to the GEM, which shifts the transfer case to low range while driving. This causes the low range fork to ratchet, trying to engage the low range sleeve, and often breaks the fork.

Before this system can shift into low range safely:

- The transmission should be in park or neutral
- Road speed should be less than 3 KM per hour
- The brakes should be applied

Any variation in these conditions could damage the transfer case. Other problems can be caused when technicians cut wires to speed sensors or other components during replacement, instead of releasing the wire from the weatherpack connector. Splices and butt connectors can change resistance readings enough to throw the computer a curve.

Another problem we hear about with the 4405 is a siren-like noise from the transfer case when the vehicle's in motion. This is usually caused by a speed sensor that was cocked in the bore during installation. Make sure you lube the O-ring and twist the body of the sensor carefully to make sure it's square and bottomed in its bore. If the sensor's cocked, the interference with the reluctor will sound like a cat caught under the car.

We could go on with many other examples of external problems that create the urge to pull a perfectly good transfer case. But time is money, and you can save both by spending a little time diagnosing the system… before you pull the unit. The car is the best dyno you'll ever have, and opening a unit before you know what's wrong is like throwing money away. Follow a process of elimination until there's no other possibility beside the transfer case before you break out the wrenches. Square up the tires on size and pressure and look at all external issues before proceeding. In the end, you'll have more time to concentrate on your profit picture