

Subject:

Establishing the cause of a comeback

Unit:

Manual transmissions and transfer cases

Essential Reading:

- ✓ Shop Owner
- ✓ Center Manager
- ✓ Rebuilder
- ✓ Diagnostician
- R & R (Installers)

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What Went Wrong and Why: Root-Cause Failure Analysis

Everyone has comebacks. Anyone who says they don't is obviously not doing anything, because the only way never to make a mistake is never to do anything.

Comebacks will have many causes, including some that are beyond the shop's control – such as human error and new parts that are defective right out of the box. If a shop is not running at a comeback rate of 5% or less, it will be dangerously close to failing as a business. This is because there are two costs involved in repairing a comeback: The first is the parts and labor invested for free in honoring your warranty; the second loss is called "lost-opportunity costs," which reflect the fact that when working on a comeback you cannot be working on a paying job. We will examine here how to make a comeback into a positive experience even though it costs money, and how to cut your losses and protect yourself from further wasted labor and parts dollars.

The first step is to diagnose your own procedures for dealing with a failure (real or perceived) under warranty and establish a mindset that will create an attitude within the whole shop that does not detract from solid performance. The first issue to deal with is "assumption." It has been said many times that "assumption is the mother of all screw-ups" and that when you assume "you make an ass out of you and me." This is absolutely true in my experience.

Train yourself never to react to an assumption and to act only on the basis of logic and facts. An example of this is common human behavior when we react to disappointment, the

innate urge to find a party to blame. Rise above this wasted emotion and learn to live with disappointment, as life will be full of them. The process begins with the customer calling or arriving at the shop with a perceived problem. It is perceived because at this point you have no idea of what the cause is, and guessing is assuming that which is not substantiated by facts.

In a typical scenario, this immediately rings an alarm bell in the service writer's head, and he usually will inform everyone who will listen of the potential disaster. This sets off ripples through the whole organization, with everyone seeing doom and gloom. The installer now begins to hate the rebuilder for his screw-up and having to do extra work. The rebuilder is now having doubts and a loss of confidence. What has been achieved at this point? Nothing positive.

The only thing that is sure is that if this type of attitude persists, everyone involved will be sure to make an error on something they are now working on and create further lost dollars. It is similar to a race driver who blows a corner during the race and, instead of putting it behind him and concentrating on the job at hand and the next corner, lets his past mistake create some new ones. Take a vow right now to become bullet proof and resist all blame and assumption until you have had a chance to establish the facts of the situation.

The second step is to avoid at all costs the urge to remove the component from the car immediately. The

continues next page

vehicle is the only dyno available to you, and removing a unit as a first step will be a big waste of time 99 times out of 100. How do we get answers? By asking questions. The vehicle will tell you what is wrong if you ask it correctly, and if you refer to a set of routines designed to establish the facts on a constant basis, you will get good answers.

Establish a checklist of questions that will provide you with some hard facts. These will start with a careful and-polite conversation with the customer during which you get a thorough understanding of what they are concerned about. You should learn what is happening, when it happens, when it started, how long it has been going on. Does engine temperature, engine speed, road speed or other operating parameters affect the problem? How many people drive the car, and does the problem occur for all of them? It would be nice to know whether the owner is letting his 18-year-old son drive the car, or did he lend the truck to a neighbor, who put 3 tons of firewood in a 1/2-ton pickup.

The next issue will be to question the shop's records to understand what we know of the vehicle. Is it under warranty? Is this the first time the problem has arisen? Who built the unit, what was the problem that initiated the repairs in the first place, where did the parts come from, who installed the unit, who road-tested the vehicle before final delivery, has the vehicle been back for a two-week check? If the warranty period is a year or longer, have all routine maintenance services been fulfilled, does the vehicle show signs of abuse such as the driving tires being excessively worn or a 4-inch lift kit installed on the truck after your repairs etc.? Leave no stone unturned, because you are now protecting your wallet and your reputation, both of which

take a long time to build up but only a few short seconds to damage big-time.

The third step is a thorough, time-consuming inspection of the vehicle. Learn to work from the outside in, which means to start with the basic, simple issues that require little or no labor to check out and, as they are found to be within spec, go to more-detailed and labor-intensive procedures with the unit removal left until last if all other possibilities are exhausted. If the vehicle is drivable, by all means road-test it completely to duplicate the customer's concerns. It may be necessary to let the vehicle get cold before conditions will appear, or you may have to find a steep driveway to see what the complaint is. This is nitty-gritty time and you should not rush any of this.

Obviously, some failures will show up immediately, and others will not occur for you. Start from the outside in, by checking tire pressures and sizes, which means actual measurement of tire circumference. Mismatched tire sizes and pressures will create many problems with transmissions and transfer cases. Note whether the tires and wheels are stock sizes or oversized replacements.

Check all fluids, making sure they are at the proper levels and are the correct type for the application. Is battery voltage correct? Are any diagnostic codes stored? Are any other parts of the vehicle damaged, excessively worn, missing or bent (such as rear-axle tubes, frame or collision damage, stripped axle splines, bent or out-of-balance driveshafts etc.). Have any major aftermarket products been added or has the original vehicle configuration been changed? This intensive process will by now begin to reveal whether there is a problem and, if so, to narrow down the cause.

Here is a simple checklist of questions to be answered before

you establish the results of your road test and inspection:

Manual-transmission/ transfer-case symptom list

Leaks

- Check fluid level and type.
- Where is the location of the leak?
- How was the location of the leak found? (observed, dye and black light, parked on a newspaper grid overnight etc.)
- Color, quality and type of fluid
- Is the case leaking or porous?
- If a seal is leaking, what is the condition of the shaft component being sealed?
- If a booted seal, is the inner lip rolled by shaft installation?

Noise, Vibration, Harshness

- Description of noise
- Location of noise
- Which gear does noise occur in?
- What range of engine speed?
- What road speed?
- Clutch-pedal position and relation to noise (engaged, released, both)
- Throttle position (idle, coast, drive)
- Operating temperature of engine (cold, normal, hot)
- Effect of outside ambient air temperature on noise if any.

Noises are typically time consuming and difficult to diagnose because all operating components of the vehicle make certain amounts of noise. Noise is a subjective issue interpreted differently by each individual.

On manual transmissions most noises are created by worn or damaged internal components, engine harmonics entering the transmissions, and external sources such as clutch assemblies or final drives, where noises "walk" into the transmission area.

Worn internal components usually will be one of two types: bearings, in which case the noise will be very sensitive to speed changes; or gear damage, which usually is a ticking type of sound or a very intense growl from components that are missing teeth.

All engines generate firing pulses as the cylinders go into the power stroke, which changes the angle of direction of the crankshaft acceleration. Clutch-disc-hub damper springs and dual-mass flywheels help to compensate for these pulses, but there will always be some slight gear rattle.

Gear rattle sounds like a combustion knock and usually happens at low speed under load. Gear rattle is not harmful to the transmission but is irritating to the customer. Neutral gear rattle occurs while the engine idles with the clutch engaged and the transmission in neutral. If the motor is revved to 2,500-3,000 rpm and the noise goes away, this is neutral gear rattle. If the clutch is disengaged the noise also will stop. This is most common on diesel engines with an out-of-time injector pump, worn or damaged dual-mass flywheel, or incorrect or worn clutch damper springs.

Backlash noises are created by changing the load on the engine or the driveline. All driveline components have to have proper clearances to function, and excessive clearance or too little clearance will show up as backlash noise when the vehicle accelerates from a stop or coasts, or the throttle position is changed.

It is also important to understand the difference in internal gearing in the unit. For instance, helical-cut speed gears are manufactured specifically to reduce noise as much as possible. Many transmissions still have straight-cut gears for reverse; therefore, reverse will be the noisiest gear in the unit. The torque capacity and ratios of the transmission generally

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determine what acceptable levels of noise are built into the unit. This means that light- and medium-duty trucks with large, heavy gear trains and numerically high ratios in the lower speeds will generate more noise than a passenger-car transmission.

Shift noise

- Shifter out of adjustment
- Shifter buzz due to aftermarket components installed
- Worn or damaged synchronizer components

- Improper type of lube in unit
- High clutch-pedal effort or worn or misadjusted clutch
- Slippage of the clutch, or too much or too little free play
- Shudder, clash, grind
- Notchy shifts

Transfer-case noise

- Diagnostic trouble codes present?
- Is fluid correct for the application and at the proper level?
- Condition of fluid, such as metal contamination

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Up To Standards

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- Description and location of noise
- Are tire sizes and pressures matched exactly on all four corners?
- Does noise change with either propshaft removed?
- Which range does noise occur in - 2WD, 4WD high, 4WD Low or neutral?
- Is one of the differentials noisy? (Noises will "walk" through driveshafts and appear to be in the transfer case or transmission.)
- At what temperatures does noise occur?
- At which throttle position does noise occur - acceleration, deceleration, coast, steady load or stationary?
- Does the unit bind, and is it being operated in 4WD on dry pavement?

To be successful one must make an investment of time into a study of what you wish to learn. This is commonly called a learning curve, which can be achieved only by understanding the theory of operation of the systems you are repairing. The motor vehicle is now an incredibly complex series of systems that interact and work together to operate the whole design. Why is it that many people are concerned with only where the parts go and never take the time to learn what their function is and how they relate to each other? Why are so many of us quick to R&R a freshly rebuilt unit without considering every other part related to its operation?

As an industry we have this innate guilt that says it must be "my unit" that is causing the problem, and we tend to focus on what we just worked on while ignoring other possibilities. Unless you are 100% sure that a step was missed in the assembly process or a thrust washer was left out etc., what are you going to see by taking the unit apart? You will see a whole bunch of new parts that you just installed, and unless you find an assembly

mistake, you are no closer to the cause of the problem. You can't see a noise and you can't watch the internal operation, and unless you understand absolutely how all the related components work you are dancing in the dark.

I can't tell you how many times I have spoken with shops that tell me they have had three different units installed in a vehicle and still have the same problem. The odds of three separate units having the same defect are about the same as those of winning the lottery; therefore, the problem must be elsewhere in the vehicle, and a lot of labor has been wasted swapping units without looking at other related issues.

Case in point: A local shop bought a 4405 transfer case from us and it would not engage any of the ranges electronically. After extensive conversations and system checks, we discovered the fault to be in the rear-window-defroster grid. What does a rear-window-defroster grid have to do with the operation of the transfer case? Nothing, except that through multiplexing the grid turned out to be influencing the transfer-case circuit.

In short, it is better to invest a little time in a comprehensive analysis of each problem in an orderly, proficient manner than to throw labor and parts at the problem until something sticks. **TD**

The Bottom Line:

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