TECHNICALLY Speaking

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Audi A8 Quattro ZF5HP24 TCC Cycling Bang

One of the benefits of being a part of the Sonnax TASC force is the sharing of information and ideas that goes on between members. Knowing that someone else has been down the road you are on and may have learned about or at least worked on the same problem you are facing, is always reassuring. It is not uncommon for members to share their hard earned knowledge with each other and with other industry contacts as well. In this case, knowledge shared between European and U.S. TASC members reached outside of the group to help a non-TASC member. Brian Workman does hotline duty and other technical chores for Cottman Transmissions. Not one to forget a favor, Brian would like to share what he learned with you.

If you have ever driven an Audi A8 or any high end car using a ZF5HP19 or 24 transmission, you know these units are pretty smooth shifting and lockup is almost undetectable. This particular Audi came in with a customer complaint of a clunk or bump when you slowed down. Initially, the car was diagnosed, the unit removed and rebuilt. The converter was cut open, inspected and welded back together. The unit was reinstalled, bulk fluid was used to refill it and then it was road tested. Unfortunately the problem was still there. When I received the call, it was described to me as going in and out of lockup while slowing down from 80 to 60 miles an hour and then magically, it stopped.

The easiest thing to check first is the nose switch on the throttle position sensor; it tells the computer when you are at closed throttle. If it was malfunctioning, the computer might see the switch opening and closing, causing the problem. The technician tested the nose switch and said the contacts opened and closed perfectly.

At this point, we have to answer the following question: Is the transmission shifting the way the computer is commanding it to or is there still a problem in the unit or the converter? Hooking up a DVOM to the ground lead of the TCC solenoid will let you watch the TCC command from the computer. If the computer is commanding the TCC on and off, you should see voltage go up and down. That is exactly what was happening. Why would the computer command the lockup on and off while slowing down? Many imports pulse their lockup on and off when slowing, but this one you could actually feel. You could compare the feeling to stepping on and off the brakes fairly hard. In addition, there was another problem present. The unit had a clunk coming out of 3rd gear. It was staying in lockup until it downshifted into 2nd.

In this situation, the shop had a Solus Pro with the Vag Com software. This made it possible to do some thorough diagnostics before attempting any further repair. Watching the data on the scanner, nothing jumped out at as being wrong. Throttle position, mass air flow, the nose switch all appeared good. With this particular problem, what you need to watch is Trans temp, TCC slip and TC solenoid amperage. The scanner will have the TCC solenoid labeled as DCSV 4. That stands for Damper Clutch Solenoid Valve. These particular parameters are found under Trans Data Logs. There are many log files so you will have to do some searching to find the right ones. Remember to set your scanner view to 4 graph mode.

Watching those 3 parameters during the road test, you will see that TCC slip RPM and solenoid amperage are inversely proportional. As TCC amperage goes up, the lockup piston is applied more and TCC slip will go down. Figure 1 is a snapshot of the recorded data. Where TCC slip is high, the amperage is low, 0.144 amps. At 0.744 amps, maximum TCC apply is being commanded. Watch the amperage as the vehicle was slowing down. It was being toggled down 0.736 amps then right back up to 0.744 amps. That is a clear indication that the computer is commanding lockup cycling. Where you see the sharp spike is where you would feel the bump.

Amperage should not change unless the computer picks up a slip. Just like a GM or Ford when you see TCC duty cycle go to 100%,

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you know the unit is commanding full lockup. Could the clutch be slipping? Could the valve body be worn like those on a GM or Ford? The graph in Figure 1 shows that there is TCC slip. You replace the valve body first and see if that makes a change. With the replacement valve body installed, the 2nd road test proved there was a problem with the original valve body. The unit now shifted more smoothly and lockup was better, (not as hard) but still not right.

Figure 1

Figure 2 shows the same parameters that were graphed in Figure 1. The difference is the amperage spikes are not as sharp. You can see the small ramps as TCC amperage is increased and then drops off. What was seen on the scan tool matched what could be felt on the road test.

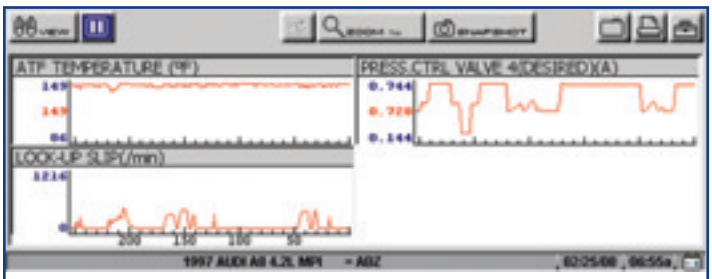

Figure 2

After making a few phone calls to get some feed back on these units, I learned from contacts at Sonnax that these ZF unit's are known to have converter problems, and this complaint is very common according to the builders in Europe. In fact, these converters are so problematic, the builders recommend using a tested ZF or a ZF rebuilt converter with synthetic fluid. The shop I was helping ordered a high end remanufactured converter. The unit was expensive, but the results were worth it! Installing the converter and using synthetic transmission fluid gave us phenomenal results. Not only did the transmission shift more smoothly than before, but lockup engagement was undetectable. The only way you knew it was in lockup was to look at the scanner.

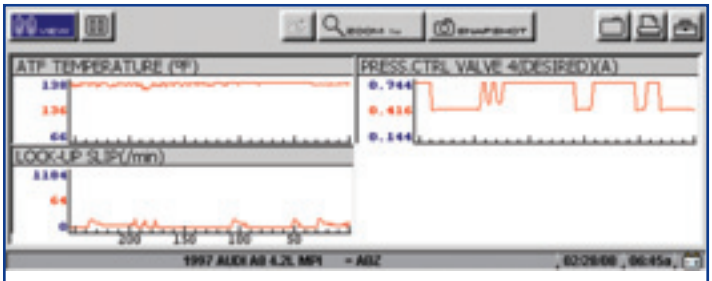

Figure 3

Figure 3 shows the data from the final road test. On TCC command you see amps go to 0.744 and you are in full lock up. TCC slip is 0 rpm's. On closed throttle you can see TCC desired amps drop to 0.416 and remain steady, TCC slip is minimal. No more spikes, no more ramping of the TCC solenoid and most important, no more TCC thump or bump. When slowing down to a stop, desired amps will remain at 0.416 amps until the transmission is commanded into 2nd gear. At that point lockup is turned off and desired amps drops to 0.144. Again, you won't feel any thump or bump.

With this type of torque converter and programming, the computer tries to control TCC slip on deceleration. If it can't get the transmission input speed rpm in line with the engine rpm, the computer will keep increasing the amperage until it reaches full lockup. There is the bump. At that point, it saw the ratio between the 2 speed sensors was not what the program intended and it immediately reduced the TCC amperage command. In this case the computer's inability to control the slip was caused by a worn out lockup clutch lining. In the transmission, when frictions wear, clutch pack clearances and piston travel increases. The same thing happens with torque converter lockup clutches and linings. This added piston travel resulted in the thump or bump you felt going in and out of lockup. These ZF units utilize a captive clutch design. Two characteristics of this design are the critical importance of piston travel on lockup function and the difficult disassembly, inspection and rebuild process. This could be why the converter was not repaired or replaced when it was initially cut open.

Another factor that contributed to the problem we experienced was a worn pressure regulator valve bore which resulted in higher line pressures. Since main line has an affect on all pressures in the unit, high line causes high converter charge pressure.

Remember all ZF-5HP-19 or a ZF-5HP-24's have this captive lockup clutch. If you happen to get a car in with this transmission and complaint, use a good converter, check the pressure regulator valve bore for wear, and always use a good full synthetic transmission fluid.

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• *For more information on captive clutches, see Joe Rivera's Dec 2005 and Ed Lee's March 2007 Transmission Digest technical articles.*