TURBO DIESEL REGISTER

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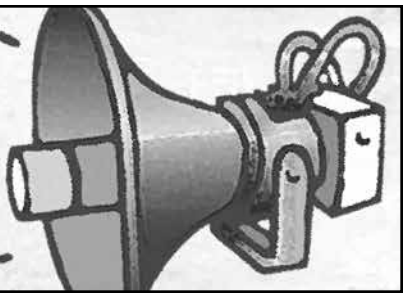
The Rest of the Story



Stan Gozzi retired from Chrysler in 2017.
He has graciously agreed to stay active in this hobby.
His column "The Rest of the Story" will give you a glimpse of the trials and tribulations that the factory guy(s) have to endure.

For TDR issue 109 the editor asked us, “What have you done to your truck with all the extra time you have had to get around to it?” Besides changing the differential and transfer case fluids to Amsoil, nothing. In fact, I went out and looked at the odometer I had driven exactly 35 miles in the past 75 days. It has sat patiently under the Cover King car cover for me to get back to work. The college also transitioned to online only classes on March 16, which means I have been teaching via Zoom since then. I have to say it is impossible to teach 6 hours of lab class a week on Zoom. So, unfortunately, the students have been shortchanged this semester. I have completed quite a few projects around the house, and I’m in the middle of an engine rebuild on a used car I picked up a couple weeks ago for $450.

DEF and Your 2013-2020 Trucks

If you spend much time on the Fourth Generation forum you might have seen some spirited discussions on DEF: the pros and the cons; and how you can keep your system trouble free. In Issue 102 (pages 102-106) I discussed some of the myths about DEF, and just how easy it is to clean a system that has crystalized.

In recent website discussions, one member in particular has spent quite a bit of time urging us to dilute the DEF from the 32.5% standard, to as low as 0%, or pure deionized water (distilled water for us lay people) to save our trucks from impending disaster and massive repair expense. I sat on the sidelines for a while, but when I got my new 2018 Turbo Diesel 2500, I decided to try a test. I knew the newer trucks including mine have a DEF quality sensor, so I was having a hard time understanding how one could run the DEF with diluted concentrations and not have “check engine” lights (CEL) for DEF quality or NOx efficiency. But enough thinking about it, time to do a test or two.

Let the Testing Begin

I let the DEF level go down to about ½ tank and checked the concentration with the OTC Refractometer we have at the college. It showed 32%. I then looked at the system using WiTECH and it also showed 32%. I added one gallon of distilled water and drove it around for a few days. The truck was now reporting 28% so I added another gallon of distilled water and drove it another few days. Now it was showing 24%. I drove it around under different conditions with no ill effects. I added another gallon, and now the concentration was showing 20% on WiTECH as well as on the refractometer. I took the truck on a couple-hundred-mile trip and was playing around watching data. One thing you can monitor, besides the DEF temperature and concentration is the DEF injection volume. Unfortunately, there was no way to run an accurate test because I had no way to duplicate driving conditions exactly. But, just looking at the DEF injection rate it appears that when using diluted DEF the system ups the amount of DEF injected to compensate for the diluted DEF. This makes sense to me, as the reaction inside the SCR catalytic converter is a chemical reaction between the DEF, the precious metals coating the substrate, and the exhaust gases. If the concentration of the DEF goes down, the volume has to go up to completely convert the nitrous oxides (NOx) to harmless gases.

Now, low DEF concentrations might just work out for us if it wasn’t for two pesky little devices the engineers added to the truck to make sure (insert your name here) didn’t mess with the system. Those two devices are a NO_x sensor and a DEF quality sensor. The NO_x sensor is in the exhaust and the DEF quality sensor is in the DEF tank. To meet the emissions standards we need to know how much NO_x is in the exhaust before and after the SCR converter. Then the ECM knows the proper amount of Urea to inject to end up with very little NO_x going past the second NO_x sensor and out the tailpipe after the SCR converter. If the two sensors do not measure the appropriate level of DEF concentration and the corresponding reduction in NO_x, it turns on the CEL, puts a message in the cluster, and if you drive it long enough, the truck will go into de-rate and eventually not start again.

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Now that we know a little background on the NOx sensor and the SCR catalyst and how it reduces NO_x emissions, what happens when you reduce the concentration of DEF? Well, the DEF quality sensor will do its job and, based on my experiment, monitor the concentration to ensure that it is 22% or higher.

Back to my results: Once I had driven for a couple hours at the 20% concentration level, I got the chime, a CEL, and a message in the cluster, "Incorrect DEF Detected, See Dealer."

A quick scan report on the truck showed an active fault code, P207F, Reductant Quality Performance. It took a little bit of playing around with concentration, but I proved that anything below 22% caused the P207F fault. I also set a P2BA9 fault, NO_x Exceedence – Insufficient Reductant Quality. The P2BA9 is saying that the ECM has determined that the NO_x reduction across the SCR catalyst is deteriorating faster than that of a degraded SCR catalyst. That is also a logical result, as there was not enough Urea concentration to convert all of the NO_x to harmless gasses. I know that because I cleared the fault, added pure DEF until the concentration changed one percent, then I drove under the same conditions again. When I got back to 22% the truck was happy. Once I had proved my theory of above/below 22%, I upped the DEF concentration to 24%. By now I was satisfied that the truck was a little smarter than I was, so I just upped the concentration so I would not have to be bothered with possibly being caught far from home and have to drain the DEF tank and refill with undiluted DEF.

So there you have it. Another solution to a problem that does not exist, and a myth debunked. As you can see from the before and after, the difference in deposits is not that dramatic.

Bottom Line

So the bottom line from my trade school/tech school experiment: if you want to add a gallon or two of deionized water once a year to do your own experiment, go ahead. (Just remember to travel with all of your factory reset-the-code tools in hand!) My advice: stay above 24% or you will be in tennis shoe mode after a while. But for me, my truck is again filled with 32.5% DEF so I can continue to do my part cleaning up the air in my neighborhood. (Don't worry, be happy.)

Stan Gozzi
TDR Writer

To Save You Time and Money

Editor's note: The TDR's mission: "To save you time and money in the maintenance of your Turbo Diesel." With that thought in mind, this DEF topic and the "Incorrect DEF Detected See Dealer" code seems to be increasing in frequency. Stan's Issue 102 discussion about removing and cleaning the DEF injector is such a simple-to-do task. Let's take you through the process. Here is a three photograph tutorial.

On my 2014 Ram 1500 EcoDiesel the injector is in the exhaust system under the passenger side of the truck, next to the frame rail.

It is held on with an expanding collar. A 4mm hex head was used to loosen the bolt. Next you expand/remove the collar. You can see the collection of white crystal material on the injector.

With the approved service tools (hot water and an old toothbrush) the white crystals were removed. I also cleaned the spray passage into the exhaust. Nice injector! Notice the three alignment tangs on the injector. Align, reattach the expanding collar and bolt it back on. Service time, 10 minutes (cold).

With the heavy duty/Cummins exhaust system the injector is held in with two 10mm bolts – it is much easier-to-service than the expandable collar on the EcoDiesel.

I called Stan to see if had any insight on the DEF-related messages and their severity. The consensus: If you get the "Incorrect DEF Detected See Dealer" you should add some fresh DEF. Since you took early action, the code may go away and/or it may be that it can be reset with a simple scanner. If you can, take the 30 minutes it take to clean your DEF injector. However, if you drive into the "5MPH Max Speed in XXX mi Service DEF System See Dealer" zone and exceed XXX miles, you will have to see the dealer for a reflash of the emissions system. The EPA does not want the DEF system compromised.

Robert Patton
TDR Staff