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In this issue of Watson Diesel Municipal News we will be discussing the evolution of emission regulations on your diesel engine.

Many of you more seasoned operators that were around in the early to mid-1970s remember the addition of emissions onto our once beloved gas engines. By around 1974 any car that you purchased probably had one or more of these devices. I was a teenager around this time and didn't understand much of what this stuff did or what it was supposed to do. Turns out that neither did the older guys working on them. The first emission device introduced in 1964 was the PCV valve or positive crankcase ventilation. Instead of having the old road draft tube venting crankcase gas into the atmosphere it was recycled back into the intake manifold to be re-burned. By 1974 emission regulations were in full swing. The introduction of air pumps, and EGR or exhaust recirculation valves were introduced. The air pump would pump fresh air into the exhaust manifold to add oxygen to help burn the unburned fuel that was still in the exhaust. The EGR valve took a % of exhaust gas and re-introduced it into the combustion chamber. The exhaust is incapable of either burning or supporting combustion, so its presence reduces combustion chamber temperature, which in turn reduces the formation of NOx. After this came the catalytic converter, electronic ignitions, and fuel injection systems.

Now fast forward 25 years and it's the same song, different verse! After 25 some years of being able to laugh at our poor gas engine brothers, look who is laughing now. Over the course of the last 25 – 30 years our gas engine brothers have refined their product to a level that no one ever thought they would see. The horsepower output, reliability, longevity, and yes lack of emissions are mind boggling! The average gas engine will run well over 100,000 miles without a tune-up, last for another 150,000 miles with regular maintenance and in light pickup truck dress get over 20 mpg. with performance that would eclipse our old "muscle cars" of the day. But it was a torturous 25 years of trial and error and tons of money spent on getting it right.

Now it is the diesel drivers turn in the EPA barrel. In 1990 it started with the addition of a simple catalytic converter (diesel oxidation catalyst) that was used to lower the NOx (nitrogen oxide gas). As more stringent regulations came into play the next step was the addition of the EGR system to further lower the NOx gas. This was effective in the same way that it was on its gas engine counterpart. That was the good news. Remember that the addition of exhaust gas back into the combustion chamber lowers the combustion chamber temperature. Combustion chamber temperature is a good thing in a diesel engine from a performance stand point as it is a compression ignition engine. Now the bad news. With lower temperature comes more soot in the exhaust as a by-product. This additional soot proved a problem in the diesel engine as it clogged up intake

manifolds, and turbochargers and the sensors that controlled the system operation. As the EPA continued to tighten the emissions output it became necessary to introduce the DPF or diesel particulate filter. It was used to essentially trap the soot. With the addition of the DPF came more sensors to tell the computer when it was full and thus ineffective. When the DPF becomes "full" the computer directs the engine to add diesel fuel directly into the exhaust system to start a fire if you will, and burn this soot off of the filter. In an effort to reduce the amount of soot being generated by the EGR system manufactures added the DEF or diesel exhaust fluid system. This tank of DEF fluid or urea would be injected directly into the exhaust causing a chemical reaction that made significant reductions in the NOx allowing for less EGR gas to have to be recirculated back into the intake and thus lowering the amount of soot associated with straight EGR only engines.

And that brings us to where we are today. In order to maintain an acceptable performance level, balanced with making emissions standards also meant using some very high tech injection systems such as the now popular "common rail systems". This system with its ultra-high injection pressures, combined with redesigned combustion chambers, computer controlled injection timing, and significantly higher engine operating temperatures, have accomplished these goals. But this has all happened at a very high price. Engine fuel mileage has suffered as well as engine life. In the early 2000s you could expect an engine to reach 100,000,000 mile plus before a scheduled overhaul. Now 500,000 mile is more common place. Also the cost of the parts to make this happen is mind boggling. Prior to emissions your typical turbocharger was \$750.00 and now you will pay upwards of \$5000.00 depending of the application. Injectors that were \$250.00 now will cost you \$750.00. The engine overhaul that was \$10,000.00 15 years ago is now well north of \$20,000.00. The sensors that are needed to coordinate all of this present constant problems as they are asked to operate in a very hostile environment. It is typical for even a well maintained system to have a dreaded "check engine" or "regen" light every week or so. DEF systems require heaters in the tank and or lines as the DEF fluid will freeze. Like our gas engine brothers 30 years ago, technicians are scrambling to find ways to keep all the balls in the air to make this all happen.

There are some operators out there that have become so frustrated that they have resorted to deleting some of these systems in order to make their engine somewhat reliable. But you have to remember that the tampering of these systems is a federal offense with huge monetary fines along with actual jail time. So what does one do? Our suggestion at Watson Diesel is first to understand the systems that your truck is equipped with. Then find a reliable shop to help you maintain these systems. Sometimes counseling by your technician will help. For example. Prolonged low speed, low load operations will not allow the prerequisites be met for the engine to regen (probably the most popular complaint that comes into our shop). In some cases where the regen has not happened for a long enough period, a trip to the shop may become necessary for us to do a "manual regen" with our laptop computer. Proper spec of new equipment will also help. We can help guide you through what is out there that is working and what is not working as well.

The bottom line is that these are the cards that are dealt to us and just like our gas engine brothers we will get through it. Things will get better as new technology along with experience will help to ease the pain. But remember as I tell all our customers. Don't complain to the engine manufacture or your shop. Complain to your government. This was their idea.