1. Technical Questions on Emissions and ANSED Exhaust Gas Diagnostics Software

1.1. What types of vehicles can be tested with ANSED?

ANSED software is designed to test virtually any gasoline or flex fuel-powered vehicle with a spark generated ignition system, from automobiles to motorcycles, either on or off road.

1.2. Why can't I test Diesel fueled vehicles?

The primary reason that diagnostics for diesel-fueled vehicles were not included in the software is the high particulate levels in the tailpipe samples. The "soot" will clog the analyzers filter systems very quickly. Diesel fueled vehicles are commonly tested with an "opacity meter", as well as a NOx analyzer – or a multi-gas analyzer with a special filtration system.

1.3. Can I use ANSED for LPG and CNG powered vehicles?

Yes. The emissions of these vehicles are quite similar to the various gasoline blends, and the ANSED software was designed to include diagnostics for these vehicles.

1.4. How do different gas types affect the outcome (i.e. Super vs. Regular)?

Whether the vehicle is running on Super, Regular, Plus, Gasohol, or E-85 brands of gasoline, you will find there is absolutely no impact on the diagnostic results. Correct AFR ratios vary widely with these different fuels, making AFR a potentially unreliable method to use for diagnostics. ANSED software is designed to utilize Lambda (which is unaffected by different fuel types) readings instead of AFR, allowing you to test virtually any gasoline blend and get accurate results.

1.5. Why isn't NOx being used in the diagnostics?

NOx can be an important variable for vehicles that fail in LOADED testing. Although NOx testing was considered during the development of the software, it was

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determined that the proper course was to design the software specifically for static testing. In static testing, it is virtually impossible to create NOx.

Key points to consider:

- If NOx is present during LOADED testing, there WILL typically be a failure in the other 4 gas readings. The diagnostics in the ANSED software will still point to the same answer. The presence of NOx at unacceptable levels is merely another proof of a problem that is diagnosed with the other 4 gases or a trouble code.
- Testing for NOx requires a dynamometer, which adds significant costs for the repair shop.
- There are liability issues in many states regarding test drives and insurance costs for the workshop of requiring test drives for the software to work properly.
- The state of internal diagnostics (onboard computer systems) for NOx related problems are actually quite good. Since NOx is an indicator of a significant problem with cylinder temperature that can lead to catastrophic engine failure and huge warranty expenses, the manufacturers have paid close attention to making sure trouble codes are set once NOx is being created in the engine.

1.6. Why is a 2 speed (idle and 2500 RPM) test not used in ANSED?

While the testing at 2500 RPM had been considered, it was determined not to include in ANSED for the following reasons:

- Since the advent of increasingly sophisticated electronic engine controls, the moment you raise the RPM above idle in an UNLOADED situation, you have put the system in an un-natural state. There are a variety of different responses (depending upon the manufacturer) that can include adaptations to lower the RPM to a normal state, variations in timing and fuel mixtures that would give false readings (masking) at the tailpipe.
- All the experts consulted agreed that the only way to accurately test a late model car at RPMs above idle would be to have a loaded test, as you would for NOx testing.

Testing at both speeds was the traditional way of diagnostics, and it had significant diagnostic value in the pre-computer engine control days when you had to run at higher RPMs to find problems with float levels, jet sizes and sticking weights in distributors amongst other things.

1.7. What does an efficient catalytic converter (CAT) do to our readings?

Analyzing the CAT was very important in the software design process. An efficient CAT cleans up a bit of the excess HC, CO, O2 (but not enough to impact the diagnosis at the levels of each gas we are using), but has zero impact on Lambda.

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ANSED utilizes all four gases, the Lambda reading and certain information about the vehicle, in combination, for diagnostics that are superior to diagnostics made on the four gases alone. In addition, the ANSED software incorporates tests that look for an inefficient CAT operation, so that ANSED can be utilized by the CAT manufacturers for warranty purposes.

- every car after 1981 is equipped with computerized engine controls. ANSED is primarily designed for these vehicles.

1.8. Why do I have to clear the MIL / Check Engine Light before testing?

When a vehicle with an on-board computer detects a fault, the on-board computer goes into a "default" mode of operation. In that mode, the onboard computer is using a set of values for fuel delivery and timing to make up for a known problem. The best thing for a technician to do is correct the known problems before attempting the advanced diagnostics with the ANSED software. Having a known trouble code is similar to opening the hood and seeing a wire unplugged, or seeing or hearing a major vacuum leak. The technician needs to correct the obvious problems before looking deeper.

1.9. Catalytic Converter and Exhaust System Codes P420-P439

The exhaust system plays a significant role in the performance of the engine. Damage to the system (crushing), leakage or any problem that causes a catalytic converter failure requires extra attention.

A good rule of thumb: The catalytic converter should last the life of any car – meaning anytime you set these series of codes and have a catalytic converter failure, something has likely happened to damage or contaminate the catalytic converter.

Please read the following section carefully for a series of quick and simple tests to insure you correct the underlying problem.

Although many technicians automatically replace a catalytic converter when they see these codes, they often correct only a symptom – not the underlying cause. In some situations, the catalytic converter may be perfectly good, but may not operate efficiently due to an imbalanced fuel mixture, or an exhaust leak or other problems as outlined below.

Before automatically replacing the converter, you can easily verify the performance of the converter with the following manual tests with your 4 or 5-gas analyzer:

First, verify that you have a LAMBDA reading between .995 and 1.005 after any repairs. This step is critical, as consistent readings outside this range will reduce the catalytic converter's efficiency:

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- Look closely for any indicators of a lean condition. This could be a LAMBDA reading higher than 1.005 – or situations where the O2 value exceeds the CO value, or when fuel trim numbers from your scanner indicates a correction for lean condition. If any of these conditions are present, you likely have a small vacuum leak, weak fuel pressure, restricted fuel filter or something similar. Note: The on-board computer may be making corrections to offset a lean condition, if undiagnosed and repairs are not made, the result could be reduced converter performance and durability.

- High hydrocarbons are often an indicator of other potential problems. If Lambda is good, and hydrocarbons exceed 65 ppm, you may still have an issue with spark or compression. If left unchecked this can result in reduced converter performance and durability, and eventually carbon contamination of the converter and O2 sensors.

Second, verify that the converter is functional with this simple test:

- Make sure there are no exhaust leaks and that the engine is in good fuel control.

- Allow the engine and exhaust system to cool off.

- Start the engine, and note the CO2 reading once it stabilizes after approximately one minute of idling.

- Once you have recorded the CO2 reading, raise the engine rpm to a fast idle (between 1500 and 2000 rpm) for 1 minute – and then return to idle and observe the CO2 reading again once stabilized. If your CO2 reading is at least .5% point higher after the fast idle period – your converter is functional and has "lit off". Please note that a catalytic converter can't "light off" unless Lambda is between .98 and 1.02.

- If the readings are virtually the same, you likely have a contaminated or damaged catalytic converter.

- If the test indicates a contaminated or damaged catalytic converter, a more in depth assessment of the engine and all related systems is required, as replacing a catalytic converter that failed due to contamination without finding the underlying cause will lead to a second failure. Common causes of failure due to contamination are:

    - Cooling system (head gasket, intake gasket) leakage
    - Use of non-catalytic converter safe gasket sealants
    - Excess oil consumption
    - Use of improper fuels.

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Often, common causes of converter failure such as problems with the ignition system, sensors, EGR system or fuel system components will often have other trouble codes (multiple codes are possible) set at the same time as the P420 – 439 series of codes, making diagnostics much easier.

A third test is designed to determine if the catalytic converter is capable of performing its job by checking the inlet and outlet temperatures with in infrared thermometer:

- Make sure there are no exhaust leaks and that the engine is in good fuel control.

- Measure the temperature of a fully warmed up converter (engine at normal operating temperature, and after a 1 minute at fast idle), by pointing your infrared thermometer at the Front Weld Ring (not the shielded area of the converter) and at the Rear Weld Ring. There should be a difference of at least 150 degrees F (65 degrees C), with the Rear Weld Ring being at the higher temperature, indicating that the converter has "lit off" and is capable of doing its job.

- It is important to note that normal converter temperatures rarely exceed 1200 degrees F (650 degrees C) on a properly running car. If you see temperatures higher than that, there is very likely a problem in the ignition, fuel or engine systems.

- Periodic or repeated temperatures exceeding 1600 to 1700 degrees F (870 to 925 degrees C) will likely damage a catalytic converter's precious metals and substrate leading to a total failure.

The last step is to verify the repairs by test-driving the vehicle:

- Use a scan tool to verify that the converter has passed the PCM monitors. If it does not, revisit the steps listed above.

- During the test drive, monitor the misfire counter during various speed and load conditions. Misfires introduce both excessive oxygen and fuel into the exhaust. This combination will quickly cause the catalytic converter temperature to rise excessively, which can cause rapid damage (melting) of the substrate.

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