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Diagnosing Emissions Problems

Why did you fail?

The following is information to help you to understand some of the basics of smog and emissions.

FAILING AN EMISSIONS TEST

When a vehicle fails an emissions test, the motorist usually receives a printout that show the test results of the vehicles emissions as well as the applicable cut points. From this, you can determine if too much HC and/or CO caused the vehicle to fail.

What is smog? Smog is airborne pollution. The type of smog that we're most concerned about in the automotive industry is ground level ozone. Ground level ozone is caused by Nitric oxides and Volatile Organic Compounds (VOCs). Nitric oxides are produced by your engine and gasoline is a VOC. Ground level ozone causes health problems such as asthma, immune system dysfunction, and cancer. It also is responsible for the orange haze you see in Los Angeles.

What are emissions? Emissions are the gasses that come out of your tailpipe. There are five automotive tailpipe emissions: Hydrocarbons, also known as HC, which is unburned gas, a contributor to ground level ozone. Carbon Monoxide, also known as CO, which is a byproduct of combustion (kind of like soot). Carbon Dioxide, also known as CO₂, is a greenhouse gas which contributes to global warming. Nitric Oxides, also known as NO_x, is a contributor to ground level ozone. Oxygen, also known as O₂, is not bad for you or the environment. Unfortunately, only 1% of what comes out of the tailpipe is oxygen.

What is checked as part of a smog inspection? There are 3 areas of inspection:

- Visual inspection is done to make sure all of the smog equipment that is supposed to be on the car is there and properly hooked up.
- A functional check of the timing and the EGR systems, to make sure that they are working properly.
- Finally there is a check of the emissions. California has 2 types of SMOG checks. SMOG Check 1 which checks emissions at Idle and 2500RPM, and SMOG Check 2 which is done at 15MPH and 25MPH.

What causes high HC (hydrocarbon)? High HC is caused by incomplete combustion; in other words, the air and fuel that went in to the combustion chamber was not completely burned, now the unburned fuel has ended up in the tailpipe. Problems that can cause incomplete combustion include:

- An ignition misfire. If a spark plug does not spark, the air/fuel mixture in the combustion chamber does not burn and then goes out the tailpipe. Worn or fouled spark plugs, bad plug wires, cap and rotor or combo of all.

- Low compression. If the compression is too low the air/fuel mixture will not ignite and the unburned fuel will go out the tailpipe.
- Hydrocarbon failures can be caused by oil burning due to worn valve guides, valve guide seals and/or rings.
- A bad catalytic converter. The converter lives in the exhaust pipe and burns unburned gas as it passes through.

What causes high CO (carbon monoxide)? High CO is caused by a rich air/fuel mixture. The air fuel ratio should be 14.7 parts air to 1 part fuel. Problems that can cause a rich mixture include:

- Problems with the feedback system (the system that regulates the fuel being added to the engine based on the amount of oxygen in the exhaust).
- Stuck choke.
- Misadjusted or fuel saturated float, or a rich idle mixture.
- On Fuel Injected and Throttle body injection systems problems with a computer sensor such as the coolant temperature sensor, air flow meter, MAP sensor, etc..
- Problems with the fuel pressure. Fuel pressure that is too high can cause a rich mixture.

What causes high CO₂ (carbon dioxide)? High CO₂ is the product of a good running engine. The better your engine runs, the more CO₂ it produces.

What causes high O₂ (oxygen)? High O₂ can be caused by a lean air/fuel mixture, but most of the time, noticeably high O₂ is caused by either a leak in the exhaust pipe allowing air to enter, or air injection pumping air into the exhaust (this is done on some cars to aid in the burning of HC). High O₂ is not a problem unless the smog machine decides the exhaust sample is too diluted to use; in which case, the car may fail the smog test for dilution.

What causes high NO_x (nitric oxide)? High NO_x is caused by high combustion temperatures and pressures. Problems that can cause high NO_x include:

- An inoperative EGR system. The EGR system was designed specifically to reduce NO_x; that's its only function. The EGR, which stands for Exhaust Gas Recirculation, allows exhaust gas to enter the combustion chamber through the intake. The exhaust gas has a cooling effect on the combustion chamber.
- Over advanced ignition timing. The more advanced the ignition timing, the higher the combustion chamber temperatures.
- Overheating. If the engine temperature is too high the NO_x emissions will go up.
- Lean air/fuel mixture. If the air/fuel mixture is too lean the combustion temperature will go up.
- Compression over specification. Normally when we think of engines aging we think of the compression going down. However, there are a couple of ways the compression can increase as the engine is used. One is carbon buildup on the tops of the pistons. When carbon forms on the tops of the pistons, the combustion chamber area decreases and the compression ratio increases. The carbon can be manually scraped off the tops of the piston to correct this problem, but that would require disassembling the engine.

- Mysterious reasons. Sometimes NOx is too high and there's no obvious cause: the EGR works, the timing and advance work normally, the engine temperature is within range, the air fuel mixture is good, and the compression is within spec. When this happens you can try a little tweaking. Retard the timing 2 degrees (the maximum allowed). Clear out the EGR passage even if the passage seems fine.
- Catalytic converters can become clogged and may need to be replaced depending on the age of your vehicle.

Both HC and CO are high? The vehicle may have a bad catalytic converter or an air pump problem.

What is a Gross Polluter? A Gross Polluter is a vehicle that has failed the smog check by a certain amount, usually somewhere around 1.5 times the maximum allowable emissions or above.

WHY SOME VEHICLES THAT SHOULD PASS AN EMISSIONS TEST DO NOT

Most vehicles that are in good running condition and properly maintained should pass an emissions test. In some cases, though, minor problems may cause the vehicle to fail an emissions test. These include:

- **Engine and/or converter not at operating temperature.** If a vehicle is only driven a short distance to the test facility, it may not be warm enough for the engine to be at normal operating temperature and/or the converter at light-off temperature. This will affect the emissions of the engine and may cause it to fail. Excessive idling while waiting in a test lane may also cause the catalytic converter and/or oxygen sensor to cool down enough where they may not control emissions properly causing higher than normal readings.
- **Idle speed too high.** A few hundred rpm can sometimes make the difference between passing and failing an emissions test if emissions are marginal.
- **Dirty air filter.** A restricted air filter will choke off the engines air supply, causing higher than normal CO readings.
- **Worn or dirty spark plugs.** Excessive plug gap and fouling deposits can create ignition misfire resulting in excessive HC emissions.
- **Dirty oil.** The oil in the crankcase can become badly contaminated with gasoline if a vehicle has been subject to a lot of short trip driving, especially during cold weather. These vapors can siphon back through the PCV system and cause elevated CO readings.
- **Pattern failures.** Some vehicles tend to be dirtier than others for a given model year because that is the way they were built. It may be the design of the engine, or the calibration of the fuel or engine control system. These kinds of problems may require special "fixes" that can only be found in factory technical service bulletins. Samurais are very prone to this problem.

In areas that have plug-in OBD II emissions testing for 1996 and newer vehicles, the vehicle will be rejected for testing if all of the required OBD II readiness monitors have not run. This may require driving the vehicle for several days until all the monitors have run. The vehicle will also fail the test if (1) the test computer cannot establish communication with the vehicle PCM (defective or disabled diagnostic connector), (2) if the Malfunction Indicator Lamp (MIL) is on, or there are fault codes in the PCM. If the OBD II system is working properly, the MIL is not on and there are no codes, the vehicle should pass the test.