

Carbon Build-Up

How Do Carbon Deposits Affect Emissions?

A properly tuned engine is required for optimal engine performance. Unless the vehicle is tuned to factory specifications, catalyst and emission related problems including catalyst efficiency codes can be triggered. Today's tune-up no longer simply consists of replacing plugs and checking fluids. Due to tighter engine tolerances and more sophisticated controls, additional work may need to be performed to prevent and correct emission related codes.

How Does Carbon Build-Up Affect Engine Performance?

As the engine operates, carbon deposits may form in places such as the valves, ports, pistons, head gasket and piston rings. This carbon can interfere with normal combustion in several ways. It can alter the engine's operating temperature, compression ratio, and several other important factors involved with combustion and sensor readings.

How Can Carbon Alter the Sensor Readings?

The carbon contributes to abnormal combustion in several ways, but the most dramatic effect in a modern fuel injected engine is the "sponge effect". As the fuel mixture in the cylinder is compressed, the carbon has a tendency to absorb both oxygen and fuel. Once the ignition spark fires, the flame front normally spreads through the chamber, consuming the fuel and air, however, the carbon has a tendency to extinguish the flame front and stifle combustion. This, combined with the fuel and air that was absorbed, results in poor efficiency. As the chamber decompresses during the exhaust portion of the stroke, the unburned fuel and air is released, resulting in both excessive fuel and air (containing oxygen) entering the exhaust system. The O2 sensor detects the excessive oxygen and the vehicle computer (ECM, ECU, PCM) compensates for this by enriching the mixture. This causes poor catalyst efficiency, and increased carbon formation. The situation is aggravated by the overly rich mixture, resulting in the engine's failure to reach a sufficient temperature to remove these deposits. In addition, the excess fuel can permanently damage the catalyst or cause meltdown (on the outlet side as opposed to the inlet) and can get hot enough to melt stainless steel substrates.

Does Carbon Alter Combustion in Other Ways?

Absolutely, in addition to causing poor combustion, excessive build up can also alter the vehicle's compression ratio. The carbon fills up spaces around the piston rings, head gasket, and spark plugs. This decreases the amount of space that is available in the combustion chamber. This increases the compression, which can cause the engine to overheat, ping (detonate), and also causes an increase in NOX emissions. Due to the fact that the carbon can retain oxygen from the combustion process, it can cause another interesting effect that can cause the vehicle to either trigger a light or fail an emissions test. A catalytic converter requires certain conditions to break down harmful emissions. It requires a slightly rich mixture and a low oxygen level in the exhaust system to break down NOX. Because the carbon causes increased NOX emissions and also causes excessive oxygen to leave the combustion chamber unconsumed, this actually impairs the catalyst's ability to remove the NOX from the exhaust.

How can this Carbon be Removed?

As outlined above, carbon build up adversely affects every aspect of combustion. In order to correct this condition, this carbon must be removed somehow. There are a number of methods that can be used, and some of them work better than others. Light build-up can be removed and prevented with the use of fuel system cleaners added to the fuel. Recommended brands are Techron Concentrate and Lucas Fuel Stabilizer. For moderate to heavy build-up, a more aggressive approach should be taken. A cleaner intended for this purpose must be injected directly into the system. Recommended brands are Seafoam, BG-44K, Berryman B-12, and Motorvac. These systems operate by introducing a solvent into the combustion chambers in greater concentration, either through the fuel rail or through a vacuum line. The vacuum method works well, but does not have precise control, nor does it clean the injectors. The main benefit is that it does not require any special tools, simply unhook a vacuum line and feed the cleaner in. Make sure to follow the instructions on the package. This method also works for vehicles that do not have Schrader valves on the fuel rail.

How can Carbon Build-up be Prevented?

By using the correct fuel octane (too high an octane may cause build-up), and by using a fuel system cleaner or high quality gasoline. Also, make sure the vehicle gets serviced at regular intervals.