CAUSES of REDUCED FUEL EFFICIENCY

OIL & FILTER CHANGES

It is common knowledge that, at some point, engine oil must be changed. Many factors contribute to a motor oil's demise, but it is essentially the accumulation of contaminants in the oil and chemical changes in the oil itself that make a motor oil unfit for further service. With time, it is inevitable that the oil will be contaminated by dirt or sludge, or succumb to the extreme pressures or temperatures found inside an engine.

Combustion By-products
Combustion produces several by-products that also act as contaminants. Water and acids lead to sludge, rust and corrosion. Soot and carbon create sludge and varnish and can clog filters. Unburned fuel in liquid form is deposited on cylinder walls where it leaks past the rings into the crankcase. Sludge deposits collect on oil pump screens, limiting the flow of oil to vital engine parts and resulting in rapid and destructive wear. When oil becomes contaminated, its viscosity changes: soot, dirt, oxidation or sludge increases viscosity and fuel dilution decreases it.

Extreme Heat
Today's engines are running hotter than ever. More horsepower, turbo chargers and aerodynamic styling have created extremely hot environments that receive less cooling from outside air. High heat leads to oil oxidation, deposits, and thickening in conventional oils. Because they are made from impure, irregular molecules, conventional motor oils are more susceptible to the effects of heat. The small, light molecules in conventional oil tend to evaporate as the oil is heated, leaving large, heavy molecules behind and leading to oil consumption and an increase in the oil's viscosity. If those large, heavy molecules are chemically unstable, they may also break-down and form deposits on component surfaces, further inhibiting the release of heat into the oil stream.

FUEL SYSTEM MAINTENANCE

We often hear about dirty fuel injectors, but what makes them dirty? Most of the time it's not actually from dirt or debris in the fuel, but the fuel itself. Gasoline contains waxy compounds that can leave varnish deposits at the injector pintle when the fuel evaporates. These deposits tend to form after the engine is shut off. Heat from the engine causes residual fuel in the injector tips to evaporate, leaving a varnish deposit.

These deposits in the nozzle build up and restrict fuel flow or disrupt the injector's spray pattern. On many late-model engines, the shape and direction of the spray pattern is critical for clean combustion and good performance. If the injector nozzle is dirty, the pattern may be distorted or deflected to one side, causing a lean spot in the combustion chamber that can cause misfire, or even pre-ignition or detonation.

It doesn't take much of a restriction in an injector to lean out the fuel mixture. Only an 8% to 10% restriction in a single fuel injector can be enough to upset the air/fuel mixture and cause a misfire or poor combustion. Because these deposits are right at the pintle opening, the only good way to remove them once they accumulate is using a powerful cleaner that is run through the injector with the injectors isolated from the fuel system. A maintenance service like this costs hundreds of dollars.

To avoid cleaning cost, loss of performance, and a decline in fuel efficiency, the best remedy is to prevent deposits from forming in the first place. Using a costly additive/cleaner in your fuel tank is not the answer. The concentration it would take to remove these deposits would cause your vehicle to run very poorly, probably not start cold and possibly cause damage to your fuel system, catalytic converter and elevate emissions. Gasoline is supposed to contain enough detergent to prevent these deposits from sticking and accumulating in the injectors. But guess what? Not all gasoline is the same.

UNDERSTANDING ENGINE DEPOSITS

Deposit formation is a normal by-product of the gasoline burning process, but if these fuel-related deposits are not properly controlled, they will cause a gradual loss of engine power, fuel economy and driveability.

The power loss and driveability symptoms that these deposits cause often occur so gradually that the driver may not even notice it, but once the deposits are cleaned from your engine, it should perform like it did when it was new.

The gasoline you buy at your local gas station is blended to conform to a minimum detergent additive standard that the federal government has established. Many gasoline retailers use a lower quality additive package that will allow power robbing deposits to build up on your engine's intake valves, in the combustion chamber, and if your engine is fuel injected, in the fuel injectors. Carbon deposits can also build up on the piston rings, causing them to stick in the piston grooves, which can lead to a loss in engine compression and cause the engine to burn oil.

The deposits that build up on the intake valves and in the ports can cause a loss in engine power because these deposits will restrict the flow of the air/fuel mixture as it flows into the engine's cylinders. The deposits that build up in the combustion chamber can cause an engine to knock or ping because these deposits can create a hot spot in the combustion chamber thus increasing the engine's need for more expensive higher-octane gasoline. The build-up of these various fuel related deposits will also cause an increase in the engine's exhaust emissions, which may cause the vehicle to not pass the smog test that is required in most areas of the country.

DEPOSITS AND PERFORMANCE

Back in the days of carburetor-equipped engines and leaded gasoline, a proper engine tune-up included the use of a top engine cleaner to remove the carbon deposits that built up on the intake valves and in the combustion chambers of the engine. Today's modern fuel-injected engines may go a lot longer between scheduled tune-ups than a vintage carburetor-equipped engine, but engine decarbonization should still be part of your scheduled vehicle maintenance program. That's because the gasoline the engine uses during the combustion process is still causing power-robbing deposits to build up in your engine.

The air flow from the PCV (positive crankcase ventilation) system and EGR (exhaust gas recirculation) valves will also cause fuel- and carbon-related deposits to build up on the intake valves, which will restrict the airflow into the engine's cylinders and cause the engine performance to diminish. The carbon deposits that form on the top of the piston and in the combustion chamber will increase an engine's need for high-octane gasoline because the deposits will artificially increase the heat in the engine's combustion chamber.

The carbon deposits that form on the intake valves both restrict the flow of the air/fuel mixture into the cylinders and negatively effect fuel vaporization. If the fuel is not fully vaporized and properly mixed with the air in the engine's cylinders during the combustion process, part of this fuel may go out of the cylinders as unburned hydrocarbons.

These unburned hydrocarbons can cause an engine to fail a smog check because the unburned hydrocarbon (HC) content in the exhaust may exceed the emission test standards. These carbon deposits can also cause cold start and driveability problems as the engine warms up because they can actually act as a sponge by momentarily absorbing some of the fuel that is needed for proper combustion.

Detergent Gasoline

The gasoline that is sold at your local gas station must conform to an EPA-mandated minimum level of "detergents" to help prevent and reduce the build-up of fuel related carbon deposits that both increase exhaust emissions and reduce engine performance. Unfortunately, all the various blends and brands of gasoline are not created equal.

Several of the world's top automakers worked together to establish a higher "Top Tier" standard for gasoline that would contain a higher level of deposit control additives. Even so, many gasoline retailers sell gasoline with a lower quality additive package that is not strong enough to keep the engine deposits under control. Unless you are always using a gasoline that conforms to "Top Tier" gasoline standards, it would be a good idea to use a fuel system cleaning chemical on a standard maintenance schedule.

EXHAUST SYSTEM

Converter Basics

The purpose of any catalytic converter is to reduce harmful emissions from the exhaust of a "properly tuned" combustion engine. It accomplishes this through a combination of heat and a precious metal catalyst that causes the harmful emissions to either oxidize or reduce to safe elements in the exhaust flow.

If the engine is out of tune and not calibrated to OEM specs, the catalytic converter's efficiency is greatly diminished and could lead to a converter failure.

A precious metal catalyst coats an extruded ceramic honeycomb substrate which has hundreds of flow channels. The channels allow the exhaust gases to come in contact with a maximum amount of surface area where the catalyst reaction takes place. The catalyst must come in direct contact with the exhaust gases for the reaction to take place. If the ceramic inside your converter becomes clogged or coated with carbon, lead or oil, then the converter's efficiency is greatly reduced.

An overly rich mixture will cause the catalytic converter to overheat because there is too much unburned hydrocarbons entering it. The converter catalyzes hydrocarbon molecules and this causes them to burn at a lower temperature, and they burn inside the converter or immediately downstream of it. If the converter gets hot enough the ceramic substrate will melt and turn into slag, blocking the passages in it.

Excess Fuel Overheating The Catalytic Converter

For some reason, whether it's faulty injectors, O2 sensors, or ignition misfire, the engine is either running too rich or is putting out too much unburned gas into the exhaust. If an O2 sensor is missing this would definitely cause an over rich fuel mixture since this is the device that tells the computer how to adjust the mixture at the fuel injectors based on whether it's too lean or too rich.

Other possible causes for the excess fuel entering the exhaust system are an incorrect fuel mixture, incorrect timing, corroded spark plugs, worn and cracked ignition wires, improper fuel pressure, a faulty oxygen sensor, sticking float, faulty fuel injector or a malfunctioning check valve.

Catalytic Converter Failure

If a catalytic converter fails, one of the most likely reasons will be: excess fuel entering the exhaust. Any fuel that leaves the combustion chamber unburned will enter the exhaust system and light-off when it reaches the catalytic converter. This constant infusion of unburned fuel will cause temperatures to continuously rise above the designed operating temperature and can super-heat the converter far above normal operating conditions and cause a meltdown. The majority of the causes (incorrect fuel mixture, corroded spark plugs, sticking float, faulty fuel injector) are a direct result of carbon deposits, poor quality fuel and/or excessive heat.