Mighty AUTO PARTS Tech Tip

FUEL SYSTEM 188

CARBON AND GUM DEPOSITS

Their Effect on Engine Performance

Two vehicles with no-start symptoms…both due to fuel related issues.

On one vehicle the customer complaint started with a misfire condition which progressed to an extended crank time to start and eventually a no-start symptom. Performing the basic checks revealed a compression loss as the reason for the no-start condition. Removing the valve covers to observe valve action revealed some lazy moving valves. While bumping the engine over with the starter we observed some valves that took several seconds to fully close and some would not completely close. Pulling the cylinder heads and removing the valves revealed heavy concentrations of carbon had accumulated on the intake valves and stems, preventing full contact of the valve face to the seat in the cylinder head. Obviously, the engine would not seal, resulting in a loss of compression.

The second vehicle had been running perfectly, but failed to start the following morning. A compression test revealed low or no compression on some cylinders. Pulling the valve covers and observing valve movement revealed slow or no valve movement once the valves were moved to the open position. The cylinder heads were removed and disassembled, revealing a gum-like residue on the valve stems, thereby restricting valve movement.

We were dealing with two fuel related issues:

1) **Carbon build-up**…Detergents and deposit control additives are added to the fuel to help prevent the formation of carbon deposits on the intake valves. This is especially a problem with Gasoline Direct Injection (GDI) whereby the fuel is injected directly into the combustion chamber instead of on the face of the intake valves, which provides a fuel wash for any contaminates, including oil vapors collected via the PCV system. Valve overlap further adds to the accumulation of deposits, as some combustion gases are forced past the intake valves promoting carbon build-up.
2) **Gum-like residue**…The residue had the appearance of molasses and was restricting movement of the valve stems in the valve guides. This condition is especially a problem on low mileage engines with tight tolerances. The condition is more pronounced once the engine cools down and the gum-like residue solidifies, forming a sticky, gummy or waxy like substance. The contamination is due to a lack of anti-oxidants and deposit control additives in the fuel to prevent the formation of gum. This condition is prevalent in fuel that has been in storage too long or blended improperly.

ELUSIVE MISFIRE CONDITIONS

In addition to the normal diagnostic procedures necessary to identify a component or system that may be causing a misfire condition, do not rule out excessive carbon deposits as the culprit.

Customer complaints of misfires, rough idle, long crank times or no-start conditions often occur due to carbon build-up on the intake valves and in the combustion chambers. Misfire codes may be stored in the ECM. Often the vehicle will run rough for a few minutes and then the engine will run perfectly. The reason is the carbon accumulates in a porous form and initially absorbs the fuel, which creates a lean fuel condition. Once the carbon becomes fully saturated with fuel, the engine will run perfectly until the next cold start. The formation of these deposits can collect on the fuel injectors, affecting their spray pattern and resulting in hard starts, misfires and excessive levels of hydrocarbons and carbon monoxide. Often, excessive carbon deposits may be viewed with a lighted bore scope through the spark plug holes.

Carbon deposits can cause an increase in the compression ratio, often requiring a higher octane fuel to prevent spark knock. This can be a problem with turbocharged engines as the boost pressure increases the compression ratio to a level resulting in violent detonation. Higher compression ratios can result in pre-ignition of the air-fuel mixture resulting in detonation. Carbon knock can also result due to the pistons making contact with the carbon deposits.

A NORMAL CHARACTERISTIC

On vehicles equipped with Gasoline Direct Injection (GDI) a common customer complaint is long crank times to get the engine started. Often technicians spend a lot of diagnostic time chasing a mechanical or fuel related problem such as fuel drain-back as the culprit. Many fuel pumps have been replaced in a futile effort to resolve this issue.

Be aware that GDI equipped engines have a longer cold crank time than engines equipped with port fuel injection. The GDI system operates at higher fuel pressures. The mechanical fuel pump must build up the required pressure before the first injection event occurs. The colder the ambient temperature, the longer the crank time. E85 fuel will further extend the crank time.

In addition, clicking noise complaints are common with the GDI system due to the noise emitted from the mechanical fuel pump and the injectors pulsing under extreme pressures. These complaints are to be considered a normal characteristic with the GDI system and no corrective measures should be attempted.

CARBON REMOVAL

There is more than one school of thought concerning the removal of carbon from the intake valves, combustion chambers and turbochargers. Most vehicle manufacturers agree that heavy concentrations of carbon being dislodged can create damage to the engine and turbocharger. Some recommend the components be removed from the engine and disassembled for carbon removal. Others recommend cleaners introduced through the intake. Removing the intake and blasting the valves with walnut shells is another option. The key is minimizing the formation of the deposits before they become heavily concentrated and can damage the engine components when dislodged. Ask your Mighty representative for information and a demonstration of his Total Intake System Cleaner. This product offers a safe and effective means of removing carbon build-up.

GM'S RECOMMENDATION

GM recommends the following procedure to free up sticking valves and to remove carbon from the valves and pistons. When performing this induction cleaning procedure, GM warns that extreme care must be taken to prevent the engine from hydro-locking when the cleaner is being introduced. If too much cleaner is introduced at a low RPM, or if too much cleaner is introduced at once, the engine can hydro-lock, causing major engine damage such as bent connecting rods. The procedure is as follows:

a) With the engine at normal operating temperature, slowly induce a bottle of Upper Engine and Fuel Injection Cleaner into the engine via a delivery device through the throttle body or an engine vacuum source, depending on the engine configuration. The engine RPM should be set at approximately 2,000 RPM to prevent the engine from stalling.

b) Once the cleaner has been introduced, allow the cleaner to soak into the carbon with the engine off for approximately 2-3 hours. Not more than 3 hours as the deposits may harden up again.

c) Add a bottle of GM Fuel System Treatment Plus (MTY FL108) to the fuel tank and fill the tank with a Top Tier fuel (explained later in this article).

d) Test drive the vehicle to circulate the fuel system treatment added to the fuel tank.

e) Re-evaluate the performance complaint. If the condition is improved but not repaired, a second decarbonizing procedure may be necessary.

f) Change the oil and filter and advise the customer to only use a Top Tier fuel. A bottle of the fuel system treatment should be added to the fuel tank at every oil change.

PREVENTIVE MAINTENANCE

Excessive carbon build-up can result in damage to engine components when large chunks of carbon are dislodged. Performing an induction cleaning annually or every 15K miles can help prevent the formation of heavy carbon deposits.

In addition, adding a fuel treatment such as Mighty's FL108 to the fuel tank following each oil change can help reduce the formation of intake valve, combustion chamber and fuel injector deposits that could damage engine components, the catalytic converter or turbocharger.

TOP TIER FUEL

Eight automotive companies including GM, Fiat Chrysler Automobiles, BMW, Honda, Toyota, VW, Audi and Mercedes-Benz worked together to develop stringent gasoline standards known as Top Tier Detergent Gasoline and they recommend it for use in their vehicles to reduce intake valve deposits. The required detergent level in this fuel contains 2-3 times more detergents than the minimum standard set by the EPA and Canadian General Standards Board (CGSB). Do not confuse Top Tier Fuel with higher octane fuels commonly sold at fuel outlets. It's all about detergent levels, not octane ratings. Top Tier Fuels cannot contain metallic additives, which can harm the vehicles emission system and create pollutants. Often these additives are used to raise the fuel octane rating.

This is a voluntary program for the fuel marketers and not all will offer Top Tier Detergent Gasoline. This fuel is considered the premier standard for gasoline performance.

For a list of gasoline brands that meet the Top Tier gasoline standards visit www.toptiergas.com and click on Retailers.

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