

Tech Tip

FUEL SYSTEM 151

CHEMICAL DEPOSITS They Can Create Major Performance Problems

The crusty deposits that form on the intake valves and fuel injector tips can create major engine performance problems. Earlier design injectors were of a pintle design and were notorious for crusty deposits forming on the injector tips, restricting fuel flow. Not long ago, the vehicle manufacturers introduced a new design fuel injector that was certain to eliminate the problem of deposits forming and baking on the injector tips. Today, some of those same vehicle manufacturers acknowledge that this style injector may require cleaning or additives in the fuel to remove the same crusty deposits. Deposits that restrict the fuel injectors will have an effect upon the idle quality; they promote hard starting, poor fuel economy, reduced power, increased emissions, and stalling.

Controlling combustion chamber and intake valve deposits is another challenge. Excessive deposits will result in an increase in exhaust emissions of hydrocarbons, carbon monoxide and oxides of nitrogen. In addition to increasing emissions, the contamination can result in a reduction in engine performance and can promote driveability issues. Injector deposit formations accompanied by intake valve and other combustion chamber deposits can create some difficult to diagnose performance conditions.

Today's fuel incorporates additives and detergents designed to minimize or prevent deposit formations in fuel injection systems, intake valves, combustion chambers and the air induction system. EPA's requirements for the fuel additives and detergents have greatly reduced deposit formations. While fuel technology offers some relief from the deposits, special cleaners may be required to remove some of the deposits. Let's consider some conditions associated with fuel injector, intake valve and combustion chamber deposits.

FUEL INJECTOR DEPOSITS

Fuel injectors contaminated with deposits result in a poor spray pattern prompting an erratic idle, loss of power, difficult starting, lean performance symptoms, increased emissions and poor fuel economy.

Most of the injector deposit conditions stem from the heat soak period that occurs immediately following engine shut-down. Obviously, short trip or town driven vehicles are the best candidates. The design of the injector also contributes to plugging. For instance, the pintle valve

design is more susceptible to plugging than the metered disc design as found in GM's "Multech" design, or other non-pintle valve design injectors. The olefins and diolefins in the fuel bake on the injector tips during engine shut-down and heat soak. The condition is more pronounced on injectors that seep fuel after engine shut-down. This condition is referred to as injector weepage.

INTAKE VALVE/COMBUSTION CHAMBER DEPOSITS

Deposits forming on the intake valves and in the combustion chambers affect the flow characteristics of the air/fuel charge, in addition to absorbing fuel until the deposits become saturated. When this occurs, lean operating characteristics can be expected until total saturation occurs. The symptoms usually diminish once the engine reaches normal operating temperature. These conditions are difficult to validate without removing some major components, or looking into the combustion chamber with a bore-scope. Several factors contribute to the formation of the deposits, including:

- 1) Engine operating temperature
- 2) Valve heat retention
- 3) Injector spray pattern in relation to intake valve
- 4) Exhaust gas recirculation
- 5) Fuel quality-detergency
- 6) Short trip driving followed by a heat-soak
- 7) Overall engine performance

Excessive combustion chamber deposits can require a higher octane fuel, as their presence affects the compression ratio of the engine. The accumulation of carbon can also promote engine knocking conditions referred to as "carbon knock." The deposits on the piston surface and the cylinder head make contact, producing the knocking condition.

Combustion chamber and intake valve contamination is nothing new. In older vehicles this was a common occurrence. Many of those contaminants resulted from oil or oil vapors. Today's engine contamination is more fuel composition related, and due to the fact that the engines operate lean during the engine warm-up period. Yesterday's de-carbonizing techniques included methods such as dribbling transmission fluid down through the carburetor with the engine running, and allowing it to soak

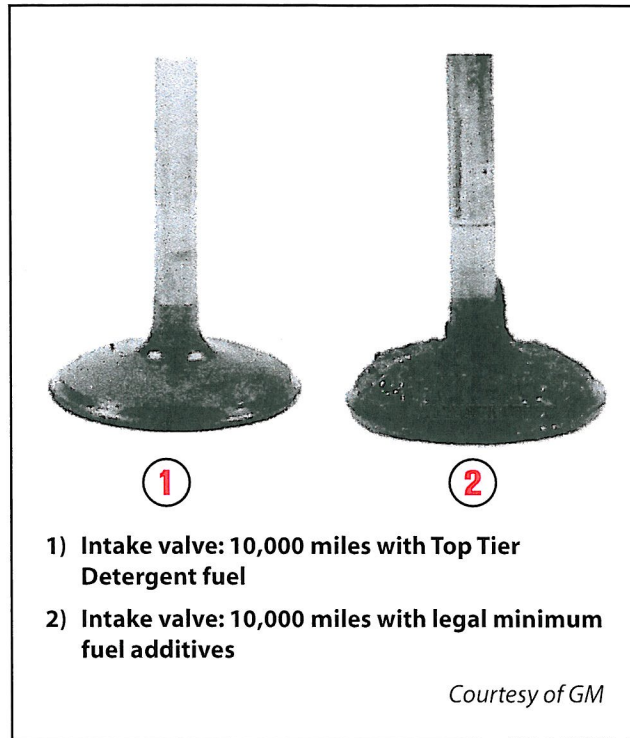
into and loosen the carbon. This was followed by a high speed road test that was often referred to as "blowing the soot out of it." This method would not be acceptable with today's engines, as it would be a catastrophic event for the oxygen sensors and catalytic converters. The chemicals used today must be friendly to those components and meet stringent EPA guidelines.

TOP TIER GASOLINE

Many of the injector plugging problems along with intake valve and combustion chamber deposits have been eliminated through the addition of detergents in the fuel. Special fuel formulations can reduce the formation of the deposits. One such fuel has been adopted by six of the world's top automakers (BMW, GM, Honda, Toyota, VW, and Audi), and is referred to as "Top Tier Detergent Gasoline." This is a voluntary program where petroleum companies can have their fuel designated by the auto manufacturers as meeting certain detergent levels. The process involves a certification or registration of compliance to certify the fuel with the vehicle manufacturers. The following gasoline brands meet Top Tier Detergent Gasoline Standards in all octane grades:

- 1) Chevron
- 2) Quik Trip
- 3) Conoco
- 4) Phillips 66
- 5) 76
- 6) Shell
- 7) Entec
- 8) MFA Oil Company
- 9) Kwik Trip, Inc.
- 10) The Somerset Refinery, Inc.
- 11) Aloha Petroleum
- 12) Tri-Par Oil Company
- 13) Texaco
- 14) CountryMark
- 15) Esso
- 16) Exxon
- 17) Mileage Stations
- 18) Mobil
- 19) Petro-Canada
- 20) Rebel Oil
- 21) Road Ranger
- 22) Severson Oil
- 23) Sunoco
- 24) US Oil

The mentioned Top Tier Detergent Gasoline suppliers offer fuel with additional detergents and additives designed to reduce deposits on fuel injectors and intake valves (see illustration).



SPECIAL ADDITIVES AND CLEANERS

When fuel detergents fail to keep the system clean, special additives may be necessary to remove the deposit formations on the intake valves, pistons and fuel injectors. This is the least expensive way to remove the deposits. Another option is to remove the components and physically clean them on the bench, which can be labor intensive and expensive.

Ask your Mighty representative about his VS7® cleaning options. He has an arsenal of special cleaners and solutions that may remove those harmful contaminants at a fraction of the cost of disassembly and manual cleaning.

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