Analyze This: Spark Plugs and Injectors

It is normal for the spark plug insulator and electrodes to be lightly coated with chalky grey/tan deposits, although rusty red deposits are more typical of unleaded fuel use.

Rich fuel mixtures, heavy fuel consumption or weak ignition can help form these dry, sooty carbon deposits, which can result in misfires, hard starting and/or hesitation.

If the engine is exhibiting any of these conditions, check to see if the air filter is clogged and try adjusting the carburetor float level. Also check the vacuum and bi-metal choke unloaders and, if necessary, free up choke shafts and linkages.

Worn plugs

Rounded electrodes with tan-coloured chalky deposits point to a worn out plug. This leads to hard starting in damp, cold weather and 'stumbling' during acceleration. Voltage tracking (gap misfire) reduces fuel economy. The simplest solution is to replace the plug with a new one.

Glazing

When insulator deposits have a shiny yellow glaze this is referred to as glazing. This is often caused by sudden wide open throttle acceleration following sustained periods of low-speed or idle operation.

Glazing leads to misfires and/or can cause the carburetor to backfire under full throttle. (Note: A misfire will not occur at low or idling speeds.) Replacing the spark plug with one that has a broader heat range can help reduce glazing.

Oil deposits

Oil ash deposits can also cause plugs to misfire 30-80 hours after installation. The plug is covered by brownish deposits heavily encrusted on the electrodes eventually masking the spark plug gap. Misfire causes deposits to become black from unburned fuel and oil. Partially enclosed gaps may cause intermittent misfires. These deposits are formed from very small amounts of crankcase oil seeping past worn or cracked valve stem seals or worn valve guides.

Elevated temperatures

Severely rounded off electrodes with a dark blue oxidized appearance point to elevated temperature damage. In this instance, the insulator will be covered with crusty, baked-on deposits. Premature or hard starting and misfiring are common symptoms.

It is important to verify that a plug with the appropriate heat range is being used. Ignition timing and advance characteristics should also be checked.

Note: Higher-octane fuels and/or adjustments to ignition timing can lead to engine detonation.

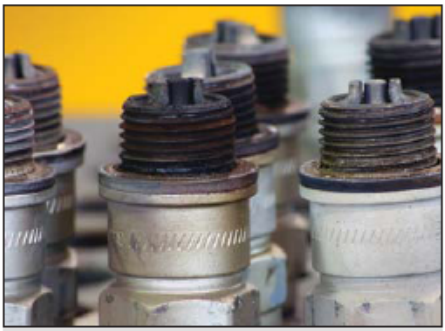
Detonation involves rapid, uncontrolled burning of the air/fuel mixture while the piston is still rising. This rapid detonation strikes the top of the piston as it is still being pushed upward in the cylinder by the crankshaft. The shock wave resulting when the detonation flame front strikes the top of the piston causes the piston to rattle in the cylinder. The sound of this shock wave and the sound of the rattling piston is what people commonly refer to as 'pinging.'

Analyze your injectors

Rudolf Diesel developed the idea for the diesel engine and obtained a German patent for it in 1892. His goal was to create a high efficiency engine. Indeed, a diesel engine compresses at a ratio of 14:1 to as high as 25:1.

Diesels use direct fuel injection—they intake air and compress it, and then inject fuel directly into the combustion chamber (direct injection). The fuel is ignited by the heat of compression and is controlled by injector timing.

Most light-duty diesels use an engine-driven inline pump



Rich fuel mixtures, heavy fuel consumption or weak ignition can form dry, sooty carbon deposits on spark plugs, resulting in misfires, hard starting and/or hesitation.

to distribute fuel under high pressure to each of the injectors. The injectors are mechanical and have spring-loaded 'poppet' valves instead of solenoids, so they pop open and spray fuel when line pressure exceeds a certain limit. Electronic controls on late model injection pumps regulate injection timing, fuel mixture and idle speed. On older applications, these required mechanical adjustments. The injector on a diesel engine is its most complex component and has been the subject of a great deal of experimentation.

Injectors have to be able to withstand the temperature and pressure inside the cylinder and still deliver the fuel in a fine mist. Diesel injectors can suffer from varnish deposits, clogging, wear and leakage. Good injectors are designed to minimize such problems and are made of heat-treated high alloy chrome steel to resist wear, and have needle-to-body gap tolerances that are plus or minus 0.5 microns for maximum fuel delivery efficiency.

Testing injectors

Remove injector from engine and connect it to a tester; close pressure gauge valve (to avoid damage) and operate hand lever rapidly for at least 10 long strokes to clean all air from injector.

Testing for opening pressure

Open the pressure gauge valve and operate hand lever slowly until sufficient pressure is developed to lift nozzle valve and spray fuel. Observe the highest pressure reading on the gauge before needle "flicks," indicating the nozzle valve is lifting off its seat.

Opening pressure on used injectors should be 2570 psi; rebuilt injectors should have an opening pressure of 2790 psi to allow the spring to "settle in." If the nozzle valve does not lift at the appropriate pressure, try turning the adjusting screw 'in' to increase or 'out' to decrease the pressure, until the correct opening pressure is obtained.

Testing for valve seat leakage

Wipe the nozzle tip dry and slowly build up the pressure to 150 psi less than the opening pressure setting, then hold this pressure for approximately 10 seconds and watch the nozzle tip for any signs of leakage. If drops of fuel collect at this pressure, the nozzle valve is not seating properly and must be serviced.

Testing for spray pattern

Close the pressure gauge valve then operate the hand lever rapidly, noting the nozzle spray pattern. The spray should come symmetrical from the tip of the nozzle body and should be completely atomized and break in a very fine mist. If spray patterns do not have equal penetration into the air, are ragged, unduly wet, streaky or not symmetrical, then the nozzle must be serviced.

Testing for back leakage

Pump up the pressure to just below opening pressure, then close the pressure valve and time the pressure drop from 2200 to 1470 psi. For a nozzle in good condition, this time should not be less than six seconds at a temperature of 10–21 C (50-70 F). At higher temperatures, a period of time slightly less than six seconds may be considered satisfactory. If the injector passes these tests, it can then be reinstalled.

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