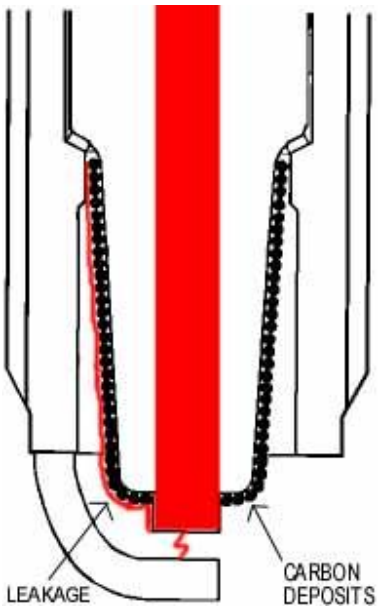
CARBON FOULING

Carbon fouling accounts for around 90% of all spark plug troubles. During combustion of the air/fuel mixture, carbon deposits can build up on the firing end of the insulator nose. As these deposits accumulate, a conductive path is formed from the centre electrode, down the insulator nose to where the insulator meets the metal shell. This build-up provides a path for the electrical current to leak through. When voltage is applied, under certain conditions, the carbon path may sink enough current so as to prevent sufficient voltage to build up at the gap, and misfire occurs. This leakage path is shown in Fig 1.

NGK spark plug designs incorporate a number of features to combat carbon fouling. Some design examples are the semi-surface discharge, supplementary gap, longer insulator nose, and extended shell. Spark plug anti-fouling design features are called on by the engine manufacturer, as appropriate during the design and development stage of new engines. With standard vehicles, the recommended plug should be used and if fouling is a problem, a check on the engine conditions as outlined on page 2 should be made.

The most effective property of a spark plug to prevent fouling is its ability to self clean. Self-cleaning is the term used to describe the burning of carbon deposits off the insulator nose when the cylinder temperatures rise above approximately 450^{0}C. Depending on the vehicle, self-cleaning will only occur at speeds above approximately 50 km/h. During times of prolonged idling and low speed driving the engine temperature is relatively low and carbon deposits may start building up on the insulator nose. On the other hand, highway and high speed driving increase the cylinder temperature enough for the carbon deposits to be burnt away and self-cleaning occurs.

FIG. 1



Note: During operation, water, oil and fuel molecules can adhere to the carbon deposits and increase the conductivity of the carbon leakage path.

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It is important to note that spark plugs **do not** produce carbon deposits. If the recommended plug is being used and there is still fouling problems the following should be checked:

Possible causes of carbon fouling	Explanation
Rich Fuel Mixture	If the air/fuel mixture is rich, combustion is not complete which can result in carbon being deposited on the insulator nose. Due to this excess fuel the insulator nose is also kept at a lower temperature so existing carbon has less chance of being burnt off.
Excessive Lubrication Oil Entering Into The Combustion Chamber	Any oil entering the combustion chamber can build-up on the insulator nose due to high compression and heat.
Clogged Air Filter	If the air filter is clogged, the intake will not draw enough air for complete combustion and carbon deposits can accumulate.
Weak/Deteriorated Ignition Components	This can be any component in the ignition system that may have deteriorated such as the coil, leads, caps, etc. Anything that has the effect of reducing spark energy may be at fault. If spark energy is lowered, misfire can occur and carbon will build-up on the insulator.
Too Cold A Spark Plug	If the plug selected is too cold its operating temperature will be lower. If the temperature is not increased to allow for self-cleaning, carbon fouling is likely to occur.
Over-Retarded Ignition System	If the ignition system is retarded then there is less compression in the cylinder resulting in a lower operating temperature. This can result in carbon build-up because the plug may not reach its self-cleaning temperature.
Prolonged Low Speed Driving or Idling	The engine needs to be at a sufficient operating temperature to achieve self-cleaning. During idling, engine temperatures drop below the required 450 ^{o}C for self-cleaning.

OTHER TYPES OF FOULING

Fuel Additives:
This is where fuel additives are added to a normal tank of fuel to combat various engine problems such as clogged injectors etc. These additives can sometimes adhere to the firing end of the plug. Under high compression and excessive heat these additives can become conductive and result in misfire.

Lead Fouling:
When lead contained in petrol as an octane enhancer adheres to the firing end of a spark plug it can create a leakage path as in carbon fouling. Lead fouling may not become apparent until accelerating from a middle range speed.

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