SPARK PLUGS

Part 1 – Construction Details

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Spark plugs and their maintenance have become a largely forgotten task with today's automobiles. Some engines no longer use them in their standard configuration and most have maintenance intervals that exceed the time a car is owned.

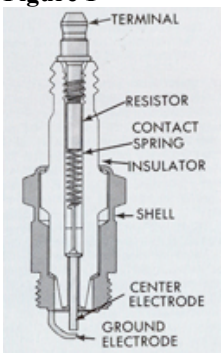
However, for most collector cars, the correct spark plugs and their maintenance are essential. In the days before high energy ignition systems, cleaning and re-gapping spark plugs was recommended every 5,000 miles, or more frequently under certain conditions, and replacement was in order every 10,000 miles.

The spark plug we typically associate with the term was the creation of Albert Champion. His ideas captured the attention of Billy Durant when he was organizing General Motors in 1908. After acquiring Champion's services, Durant provided essential funding for Champion's continued development of his spark plug and incorporated the company as the Champion Ignition Company of Flint; later it became the AC Spark Plug Division using Albert Champion's initials. Champion's original backers retained the rights to use the original name, Champion Spark Plug Company. Both companies became giants in the production of spark plugs.

Spark Plug Basic Construction

Although relatively simple, spark plugs are precision pieces. The general construction of a spark plug includes the following features (See Figure 1):

Figure 1



Spark Plug Construction

Insulator: This component is manufactured from aluminum ceramic oxide. It is dry-molded and then kiln-fired at a temperature exceeding the melting point of steel. This process results in exceptional dielectric (*dielectric = direct current nonconducting*) strength, high thermal conductivity and excellent resistance to shock.

Ribs: Insulator ribs provide extra protection against secondary voltage or spark flashover and assist in griping the spark plug wire boot to the plug body.

Shell: The steel shell is fabricated to exact tolerances using a cold extrusion process.

Hex: The hex portion of the shell provides for installation and removal and is of uniform sizes throughout the industry.

Plating: The metal shell is treated to protect against rust and corrosion using cadmium or other metal treatments.

Seat: (See Figure 2) Some spark plugs use a square seat and a folded metal gasket that provides a smooth surface for sealing. Others use a close-tolerance tapered seat to provide an effective seal between the head and the plug. Beginning in 1956 some auto manufacturers began to use tapered seats that provide for improved heat transfer from the plug to the head.

Figure 2

Spark Plug Seats, with gasket (*left*); with tapered seat (*right*).

Threads: Threads on the shell enable it to be fitted to the cylinder head and are normally rolled, not cut, to SAE standards. The typical sizes are 10, 14 and 18 millimeters diameter.

Ground Electrode: Ground electrodes come in many configurations and most are manufactured using nickel alloy steel, although other metal alloys have been used in recent years. The ground electrode must withstand spark and chemical erosion under extreme temperatures.

Insulator Nose: The insulator nose is that portion of the insulator inside the spark plug shell. There are many different configurations of insulator nose shapes and sizes. The primary purpose of the nose is to protect the center electrode.

Center Electrode: Like the ground electrode, the center electrode must resist spark and chemical erosion under the widely varying and extreme temperatures of the combustion chamber.

Resistor: Some, not all, plugs have a built-in resistor as part of the center electrode to reduce radio interference by the ignition system and to reduce electrode erosion caused by excessively long sparking.

Terminal: The terminal at the upper end of the center electrode provides a way to connect the plug to the engine's secondary circuit wiring. Although the terminal style shown in Figure 1 is for snap-on terminals, some of these terminals screw on and off. This enables the snap-on connector to be removed and the plug wires with a ring terminal connected to the plug with a knurled nut.

Spark Plug Gap Types

The spark created when electrical energy jumps the gap between the center and ground electrodes ignites the air-fuel mixture in the cylinder. This action is not a one-time discrete action, but rather a series of preliminary surges before a full-fledged spark forms. Each of these are quenched and reformed before the sparking cycle is complete. Yet, all of this takes place in only a few ten-thousandths of a second.

The exact configuration of the juxtaposition of the two electrodes

forming the spark plug gap has many variations. The more common include:

Regular Gap: (See Figure 3, P-Gap) This design has the ground electrode extending from the shell to the mid-point of the center electrode and requires less voltage at high RPM. The design protects from any ingested particles wedging between the gap and shorting out the plug.

Projected Nose Gap: (See Figure 3, Y-Gap) This design is commonly used in overhead valve engines where sufficient clearance exists. The design enables the incoming fuel charge to cool the insulator tip at high speeds and provides excellent fouling protection from rich mixture condition. The plug also runs hotter at lower speeds.

Fine Wire Gap: (See Figure 3, P/G-Gap) This design is intended for racing applications except when using supercharging or turbocharging.

Retracted Gap: (See Figure 3, R-Gap) The recessed plug electrodes are intended for racing applications where physical clearance issues exist or supercharging is employed.

Figure 3

Spark Plug Gap Types; *Note: Letter designations are those used by Champion.*

The most common gap types for normal car use are the Regular or the Projected Nose Gap types.

Continuation

In subsequent columns I will address the very important heat range considerations in the design and selection of spark plugs along with “reading” spark plugs and their maintenance.