How TO Read A Spark Plug

NORMAL FIRING END
A grayish tan to white color indicates the correct heat range spark plug is in use, the fuel and ignition systems are in good shape and overall engine mechanical condition is good. Replace with Champion plugs of the same heat range. Refer to the owner’s manual for recommended spark plug replacement interval.

WORN OUT
Excessively worn or rounded center and/or ground electrodes indicates that the plug has worn passed acceptable levels. Although the engine may still appear to function normally, excessive wear can cause acceleration and random misfires, hard starts, reduced fuel economy and damage to other ignition components (wires, coils and distributor cap). Be particularly aware of ground electrode wear in ignition systems that fire both positive and negative polarity. Excessively worn ground electrodes can become a source of pre-ignition. When a plug has this type of appearance, it has simply exceeded its useful life. Replace with Champion spark plugs of the same heat range and design.

DETONATION
In cases of light detonation, small black or gray spots will be noticed on the core nose of the spark plug. In cases of severe detonation, insulators may be cracked and/or chipped. The same high pressure waves created during detonation can break spark plugs, damage intake valves and break pistons. Make sure that the correct octane fuel is being used, assure proper operation of emission and computer systems (paying special attention to the EGR system) and assure the correct heat range of spark plug is being used.

SPASH DEPOSITS (GLAZING)
Full or partial coverage of shiny contaminants on the insulator core nose indicate splash deposits. Sometimes called glazing, the use of fuel injector cleaning machines, fuel additives, carburetor and choke cleaners or other aggressive solvents is the most common cause. Always perform fuel injector and carburetor service BEFORE installing new plugs to avoid premature failure and costly comebacks. If plugs appear to be glazed/splash deposits replace with Champion spark plug of the same heat range.

FUEL ADDITIVES
Red to purple deposits on one side of the core nose is an indication of a fuel additive. While many of these deposits are non-conductive and do not contribute to lack of performance, some fuel additives contain octane boosters that leave conductive deposits on the core nose. Care should be taken to select fuel additives that are compatible with ignition systems and do not contain conductive materials such as octane boosters.

CARBON TRACKING
Dark brown or black lines down the side of the insulator indicate carbon tracking. In some cases the “tracking” pattern can be so extreme it can give the appearance that the insulator is cracked or punctured and “leaking” voltage. Improperly sealing spark plug wire boots are the primary cause of carbon tracking. Always check wire boots for cracking, splitting, hardening or distortion that would prevent the boot from properly sealing. Spark Plugs with evidence of carbon tracking need to be replaced, as the carbon built up on the insulator will continue to attract ignition voltage, even with wire replacement.
The key component of a spark plug is the electrodes. The electrodes are the ‘business end’ of the spark plug and are designed to conduct electricity and create a spark needed in the combustion chamber while providing a gap for the spark to jump across.

The shell of a spark plug is a threaded metal hex that is used to seal the combustion chamber and provide a means to remove and install the spark plug. Once the shell is formed and threaded, it is zinc-plated to extend its life and reduce the chances of seizure in aluminum cylinder heads. Champion uses technologies such as TinTac® and ULTRASeal™ to further reduce corrosion and seize.

The insulator has two functions. First, it insulates the secondary ignition voltage from grounding anywhere except across the gap in the combustion chamber. Its second function is to move the heat picked up in the combustion process into the cooling system. The ceramic must be able to contain the high voltages used in today’s ignition systems, while thriving in the harsh combustion chamber. The ribs at the top of the insulator are designed to prevent the spark from traveling to ground along the outside rather than the center of the spark plug.

The spark plug is made up of three major components: the electrodes, shell, and insulator. The shell has a proprietary approach to electrode design. The insulator has two functions. The shell has a proprietary approach to electrode design.

SAC-9 Suppressor
Champion developed the SAC-9 suppressor in the early 1980’s. This extremely reliable resistor/suppressor is formed from strontium carbonate, aluminum oxide and copper oxide powders. In fact, out of billions made, not a single SAC-9 suppressor has ever been found to fail in service. They are used in many Champion “R” type resistor plugs. An important feature of Champion plugs with the SAC-9 suppressor is that the resistance of the plug cannot be accurately measured with typical low voltage ohmmeters.

F.I.S.S. Resistor (Fired In Suppressor Seal)
The F.I.S.S. resistor was added to the Champion spark plug line in the mid-1990’s. This unique and highly durable suppressor can be easily identified in all Champion automotive plugs that have a black terminal end.

The Champion F.I.S.S. process uses a proprietary glass mixture that has inherent resistive qualities to help suppress RFI in the ignition system. The glass mixture is melted in a heated kiln and forms a solid glass seal when the plug terminal is assembled and the mixture cools inside the insulator. The cooling action also produces a perfect hermetic seal for the center electrode.

The Champion F.I.S.S. resistor provides technicians the ability to check resistance with a conventional DVOM (Digital Volt Ohmmeter). The Champion F.I.S.S. resistor will produce a terminal resistance in the range of 3,000-10,000 ohms at room temperature.

“Q” Type Inductive Suppressors
For high performance, capacitive discharge (CD) ignition systems, spark output can be greatly reduced by a spark plug’s resistance. In the early 1970’s Champion developed new suppressor plugs which use a wire wound inductive coil to reduce RFI without negatively affecting ignition performance. These coils are used in all Champion “Q” type suppressor plugs. “Q” type suppressor plugs are specified for most Evinrude and Johnson outboard engines with CD ignition. Usage of non-Q types (or standard resistor plugs) can actually cause engine misfire and a loss in performance.
What Is Spark Plug Heat Range?

When we talk about the heat range of a spark plug, we’re referring to its ability to move heat away from its tip or core nose into the cooling system. A cold spark plug is defined as having a cooler tip (electrode) temperature than a hot plug.

With today’s fuels, we know that anytime the tip of the ceramic core nose goes below 850° F, carbon will build up and the spark plug will foul. We also know that if the tip temperature of the plug exceeds 1550°, the metals will begin to break down. At approximately 1700°, the plug will glow and can become a source of pre-ignition within the combustion chamber. Armed with this information, it becomes clear that maximum performance can be achieved with a spark plug that has a temperature of greater than 850° at idle, but no more than 1550° under wide-open throttle. There are optimal ranges within this spectrum for each engine design.

Champion uses thermocouple spark plugs to read electrode temperatures and the engine expertise of Federal-Mogul engine research centers to determine the proper heat range for each application. Champion tests each application listed in its catalog every year for proper selection.

Champion strongly recommends that heat ranges not be randomly changed and that plugs not be selected based on cross-referenced information, but selected based on the application section of our catalog.

Taking Technology to the Next Level

Champion focuses on the business end of the spark plug unlike any other manufacturer. Our proprietary approach to electrode design focuses on three key areas:

1. **Conductor** — Precious metal is utilized to match O.E. specs and provide upgrade opportunities.
2. **Geometry** — Sharper focus produces greater spark efficiency. Champion spark plugs are test proven to deliver a consistently focused spark that optimizes performance.
3. **Thermal Management** — Exclusive Heat-Active™ alloy enables the spark plug to heat up quickly and maintain stable operating temperature under varying heat loads.

Champion uses a proprietary approach to designing its entire line of automotive spark plugs. Some O.E. engines are designed to operate with precious metal spark plugs while other engines are equipped with standard non-precious metal designs. No matter what engine or vehicle make, Champion provides three or four levels of automotive plugs to best suit your customer needs but never recommends a different plug type than specified by the O.E. manufacturer.

Platinum Power™ — Powerful Performance™

The advantage of this design is that platinum has extremely good wear characteristics and can reduce gap growth. Platinum Power provides exceptional up-sell opportunities for engines originally equipped with standard nickel/copper spark plugs. It is also a direct replacement on many late model O.E. Coil-on-Plug engines.

1. **Platinum Power** uses a platinum pad welded to a nickel alloy center electrode for long life. Because platinum wears less than nickel alloy, the plug maintains the gap setting over its life. By maintaining proper gaps, the voltage to fire the spark plug is kept at consistent levels, reducing the chance of misfire.

2. **Spark scavenging** is kept to a minimum by combining a thin-wire center electrode with a V-trimmed ground electrode. This electrode combination creates sharp spark focus and less spark scatter enabling better engine performance than with a standard plug.

3. In the case of Platinum Power, the electrodes also use an exclusive Heat-Active™ alloy that reach operating temperature quickly and maintain stable operating temperatures under varying engine loads.

Double Platinum Power™ — More Powerful Performance™

This design is widely used as an O.E. spark plug where there is a distributorless ignition with Waste Spark design. In this ignition system, one bank of spark plugs fire from the center electrode to the ground and the other bank fires from the ground electrode to the center.

1. **Double Platinum Power** has platinum on both the center and ground electrodes. The center electrode is platinum fine-wire, which is riveted onto the nickel alloy center electrode. The ground electrode uses a platinum pad welded to the ground electrode surface to ensure longer life and minimal wear on both electrode surfaces.

2. The spark quality is more precise and greatly enhances the idle and acceleration characteristics of every engine. The fine-wire and V-trimmed electrodes create sharper spark focus than conventional plugs which greatly reduces the chance of misfire.

3. Champion also uses its exclusive Heat-Active™ alloy to reach operating temperature quickly and maintain stable operating temperatures under varying engine loads. While this spark plug is primarily designed for Waste Spark engines, it is a very good up-sell for either the standard plug or the single platinum.
Champion Iridium offers unsurpassed performance regardless of engine or ignition type. Champion pioneered the use of iridium in Aviation and Industrial spark plugs in the early 1970’s. Now, iridium is quickly becoming the technology of choice for O.E. engine manufacturers worldwide. Iridium is preferred because of its stabilizing effect on ignition voltage and its excellent wear characteristics.

1. Champion Iridium features an extremely fine-wire iridium center electrode that is “laser-locked” to the center electrode using a patented process. In addition, every Champion Iridium features a platinum ground electrode to ensure the longest life and greatest erosion resistance in any ignition system.

2. The iridium fine-wire center electrode and platinum V-trimmed ground electrode produce the sharpest spark focus. Consistently focused spark provides the greatest engine performance regardless of engine type or ignition system. This high level of performance can be depended on throughout the life of every Champion Iridium.

3. Champion uses its exclusive Heat-Active™ alloy to reach operating temperature quickly and maintain stable operating temperatures under varying engine loads.

This standard spark plug offering has been used as original equipment on a wide variety of engines for many years. The plug has a nickel alloy center and ground electrode and has reasonably good wear characteristics. In addition, the extrusion of copper into the center electrode allows for an increase in conductivity and heat control. Although not specified for many late model applications, this spark plug design is used extensively in non-automotive applications, such as lawn and garden and power equipment.

Champion provides a resistor plug for almost all automotive applications, while non-resistor types are available for power equipment where specified.

Champion has been the undisputed leader in small engine spark plugs for over 80 years. That engine expertise has been applied to a comprehensive line of premium spark plugs specifically designed and engineered for small engine applications. For lawn and garden, marine, motorcycle and ATV engines, Champion delivers enhanced power and years of dependable performance.

- **EZ START™**
  - **EASIER STARTING**...Fine-wire design concentrates spark voltage.
  - **OPTIMAL PERFORMANCE**...Projected core nose provides maximum anti-foul resistance.
  - **MAXIMUM FIRING VOLTAGE**...Booster gap delivers maximum energy to the electrodes.

- **POWER SPORT™**
  - **DECREASED FOULING**...Increased bore clearance between the shell and the core nose promotes better scavenging of deposits that cause fouling.
  - **MORE POWER**...Thin-wire center electrode helps focus the spark for maximum power.

- **STAINLESS STEEL MARINE™**
  - **REDUCED RFI (Radio Frequency Interference)**...Patented “Mag” suppressor provides maximum protection from “radio noise” and interference in GPS/fish finders.
  - **THREADS NEVER RUST**...Stainless steel threads provide a lifetime of corrosion resistance for worry free removal.
  - **HEAT-ACTIVE™ ALLOY**...Provides maximum heat dissipation and conductivity.