By: section-8

While I'd like to take credit for this, the information contained herein is directly from the NGK site. I've seen these questions asked over and over again, and thought you guys might just benefit from seeing it already up in print. Also, I stuck the info here since I couldn't really say it belonged to any other forum in particular (FI, Nitrous, NA all have to have spark plugs/wires). So here goes:

Q: How often should I replace my spark plugs?

A: Unfortunately, there is no single answer to this question. As spark plugs grow older, they lose their sharp edges as material from the center and ground electrodes is slowly eroded away. As the gap between these two points grows, the voltage required to bridge the gap increases proportionately. Even the best ignition systems will be strained to supply enough voltage to completely burn the fuel. It is at this point, when fuel is being left unburned, that the time has come to change spark plugs.

Replacing worn out spark plugs with new ones (with sharp new edges) effectively restores the ignition system's efficiency. Misfires are reduced, power is restored, economy of operation is enhanced and emissions are reduced.

The best guide is the manufacturer's recommendation for your vehicle, as this particular service varies from brand to brand and model to model. In the absence of this information or in conjunction with it, you can rely on the advice of a mechanic who is familiar with your type of vehicle. In the best of all worlds, this would be a mechanic who is also familiar with the vehicle you own. If you find a good mechanic, whether dealer or independent, stick with him. The better he knows your personal vehicle, the better he will be able to diagnose and service it. The end result is very much like a doctor-patient relationship and, in the long run, you will have a healthier vehicle.

Q: How do I choose the right spark plug?

A: There are several factors - such as thread reach, thread diameter, the insulator nose projection and whether the spark plug incorporates a gasket or is of the conical type - to consider when choosing the correct spark plug for your needs.

In most cases, it is not until the engine is modified, or the compression is raised significantly, that stock ignition systems and spark plugs begin to show signs of being inadequate. At this point, a variety of factors determine which spark plug will be best suited for a particular configuration. In these modified engines, specific electrode/tip combinations, electrode materials and colder heat ranges can provide measurable gains in power. If your vehicle has had extensive modifications, it would be best to seek the advice of the manufacturer of your vehicle, the aftermarket supplier who manufactured your modifications, or your mechanic.

Q: How do I "read" a spark plug?

A: Being able to "read" a spark plug can be a valuable tuning aid. By examining the insulator firing nose color, an experienced engine tuner can determine a great deal about the engine's overall operating condition.

In general, a light tan/gray color tells you that the spark plug is operating at optimum temperature and that the engine is in good condition. Dark coloring, such as heavy black wet or dry deposits can indicate an overly-rich condition, too cold a heat range spark plug, a possible vacuum leak, low compression, overly retarded timing or too large a plug gap.

If the deposits are wet, it can be an indication of a breached head gasket, poor oil control from ring or valve train problems or an extremely rich condition - depending on the nature of the liquid present at the firing tip.

Signs of fouling or excessive heat must be traced quickly to prevent further deterioration of performance and possible engine damage.

Click here for examples of plug conditions
http://www.ngksparkplugs.com/techinfo/spark_plugs/faq/faqread2.asp?nav=31200&country=US

Q: How much of a performance improvement can I expect from changing plugs?

A: A common misconception is that changing spark plugs will result in a large power increase. In most cases, removing even seriously worn out spark plugs will only result in very modest power gains, typically about 1-2% of total engine output. This could be even less for computer-controlled vehicles, primarily because most newer vehicles have more powerful ignition systems and the vehicle's computer can make adjustments so that vehicle operation seems smoother and more seamless.

Many people think that simply supplying more spark to the firing tip can and will combust more fuel. What they don't understand is that most newer cars' engines are so efficient that they are already burning all of the available fuel. Simply adding more spark voltage can't burn more fuel because there is no more fuel to burn.

When a stock or near-stock engine is given a fresh set of spark plugs, peak efficiency is restored. The power gains that come from this restored state of tune are usually minimal. Any company that tells you that their spark plug will provide significant gains in power in a stock or near-stock engine is making blanket statements that may not be supportable.

Q: What is a "fouled" spark plug?

A: A spark plug is considered fouled when the insulator nose at the firing tip becomes coated with a foreign substance such as fuel, oil or carbon. This coating makes it easier for the voltage to follow along the insulator nose, leach back down into the metal shell and ground out rather than bridging the gap and firing normally.

Many factors can contribute to spark plug fouling. The air/fuel ratio may be too rich as a result of incorrect carburetor adjustment or a poorly performing fuel injection system. Worn piston rings or valve seals may allow too much oil to leak into the combustion chamber, leading to oil fouling. The ignition system may not be performing properly. Prolonged idling or continuous low-speed driving may keep the spark plug from reaching its optimum operating temperature. Using too cold a spark plug can lead to the same problem. Finally, a dirty air cleaner can create a too-rich condition, which can lead to fouling.

Fuel, oil and carbon fouling can all be the result of different causes but, once a spark plug is fouled, it will not provide adequate voltage to the firing tip and that cylinder will not fire properly. In many cases, the spark plug cannot be cleaned sufficiently to restore normal operation. Therefore, it is recommended that a plug be replaced once it is fouled.

Q: Do I need to set the "gap" when installing a new set of plugs?

A: Maybe. A spark plug part number might fit hundreds of engines and, although the factory will typically set the gap to a pre-selected setting, this may not be the right gap for your particular engine. Insufficient spark plug gap can cause pre-ignition, detonation and even engine damage. Too much gap can result in a higher rate of misfires, loss of power, plug fouling and poor fuel economy. It is always best to check the gap against the manufacturer's specifications.

Another consideration that should be taken into account is the extent of any modifications that you may have made to the engine. As an example, when you raise compression or add forced induction (a turbo system, nitrous or supercharger kit) you must reduce the gap (about .004" for every 50 hp you add). However, when you add a high power ignition system (such as those offered by MSD, Crane, Nology) you can open the gap from .002-.005".

If you have any questions, please contact the NGK Sparkplugs Tech Staff here. The manufacturer of your vehicle, the company that produced the aftermarket products you've used and/or your mechanic are all additional sources of gapping information if you've modified your vehicle.

Q: Are special plugs always necessary on a modified engine?

A: It depends on the modifications. The term "modified" refers to those engines that have received bolt-on improvements that may or may not raise the engine's total compression ratio. These can include turbo charging, supercharging, nitrous oxide injection, the use of smaller-chambered cylinder heads, modified piston configurations, free-flowing cylinder heads, change of induction components and/or the use of different fuel types and octane. These kinds of modifications generally require a change from stock spark plugs.

Modifications that will typically not require specialized plugs (in most cases the factory installed plug will be more than adequate) include adding a free-flowing air filter, headers, mufflers and rear-end gears. Basically, any modification that does not alter the overall compression ratio will not usually necessitate changing plug types or heat ranges. Such minor modifications will not significantly increase the amount of heat in the combustion chamber; hence, a plug change is probably not warranted.

However, when compression is raised, along with the added power comes added heat. Since spark plugs must remove heat and a modified engine makes more heat, the spark plug must remove more heat. A colder heat range spark plug must be selected and plug gaps should be adjusted smaller to ensure proper ignitability in this denser air/fuel mixture.

Typically, for every 75-100 hp you add, you should go one step colder on the spark plug's heat range. A hotter heat range is not usually recommended except when severe oil or fuel fouling is occurring.

Q: How do I install spark plugs correctly?

A: It is essential to tighten a spark plug to the specified turning angle or torque setting. First, screw in the plug finger tight until the gasket meets the cylinder head. Then seat the plug/gasket with a torque or turning angle wrench as specified in the chart in this link:
http://www.ngksparkplugs.com/techinfo/spark_plugs/faq/faqtorque.asp?nav=31200&country=US

Q: When should I use a resistor spark plug?

A: NGK "R" or resistor spark plugs use a 5k-ohm ceramic resistor in the spark plug to suppress ignition noise generated during sparking.

NGK strongly recommends using resistor spark plugs in any vehicle that uses on-board computer systems to monitor or control engine performance. This is because resistor spark plugs reduce electromagnetic interference with on-board electronics.

They are also recommended on any vehicle that has other on-board electronic systems such as engine-management computers, two-way radios, GPS systems, depth finders or whenever recommended by the manufacturer.

In fact, using a non-resistor plug in certain applications can actually cause the engine to suffer undesirable side effects such as an erratic idle, high-rpm misfire, engine run-on, power drop off at certain rpm levels and abnormal combustion.

Q: Why are there different heat ranges?

A: It is a common misconception that spark plugs create heat. They don't. A heat range refers to how much heat a spark plug is capable of removing from the combustion chamber.

Selecting a spark plug with the proper heat range will insure that the tip will maintain a temperature high enough to prevent fouling yet be cool enough to prevent pre-ignition. While there are many things that can cause pre-ignition, selecting a spark plug in the proper heat range will ensure that the spark plug itself is not a hot spot source

Q: What do the numbers and letters in a part number represent?

A: The various numbers and letters in a spark plug code or identification number basically identify the features and functions of a particular plug. Included would be information such as plug type, heat rating, construction, thread diameter, thread reach and firing end construction.

Click on the link below to download a guide that will help you decipher the various NGK alpha-numeric combinations. You will need to open it with Adobe Acrobat Reader. If you do not already have Acrobat Reader installed on your computer, we've provided a link to the free download area for your convenience.

http://www.ngksparkplugs.com/techinfo/spark_plugs/partnumberkey.pdf
http://www.adobe.com/products/acrobat/readstep.html

Q: Does humidity affect spark plug temperature?

A: Yes, humidity does affect spark plug temperature. As the humidity increases, the intake air mass decreases. This results in lower combustion pressures and temperatures, causing a decrease in the spark plug's temperature.

Q: Does ignition timing affect a spark plug's temperature?

A: Yes, ignition timing directly affects the firing end temperature of the spark plug. Advancing the ignition timing prolongs the time to compress the burning gases. The pre-ignition temperature also elevates gradually, since the pressure and temperature of the combustible mixture is low before ignition. Advancing your timing elevates firing end temperatures.

Q: Does compression ratio affect firing end temperature?

A: Yes, the by-product of increased compression is the elevation in cylinder temperatures. This is why it is recommended to choose a spark plug suitable for your application. NGK Spark Plugs recommends dropping heat ranges and altering Air/Fuel mixtures and timing as needed. It is very important to dissipate the excess heat from the combustion chamber in order to prevent pre-ignition.

Q: Can old spark plugs be cleaned?

A: Yes, you can clean spark plugs. However, it is good to remember that spark plugs are a wearable item, so it's important to make sure you check to see if it's worth cleaning before you go through the following steps.

If the firing end is wet, make sure you clean the spark plug with a quick drying cleaner. (Examples: contact cleaner or brake cleaner). Sand blast the spark plug using low air pressure and use a dry compound. Completely blow all the sand from the spark plug. Using a wire brush clean the threads and re-gap. NOTE: Insufficient cleaning of the spark plug may lead to spark plug failure in a very short period of time. Clean the spark plug thoroughly to avoid problems later. Remember, if a spark plug is fouling it's usually a result of engine side factors or incorrect heat range selection.

Q: What is the maximum I can open or close the gap?

A: NGK doesn't recommend adjusting the spark plug gap < or > .008". The reason for this is the ground electrode and center electrode won't line up properly, hindering spark plug performance.

Q: What is pre-ignition?

A: Pre-ignition is defined as the ignition of the air/fuel mixture before desired ignition timing.

Q: What is detonation?

A detonation is a spark plugs worst enemy. It can break insulators and ground electrodes. Spark plug temperatures can reach in excess of 3000 °F. Detonation, in simple terms, is a violent uncontrolled burn of the air/fuel mixture, which occurs when excessive heat and cylinder pressure causes the air/fuel mixture to spontaneously ignite.

Here's a link to some spark plug Tech info...really good reading
http://www.ngksparkplugs.com/techinfo/spark_plugs/techtips.asp?nav=31000&country=US

How spark plugs work:
http://www.ngksparkplugs.com/techinfo/spark_plugs/techtips.asp?nav=31000&country=US

How to Install spark plugs:
1. Installing spark plugs

Torque is one of the most critical aspects of spark plug installation. Torque directly affects the spark plugs' ability to transfer heat out of the combustion chamber. A spark plug that is under-torqued will not be fully seated on the cylinder head, hence heat transfer will be slowed. This will tend to elevate combustion chamber temperatures to unsafe levels, and pre-ignition and detonation will usually follow. Serious engine damage is not far behind.

An over-torqued spark plug can suffer from severe stress to the Metal Shell which in turn can distort the spark plug's inner gas seals or even cause a hairline fracture to the spark plug's insulator...in either case, heat transfer can again be slowed and the above mentioned conditions can occur.

The spark plug holes must always be cleaned prior to installation, otherwise you may be torquing against dirt or debris and the spark plug may actually end up under-torqued, even though your torque wrench says otherwise. Of course, you should only install spark plugs in a cool engine, because metal expands when its hot and installation may prove difficult. Proper torque specs for both aluminum and cast iron cylinder heads are listed in the link above.

2. Installing spark plugs - Lawn & Garden Equipment

1. Confirm that the thread reach of the spark plug is the right one for your engine.

2. Remove the dirt at the gasket seal of the cylinder head.

3. Tighten the spark plug finger tight until the gasket reaches the cylinder head, then tighten about 1/2-2/3 turn more with a spark plug wrench.
(Taper seat: About 1/16 turn more).

3. Gapping

Since the gap size has a direct affect on the spark plug's tip temperature
and on the voltage necessary to ionize (light) the air/fuel mixture, careful attention is required. While it is a popular misconception that plugs are pre-gapped from the factory, the fact remains that the gap must be adjusted for the vehicle that the spark plug is intended for. Those with modified engines must remember that a modified engine with higher compression or forced induction will typically require a smaller gap settings (to ensure ignitability
in these denser air/fuel mixtures). As a rule, the more power you are making, the smaller the gap you will need.

A spark plug's voltage requirement is directly proportionate to the gap size. The larger the gap, the more voltage is needed to bridge the gap. Most experienced tuners know that opening gaps up to present a larger spark to the air/fuel mixture maximizes burn efficiency. It is for this reason that most racers add high power ignition systems. The added power allows them to open the gap yet still provide a strong spark.

With this mind, many think the larger the gap the better. In fact, some aftermarket ignition systems boast that their systems can tolerate gaps that are extreme. Be wary of such claims. In most cases, the largest gap you can run may still be smaller than you think.

4. Indexing

<u>This is for racers only !!</u>
Indexing refers to a process whereby auxiliary washers of varying thickness are placed under the spark plug's shoulder so that when the spark plug is tightened, the gap will point in the desired direction.

However, without running an engine on a dyno, it is impossible to gauge which type of indexing works best in your engine. While most engines like the spark plug's gap open to the intake valve, there are still other combinations that make more power with the gap pointed toward the exhaust valve.

In any case, engines with indexed spark plugs will typically make only a few more horsepower, typically less than 1% of total engine output. For a 500hp engine, you'd be lucky to get 5hp. While there are exceptions, the bottom line is that without a dyno, gauging success will be difficult.

5. Heat Range selection

Let's make this really simple: when you need your engine to run a little cooler, run a colder plug. When you need your engine to run a little hotter, run a hotter spark plug. However, NGK strongly cautions people that going to a hotter spark plug can sometimes mask a serious symptom of another problem that can lead to engine damage. Be very careful with heat ranges. Seek professional guidance if you are unsure.

With modified engines (those engines that have increased their compression) more heat is a by-product of the added power that normally comes with increased compression. In short, select one heat range colder for every 75-100 hp you add, or when you significantly raise compression. Also remember to retard the timing a little and to increase fuel enrichment and octane. These tips are critical when adding forced induction (turbos, superchargers or nitrous kits), and failure to address ALL of these areas will virtually guarantee engine damage.

An engine that has poor oil control can sometimes mask the symptom temporarily by running a slightly hotter spark plug. While this is a "Band-Aid" approach, it is one of the only examples of when and why one would select a hotter spark plug.

6. Using "racing" spark plugs

Be cautious! In reality, most "racing" spark plugs are just colder heat ranges of the street versions of the spark plug. They don't provide any more voltage to the spark plug tip! Their internal construction is no different (in NGK's case, as all of our spark plugs must conform to the same level of quality controls) than most standard spark plugs.

There are some exceptions, though. Extremely high compression cars or those running exotic fuels will have different spark plug requirements and hence NGK makes spark plugs that are well-suited for these requirements. They are classified as "specialized spark plugs for racing applications". Some are built with precious metal alloy tips for greater durability and the ability to fire in denser or leaner air/fuel mixtures. However, installing the same spark plugs Kenny Bernstein uses in his 300+ mph Top Fuel car (running Nitromethane at a 2:1 air/fuel ratio and over 20:1 dynamic compression) in your basically stock Honda Civic (running 15:1 a/f ratios with roughly 9.5:1 compression) will do nothing for you! In fact, since Kenny's plugs are fully 4 heat ranges colder, they'd foul out in your Honda in just a few minutes.

NGK as a company tries to stay clear of saying that a racing spark plug (or ANY spark plug) will give you large gains in horsepower. While certain spark plugs are better suited to certain applications (and we're happy to counsel you in the right direction) we try to tell people that are looking to "screw in" some cheap horsepower that, in most cases, spark plugs are not the answer.

To be blunt, when experienced tuners build race motors, they select their spark plugs for different reasons: to remove heat more efficiently, provide sufficient spark to completely light all the air/fuel mixture, to survive the added stresses placed upon a high performance engine's spark plugs, and to achieve optimum piston-to-plug clearance.

Some of these "specialized racing plugs" are made with precious metal alloy center/ground electrodes or fine wire tips or retracted-nose insulators. Again, these features do not necessarily mean that the spark plug will allow the engine to make more power, but these features are what allow the spark plug to survive in these tortuous conditions. Most racers know screwing in a new set of spark plugs will not magically "unlock" hidden horsepower.

7. Using high power ignition systems

Many of the more popular aftermarket ignition systems are of the capacitive discharge type. They store voltage, or accumulate it, until a point at which a trigger signal allows release of this more powerful spark. Companies like Mallory, MSD, Crane and Accel, to name a few, offer such systems.

They affect spark plugs in that they allow the gaps to be opened up to take advantage of the increased capacity. The theory is that the larger and the more intense the spark you are able to present to the air/fuel mixture, the more likely you will be to burn more fuel, and hence the more power you will make.

We encourage the use of such systems, but only on modified or older non-computer controlled vehicles.

In reality, computer controlled vehicles do such a good job of lighting off the air/fuel mixture (as evidenced by the ultra-low emissions), added ignition capacity would do little to burn more fuel since the stock configuration is doing such a good job. Older non-computer controlled vehicles or those that have been modified with higher compression or boosted (nitrous, turbo, supercharged) engines can certainly take advantage of a more powerful ignition system.

Wire Sets

Overview

NGK Variable Pitch resistor cables provide uniform resistance and insure outstanding electrical conductivity in high quality cables. This produces the impedance necessary to suppress radio interference throughout the entire frequency spectrum.

The RFI (Radio Frequency Interference) noise is generated by ignition systems and can interfere with computer controls and on-board electronic systems of late model vehicles. When used in combination with resistor spark plugs, NGK resistor cables provide exceptional noise suppression without negatively affecting engine performance.

A layer of ferrite magnetic material wrapped with variable pitch metal wire covers the fiberglass strand core. The inner layer of insulation is made of polyvinyl chloride, with a heat resistance of 100ºC. The outer jacket is made of one of two materials, depending upon the application. These materials are:

1) EPDM (Ethylene Propylene Dien Monomer) a rubber compound that is heat resistant to 180ºC

2) NGK's new silicone vinyl insulation that is heat resistant to 250ºC

NGK cable resistance is only a fraction of that found in ordinary solid carbon core resistor cables. Ordinary solid carbon-core wires, used as original equipment on most Japanese vehicles, are not as efficient and effective.

In addition, the resistance of solid carbon-core wires tends to increase over a period of time, while the resistance of NGK's wire-wound cables remain virtually unchanged. While resistance is necessary to suppress radio frequency interference (RFI), too much resistance reduces sparking and ignition energy.

NGK resistor cables are packaged in sets consisting of one coil wire (where applicable), and four, five or six plug wires, as appropriate. Every set is tailored to the right cable length for the exact make and model specified.

Please read, and take from this info what you can. Whenever there is a question about spark plugs posted, and the answer can be found above, I will be posting a link to this topic and most likely locking the original.