How Nitrous Oxide Affects the Spark Plug

If you're a gear head your well aware you have to pay to play. There's many ways to build horsepower however one of the easiest and least expensive ways to build horsepower is to install a nitrous system. The term laughing gas is fitting for a product that provides sheer excitement on and off the track.

History of Nitrous Oxide:

Nitrous Oxide was first discovered in 1793 by the English scientist and clergyman Joseph Priestley. Priestly first thought nitrous oxide could be used as a preserving agent to no avail. Soon it was discovered, that when inhaled, nitrous oxide made people laugh and giggle, hence the term laughing gas. For the next forty years nitrous oxide was used for entertainment purposes in traveling medicine shows and carnivals.

In the mid 1800's it was discovered when nitrous oxide was inhaled, the human body felt little pain. An experiment was performed in a dentist's office to determine if nitrous oxide would provide pain relief during tooth extractions. The successful experiment introduced general anesthetic and is still used in dentist offices to this day.

During World War II nitrous oxide was introduced to boost power in aircraft engines. Since its introduction into the internal combustion engine, nitrous oxide has proven to be a cost effective means to build horsepower.

How Nitrous Oxide Works:

Nitrous Oxide is a colorless almost odorless gas containing two parts nitrogen and one part oxygen. When nitrous oxide is heated to approximately 570 °F the nitrogen and oxygen split. Since more oxygen is being injected into the combustion chamber more fuel can be injected enabling an engine to create more horsepower.

Another advantage occurs during the vaporization process. When Nitrous Oxide vaporizes it cools the intake air temperature, which in turn increases air density, providing more oxygen and higher compression.

Nitrous Kits:

Nitrous kits are available for EFI, Carbureted and Diesel applications. Many companies offer plate, direct port and nozzle type systems. Systems are available in single stage and two stage systems. If you're considering a nitrous system we highly recommend contacting reputable nitrous companies in order to select the correct nitrous system for your application.

Wet Nitrous Oxide Systems:

A wet nitrous system introduces a homogenous mixture of nitrous and atomized fuel into the intake air.

Wet nitrous systems are safe provided you properly tune your vehicle and follow the instructions provided with your system. Wet systems are recommended for naturally aspirated and forced induction applications.

Dry Nitrous Oxide Systems:

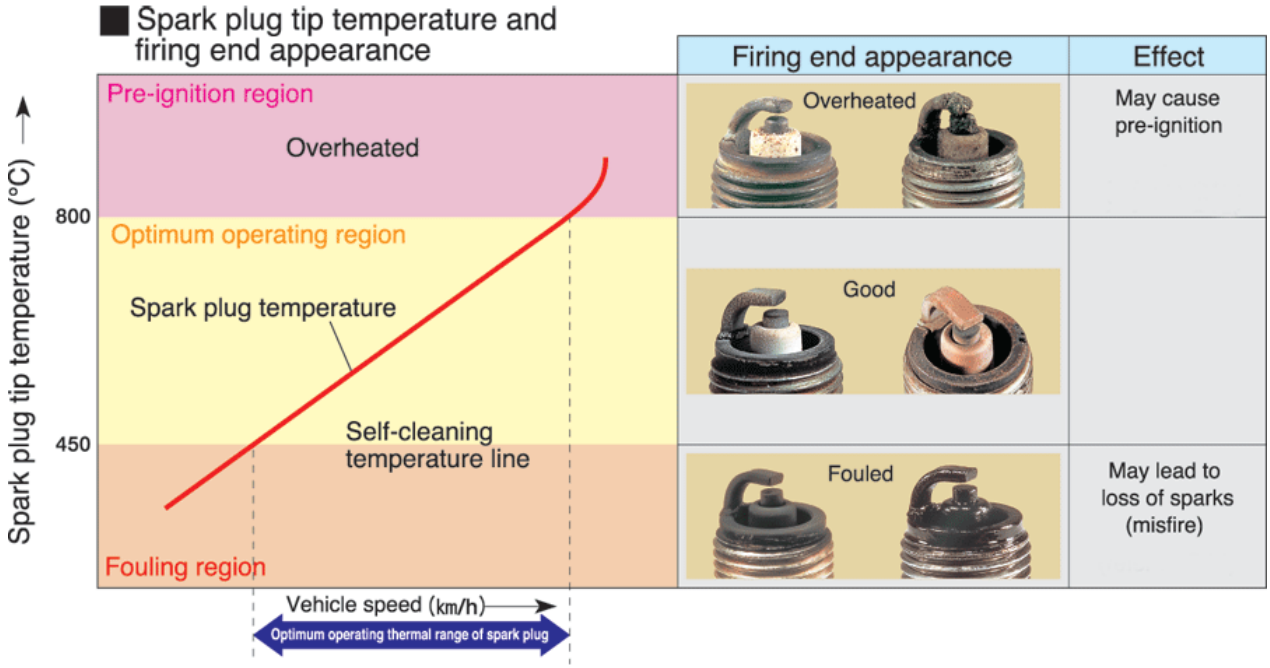
A dry nitrous system injects nitrous directly into the intake runners or injector plate.

Dry systems are recommended for naturally aspirated engines and are not recommended for use in forced induction applications. These systems are simple to install and tune. Again it's important to properly tune your vehicle and follow the instructions provided with your system.

Nitrous Oxides Affect on Spark Plugs:

So how does nitrous oxide affect the spark plug? More horsepower's produced because we're injecting more oxygen, fuel and air density is higher. All these factors create more heat. What do we do with the excess heat? To answer this question we must first understand how the spark plug works.

The spark plug has two functions; one is to ignite the air/fuel mixture and the other is to transfer heat from the combustion chamber. Spark Plug heat range is selected through a series of pre-ignition tests. Thermal couple spark plugs are used to record internal center electrode and ground electrode tip temperatures. Optimum firing end temperatures must fall between 500ºC ~ 800ºC. If the tip temperature falls below 450ºC the spark plug is considered to be in the fouling region. This means the tip temperature isn't hot enough to burn off carbon deposits. If the tip temperature rise's above 800ºC the spark plug tip temperature is too hot and the spark plug is considered to be in the pre-ignition region. Pre-ignition is detrimental to an engine and can ultimately lead to spark plug failure and extensive engine damage.



(Figure 1)

Heat Rating:

A spark plug must dissipate heat generated in the combustion chamber. Insulator nose lengths determine heat rating if the insulator nose is long the spark plug is considered to be a hot type and if the insulator nose is short it's considered to be a cold type (See Figure #2). Heat is transferred out of the combustion chamber through the spark plugs insulator into the cylinder head cooling passages.

Example:

A stock 1999 Honda Civic Si is pre-ignition tested at the factory and a heat range of six has been selected for the application based on the spark plugs tip temperature. This means the tip temperature falls within the 500°C ~ 800°C window and is hot enough to burn off carbon deposits and cool enough to prevent pre-ignition. If we use a stock heat range of six and add a 125 hp shot of nitrous, the spark plugs firing end temperature will rise above 800°C. At this point the tip temperature is too hot and pre-ignition will occur, leading to spark plug failure and extensive engine damage. We must select a cooler spark plug with a shorter insulator nose so the correct amount of heat is transferred bringing the tip temperature within the 500°C ~ 800°C window.

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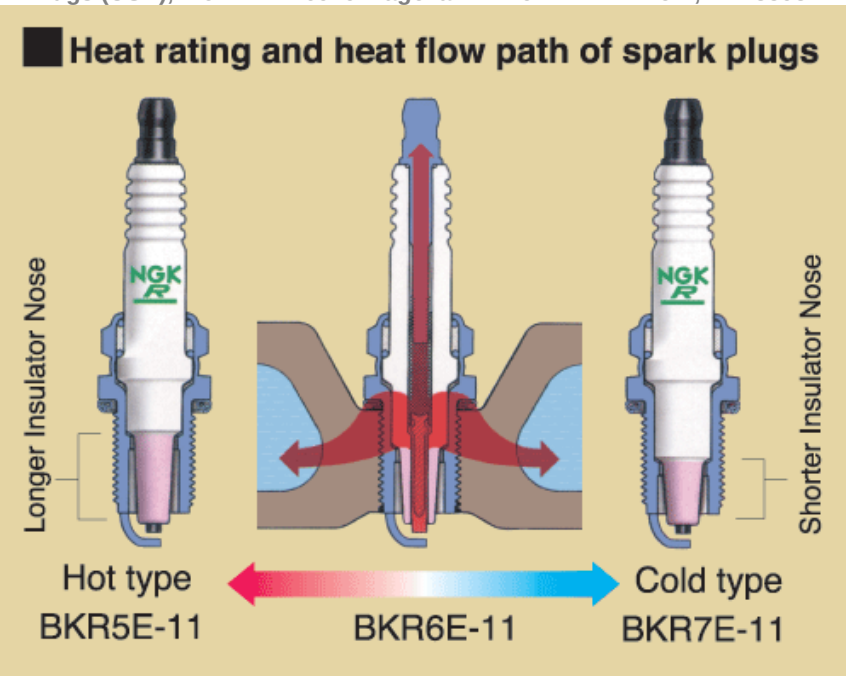

(Figure #2)

NOTE (Figure #2) NGK Spark Plugs heat rating is 2 **HOT**~ 12 **COLD.**

Nitrous Street / Strip:

Unfortunately spark plug manufacturers are unable to manufacture adjustable heat range spark plugs. NGK Spark Plugs recommends dropping one heat range for every 75 shot of nitrous. When using less than a 75 shot of nitrous on the street, one step cooler spark plugs should be sufficient provided air/fuel ratio and timing are adjusted properly. When two step cooler spark plugs are utilized on the street the tip temperature under normal operating conditions (without nitrous) may be too cold and possible spark plug fouling may occur. Fouling can lead spark plug insulator failure, drivability issues, loss of performance and poor starting.

When large amounts of nitrous are being used on the street we recommend switching spark plugs in and out. Use a hotter spark plug when running all motor and a cooler spark plug for nights you decide to run nitrous.

Nitrous Off Road:

Racing applications follow the same guidelines. . Select a spark plug for your engine without nitrous and then select a spark plug for nitrous. For every 75 shot of nitrous drop one heat range. Race vehicles in most cases run enormous amounts of nitrous so it's not uncommon to use extremely cool spark plugs. This can pose a problem when the race vehicle is driven to the starting line, pit area and idled for extended periods. Spark Plug fouling occurs rapidly in race vehicles leading to loss of power, misfiring, poor starting and spark plug failure. Again make sure you've adjusted air/fuel ratio and timing correctly.

We highly recommend replacing spark plugs every round as a safety precaution

Conclusion:

Whether you own a street/strip car or an all out race car, nitrous is a cost effective way to build horsepower. Simple to install, nitrous has many benefits provided you follow the instructions and properly tune. Failure to tune your vehicle properly will guarantee spark plug failure and severe engine damage.

For more information regarding spark plugs for your nitrous application contact NGK Technical Support at (877) 473-6767 option #2 or visit us www.ngksparkplugs.com.

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