Spark duration, commonly called Burn Time, is measured in milliseconds (ms). This Spark Duration/Burn Time is the time from the peak firing voltage, when the ECU signal to coil driver is removed and the coil has reached a saturation point, and starts to discharge the coil charge through the spark plug to the point at which the coil charge can no longer sustain the spark.

This Spark Duration is directly related to engine timing. In a perfect world, Spark Duration will start at approximately 30 degrees before engine cylinder TDC. The spark initiated at this timing degree is to preheat a small amount of air/fuel mixture next to the spark plug electrode to start the combustion process.

As the crankshaft rotates to about 20 degrees BTDC, the pressure in the engine cylinder continues to rise and is now above the compression line that the cylinder would be at if no air/fuel mixture was present.

The period of time between approximately 30 and 20 degrees BTDC is called ignition delay.

By the time the cylinder reaches ~5 degrees BTDC, the cylinder pressure is approximately double that of the compression line at that point.

The rate of combustion increases significantly from this point to about 15 degrees ATDC. Because the combustion process progresses very rapidly. The combustion process should be complete between 20 to 25 Degrees ATDC.

Now that the Spark Duration/Burn Time has been defined for a properly tuned engine, let's discuss what happens if this is not the case.

Having the Spark Duration/Burn Time start too early and you run the risk of having compression from ignition of the air/fuel mixture acting against the cylinder piston. This could result in a loss of power because the cylinder would not be doing any useful work. If the fuel/air mixture ignited causing the cylinder pressure to raise extremely rapidly because of the timing being too early, the possibility of engine knock or detonation causing engine damage is probable.

If the fuel/air mixture is ignited too earl and the cylinder piston is ATDC, then there will be less work done, resulting in a loss of power.

Spark Duration is directly affected by the amount of secondary coil voltage, coil charge, that is available.

Factors that affect Spark Duration/Burn Time are:

Coil Output
Secondary Coil resistance
Air/Fuel charge
Secondary short circuits that shunt the coil charge to places other than the spark plug

Low primary coil circuit current

Spark Duration/Burn Time for each engine cylinder should be the same. Industry guidelines to be considered are:

1.0 to 2.0 ms is considered normal
0.8 to 1.0 ms is considered to be shorter than normal, but may be acceptable depending on your system
Less than 0.8 ms is considered too short and needs to be investigated and rectified
2.0 to 2.4 ms is considered to be too long, but may be acceptable depending on your system
2.4 ms and more is considered to be too long and needs to be investigated and rectified

Spark Duration/Burn Time increases to the maximum, known as the Maximum Spark Duration/Burn Time, during acceleration to accommodate a richer air/fuel mixture, and decreases during deceleration, known as the Minimum Spark Duration/Burn Time, because the air/fuel mixture is reduced, not enough fuel to burn. The Maximum and Minimum Spark Duration/Burn Times are just as important as the Spark Duration/Burn Time at idle.

The spark (burn) duration needs to be matched to the amount of charge to be completely dissipated through the spark plug in the required amount of time for complete combustion. This setting will probably be determined through experimentation.

The last piece of this puzzle is the spark plug. The resistor spark plug is the spark plug of choice. The other factors are spark plug electrode gap, spark plug heat range, and what does the spark plug look like.

Reading a spark plug for optimal engine performance. The information available to you regarding this is a lot and is important. Engine operating temperature, ignition timing, air/fuel mixture, spark plug heat range, and engine maintenance condition all affect the spark plug operation.

If you are going to ask about the spark plug gap and what might be recommended, you should start to research this requirement so that you understand what this will do for you, or maybe not. You will find that the spark plug gap is only one part of the spark plug equation.

Industry experts mention that even though today's engine control systems are very good, and that a well-tuned carbureted engine will perform well, that as the systems start to degrade, change (distributor for example), using the spark plug as a diagnostic tool is important.

What should the spark plug gap be to provide optimal cylinder firing and dissipation of the coil charge? The amount of voltage and current of your ignition systems, the cylinder pressure, and air/fuel mixture density play a part in the determination.

It is mentioned that to find the best spark plug gap for your application will generally be an experimental process. Most of us do not delve too deeply into the specifics regarding the spark plug gap, but we do look for advice on this issue because we have heard that the spark plug gap can assist us in our engine performance goals. I would surmise that most of us have been in this situation. I have never been concerned about this because most of my vehicles are bog standard and didn't require me to think much on the matter. I am guilty of just taking a new spark plug and using it, occasionally checking the spark plug gap, but not often.

A rule of thumb used by the industry is that the more power an engine makes the smaller the spark plug gap needs to be because of higher cylinder pressures, and denser air/fuel mixtures. There is a need to have an intense spark to light the dense, wet fuel mixture required in high powered race or performance engines. A larger spark plug gap would create a longer spark arc, but without sufficient oomph from the ignition system (voltage and amperage), the spark will be weak. In this case a small intense spark is better than a large, weak spark.

If you are going to go down this road, have a few sets of plugs handy, gapped to various sizes. Start at the OEM recommended spark plug gap, then go up in incremental stages until the engine starts to perform badly. Try a few sets of plugs that are gapped less than the OEM recommended spark plug gap, and do this until the engine starts to perform badly. Keep notes of how the engine performs at idle, cruising and "pulling" to max RPM, then choose the spark plug gap that best suited your engine.

Spark plug heat range is another consideration. Treat this the same way as you would/will the spark plug gap issue. Using the best spark plug gap that you have determined for your engine, purchase a few sets of spark plugs with different heat ranges. Trial each and choose the best heat range for your application.

Spark plug electrode shape and size is a consideration. Most industry experts and manufacturers will mention that for normal, everyday engine operation the OEM spark plug recommendation will provide you with the best engine performance that will require. The newer, "fancier" spark plug designs may last longer, provide better fuel economy, maybe, but overall, the additional cost is not worth it. It is probably better to change your spark plugs more often.

You can test the shape/size of the chosen spark plug the same as you would for spark plug gap, and heat range. Take the spark plug of choice and modify the spark plug electrode shape/size and test. When you "feel" you have the correct electrode shape and size, this is what you will use.

As mentioned, there are aspects of spark plug condition such as ignition timing, air/fuel mixture, and heat range, amongst others that can provide insight into how well the engine is operating. Spark plug colour is the most commonly sought after spark plug health indicator.

If you are into engine performance, or the DIY “hot rod” scenario, learn about spark plugs, and how this innocuous component can aid you in achieving your goals.