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Other than installing thermo-coupler sensors in the combustion chambers the only real way that you know what is happening inside your engine is to read the spark plugs. Both the fuel mixture and the ignition timing result in coloring of the spark plug's porcelain and ground strap. The trick is to how to get the correct coloring without going into detonation and destroying the engine or by going too rich and raising the ring lands.

Spark plugs can only be correctly read if the car has been shut down immediately at the end of a run without driving it back to the pits. Get off the track and coast to a place you are safely out of the way and either read the plug there or change one or two with some you have in your pocket so you can read these uncontaminated plugs when back to the pits. Or you should tow the car back to the pits. It may take a couple of runs to get see the sparkplug color.

Reading For Air Fuel Mixture

The porcelain around the plug's center electrode can be divided into three areas for reading. The area that is closest to the tip is affected by the idle and transition circuits carburetor circuits and is of no real concern to a racer. If this area is gray then you drove the car back to the pits and you cannot correctly read the plugs.

middle area is only colored when you drive down the road at around a steady 30-40 mph and is normally affected by the primary circuit jetting with the power valve closed and this is really of no concern to the racer. The area you are interested in is that third that is all the way up inside the plug where the sun don't shine. This area is colored when all is wide open under full power because the combustion chamber heat totally cleans off the other two areas. It will take a special plug reading flashlight with the magnifying glass to view it correctly. Plugs cannot be correctly read by just quickly looking at them with the naked eye. You see people doing it all the time because they do not know how to read plugs.

Normally aspirated cars should have a light gray or tan hydrocarbon ring or as some call it a "fuel ring" all the way up inside around the third area closest to the point where the porcelain is attached to the metal jacket of the plug. The actual color may depend on type of fuel you use. This fuel ring should appear like a light shadow. Most VP C-15, C-16 or C23+ fuels will show as a light gray when correct. This fuel ring starts to color on the porcelain side that is below the ground strap and works its way around either side of the center electrode until it completely joins. Sometimes it may take two or three runs to see a good coloring. Note: New engines or engines that pump a little oil may show a thin oily line way down inside on the porcelain where the porcelain meets the metal wall of the plug. This oil line has nothing to do with the air/fuel mixture but may be confused with the fuel ring you

are looking for. If you are having a hard time figuring out if what you are reading is correct or because you are not sure if the plug heat range is correct then tow the car back to the pits and drop the headers and look inside the pipes. If they are black then you are too rich, if they are light gray or white then you are too lean. The pipes should be a medium to dark gray or tan color.

Normally the white area of the porcelain has a chalky appearance. If you see the porcelain take on a shine then it is time to change the plugs because the glass that is in the porcelain has been melted and has glazed the surface. If the car has been running rich (due to lots of idling or incorrect fuel mixture) then it is possible to glaze the plugs and short them out during a run because of the sudden heating of the plug with the soot on the porcelain. This glazing appears to be a glossy coating on the porcelain with a splashes of color of greenish yellow or brown. These two different glazings will cause the plug to short out and misfire and raise ring lands or make a popping through the exhaust when going down the track.

Reading For Ignition Timing

Ignition timing is directly responsible for the heat in the combustion chamber and therefore the color of the plug's ground strap and the color of the first few threads on the outside of the plug. The ignition timing can be checked by looking at the color of the plug's ground strap and the position of the "blue line" on the strap.

The blue line really indicates the point at which the strap has reached annealing temperature of the metal. To help to understand this think of a bar of steel (ground strap) on a table that is being super heated with a acetylene torch at one of the tip ends. As the end heats up and the heat starts moving down the bar you will see a blue line across the bar at some point down the bar away from tip with the torch. This blue line reflects the temperature that is the annealing point of the metal. As the temperature increases the blue line moves further down the bar away from the torch. Similarly, the blue line moves down the spark plug ground strap as you put more heat in the engine.

If you are using a gold colored ground strap like with an NGK spark plug then not enough timing will show the ground strap as still gold or going light gray maybe with a few bubbles on it after a run. As you advance the ignition and put heat in the engine the plug ground strap will turn darker gray as well as the metal at the end of the threaded area. As the metal turns medium to dark gray you should start looking for the blue line (band) around the ground strap. Ideally, you want this blue line to be just below where the ground strap makes the sharp bend and above the weld. If you advance the ignition too far the blue will disappear off the strap and the strap will pick up rainbow colors (blues and greens). The next step beyond that is to start melting the strap from the tip end and detonation. When you are close to the correct timing then only change the timing by one degree at a time. If you ignition system has the capability of adjusting the timing of each cylinder independently

(ICT) then you can use that feature to have the blue line in the same position on all the plugs. First, adjust the basic timing to get as many of the plugs to have the blue line just at the sharp bend in the strap

Now adjust the ICT to move the blue line to the same point on the remaining plugs. Once all the plugs read the same you can advance the ignition a little at a time to put the blue line just above the weld on the strap or whatever point gives you the best performance.

Other Things To Look For

The round flat circular area of the plug at the end the threads should be dark gray or flat black and should not be sooty. If it is sooty then it can mean that your plug has not been tightened enough and you are sucking and blowing fuel and air past the threads of the plug.

Detonation shows up on the plugs as spotting on the porcelain. There are two different types of spotting seen. One type appears as just black spots and the other appears as little bright spots like diamonds. The black spots (look like pepper sprinkled on the plug) indicate a little too much heat on the plug which causes detonation by having the heated plug fire off the mixture prior to the spark firing. This creates two flame fronts that collide and can cause great amounts of damage. If you see black spots on the porcelain and you know the tune-up is correct then you may need a colder plug. If you are not sure then increase the carburetor jet size

slightly, take out some timing, or go to a colder plug. If you hold the plug in the sun and you see what appears to be small diamonds on the porcelain then your detonation is severe enough to be blowing off the aluminum from your piston and you need to add fuel and/or take out timing now.

Spark Plug Heat Range

If you keep on adding timing until your finish MPH falls off but you still have no color on the plug's ground strap but the porcelain has good color then your plug is too cold.

If you have lots of color on the ground strap but the porcelain is clean and white then the plug heat range is too hot. The heat from the plug is cleaning of the fuel ring from the porcelain.

