Tuning With Unleaded Gasoline

Summary: Using Unleaded Racing Gasolines requires more careful attention to spark plug reading than with the use of leaded gasoline. Checking out the color of the inside of the exhaust pipes is not effective when using unleaded racing gasolines.

When tuning with an unleaded racing gasoline, one needs to pay a little more attention to some details than with leaded gasoline. Spark plug reading becomes more critical because it is harder to get color on the plugs with unleaded. Getting the air/fuel ratio correct is tougher because most unleaded gasolines contain oxygen which adds to the oxygen in the air. Looking at the exhaust pipes will not tell much except that there is no gray color from the lead. How do we accomplish this task that was previously done with the naked eyeball?

Some of this is really tough because we get accustomed to one way of doing things and our world begins to turn upside down as fuel parameters and environmental regulations change. To start the process you need a good light to "read" the spark plugs. It has to be a light with a magnifying glass associated with it. There are several available on the market. They resemble the instrument that your doctor sticks in your ear to have a look at what ever he is looking at in there. Maybe for us involved in racing, he is simply checking to see if the pathway to the other ear is clear so that he can see daylight out the other side.

Spark Plug Reading

It is always best to start with a new set of plugs. When reading the plugs, always look at the entire set, and make jet changes where they are needed. The carburetor does not have to have the same size jets in all four corners. In fact, it is very unusual in a racing engine to have the same size jets in all four corners of the carburetor. This is due to differences in manifolding, inertia forces, etc.

Reading spark plugs needs to be done with proper light / magnifying glass mentioned previously so you can see all the way down (invert the plug to read it) into the plug where the insulator (white part of the plug) comes through the steel case. What you are looking for here is a slight coloring on the insulator just above the steel case. This is called the "fuel ring" and to have the correct air fuel ratio, the "ring " should be visible all the way around the insulator. If it is spotty or very light, the engine either has not run long enough to develop a fuel ring, or it is too lean. A visible ring that just offsets the white color of the ceramic is usually a good sign.

In contrast, leaded racing gasoline will color a plug much quicker than unleaded and a correct "fuel ring" will usually be little darker due to the lead in the gasoline. To correctly read a plug with leaded gasoline, it is necessary to have the same good light / magnifying glass identified above. They are not cheap, so don't try to steal one from your doctor's examining room.

Besides the fuel ring as an indication of the correct air-fuel ratio, another indication is light shiny spots at or near the tip of the insulator ***on Autolite plugs only***. These are difficult to see and show up on Autolite plugs only. It has to do with the material used in the insulator. Not all insulatiors are the same.

If the spark plug insulator shows any sign of small dark spots, especially at or very near the tip, detonation is taking place in that particular cylinder. Those dark spots are sometimes referred to as "speckles" and are very small pieces of aluminum oxide that have been cooked off the top of the piston due to the abnormal temperature / pressure that occurs during detonation. One cannot afford much of this before failure. If this condition is observed, a determination must be made as to whether the mixture is too lean, or if there is too much spark timing. Keep reading, we're not there yet.

Looking at the side electrode of the plug will help to determine the correct spark timing. Ideal timing is indicated when the side electrode shows heat all the way to the case. If there is not an indication of heat all the way to the side electrode / case, then spark timing should be increased. If the heat line stops 1/16th of an inch short of the side wire / case connection, the engine needs an additional 0.5^{o} of timing.

If spark timing appears to be correct, but there are signs of detonation, the air fuel mixture is too lean. The carburetion must be made richer by going to larger jet(s).

Detonation is unlikely to occur in all cylinders at the same time unless the spark timing and/or the air fuel ratio is way off. Normally detonation will show up in one or two cylinders. Richen only the corner of the carburetor(s) that feed the problem cylinders. Be sure to verify that the detonation problem has been resolved.

Jet Changes and Density Altitude (DA)

Racers use " Density Altitude" (DA) as a measurement when tuning an engine. If, for instance the DA is 1200 feet, this means that the air at that racetrack has a density equal to what air would be at 1200 feet above sea level if standard conditions exist at sea level. As the DA increases there is less oxygen available, and the mixture needs to be leaner. For every 750 feet that DA increases, the jet size needs to be reduced by one size. In contrast, for every 750 feet that DA goes down, jet size needs to be increased by one size.

Air Fuel Ratio

In the "old" days, all that we had to be concerned with is getting the correct amount of oxygen from the air mixed with the correct amount of gasoline being used. In tuning with unleaded gasoline, we also need to take into account the amount of oxygen in the gasoline (if there is any). This part can become critical.

Let's assume that a racer has his engine "dialed in" on ***Rockett Brand™ 111 Leaded Racing Gasoline*** and his sanctioning body is switching to ***Rockett Brand™ 100 Unleaded Racing Gasoline***. The 111 has a specific gravity (SG) of 0.721, and the 100 has a SG of 0.719. Since the two gasolines have nearly identical Specific Gravities, the fuel change would not normally require a jet change. But, there are exceptions. The new fuel in this example (Rockett Brand 100 Octane Unleaded) contains 3.5% oxygen derived from the ethanol required by the EPA. The oxygen in the fuel makes the air/fuel ratio leaner. To fix the lean condition, the mixture must be richened by at least two jet sizes. Just try to remember what an old guy(he was about 30) told me when I was 17: **"When in doubt, go richer"**. This can reduce the need to build (or buy) a new engine.

The above example is why it is critical to know how much oxygen is contained in the unleaded gasoline used. This is also the same reason that racing with street gasoline is not a good idea since one never knows how much oxygen is contained in the street gasoline. Know your racing gasoline, know your racing gasoline supplier, know if it contains oxygen, and if so, how much? Don't depend on information from your buddies. Call your supplier (does this sound bad or what) and if he doesn't know, change suppliers.

Exhaust Pipes

Using an unleaded gasoline will not color a pipe to the gray that we saw with leaded gasoline, so don't look for it. Exhaust pipes used with unleaded gasoline will be slightly black in contrast to the gray that was observed with leaded gasoline.

Experience

All of this takes experience. The more you do it, the easier it will become. Take your time, pay attention to details, and everything will come together.

For tech info, or your nearest Rockett Brand™ DistributorCall 800-345-0076

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