How Much Octane?

Street-legal racers are always looking
for better performance; 76's 100-octane
gasoline in one answer

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When thinking of octane numbers, most automotive enthusiasts subscribe to "More's Law," which is: "If some's good, more's better." This is frequently the case high-octane race fuel for street legal drag racing cars. So, what is octane, why is it needed, and how can it help a street machine make an occasional great pass?

The engines in many street-legal cars have been modified to improve performance. These modifications, which include after market headers, carb/intake manifold, camshaft, rockers, fuel-injection system, higher compression, and modified cylinder heads with big valves, can lead to increased horsepower as a result of getting a greater amount of the proper air/fuel mixture into the engine. When more of the proper air/fuel mixture is in the combustion chamber, the cylinder pressure is greater than it would be in an unmodified engine. This increased cylinder pressure needs more octane. If the octane number of the gasoline is not high enough, it can result in detonation and destruction of the engine.

Even some unmodified engines may benefit from higher octane gasoline. As under-hood temperatures increase, the engine needs a higher octane gasoline. In a dry climate like much of the Southwest, the lower humidity also contributes to increased demand for octane. On a low-humidity, 100-degree day with the air conditioner on, an engine's octane appetite can increase by three to four numbers.

76 Unleaded Racing Gasoline is legal for street use and will not harm catalytic converters or oxygen sensors. It provides street engines that require high octane the opportunity to operate at maximum output with no damage from detonation. This gasoline can be used in 1960s muscle cars as well as current performance cars and has been used successfully in four-inch bore engines with aluminum heads and compression ratios up to 12.5:1. Bigger bore engines may need to use lower compression ratios.

The benefit to using a 100-octane gasoline in high-performance street engines goes beyond the octane number. The distillation curve of the gasoline defines the temperature at which various amounts of gasoline are evaporated. Gasoline must be in a vapor form to burn, so the more readily it vaporizes (within limits), the better it will work in your engine. 76 Unleaded Racing Gasoline has a low 90-percent point compared with street gasoline. This can be a performance benefit in some engines because of the ability of the gasoline to evaporate more readily, contributing to more complete burning, which in turn leads to greater efficiency and power.

DEFINING OCTANE NUMBER

What is octane? How can it help my engine? Two laboratory octane numbers determine the overall octane quality of a gasoline. Both numbers are determined in single-cylinder, variable-compression-ratio engines. The first is the research octane number (RON), where operating conditions are mild.

This is the number that gas stations in the 1960s put on their advertising signs out in front, numbers that ranged from a little over 100 to as high as 104. If an engine is detonating (pinging) at part throttle, it usually needs more RON.

The second laboratory octane number is also determined in a single-cylinder, variable-compression-ratio engine and is called motor octane number (MON). The MON test is conducted under more severe operating conditions (higher rpm and higher inlet temperature) than the RON test, and as a result, the number is lower. If an engine is detonating at wide-open throttle, a higher MON will usually satisfy it.

The number shown on the black and yellow sticker on the service station gas pump is the average of the RON and MON, or antiknock index (AKI). If the sticker shows an AKI of 92, RON is typically between 96 and 97, and MON is typically between 87 and 88. The RON and MON can vary slightly but still must average a minimum of 92 to have a pump posting of 92. Higher octane unleaded fuels will have a greater difference between RON and MON. For instance, 76 Unleaded Racing Gasoline has a RON of 106 to 107 and a MON of 94 to 95, which gives an AKI of 100 to 102.

Higher octane does not necessarily mean more power. If a racer's engine is detonating on 92 octane gasoline, using a higher-octane quality fuel is definitely a plus. If your engine is detonation-free on 92 octane gasoline, the benefit of using a higher octane product is limited to the distillation characteristics discussed earlier.

OCTANE REQUIREMENT

The octane requirement of an engine in a vehicle can be measured on a chassis dynamometer with a standard series of reference fuels. Racers are not expected to conduct these tests but must be able to recognize when they need a higher-octane number gasoline. Keep in mind that higher octane does not mean more power unless your engine is experiencing detonation. If racers are not sure if detonation exists, try a higher octane gasoline and see if their speeds and e.t.s. improve. If they do improve, probably the engine was experiencing detonation.

CONTRIBUTING FACTORS

Many factors significantly increase an engine's octane requirement. 'I'hey include a higher compression ratio, a bigger cylinder bore, leaner mixtures, higher coolant and intake-air temperatures, dry air (low humidity), higher barometric pressures, altitude closer to sea level, and more spark advance. Also, cast-iron heads need more octane than aluminum heads.

WHAT IS DETONATION?

The octane number of a gasoline is a measure of its resistance to detonation. Detonation occurs when the octane number is too low for the engine and its operating conditions. When the spark plug fires, the flame moves through the air/fuel mixture, burning it very rapidly. Detonation occurs if a portion of the unburned air/fuel mixture gets raised to a temperature and pressure it cannot tolerate and ignites before the flame front gets to it. Detonation causes the maximum pressure in the combustion chamber to be reached before the piston reaches top dead center and pushes down the piston before it has reaches the top of its travel. Much of the gasoline's energy is wasted in trying to move the piston up while the high-pressure gasses are trying to push it down. The extreme temperature and pressure developed can cause broken rings, rod-bearing damage, piston overheating, and erosion of the aluminum. Pistons sometimes end up with holes in their tops from the high temperatures and high pressures.

THE GASOLINE FOR RACING

76 Unleaded Racing Gasoline is a clean burning, street-legal racing fuel with a minimum-octane number (AKI) of 100, designed for high-performance and specialty vehicles. It is the highest octane street-legal racing fuel available. It contains a complete additive package approved by Environmental Protection Agency and California Air Resource Board that keeps carburetors, fuel injectors, and intake valves clean. 76 Unleaded Racing Gasoline can be blended with motor gasoline with no adverse effects. It blends linearly which means that if five gallons of the product are mixed with five gallons of 92-octane gasoline, the end result is 10 gallons of 96-octane gasoline.

Use the custom blending, chart to economically produce the octane number that your vehicle requires. For example, if you want 98 octane and your street gasoline is 92 octane, look at the upper half of the chart (for 92 unleaded). The number 98 appears in the body of the table in several places, one being where the vertical column indicating six gallons of 100-octane unleaded intersects with the line that indicates two gallons of 92 octane. Therefore, if you mix six gallons of 100-octane unleaded with two gallons of 92-octane unleaded, the result will be 98-octane unleaded gasoline. If your street gasoline is 93 octane, use the same procedure with the lower half of the table.

KNOCK-SENSOR-EQUIPPED VEHICLES

In the late 1970s, the automakers began using knock sensors on engines. When the knock sensor senses detonation, it sends a signal to the main computer, which retards the spark timing until detonation ceases. By the early- to mid-1990s, knock-sensor systems were becoming much more sophisticated and could be found on about 50 percent of all new cars and trucks. The number increases slightly each year. The best thing about a knock-sensor system is its ability to reduce or eliminate engine damage due to detonation. It can, however, cause spark-timing retard, which reduces horsepower and fuel economy. Still, the trade-off can save lots of money and is a good compromise. Detonation normally occurs in one or sometimes two cylinders unless a serious fuel-starvation problem exists. Most engine-management systems reduce the spark timing in all cylinders, although some reduce the timing in only the cylinder that is detonating. Using a gasoline high enough in octane to satisfy the engine under all types of conditions will ensure maximum performance from all cylinders.

EXHAUST-VALVE-SEAT CONSIDERATIONS

In the 1960s, all gasoline contained tetraethyl lead, which was an easy way to increase the octane number. The lead oxide from the burned tetraethyl lead left a coating on the exhaust valve seat that provided protection from wear. If racers are using an older engine that does not have hardened exhaust valve seats, they should use an after market lead substitute. If they are getting ready to do a valve job on that 1960s car, they should have hardened seats installed so they don’t have to mess with additives.

LEADED RACING GASOLINE

Using leaded racing gasoline on the street is illegal. The user and the seller can both be fined up to $10,000 each.