

Do all octane boosters offer a genuine increase in octane rating? If they do, then by how much do they really increase the octane rating? The following article was originally published in Fast Fours Magazine.

Octane boosters are popular in the performance scene because they often regain power lost through detonation. Sold for around \$10 - \$40 in a handy bottle, they're a convenient fuel additive and horsepower helper. But with so many brands on the market, you may be fooled into thinking they're all as effective as one another.

Well, they're not! Differing chemical compounds, additives and even volumes, mixed in with a good percentage of advertising, "independent" testing and testimonials all conspire to confuse the consumer away from the single most important point: does it improve the octane rating? Let's find out the truth. Firstly, Do I Need an Octane Booster?

The boys at "The Macquarie Library" describe detonation as: "Excessively rapid burning of the fuel mixture, often caused by auto-ignition due to excessive temperatures in the combustion chamber, incorrect ignition timing, lean mixtures, too high a compression ratio or unsuitable fuel." Basically, a too-low an octane rating. Heard as a faint, metallic rattle, detonation is accompanied by a loss of power and can cause serious damage to piston crowns.

The significance of detonation is such that many companies produce fuel additives designed to increase the inherent octane rating of a given fuel. The proliferation of octane boosters has in part come about in recent times thanks to low quality fuels.

White or "Super" leaded fuel has been reduced from 98 to 95-96 octane, Premium Unleaded has also dropped to a minimum of 95 octane. And this presents a problem for high-performance cars designed to run on higher octane or 100 octane Japanese fuel. Japanese import performance cars, Subaru's STI WRX for example, runs an ECU program for 100 octane fuel and will detonate on lower octane fuels. All engines are different though and with Honda's S2000 2.0-litre engine running a high 11.0:1 compression ratio, it relies on advanced engine management as much as quality fuel. But it can sustain its power on PULP. And of course any turbo owner who has experimented with boost will know if you run too much, it will detonate, so improving the octane is vital for maximum performance.

Normally, octane boosters would be of little use if an engine is not detonating. However, with the advent of more sophisticated ECU/EFI programming many engines can optimise the engine management system by advancing the ignition timing and thus benefit from higher octane fuel. This means more power. They are also advantageous as an "octane buffer" for highly tuned vehicles. For example, if your vehicle is mapped for 98 octane and you are using 98 octane fuel, then it may be of benefit to use an octane booster to increase the octane to 99 or 100 as a safety margin, in the event of having "degraded" fuel etc.

The Contestants

For this test we tracked down nine common makes and variations of octane booster; two fuel "additives," a straight race fuel and a drum of Toluene. Where there were several different "levels" of octane boosters in the one brand, we chose the strongest version.

The biggest claims the manufacturers have is the amount of "points" they claim to increase. This can be ambiguous as a "point" can relate to either 1.0 RON (Research Octane Number) octane points, or 0.1RON octane points.

The list of entrants in our octane Olympics included:

STP Octane Booster

Wynns Octane 10+ Power Booster

Amsoil Series 2000 Octane Boost

Super 104+ Octane Booster

VP C5 Fuel Additive

ELF HTX 330 Racing Fuel Stabilizer

Nulon Pro Strength Octane Booster

PowerFuel Super Street Nitro Based

PowerFuel Max Race Nitro Based

NF Octane Booster Racing Formula

NOS Octane Booster Racing Formula

Toluene

VP Motorsport 103 Unleaded Racing Fuel

The Test

To conduct these tests we contracted independent laboratory Intertek Testing Services, who would test our products on a “knock engine.” We also had to find a base fuel to add our boosters to so we went to the closest public petrol station, which happened to be Shell.

Being a performance-based test, we chose premium unleaded fuel as this represents the most common high performance fuel (i.e.: if you start with regular unleaded, you're wasting money!) We should add that "some" boosters would have improved the octane rating of regular unleaded proportionately more than our tests with PULP.

With a RON rating at a minimum of 95, we first established the exact octane of the PULP. The biggest surprise was our randomly select Shell resulted in a quite high 96.8 RON. We precisely measured and mixed each additive to the PULP, according to the manufacturer's recommendations and poured each into the knock engine's tank. The compression ratio was then slowly increased until it started to knock, gaining a threshold of detonation and subsequently a maximum RON rating.

Of less importance but still worth mentioning is the design of the bottles: since most people will be pouring it straight into a tank, the design of a bottle is important to prevent any spillage on paintwork causing damage. So let's look at the results!

Octane Points

As mentioned earlier, it's very easy to confuse octane ratings as there are a number of separate international standards. MON (Motor Octane Number) is the number derived from a fuel when it's applied to a test engine run at 3000rpm rather than 600rpm and with higher inlet temps and ignition advance. The importer of 104+, Andrew Holdsworth, suggested MON is seen as a more real-world test. Although none of the fuel companies promote the MON figure which is normally between 7 and 10 numbers less than RON (Research Octane Number). Intertek's Graeme Marks believes RON provides the general public with an idea of which additive works more effectively. And being the most commonly-used reference, we've decided to use RON for all our tests.

The Results

BASELINE OCTANE 96.8

11th PowerFuel Super Street Nitro Based - 946ml treats 35 litres RRP: \$35
Octane Improvement: 97.0 (+0.2 RON)

Right from the start, we were told PowerFuel's additives weren't necessarily octane boosters, but horsepower helpers. We kept this in mind when testing both the products, but of the two, only the Super Street claimed it was specifically designed to increase the octane rating of PULP. With a 20-percent nitro mix, Super Street Nitro-Based still improved octane ever so slightly (0.2RON) but the real test for these two would really come on dyno power runs.

10th PowerFuel MaxRace Nitro Based - 946ml treats 35 litres RRP: \$45
Octane Improvement: 97.0 (+0.2 RON)

Containing another 15 percent more nitromethane than the SuperStreet formula, MaxRace doesn't claim to increase octane, but the verbal recommendation was the same, i.e.: its main characteristic is to boost horsepower, not octane. For a fair comparison of these two additives, you need to look at the power they produce. As for octane, it proved very similar to the SuperStreet formula bumping up octane ever so slightly.

9th STP Octane Booster - 350ml treats 57 litres RRP: \$10.95
Octane Improvement: 97.4 (+0.6 RON)

One of the cheapest of the group, the STP was also one of the hardest to find. Auto stores either didn't stock it, or had simply run out! Claiming to increase the octane 2-5 points, in a well-designed-for-pouring bottle, the STP – used in the ratio determined by the label - improved the octane marginally by just over half a point. A little disappointing unless you interpret STP's claim actually meant 0.2-0.5 points. Then it's a good result!

8th Wynns Octane 10+ Power Booster - 325ml treats 60 litres RRP: \$10
Octane Improvement: 97.6 (+0.8 RON)

Wynns was the cheapest of the lot and claimed an increase between two and five points, again not actually listing what a "point" related to. Strangely though the 10+ could indicate 1RON and if this is the case going by our tests it almost lived up to its name. But, not quite, increasing the octane rating by 0.8RON.

7th Super 104+ Octane Boost - 473ml treats 83 litres RRP: \$25.95
Octane Improvement: 97.5 (+0.9 RON)

The acknowledged winner of all previous testing, Super 104+'s bottle stated we should expect an increase between four and seven point. With a new formula introduced about 12 months ago, identified by an "Eagle" logo on the back of the bottle, the Super 104+ seems to have lost its edge with a marginal gain of just less than 1.0RON.

6th VP Racing C5 - 355ml treats 75 litres RRP: \$19.95
Octane Improvement: 98.1 (+1.3 RON)

VP has a strong reputation with fuels and its high octane formulas are very popular with drag racers. VP Racing's C5 Fuel additive lacked information concerning its contents or claims, but the C5 additive still provided a reasonable increase of 1.3RON

5th NOS Octane Booster Racing Formula - 355ml treats 60 litres RRP: \$28
Octane Improvement: 98.6 (+1.8 RON)

NOS, a relatively new octane booster, comes in "1/10th" scale bottles designed to emulate the actual nitrous bottles of its successful NOS systems. The Racing Formula is the strongest of three concentrates and containing Hydrotreated Aliphatics and Methylcyclopentadienyl Manganese Tricarbonyl (try saying that 10 times in a row), it contains a lead replacement which NOS claims increases the octane rating by as much as seven points. Obviously not recommended for street use, it also included with a handy pouring spout. In testing, it proved a good result improving the octane rating by almost 2 RON.

4th ELF 330 Fuel Stabilizer - 1000ml treats 50 litres RRP: \$45
Octane Improvement: 98.6 (+1.8 RON)

"If you spill it on your paintwork, don't rub it off – rinse it with water" were the words of warning. We were also told to "pre-mix" the ELF before adding it in a fuel tank (which we were doing anyway) as the ELF has a tendency to settle to the bottom of fuel if it's either not mixed properly or left to sit. This was made somewhat more difficult by the design of the bottle, which tends to drip when pouring. With some nasty stuff known as Aniline, the ELF 330 doesn't claim any numbers, but provided a decent 1.8 RON point improvement.

3rd Amsoil Series 2000 Octane Boost - 354ml treats 57 litres RRP: \$23
Octane Improvement: 98.8 (+2.0 RON)

Recommended for off-road and racing use, the Amsoil Series 2000 claimed to increase the octane rating by up to seven points. It came up a little short, but still proved surprisingly good with a full 2.0 RON improvement. This was good enough for the bronze medal in our Octane Booster Olympics.

2nd Toluene (Toluol) - 20 litres treats 100 litres RRP: \$48
Octane Improvement: 99.3 (+2.5 RON)

Since toluene (pronounced toll-you-eeen – also known as methyl benzine) isn't a commercially advertised octane booster, we were unsure of exactly what ratio to mix the clear Toluene to the fuel. From personal experience, and although we had seen high percentages increase octane even further, 30 percent was considered the maximum. Available only from various fuel distributors (it is a special order through services stations), under advice we ran a 20 percent mix (quite a lot more than the others) and saw an impressive improvement of 2.5 RON. This achieved the silver medal.

1st NF Octane Booster Racing Formula - 250 ml treats 80 litres RRP: \$29.95
Octane Improvement: 99.6 (+2.8 RON)

An Australian-made product from Perth, the NF Octane Booster Racing Formula was the smallest bottle in the field, but looking at the mixing ratio, also the strongest relying on an incredibly small dose – a mere 3 percent! Claiming to increase octane as much as 6.0 RON, NF took the gold medal in a surprising tie. If it were a split decision based on concentration though, it would be the clear winner

1st Nulon Pro Strength Octane Booster - 500 ml treats 60 litres RRP: \$20.95
Octane Improvement: 99.6 (+2.8 RON)

The Australian-made Nulon Pro Strength Octane Booster is the top of the range Nulon fuel product, claiming to boost octane "up to seven number". The Pro Strength gained a joint gold-medal equalling NF's 2.8RON increase.

Race Fuel

VP Motorsport 103 fuel - Used straight fuel (20-litre minimum) RRP: \$70
Octane Improvement: 107 (+10.2RON)

Purely for interest, we also decided to test a straight racing fuel. While there are many available (such as ELF) for no particular reason we chose VP. The highest octane VP fuel which was still totally street-legal was the Motorsport 103. Working out at \$3.50 per litre and "designed for maximum power and throttle response", the VP was very impressive with an octane rating of 107RON – more than 10RON points more than PULP. Obviously more expensive than the boosters but if octane is problem, racing fuel like VP may be the answer.

Further Information

As the name suggests, a knock engine is designed to test the detonation or anti-knock rating of fuels and fuel additives. It's a slow revving engine capable of running most fossil fuels through an adjustable compression ratio. As the comp ratio increases, it accurately measures the intensity of the knock and determines the fuel's octane rating.

The world standard is a one-cylinder two-valve four-stroke engine with exposed valve gear. Archaic in appearance, a "carby" is fed from any one of three fuel bowls to allow three different fuels to be run back to back. The mixture is actually controlled via gravity feed and by raising or lowering the float level of each bowl! Run under load via a belt-drive linking the flywheel and load system, it ensures a real world situation and ensuring minimal variation between tests, oil temperature, intake air density and air temperature are all monitored and controlled.

The engine is somewhat agricultural; however its unique ability to vary the compression ratio while running between 5.0:1 and 15.0:1 is quite amazing. The operator simply winds a handle and the entire head and cylinder assembly moves up and down relative to the crankshaft.

A knock sensor measures both the frequency and intensity of the ping (as displayed on a knock metre). Figures are then cross-referenced on a chart using the information provided by the knock meter, plus the height of the head and barrel.

Finally, knock intensity is figured in and the fuel's octane rating determined.

Taking two hours to warm, this \$200,000 engine is super robust and rarely needs rebuilding. Individual tests can then proceed at approximately \$120 per test sample.

Being subjected to so much detonation, you can only imagine how much maintenance an engine of this nature must need. Interestingly, this isn't the case as the piston and rod assembly are rejects from a monstrous ship engine (just kidding)! They're huge with an incredibly thick piston crown contributing to a combined gudgeon pin and piston weight of 1794 grams! Likewise, the rod weighs an astonishing 1929 grams. The bottom line is these engines which have replacement value of over \$200,000 and almost never require rebuilding.

Dyno Boosters

Ultimately, the role of an octane booster is to regain horsepower lost through detonation or retarded ignition timing due to detonation. But two of our products, the nitro additives, weren't specifically designed to increase octane. Instead, they contained a mix of nitromethane (the petrol Top Fuellers run) in a "percentage" concentrate. Power Fuel's Super Street and Max Race additives had 20-percent and 35-percent nitro respectively, and the Australian importer specifically claimed they would increase power, not necessarily octane.

So, we took those two products and the two best-performing octane boosters to MRT Performance for some Dyno Dynamics dyno testing. Interestingly, we were going to use MRT's rally Civic, which normally runs on avgas. On PULP – even with the booster – it was pinging too much, so a Jap-spec EF Honda Civic was used with a 1.6-litre VTEC and about 10.0:1 comp ratio.

The graphs tell the story though, and to be fair to the products, with variables such as heat soak, the results weren't as conclusive as could be gained from an engine dyno. But that is not to say the products don't work. As our test proves, they do, but it's not as easily measured on a chassis dyno. Plus the Civic had no detonation problems on PULP, further hampering the apparent effectiveness of the boosters.

Summary

Both the Nulon Pro Strength and the NF Racing Formula rated the best octane boosters in our test. And considering that less NF was needed than Nulon, it evens out a little with a slightly higher cost. Still, both proved extremely effective at increasing octane, even outranking Toluene, which needs much higher levels of concentration.

The VP Motorsport 103 fuel was an interesting exercise, and if a little more effort (i.e.: buying it from the selected outlets) is worth the octane, it's a good representation of what to expect from straight racing fuel.