MORE POWER FROM ANY ENGINE

15 IDEAS FOR SQUEEZING MORE HORSES FROM YOUR MOTOR

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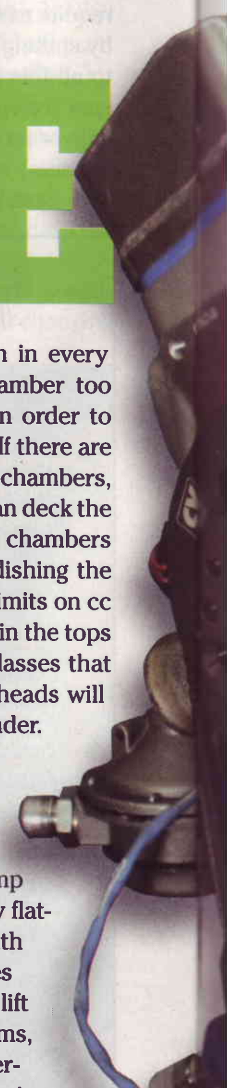
We've all heard about the three inevitabilities in life: death, taxes, and a mother-in-law who thinks you don't deserve her daughter. For racers, there's at least one more: the nagging suspicion that you are down on power. Whether it's true or not, it's always fun to dream about how many more races you could win with just a few more ponies spinning the crankshaft. With that in mind, here are 15 tips for getting more power from any engine. Try not to burn up the tires.

1 MAXIMIZE COMPRESSION

It's a simple rule: Compression equals power. Of course, everybody knows it, including race officials. That's why almost every class has limits on combustion-chamber volume and mandates flat-top pistons to effectively limit compression. So why is this a tip? Easy—make sure you are pushing your compression limit on every cylinder. If you aren't, you're leaving power on the assembly bench. Combustion chambers in stock cylinder heads can vary by a couple of cc's for several different reasons. They include core shift, valve seats cut to varying depths, or other casting problems. Because engine builders want to make sure their pieces are legal, the practice is to bring as many combustion chambers to the minimum cc limit and leave the rest large.

Make power by maximizing the compression in every cylinder. Instead of being afraid to make a chamber too small, use a few tricks to open them back up in order to bring every chamber to maximum compression. If there are differences in the volume of the combustion chambers, there are several options to even them out. You can deck the head on angle from side to side. Then, once the chambers are too small, you can open them back up by dishing the valves as necessary. If you are still pushing rule limits on cc or compression, cut slightly larger valve pockets in the tops of the pistons. Finally, check your rules. Some classes that don't normally allow any grinding work on the heads will allow minor touchups to enlarge a problem cylinder.



2 ROLL 'EM OVER

If your rule book allows roller cams, you should definitely take advantage of it. Roller lifters allow cam designers to push the ramp speed limits that hold back engines controlled by flat-tappet cams. That alone translates into power with more aggressive cam profiles that open the valves quicker and keep them at the upper limits of the lift zone longer. If you aren't allowed to use roller cams, machine in the largest lifter bores possible. Larger-diameter flat-tappet lifters also allow more aggressive lobe ramps.

There is also the friction factor. The roller lifters greatly reduce losses associated with driving the valvetrain. While

No matter what engine you're running, there are things you can do to up the power ante. Although Clements Racing Engines won't reveal all the specs on its 800hp, 400ci, all-aluminum monster, many of the tricks used here can be used to get more horses from your mill.

we are freeing up horsepower by reducing friction, don't forget roller rocker arms. These are common at mid-to-upper levels of racing. If you're racing in a Super Stock class, check to see what you're running. Good roller rockers can add as much as 10 hp at the upper rpm limits.

3 FAKE IT

Synthetic means fake. But when it comes to motor oil, the gains that can be made are real. You need mineral-based oil in a new engine in order to get the rings to set. After that, don't let anything except premium-blend synthetic oil get into your engine. Synthetic oils lubricate better at lower viscosities, hold up better against heat, resist gumming up, and just plain work better. Back-to-back tests on an engine dynamometer with an engine that has already been broken in showed a 5hp gain in synthetic over mineral oil, at the same weight.

The superior lubricating properties of synthetic motor oil will often allow you to move to a lower weight, but be careful here. Before changing weights of oil, be sure to check with your engine builder first.

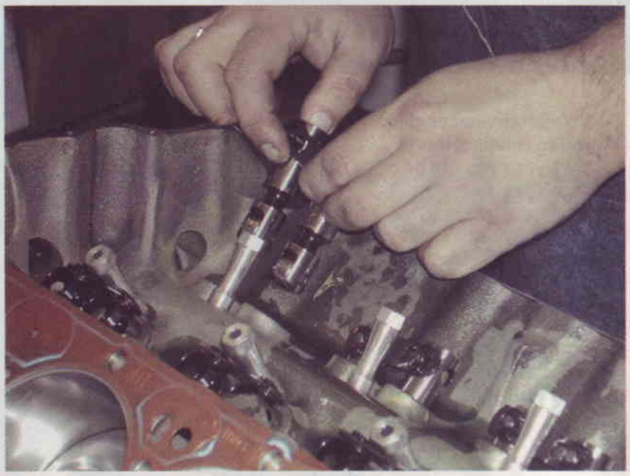
4 BIG BORE, SHORT STROKE

Most classes limit maximum displacement but say little in the way of bore and stroke limits, so what do you do? Many engine builders are pushing the limits of big-bore, short-stroke engines. A race engine is a big bundle of compromises; but, if handled correctly, utilizing a bigger bore can have several advantages.

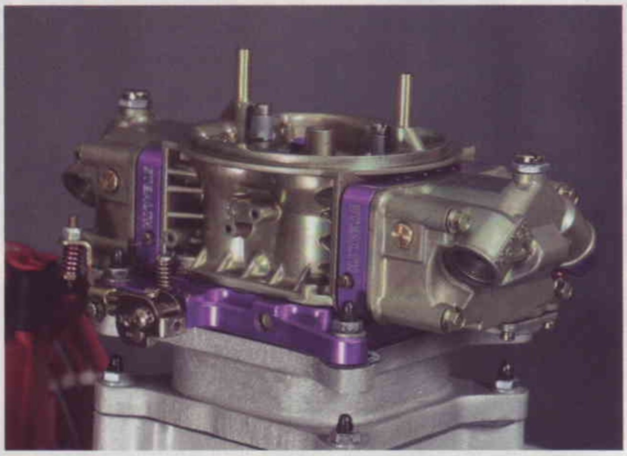
First, a bigger bore helps reduce one of the biggest limitations in a two-valve engine: valve shrouding. Before the air/fuel mixture can move down into the bore, it has to move out to get around the valve. If it hits the cylinder wall as soon as it moves past the valve, flow is limited. It's better to have more room between the valve seat and the nearest obstruction.

Another advantage comes from shortening the stroke. Because the piston travels a shorter distance, piston speed in a short-stroke motor is slower at the same rpm. On the power stroke, this translates into the piston spending more time in the top inch or two of the bore—where power is made. Shortening the piston travel also reduces the area of cylinder wall that must be scrubbed by the ring package. Reducing the contact between the rings and cylinder wall means less friction.

Finally, given the same deck height, shortening the stroke means you can stuff in a larger rod. A higher rod/stroke ratio reduces the maximum angle between the center of the rod journal and the center of the wrist-pin when the piston is centered between TDC and BDC. This reduces the tendency of the rod to try to push the piston into the cylinder wall, also reducing friction. There is a limit, however. Generally, increasing the rod/stroke ratio pushes the powerband higher in the rpm range. If you push the ratio too high, the engine will lose all responsiveness coming out of the turns.



Roller cam/lifter combinations require less energy to turn and can also take advantage of more aggressive cam-lobe profiles not possible on flat-tappet cams.



A stock carburetor from the major manufacturers is going to be good right out of the box. Rarely will it be perfect unless it gets a little TLC from a good carb tuner.

5 DIAL YOUR CARBURETOR

Few areas of a race engine can limit potential more than a poorly calibrated carburetor. It goes beyond just changing the jets. An out-of-the-box carb will work adequately, but to really make sure it feeds just the right amounts of air and fuel to the cylinders, it needs a lot of TLC from a capable carb tuner.

The first thing a good carb tuner will do is blueprint the entire assembly. No matter how high the factory's quality standards, a mass-produced product will have limits on how tightly tolerances can be held. Because a carb tuner deals with each carburetor on a case-by-case basis, he can dial in every piece exactly to the blueprints' specs—and then some.

Other areas where a good carb tuner will spend some time are the carb's throats, making sure each flows to maximum velocity and all four (or two, if that is the case) flow identical numbers. The boosters are also critically important. They must be precisely located in the venturis in order to maximize signal without blocking flow too greatly. Finally, good gains can also be found by working on the butterflies. They must shut completely, yet still allow the right idle rpm in order for the engine to have good torque from the low rpm.

6 MINIMIZE YOUR MAINS

You can lower the friction between the rod mains on the crank and rod bearings by reducing the side diameter of the mains. The stock rod journals on a Chevy 350 are 2.100 inches, but in Bow-Tie equipment, they are reduced to 2.000. Aggressive engine builders have been pushing the limits in stock car racing engines to the 1.888 Honda journal size.

Reducing the size of the journal reduces the amount of bearing surface, which reduces the associated friction. Cutting a main down from 2.100 to 1.888 may not sound like much, but multiply that eight times for all the connecting rods, then multiply that number by your average racing rpm. Now you get the picture.

Smaller bearings also have other benefits. They require less oil to lubricate properly. Everybody knows the oil pump is a big source of loss of power to the rear wheels, so any chance you get to dial down the oil pressure should be welcomed.

A third benefit from this tip is that rod mains also mean the big end of the rod can be smaller. We are now talking less rotating weight and more clearance inside the block for stroker applications. The advantage here won't necessarily be big numbers on the dyno, but you will feel it on the track by how quickly the engine responds to the throttle. The reduction in rotating weight and friction translates into an engine that will spin with greater authority.

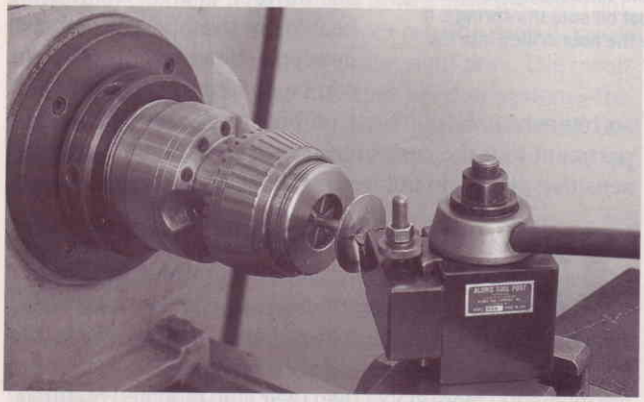
7 ELECTRIC COOL

Ever go to the gym and see one of those stationary bicycles with the big fan for a wheel? The resistance of the fan pushing air around makes for a pretty good workout. Now, picture that fan on the front of your engine.

The energy required to turn the fan is the same thing a mechanical radiator fan is doing to your engine. Air may seem thin when you're sitting in your La-Z-Boy watching Monday Night Football, but at 7,000 rpm, it's a viscous, power-robbing syrup. Now imagine someone offered to put a second motor under your hood. You'd take it, right? That's exactly what an electric radiator fan is all about.

Electric radiator fans completely remove the task of pulling air through the radiator from your racing engine. If the race is short and you can get away with using just the power from your battery, the electric motors that power the fans are free energy. If you're competing in longer races and must use an alternator to keep your battery from going dead, you're still doing better than using a mechanical fan.

A secondary benefit of electric radiator fans is efficiency. The fans mount directly to the radiator, and their close proximity to the unit means much more air is pulled through the radiator instead of around it. This also means you don't need to build a fan box—which makes it easier to get to the front of your engine while it's in the car. Hey, that's not a power tip, but who can't use a few tips on saving time and energy?



Even if you aren't allowed to grind in the combustion chambers, you can make specific (although small) adjustments to combustion chamber volume by dishing the valves.

8 GRIND IT OUT

If your rules allow it, you probably already know the value of a good head porter. No cylinder heads are perfect from the foundry, and unless you're buying CNC pieces of art, your cylinder heads could probably use a little work with a carbide bit to ensure the air/fuel charge makes it to the combustion chamber as efficiently as possible. It's not just about getting the most flow possible. A good port job takes the fuel, as well as the air, into consideration. The fuel has to stay in suspension if it's going to burn properly once the spark is applied, so a good intake port is built to ensure the fuel doesn't separate from the air. The most common methods used are as follows: shaping the short turn so the air doesn't slow too much before entering the chamber, and designing boundary layer turbulence so there aren't "dead" spots against the walls.

When going to all this trouble to build the perfect cylinder-head ports, don't forget the intake manifold. To us, the manifold and heads are two completely different parts. But racing fuel, once it's mixed with air in the carburetor, does not differentiate between an intake manifold runner and an intake port. There is, however, a rough transition between the two. So when having your heads ported, consider the entire path from the bottom of the carburetor all the way to the valve seat.

9 TAILORED SEATING

Speaking of valve seats, there's another good source of power. The science of power has come so far that good engine builders are beginning to tailor their seat designs to match the maximum valve lift. Don't think that the "standard" valve job of 45 degrees at the seat with adjoining cuts of 65 degrees into the throat and 30 degrees going into the chamber is always the best. There are other options, depending on the maximum lift of the valves and how much longevity you demand.

High-lift engines, those reaching 0.750 and over, may benefit from steeper seat angles. This is because during the majority of the time the valve is open, it is an appreciable distance off the seat. Because of the distance, the air/fuel mixture doesn't have to bend as much to get around the valve. In this situation, a valve seat around 50–55 degrees may improve flow into the chamber. The other angles will also be steeper, and you may simply want to subtly blend in the transition between the port and seat by hand. Be aware that a steep seat angle like this causes the valve to pound the seat. Even with hardened seat inserts, they aren't going to last long.

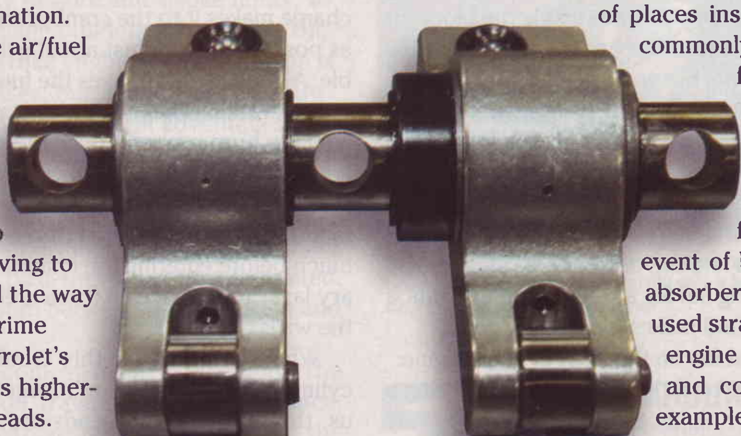
Lower-lift engines (engines with less than 0.500 lift) may see a difference with shallower seats. The opposite reasoning is true here. Low maximum lift means the valve spends most of its time near the seat, and the incoming air/fuel mixture must travel around the lip of the valve to get into the chamber. In this situation, a seat angle from 40 to 45 degrees may help flow. The trouble here is that the angle may direct air straight into the chamber walls and actually increase shrouding. It can work, just not in every case.

10 GET UP, STAND UP

We're on a roll with the valvetrain, so here's another idea that will make more power with almost any engine combination. Straighter valves improve air/fuel flow into the combustion chamber. The reason is, as the valves are angled straighter (parallel with the direction of piston travel), the pressure drop created by the piston moving to BDC acts more equally all the way around the valve. For a prime example, please see Chevrolet's 23-degree heads versus its higher-performance 18-degree heads.

On an angled valve (moving the line of valve movement more toward perpendicular to the line of piston movement), the pressure drop pulls the air/fuel mixture mostly through the bottom of the valve (the area closest to the piston) because it is in a straight line. The part of the valve that is angled away from the bottom of the cylinder does not flow as much of the air/fuel charge because of the convoluted path the mixture must travel to enter the combustion chamber and move down into the cylinder.

The moral of this story is to keep a minimum angle on the valves. For any given head, angle-milling, when done correctly, is almost always an improvement. This process not only improves the valve angles but reduces chamber volume and raises the ports.


A second option for cooling the valvesprings is to use special rocker arms that shoot oil onto the springs. If you look closely, you can see the hole drilled into the body of the rocker.


Engine coatings are still being discovered as reliable ways to increase engine power. The bonus is that special blends are being produced today that can be reliably applied by the builder in his own shop.

11 YOUR COAT, SIR

Engine coatings are only recently becoming accepted by the majority of engine builders, so the science of coatings for race engines is still on the steep part of the learning curve. Coatings can serve many purposes: Friction reduction, heat absorption, and heat deflection are the most common usages, but there are also other uses such as chemical resistance and the all-important "looks pretty" factor. Since the first three are the ones that have to do with making power, those are the only ones we'll deal with here.

Friction-reduction coatings can be used in a multitude of places inside a race engine. Most commonly, friction reducers are found on the piston skirts and bearings. The best ones not only reduce parasitic losses but also protect parts for a short time in the event of brief oil starvation. Heat absorbers and deflectors can be used strategically throughout the engine to keep hot things hot and cold things cold. A good example is coating the intake manifold to insulate the incoming air/fuel charge from being heated by the block or exhaust headers. Headers, meanwhile, can be coated to retain the heat so temperatures don't get so hot inside the engine compartment that the carburetor, electrical system, and other sensitive pieces do not become heat soaked.

12 GIVE 'EM THE SHAFT

At low rpm levels, there is probably no difference between stock stud-mounted rocker-arm systems and race-specific shaft systems. The same holds true for both systems on new heads. Shaft-mounted rocker arms are inherently more stable than their stud-mounted brethren. When you factor in a combination of high rpm along with all the variables that come with time and wear, a shaft-mounted system will definitely preserve your power longer.

13 OIL BE DARNED

Never underestimate the value of a good oil pan. Racing pans do more than just ensure your oil pump gets adequate oil flow by gating off the sump. They also make power. A good racing pan is designed to get oil away from the crank and keep it away. Oil, like water, offers more resistance as you try to move it. Imagine jumping off the high dive and hitting the water flat on your back. Yeah, it hurts just thinking about it, but that's the same effect when any part of your crank makes contact with oil splashing around in the bottom of the pan. A point on the outside of the counterweight of a crank spinning in excess of 7,000 rpm is moving at around 170 mph. Any oil it contacts will offer a significant amount of resistance. That's why good racing pans have windage trays designed to scrape oil off the crank and big kick-outs to keep it away once it's off. The kick-outs, or wings, in a pan serve a few important purposes: they keep oil away from the crank; they increase volume while keeping the pan shallow so the engine can sit low in the car; and they increase the surface area of the pan, which increases its capability to cool the oil.

Many racers confuse the purpose of the large volume built into a racing oil pan. It isn't to hold extra oil so the oil temp stays lower. That only brings the oil level back to stock oil pan levels and introduces windage. The extra volume is to keep the oil in the bottom of the pan and away from the crank. When compared to a stock pan, a good racing pan can make a dozen horsepower or more just from reducing windage.

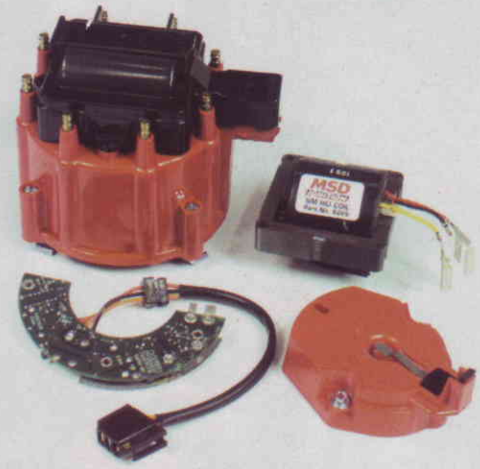
14 LET THE SPARKS FLY

Modern racing engines are continually pushing the maximum rpm envelope. More rpm mean higher gear ratios, which means better mechanical leverage at the rear wheels. That's a good thing, but higher rpm also mean the electrical system has less time to recharge between spark-plug firings.

Many stock classes require stock ignition systems. For most racers, that means running some version of an HEI. An HEI (High-Energy Ignition) is a good, simple ignition for low-rpm street cars, but it runs out of power around 5,000 rpm. When that happens, it simply cannot provide enough spark to properly fire every cylinder at the right time. The result is the same with any overmatched ignition system—the engine simply seems to "lie down" at the end of the straights. If this is one of your problems, consider upgrading your ignition system.

15 COOL SPRINGS

With racing engines pushing the rpm limit ever higher, the weakest link has become the valvesprings. They are required to be super strong to keep the entire valvetrain under control at extreme rpm without breaking or even losing pressure over time. You can help them do that by making sure they stay cool. This is especially important in dry-sump engines where you are pulling a lot of vacuum throughout the block and inside the valve covers. Now, any cooling oil that reaches the springs is quickly sucked off and pulled back into the oil reservoir.



Make sure your ignition is keeping up with your engine's power needs. The more rpm you run, the less dwell time the ignition has to recharge, and the more stress you put on the system. Stock HEIs are notorious for this, causing an engine to "lie down" at the end of the straights. If you are having this problem, look to upgrade to a racing unit.

Oil squirters in the valve covers shoot a steady stream of cooling oil onto the valvesprings to keep them within a reasonable operating temperature.

Use oil squirters to make sure a steady stream of cooling oil is showering your valvesprings. The conventional route is to use squirters built into the valve covers. They are relatively simple but require an extra line to run from the pump to the connection on the valve covers. A simpler route is to use special rocker arms with a built-in squirter. These are special shaft-mounted pieces that receive oil from the pushrod and use it to lubricate the shaft. A small hole drilled into the body of the rocker allows oil that's pumped in around the shaft to squirt out and onto the valvespring. This doesn't provide quite the coverage that valve-cover systems do, but it still works very well.

This tip doesn't translate directly into power, but you can use its effects to make more power. By helping your springs stay cooler, they will last longer. Now you have less concern about losing power due to a spring dropping its tension. This can even allow for a more extreme spring selection. **EM**