

BORE VERSUS STROKE



Bigger might be better, but there are different ways to get there

► Thank goodness someone was listening in class. When some of us were reading moto magazines in geometry, others were learning all about pi and the wonderful things it can do to motorcycle engines. Those guys went on to devise ways to get more displacement, which is a great way for the rest of us to throw more roost farther into the air.

Okay, we can put 3.1416 into a calculator with the radius of the bore squared and the stroke to come up with the size of a motor. And when you increase the bore or the stroke—or both—good things happen. The bottom line is that we've ridden a number of modified bikes recently and we believe in displacement more than ever. Never mind those guys who say no one can handle the power of a stock 450. We've found that more displacement can actually make a bike easier to ride.





Making a stroker used to be the difficult way of getting more displacement. Hot Rods now sells a crank with all the hard work done.

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BUT HOW DO YOU GET THERE?

So is it better to bump up the stroke, increase the bore, or change the value of pi? Different tuners say different things about the first two options—no word on the last. We wondered ourselves, but the only way to really find the truth would be to set up two identical bikes, bore one, stroke the other then go riding. So that's what we did. We gave Terry Varner of Varner Motorsports two 2007 Honda CRF450s and a pile of parts. He gave both bikes some headwork and a Hot Cams Stage 2 cam. But bike number one was bored out and got a 2mm oversize CP piston. Bike number two got a new crank from Hot Rods that provided 3mm more stroke. When they were bolted back together, the bored bike measured 468cc and the stroked Honda was 471cc. Which would run better? Were they both the same?



The stroker had more power everywhere according to the dyno. On the track, it felt like more top and more rev with sleepy initial response.

There are all sorts of theories about bore versus stroke. First off all, you need to understand that all the modern 450s have huge bores and relatively short strokes. Honda, Yamaha and just about everyone else have

arrived around a 95mm by 63.4mm configuration basically to keep the height and weight of the motor down and to allow for huge valves. The longer strokes of old-world four-strokes, on the other hand, mean high-

We've been big fans of the way a Honda 450 reacts to a bigger piston. Millennium and CP pistons made the bore 2mm larger; Terry Varner did head and carb mods to both bikes.



The big bore had lots of snap but that didn't make it any more difficult to ride. The only chassis differences between the two bikes was suspension, with MB-1 building the stroker and Precision Concepts working on the big bore.

er piston speed, less piston weight and more fluid velocity of the fresh fuel charge that enters the cylinder. Additionally, a stroked motor makes for a different rod angle, and that is said to affect power delivery, too.

MORE PARTS

This kind of test wouldn't have made any sense until now. While there are lots of places to find over-size Honda pistons and a few different places that will either resleeve or

bore and replate the cylinder, making a stroker was a very difficult, labor-intensive process. Now Hot Rods has a stroked crankshaft ready to install. You still have a lot of engine disassembly, but there's no machine work to do. You don't even have to have a spacer under the cylinder. For the ethically challenged 450-class racer, there's no way to tell either of the motors from a stocker. Most racing organizations hang on to the Open class and any size bike is legal in the vet class, so the bottom line is that no one really cares. If you can hang on to something larger than a 450, they figure then good for you.

We decided to build both bikes for GP racing, which meant that we could go even farther into crazy territory with power output. Varner's headwork is probably responsible for another horsepower or two, as is the Hot Cam Stage Two cam. Varner also modifies the carb. We installed an FMF 4.1 pipe and Powerbomb header on both.

To make them acceptable for the length and off-road elements of WORCS-style races, the bikes got

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Between the stroker crank, the Hot Cams Stage Two cam and the Varner headwork, the CRF471 was incredibly fast.



Which motor is better? Most riders would probably prefer riding the big bore a gear high. The stroker is a revver, and that takes a very aggressive rider.



The bikes will probably be raced in GPs, so Wheel Wright built up 18-inch rear wheels for both. They also had 3.2-gallon IMS tanks.

Mod/Part	Company	Retail	Phone
3mm complete stroker crankshaft.....	Hot Rods Products	\$395.96	(515) 402-8100
Carb/intake track Mod	Varner Motorsports	\$250.00	(909) 227-6156
Cylinder Head Porting	Varner Motorsports	\$549.00	(909) 227-6156
Clutch springs.....	Varner Motorsports	\$59.00	(909) 227-6156
Megabomb System 4.1	FMF Racing	\$849.99	(310) 631-4363
13.5:1 96mm CP Piston.....	CP Piston.....	\$229.95	(949) 567-9000
Stage Two CRF450R cam	Hot Cams	\$189.95	(515) 402-8005
Outer clutch cover.....	Hinson Clutch.....	\$225.00	(909) 946-2942
Inner Hub/Pressure Plate	Hinson Clutch.....	\$479.99	(909) 946-2942
Clutch Basket	Hinson Clutch.....	\$239.99	(909) 946-2942
Coolant hoses.....	CV4	\$111.00	(800) 874-1223
Custom graphics kit	Flu Designs.....	NA	(661) 256-2313
Cometic gasket kit	Cometic Gasket	\$136.10	(800) 752-9850
Foam air filter.....	Uni Filter Inc	\$26.95	(714) 535-6933
Triple clamps.....	Applied Racing.....	\$395.95	(800) 853-0555
Elite Perch/w Hot Start.....	Works Connection	\$179.95	(800) 895-8292
Radiator braces.....	Works Connection	\$59.95	(800) 895-8292
D756RR front tire	Dunlop Tire	\$112.69	(800) 845-8378
D952 rear tire	Dunlop Tire	\$109.55	(800) 845-8378
Vented Uniko handguard.....	Acerbis.....	\$37.95	(208) 622-1000
3.2 Gallon fuel tank.....	IMS Products.....	\$225.00	(951) 653-7720
Oversize Radiators	Fluidyne Powersports	\$449.95	(888) 949-0238
Z-Ring 520 ZRH Chain	Regina USA	\$122.95	(410) 221-2800
TwinWall 997 bend bars	Renthal.....	\$119.95	(877) 736-8425
Fork Revalve.....	MB1 Suspension	\$190.00	(951) 371-5045
Shock Revalve.....	MB1 Suspension	\$190.00	(951) 371-5045
Bore & replate cylinder.....	Millennium Tech.....	\$214.00	(920) 893-5595

3.2-gallon IMS fuel tanks, Acerbis vented handguards, and every guard that Works Connection makes. Wheel Wright laced up 18-inch wheels for both.

WHAT WE EXPECTED, WHAT WE GOT

Here's what we thought would happen: we figured the stroker motor would be smoother and easier to ride and we thought the big bore would be a hard-hitting brute. The longer stroke motor should have more rev because of the smaller, lighter piston, and the big-bore should do everything early then sign off. Frankly, we figured that modern four-stroke motors were already so over-square that giving them a bore that was bigger still would be going past the point of diminishing returns.

But that's not how it worked out; not exactly, anyway. Yes, the stroker did make more power higher. Yes, the big bore had more snap. But that didn't mean that the big bore was harder to ride. In fact, the opposite might have been true. The low-end hit of the big bore was easily handled by up-shifting and running a gear higher. The stroker liked being revved so much that you felt

that you were loafing if you didn't keep it singing. Faster riders didn't mind that at all; they're used to keeping a big four-stroke pegged. Novices and intermediates, not so much.

The most interesting part was that the stroker looked better on the dyno at virtually all rpm. We think the big bore felt so much stronger down low because it does more at small throttle openings. Dynos measure horsepower with the throttle wide open, but in the real world that almost never happens. We do most of our riding at half throttle and that's where the big bore has such good response. All our riders agreed that the stroker might be faster in the hands of a very talented rider, but the bored CRF was more user friendly.

Does this mean that the same will be true of all bikes, that increases in bore will always have that result? Hardly. It all depends on the bike. Small motors often lose too much rpm with large increases in bore size. All we know for sure is that the Honda CRF went from fast to faster in both configurations. But only one was easier to ride as a result. □



CHEF'S SPECIAL

The inevitable combo: bore AND stroke

► It was so obvious that we ignored it completely. In our quest to answer the bore versus stroke debate we pretended not to have the next step all planned out from the start. But now, for the record, here's the official question: if additional bore has one kind of benefit and stroke has another, then what about more bore *and* more stroke?

So when we were finished testing the two bikes, we gave them back to Terry Varner and he merged them into one. The stroked CRF471 got a fresh big-bore cylinder just like the one from the CRF468. The result was a 491cc freak of science. It kept Varner's head and carb mods and almost everything else. The only other change was the switch to a Hot Cams Stage Three cam. Both bikes had Stage Two cams for the original test sessions and Varner ran all the configurations on his dyno. The Stage Three, which is designed for oversize engines, got the final nod because of its benefit on overrev.

The dyno gave us a little preview of what the 491 could do on the track. A stock Honda CRF450R produces 50.8 horsepower at 8250 rpm then trails off dramatically. The 468cc big bore and the 471cc stroker both showed an increase of five horsepower at peak with a much broader spread. The 491cc combo made two more horsepower than *that*. And it carried the advantage forever. From 7000 rpm all the way past 11,000 rpm, the 491cc never falls below 50 horsepower.

Mark Tilley was the first man on the beast at Competitive Edge Raceway. This is a track with deep loam and fast straights. Basically, it was one of the few tracks that could handle the 491. "It's fast," Mark said, shaking his head. "Real fast. I don't know if you could even use that much power on most tracks. Even here, there are only a few places where you can open it up. And those straights get used up real fast." Later, when Mark rode a bored-only 468 for reference, the power of the 491 was really illustrated. "Now the 468 seems slow," he said. This was a bike that generated awe just a week earlier.

As far as power characteristics, it really did have a little of each bike. It definitely had the low end snap of the bore-only machine. And we can only assume that it had the scream of the stroker. We aren't really sure on that last point because no one had the nerve to scream it for more than a few microseconds.

There were two negative aspects of the 491 that we didn't notice on either of the other two bikes. First of all, it was harder to start. Second, it ran very hot. In most racing situations you wouldn't have an issue with the latter of those two; it would only be a problem at very low speeds. And frankly, if you're riding this bike at low speeds, you're missing the point. The only places you need this type of power are on the start and on long, deep hills. The rest of the time, very few people are using the power of a stocker.

But needing it and wanting it are two different things. □