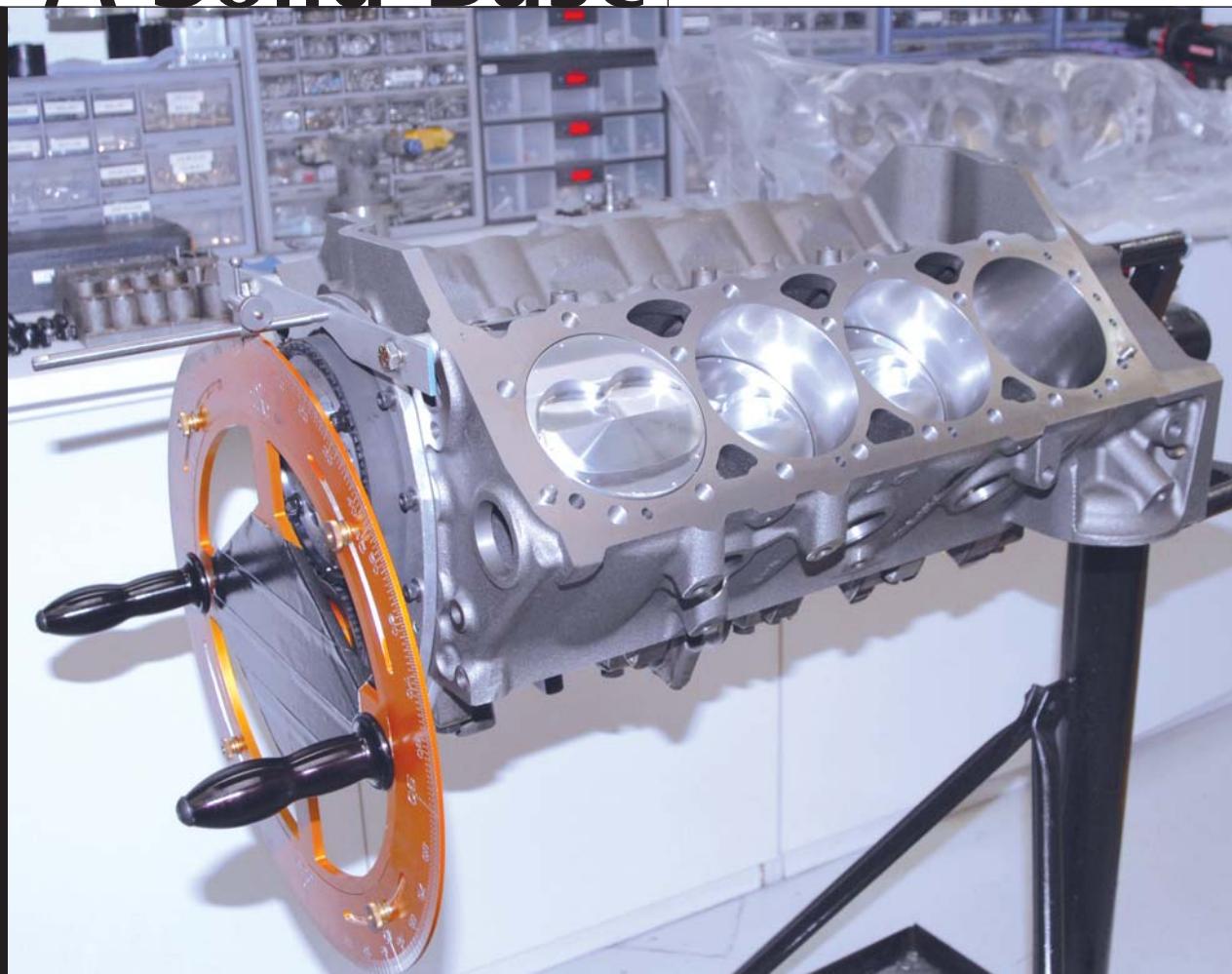


THE

A Solid Base

THE BOTTOM END OF THE "RAT TRAP"



Written by Jake Amatisto
Behind the Lens: Scott Sparrow

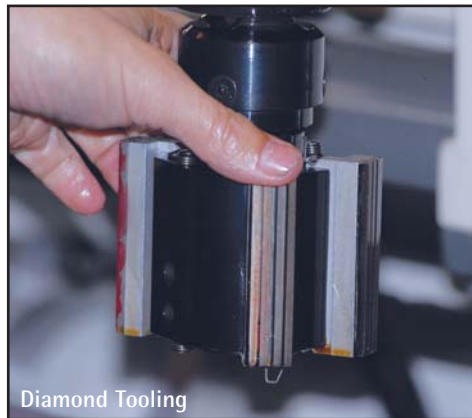
Last month we introduced a new engine project we'll be covering this year in *FSC*, a high-winding 406 small-block that we aim to make over 750 horsepower with. Starting with some off-the-self parts (except for a custom cam from Comp Cams), Mark Rapp of Rapp Racing Engines out of Huntington Beach, California designed this engine with high-rpm horsepower in mind. Not only do we want to reach our power goals with this combo, but we also want to see what e.t this 406 can produce in a 3,300-pound Chevelle. We're hoping for nines in the quarter.

It's hard to talk about the shortblock of an engine without mentioning something about what's going on the top end, and the 406 in question here will feature some of the industry's newest parts too—Comp Cam's Elite Race roller lifters and Air Flow Research's 235cc cylinder heads. The Elite Race roller lifter line is designed for engines just like this one, high revs and big valve spring seat pressures. The engineers at Comp definitely stepped up the program when it comes to these lifters. Some of the features to care about include super-strong .400" roller axles and a bearing package that houses twenty three

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► Starting with a fresh **SHP Dart block**, Pfaff Racing Engines in Huntington Beach bored and honed it to accept our 4.155" pistons.

► Pfaff uses **diamond tooling** on his machines for their superior wear characteristics over stones.



Diamond Tooling



SHP Dart Block

"Tony Mamo at AFR came up with a camshaft that should move enough air in the upper rpm range to really use the 235's flow characteristics."

—Mark Rapp, Rapp Racing Engines



A Word on Paul Pfaff Racing Engines

Paul Higgins of Paul Pfaff Racing Engines out of Huntington Beach, California handled the machine work on this engine project and was able to give a couple tips when it comes to machining a block. First, when decking the block, Pfaff likes to make a few passes over the block's deck surface with the Rotler before reaching the desired deck height. Also, Pfaff used diamond tool bits instead of stones. The stone tooling tends to wear unevenly, whereas the diamond stays truer, longer. The block was zero decked, bored and honed at Pfaff's before going to Rapp Racing engines for assembly. Pfaff and Rapp sound like a comedy duo or private eye team, don't they?

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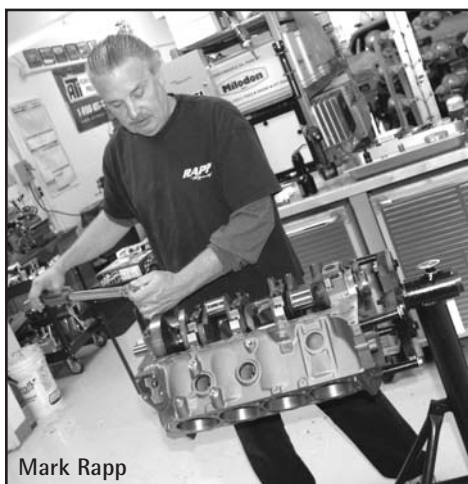
SRP's Professional Series Pistons

Engine designer Mark Rapp chose SRP's Professional Series piston for this 406 buildup. They feature a small dome that provides nearly 14:1 compression with a 60cc combustion chamber and also have the low-friction skirt coating applied to them. Rapp opted for vertical gas ports on these to help piston ring seal also. One cool thing about the Professional Series is they come with the piston rings, which is a nice addition to the whole package.

needle bearings, which disperses the load more effectively than previous designs so they can stand up to high spring pressures. The lifter bodies feature a low friction REM polishing process to remove stress risers, which also assists in oil control—more on these lifters in the next part of this series. The cylinder heads we're using on this project are AFR's ultimate solution for the big-inch small-block racers that want to, or have to, keep the 23-degree Chevy valve angle. They flow about 316 cfm at .550 lift, 330 cfm at .650, and 340 at .800 lift right from the box. These heads are a great bolt-on for someone with a big cubic-inch small-block, or in this case, a medium-sized engine with a lot of rpm. We contacted engine builder Rapp about the idea behind these heads on a smallish engine, "We worked closely with Tony Mamo

at Air Flow Research on this combo. We approached him at SEMA last year about the goals with this small-block; 750 horsepower with a single 1,050 cfm carburetor. He decided on the 235 Eliminators. Even I was skeptical about the 235s at first, but Tony Mamo at AFR and I came up with a camshaft that should move enough air in the upper rpm range to really use the 235's flow characteristics. We're looking to rev to around 8,500 rpm when it's done." We'll touch more on the top half of the engine in the next segment, here, we go over the bottom end.

The beauty of an engine like this is it's fairly affordable since the parts are readily available off-the-shelf. Starting with Dart's popular SHP engine block, Rapp and engine owner James Furguson designed this high-powered naturally-aspirated



Mark Rapp



Callies

Because of the rpm range desired, windage can be a big issue.



Magnetic Base Dial

combo that saves money in the right places, yet doesn't skimp on the quality or cut corners. Even something that's usually custom on other engines of this level, like the pistons, can be ordered straight up. Rapp chose a set of slugs from SRP's Professional Series line and can be found in SRP's catalog as part number 271066. They provide a 13.9:1 compression ratio with the AFR's 60cc chamber, and Rapp opted to go with the optional gas-porting feature on them to utilize low-tension rings and a vacuum pump more effectively. They are forged, have a skirt coating on them, and measure 4.155." The ring pack used in this build actually comes with the SRP pistons we're using. They are designed to have low-tension to work with a vacuum pump and also the pack comes with the essential Napier-style second ring. The rods are forged h-beams from Comp Star Components (A division of Callies) that measure 6.000" and feature ARP2000 rod bolts. Although this engine will see enough rpm to possibly take advantage of an aluminum rod, Rapp decided on steel rods for their

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► With the block back at Rapp Racing Engines, **Mark Rapp** torques the main caps down before measuring for the main bearings.

► After messing with a couple different Clevis bearings, Rapp ended with .003 of bearing clearance and tightened the **Callies** crank down.

► To keep your engine from eating the thrust bearings, it's important that crank endplay is checked. Here, Rapp adjusts the amount using a **magnetic base dial** indicator. It was within spec.

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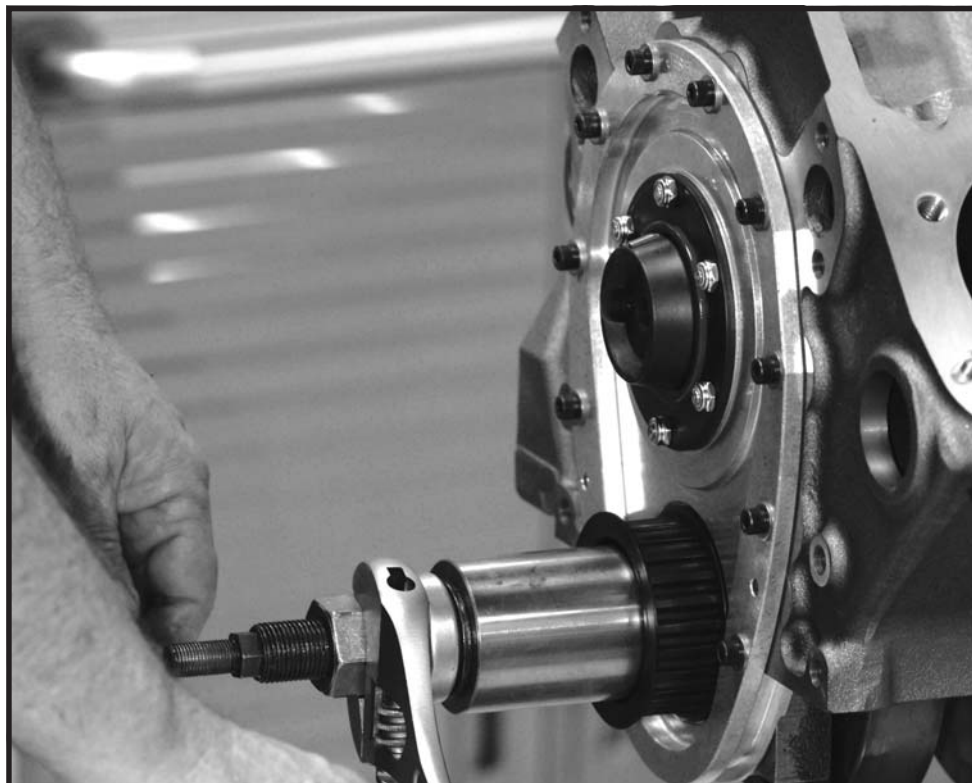
THE BOTTOM END OF THE "RAT TRAP"



Filed the Rings

longevity. "The engine owner thinks he's going to drive it on the street, I don't know about that," Rapp laughed, "but if he does, we don't need those miles of fatigue in the rods, so we went with the Comp Star h-beams," Rapp said. The crankshaft in this engine is a Callies crank with 3.75" of throw. "The idea was to take some stroke out of it and go with a larger bore to unshroud the valves and help the 235s breathe better," Rapp said. The shorter stroke will also promote rpm acceleration as well. We also asked Rapp what he likes for rod and main bearings, Rapp explained, "We use Clevite H-Series bearings in a lot of my engines. This one took a CB363HXN bearing to get the right clearance." Since the fillet radius on the cranks these days are getting larger, many engine builders are using the "X" (extra clearance) or "N" (narrow), or both to get the right clearance. Rapp set up both the rods and mains at .003.

The oiling system we're using on this engine is from Milodon. Because of the rpm range desired,



Jesel Belt Drive

To keep our cam and valves on time, we opted for Jesel belt drive on this 406 Chevy. The belt is actually superior to a chain, as it won't stretch and the adjustability is nice for fine-tuning. For those that don't know, these covers often times need some additional machining for them to fit flush, so Rapp had to clearance some areas. But after all, we're building a race engine, not a Lego construct.

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► For installing the pin retainers, which happened to be locking rings on these particular **SRP slugs**, Rapp uses a very effective tool that makes piston/rod assembly much easier.

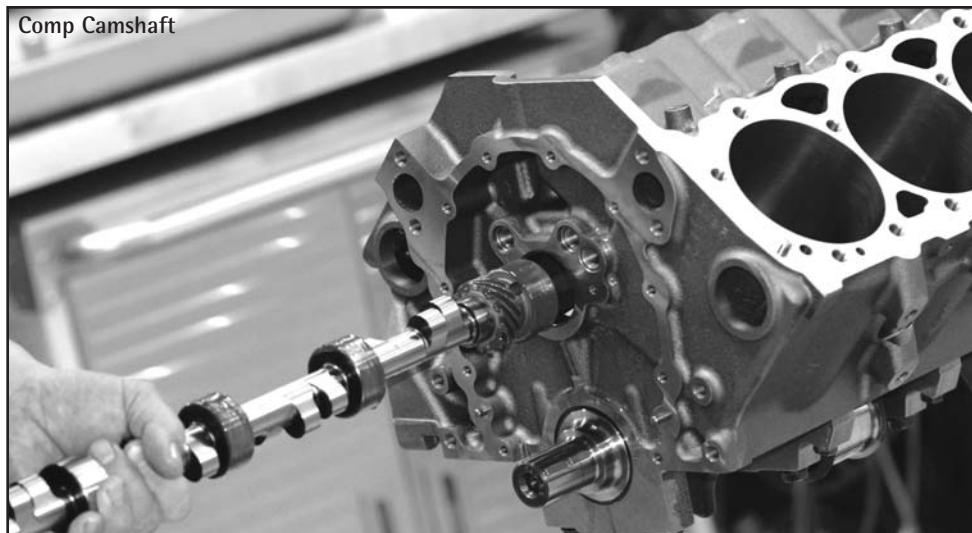
► Once the SRP pistons were hung on the rods, Rapp **filed the rings** while keeping the engine naturally-aspirated manners in mind. We ended up with .025 on the top, and .023 on the second.

► We'll touch more on the **Comp camshaft** we're using in this engine on the top end article, but we have to say, it's pretty nasty.

SRP Slugs



Comp Camshaft



Even something that's usually custom on other engines of this level, like the pistons, can be ordered straight up.

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Short Block Assembled

With the shortblock completed (mock up), we are looking forward to fitting on the AFR 235cc heads on and the top end together. The next image you see of this 406 should be ready to go, carb to pan. Keep reading *FSC* to find out what happens to the Rat Trap.

windage can be a big issue with an engine like this so Ken Sink at Milodon sent one of there best drag race pans for small-block Chevys. It features a kickout and a built-in windage tray to help keep the oil off of the crank, which frees up power, especially in high rpm applications. At the heart of this engine is a standard volume oil pump, not a high-volume, "Think about it, the more oil the pump has to move the more power it takes to move it and since this engine has a mechanical roller and roller rockers, we don't need the extra oil. Even on flat

tappet engine we run standard pumps, and some guys will even modify the pumps to move even less-than-stock oil volumes," Rapp said.

With the shortblock mocked up, the next step is to permanently fit everything and torque it down. We mentioned earlier that the crank has been lightened, but it should read "it was getting lightened," because the crank was still being machined for that. Once the crank is back at Rapp's shop he'll setup the top half and *FSC* will be there to check it out. ■



Piston Hammer



Clevite "HNX" Bearings

"The idea was to take some stroke out of it and go with a larger bore to unshroud the valves."

—Mark Rapp, Rapp Racing Engines

S O U R C E

Air Flow Research
877.892.8844
airflowresearch.com

Comp Cams
800.999.0853
compcams.com

SRP Pistons
714.898.9764
srp.com

Dart Machinery
248.362.2027
dartheads.com

Rapp Racing Engines
714.842.7300
rappracingengines.com

Paul Pfaff Racing Engines
714.894.7573
pfaffengines.com

Milodon Inc.
805.577.5950
milodon.com

Jesel Valvetrain Innovation
732.901.1800
jesel.com

Callies Performance Products
419.435.2711
compstarcomponents.com

Clevite Bearings
Mahleclevite.com

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► Here, Mark Rapp fits the engine's CompStar h-beam rods with the **Clevite "HNX" bearings**. Rapp is a firm believer that when it comes to bearing clearance, it's better to heir on the looser side.

► With a few taps from the **piston hammer**, Rapp sunk the SRP slugs into the SHP block.