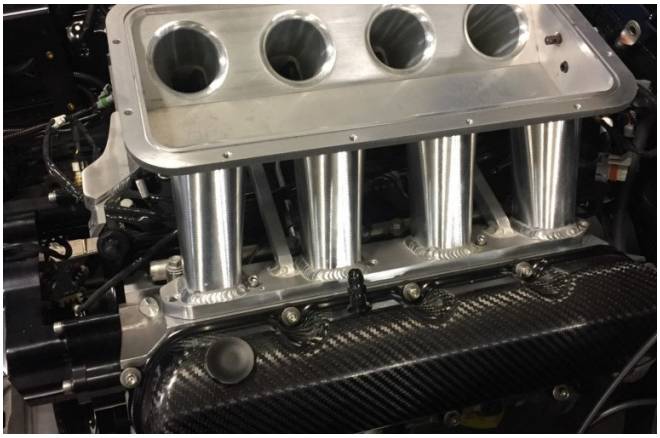
Stout Small Block: The COPO 302 Cubic-Inch Direct Injected Engine

Chevrolet devolved the original 302 cubic-inch engine for the first generation Camaro so it could compete against the Mustang in SCCA competition. The high-revving small-block accomplished its goal of winning in the SCCA and on the drag strip, as well. This iconic engine has been resurrected and can now be found in the modern COPO Camaro spinning to high RPM levels with a modern direct injected fuel system.

When the COPO made its return in 2012, GM introduced it with 350, 396, and 427 cubic-inch engines followed by a supercharged 350 cubic-inch engine. As the COPO program progressed people were snatching up the 350 and 427 cubic-inch engines, but the lower classes in the NHRA where smaller engines were needed saw some vacancies. GM wanted to earn more manufactures points in the NHRA, so they added the 376 and 302 cubic-inch direct injected engines to fill the need.



The Super Stock version of the 302 uses a custom CFE intake and carbon fiber lid.

The 376 cubic-inch had some limits with fuel delivery and the stock ECU. Rich Rinke, who is part of the COPO Build Center team, decided to work with the direct injected 302 engine in his stocker. As Rinke worked with the engine in the NHRA class racing environment he found the mechanical fuel pump had its limits and would shut off at around 7,900 RPM. This was due to the lifter in the back running the mechanical pump on the LT1/LT4 style engines. This system wasn't designed to spin at the dizzyingly-high RPM numbers Rinke was asking it to so he had to come up with a new plan.

After doing some investigating, Rinke found other companies had some direct injected setups for fueling, but they were geared towards lower RPM applications or supercharged applications. At this point, Rinke decided to go in his own direction to solve the issue for the direct injected 302 cubic-inch engine.

COMP Cams' Billy Godbold (left) with Rinke.

"With the help of my son, Jack, we started to plot out the math on how to make the fuel pump lobe work at higher RPM. We were able to come up with a cam profile and shared it with Billy Godbold at COMP Cams to create. This was new territory and Billy was willing to try anything, so he made the first camshaft and we ran it on a test engine, it did well going up to 9,600 RPM without any issues at all," Rinke says.

Rinke then began to work on the fuel rails of the engine to make sure the hungry engine could be fed the right amount of fuel as the RPM climbed the tachometer. The direct injection system posed another set of interesting challenges for Rinke that he was ready to solve so he could keep the engine happy.

"The fuel rails had restrictions in them, and rather than drill them out, I put

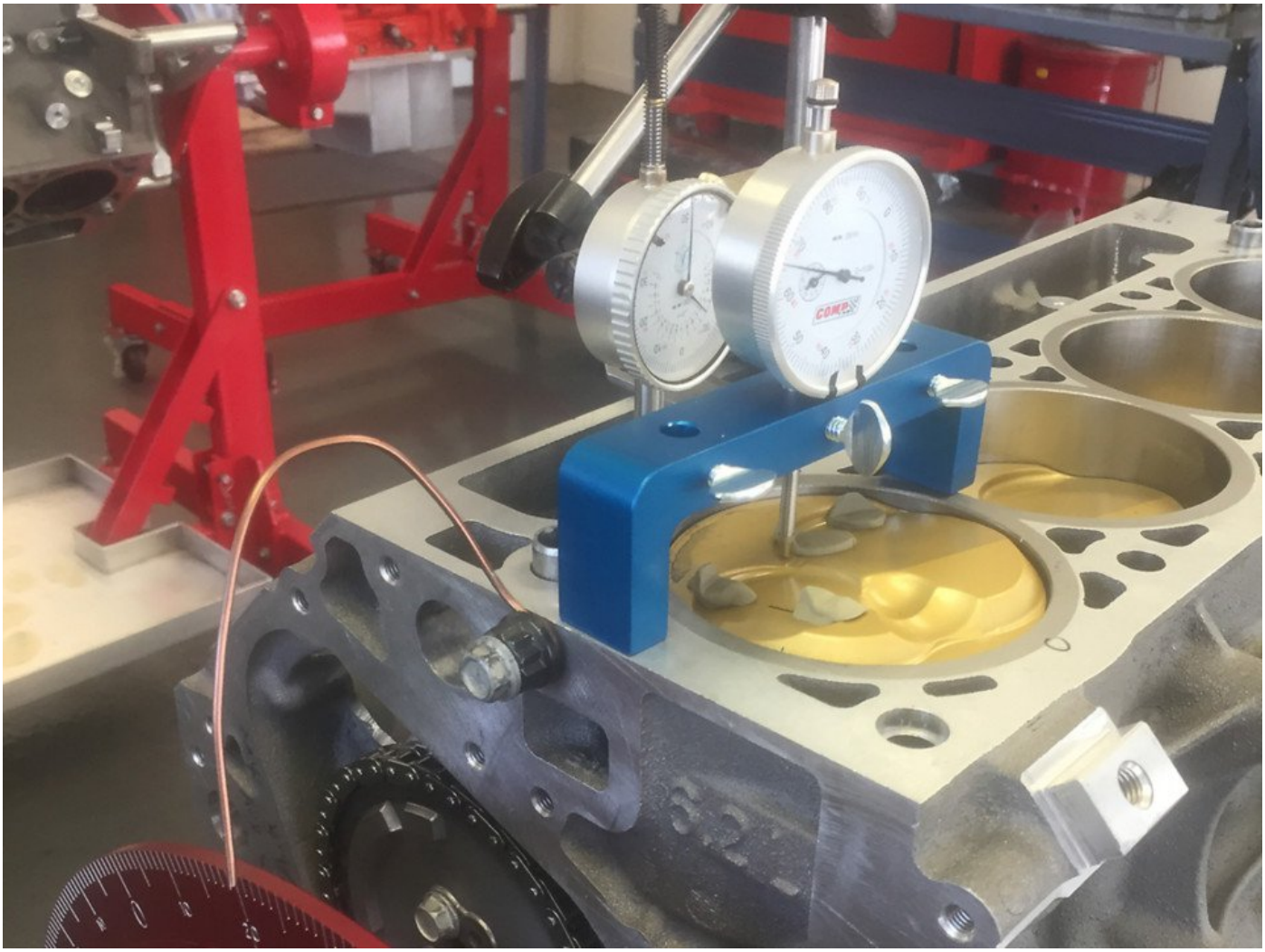
jets in them so I could maintain rail pressure. Direct injection is unique because it runs a riser pump to the LT1/LT4 pump which has a pressure regulator that's controlled by the ECU and pulses into the fuel rail. That pulse is critical because if the Bar goes above 180 or 190 the system will shut itself off because it thinks there's too much pressure. In order to dampen the pulse to the pump we ran a .0030 orifice in there so it will pump the fuel in without kickback from the pressure," Rinke says.

After working through all the different issues to get the direct injection system to function at a high level, Rinke was ready to put his theories to the test. An engine was built that had all of the new fuel delivery parts, the special camshaft, and upgraded valvetrain to see what it would do.

"The engine ended up going all the way up to 9,600 RPM right out of the gate, so we knew we had something. We were looking at the lambda

numbers and decided to build the full race engine and that went to 10,200 RPM with no fuel delivery issues. We knew mechanically we could make an engine buzz that high, but with the direct injection there's nobody out there that's within 2,000 RPM of our numbers, Rinke says.

Why all of the work to make a 302 cubic-inch engine work in NHRA class racing? It's simple: horsepower-to-weight is what makes the world go 'round in Stock and Super Stock. Having a small and lighter package that makes big power puts you at a huge advantage when choosing a class. The modern direct injected 302 also can make power easier versus trying to use an older small-block filled with rare and unique parts.



"For Stock racing, it gives you the ability to run against the other small displacement engines with a product that can easily run one-second under

the class index right off the bat and with a relatively low cost involved. It's basically a stock LT1 motor with stock heads, stock block, and the geometry is pretty much stock carried over. You just put a cam in it with a good set of pistons and rods to create this engine and it flies," Rinke says.

This lightweight package that includes the 302 creates a better weight distribution scenario for the racer to work with. Rinke launches his 302-powered Camaro at 4,500 RPM regularly and cuts 1.25 60-foot times.

"Super Stock it is very much like stock and has the advantage of being a smaller, lightweight package for the horsepower rating that's easy to tune at 700 horsepower. It should run at least a second if not more under the index all day long. It isn't as hard to buzz this at a high RPM level, makes good power, has parts that are available, and is reliable," Rinke explains.

Making this package work wasn't an easy task but it was right in Rinke's wheelhouse. It gave him the opportunity to explore something new and find a way to make big horsepower out of a small engine.

"I enjoy the challenge of all of this and doing something that people say can't be done. It's all in the numbers and you can figure it out from that. This is all new ground and I didn't know anything about direct injection when this all started but you have to throw some numbers against the wall to see what needs to be done. The car is always telling you something and you have to remain open-minded to figure it out," Rinke says.

Taking a direct injected engine into territory that has never been attempted before was an interesting journey for Rinke. It took some creative problem solving to figure out the fuel supply side, camshaft lobe, and modification of different fuel pumps to make the direct injection work. The final product is a screaming small-block that will help COPO racers do well in both Stock and Super Stock racing.