DIESEL WORLD

YOUR GLOBAL DIESEL RESOURCE

JUNE 2014 • VOLUME 9, NUMBER 6

GAS vs. DIESEL: WHO WINS MPG BATTLE?

DIESEL WORLD

DIESELWORLDMAG.COM

35+ DIESEL TUNING OPTIONS

FIRST LOOK: 2014 GM HDs!

GM's NEW 2.8L DIESEL

PLUS POWER STROKE FILTER UPGRADES

INSIDE A TORQUE CONVERTER

+

CUMMINS INJECTOR NOZZLES

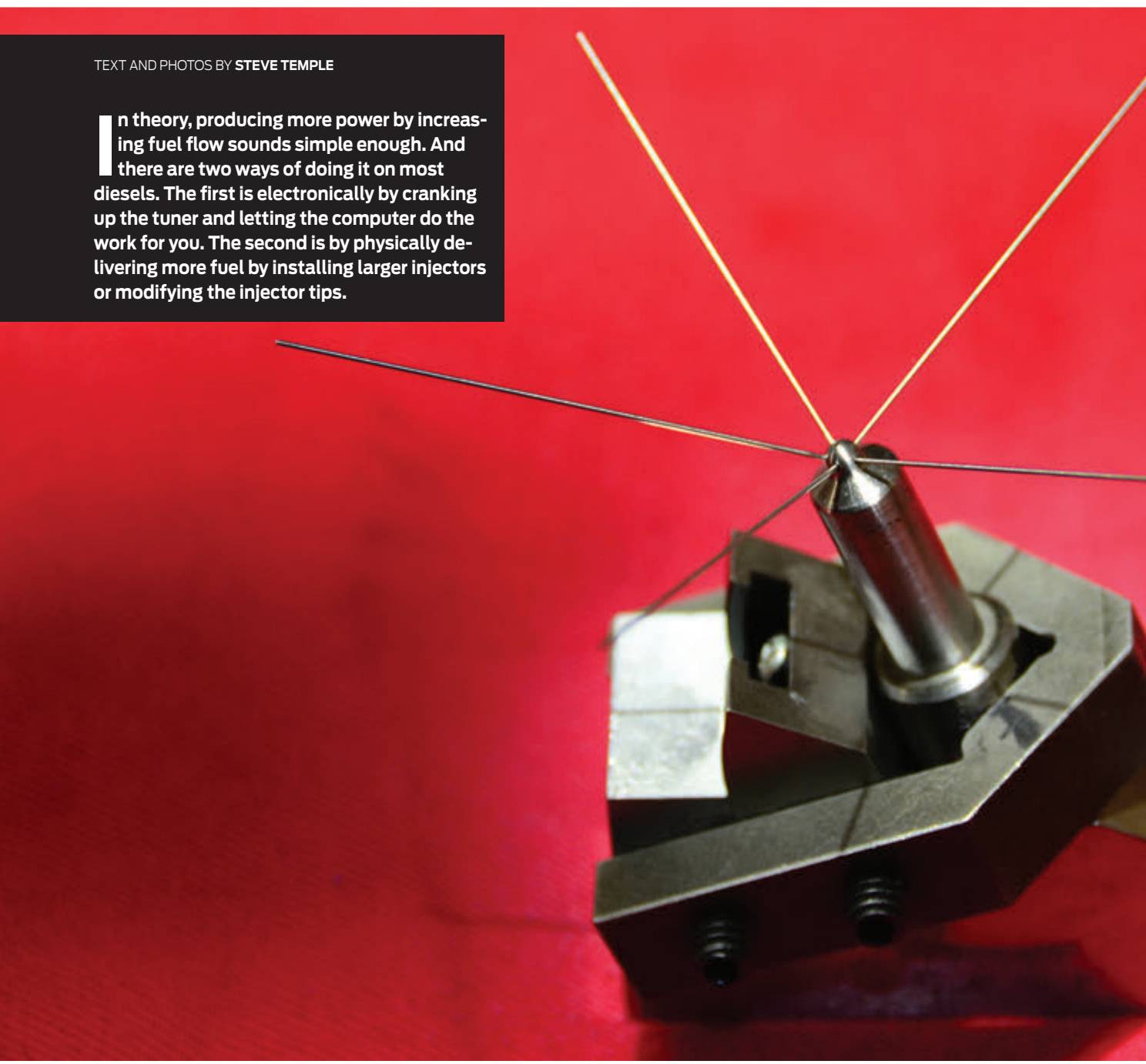
WWW.DIESELWORLDMAG.COM
JUNE 2014 • VOLUME 9, NUMBER 6
$5.99 U.S. • DISPLAY UNTIL: 5/13/14
06
0 74470 01290 0
Engaged Media By Beckett

HOLE SHOT

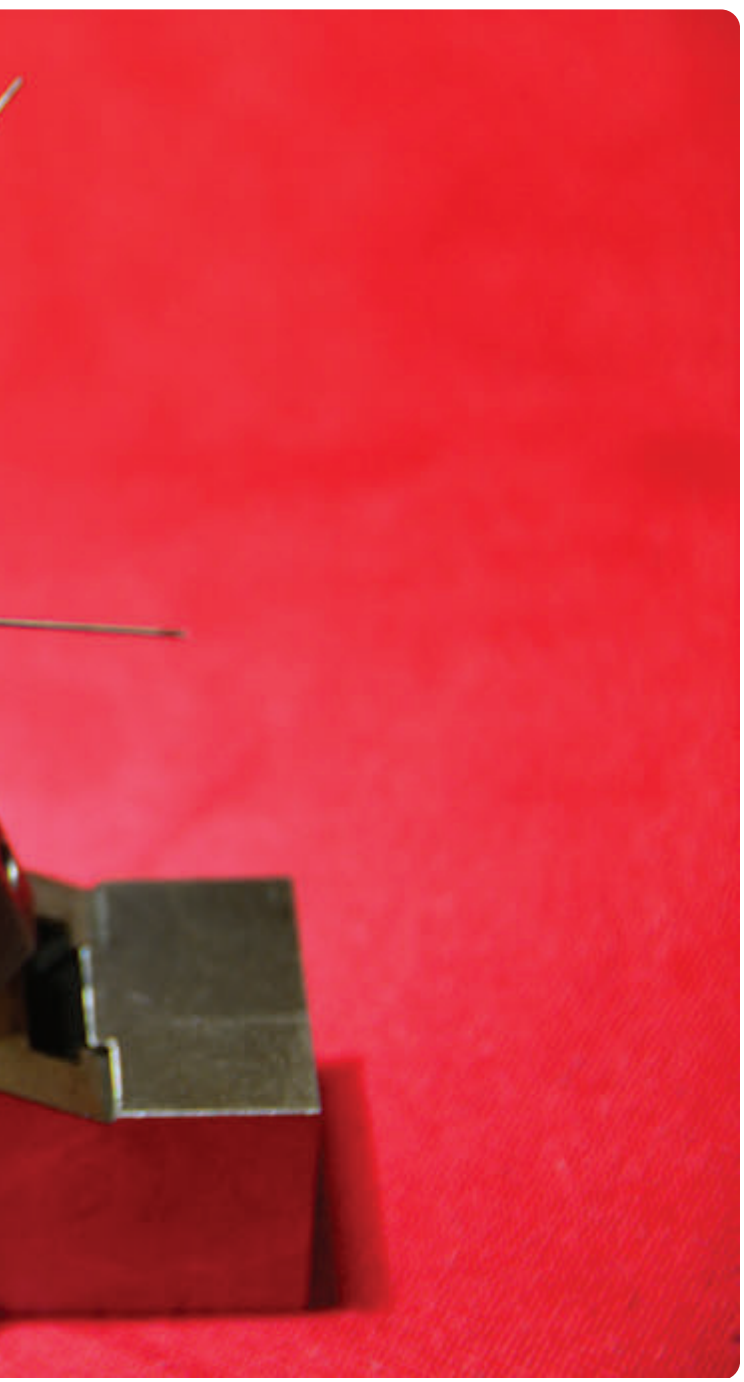
Scheid Diesel Secrets To Injector Nozzle Upgrades

TEXT AND PHOTOS BY **STEVE TEMPLE**

In theory, producing more power by increasing fuel flow sounds simple enough. And there are two ways of doing it on most diesels. The first is electronically by cranking up the tuner and letting the computer do the work for you. The second is by physically delivering more fuel by installing larger injectors or modifying the injector tips.



But there's more to making extra power with fuel than meets the eye according to Dan Scheid of Scheid Diesel Performance. Dan's legendary in the diesel industry for creating high-power pick-ups for sled pulling, among many other high-performance applications. We sat down with Dan at his Terre Haute, Indiana, facility and he shared his insight about upgrading street-driven trucks, too. It stands to reason that if he can pull more than 2,700 horses out of a competition diesel pickup, he knows a thing or two about enhancing the fuel systems on a regular-duty, daily-driven truck.

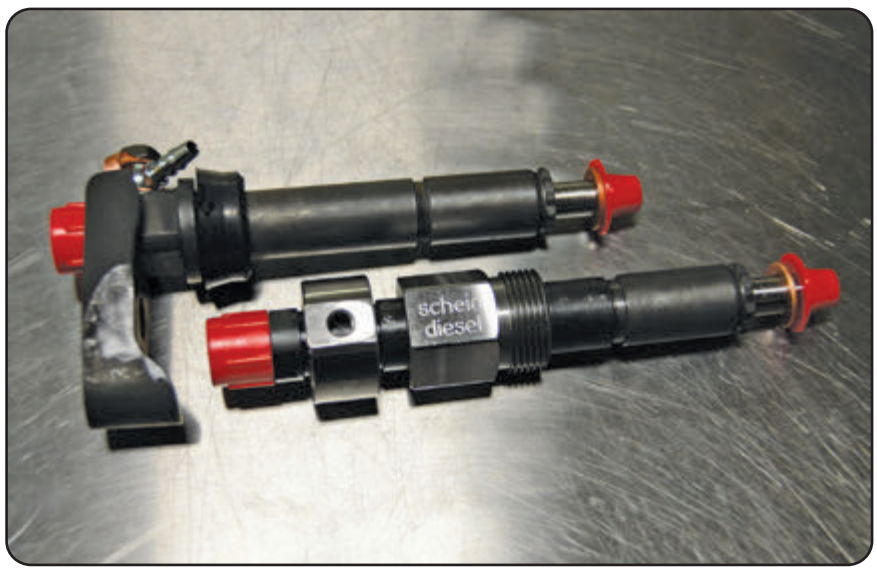


It turns out that for a modest increase of around 100 to 300 hp, just enlarging the orifices in an injector nozzle might be sufficient. But when you start looking at higher levels, things get way more complicated. In addition to increasing the size of the holes, other factors come into play, such as the number of holes, the spray pattern, and spray angle, along with various engine upgrades. "We

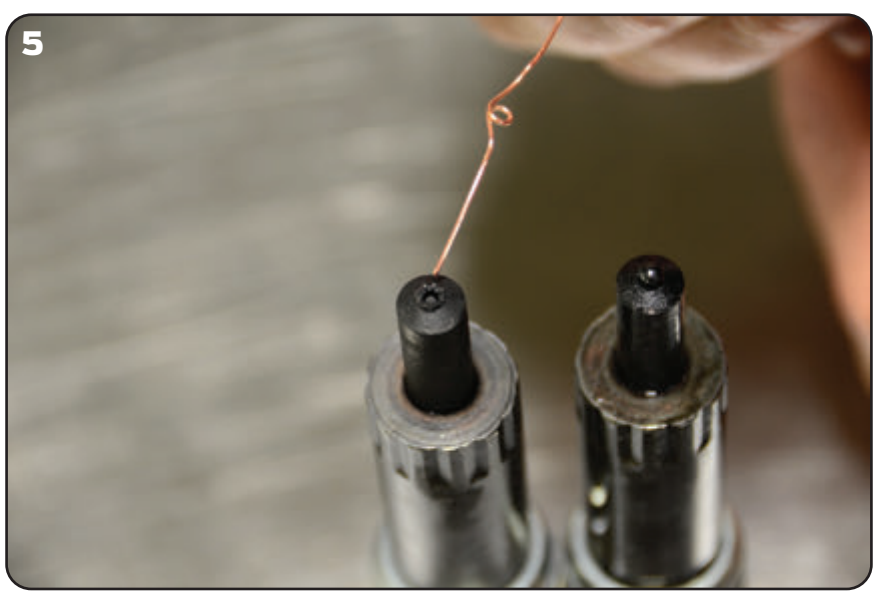
1 At left is a stock, IH injector body with a single feed. At right, additional fuel-feed holes are evident in a Scheid billet tri-feed injector body.

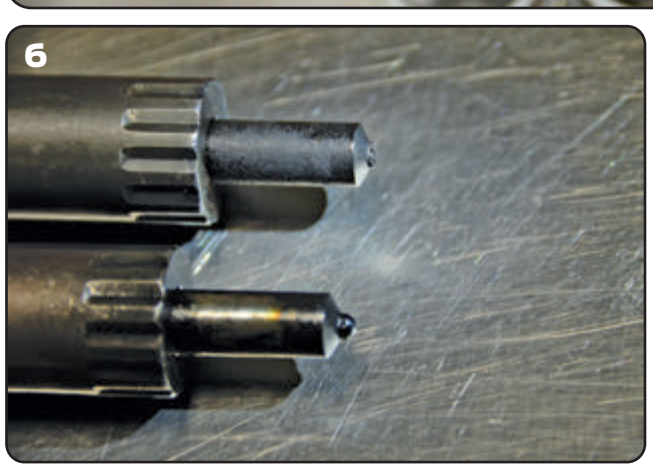
2 This cutaway view was actually caused by a defective injector that blew up, splitting the body. Factory injector bodies are typically made of weaker, cast metal rather than billet.

3 Here's another view of a damaged injector, caused by an incorrect spray orifice and/or a quick-rate pump cam. Static pressure on an injector starts at 4,500 psi, but during operation can go as high as 15,000 psi, putting considerable load on the assembly.



4 Scheid's injector assemblies are designed for high-flow, high-load applications. Made of chromoly with more material than a factory unit, they have more tensile strength and custom feed passages. At top is an IH type for a Navistar DT466. The lower unit is for a Cummins B-series.





5 & 6 Look closely at the tips; note how one of them has burst. These are the "sac type," referring to the area where the pintle or pin seats within the injector. This type is considered to be more durable than the "sacless" VCO (valve closes orifice) nozzle.

want to build a solid base for a customer," Dan says.

Before we get into those other details, we'll start with the basics of enlarging the holes in the injector tips. Typically, each nozzle hole on a factory injector measures about .007 inches. Compare that with the largest ones done by Scheid, which can be as big as .039 inches. That's more than five times as large, like the difference between a drinking straw and a fire hose. Of course, that maxed-out orifice is usually only for competition rigs.

Also, the number of holes can vary from five to eight on a factory injector to as many as 12 on a custom injector. Scheid increases fuel flow by enlarging hole size and, in some applications, the number of holes. Flow rates on a 2,750-hp sled puller can run as high as 1,600 cc, representing as much as a 500 percent increase.

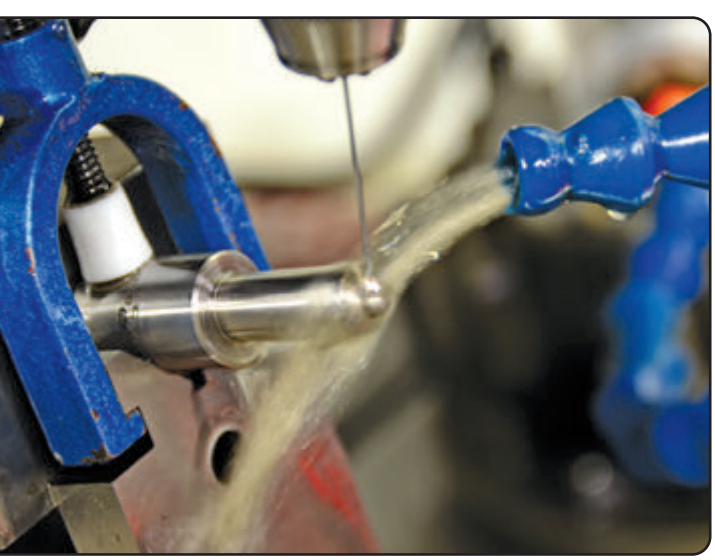
To enlarge and modify the holes, Scheid employs EDM (Electrical Discharge Machining, also called "burning"). Used extensively in the fine machining of complex forms and shapes in mold and die cutting, this device also handles fine-hole drilling in injector cups. It employs a thermal process (called a dielectric field) that removes and re-deposits material on the object being machined. The recast area is usually much harder than the original surface with more resistance to abrasion and corrosion. While some diesel performance shops rely exclusively on extrude honing to modify an injector nozzle, Scheid prefers EDM for maintaining precise spray angles and orifice sizing (with tolerances typically within two to four percent).

Speaking of spray angles, that's almost a subject in itself, since where the fuel hits the piston top can dramatically affect performance. "We don't want the fuel to spray the cylinder walls," Dan explains. On the other hand, if the spray is too concentrated in the center, not enough diffusion takes place in the air/fuel mixture. "Ideally, we like to see the fuel spray hit right at the edges of the fuel cup," he points out.

Piston configurations vary, so that's only a general guideline. Aiming the spray properly is critical to hit "the sweet spot," and depends on head porting, pump timing

7 Electrical Discharge Machining is a very precise way to enlarge or add holes in an injector tip, and also change the spray pattern. Careful inspection with a 25X power magnifying glass helps to evaluate modifications made to the injector nozzle.

8 This Scheid nozzle features a 12-hole, purpose-built tip for high-horsepower applications.



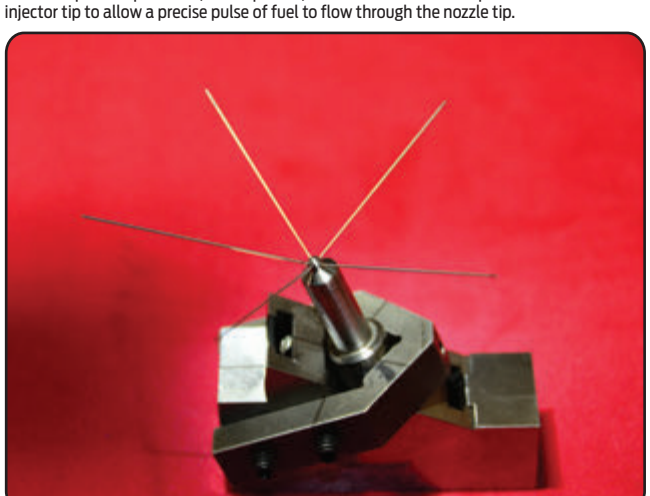
9 Operating the EDM's "spark machining" requires a flow of both deionized water and dielectric fluid.

10 & 11 Using an aerosol can of cleaning fluid to illustrate, you can see the difference in the volume of spray. At left, the jets have a fairly uniform size, but at right, the top two jets are slightly wider, since the orifices have been enlarged to deliver more fuel.

12 A factory injector might have only three holes in the nozzle, while a performance unit anywhere from four to 12 holes.

13 By shining a flashlight through each injector body, you can see larger points of light on the tip at right, showing the difference in volume. Fuel flow can be increased by anywhere from 20 to 500 percent, depending on the application.

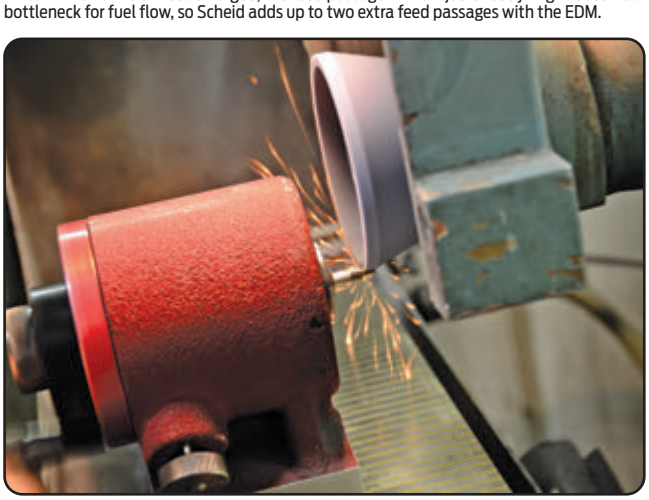
14 These pen-shaped units, called pintles, act like valves that lift up from the seat in the injector tip to allow a precise pulse of fuel to flow through the nozzle tip.



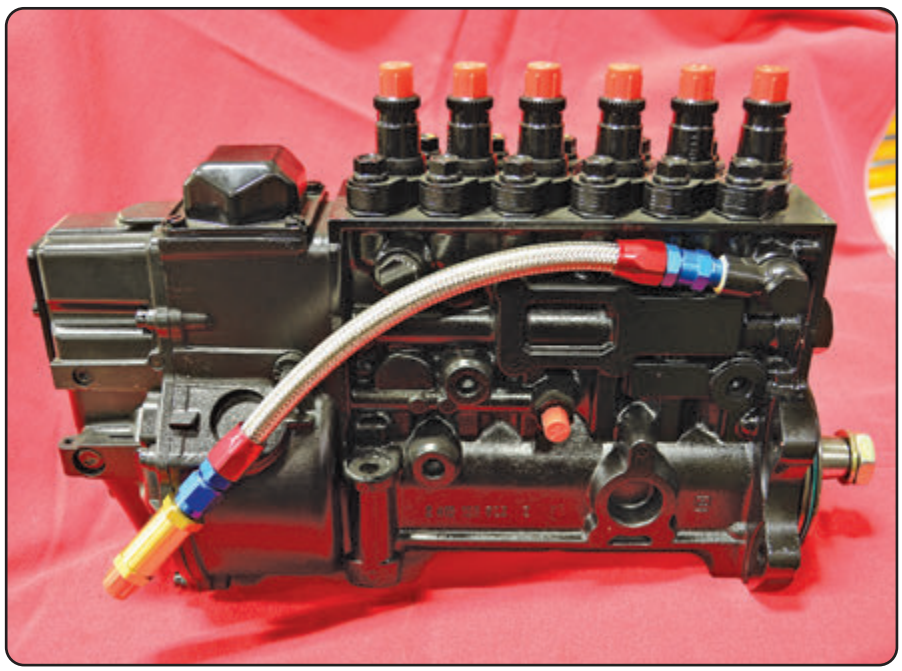
15 This holding fixture with wire pins is for evaluating the spray angles, which form a funnel-shaped flow onto the piston, typically at 142 to 160 degrees for stock to mild applications.

16 This injector has a sac tip, which is generally more durable than the sacless type. A sac tip doesn't have a tunnel or trough for the fuel, but instead a cone-shaped area for seating the pintle.

17 With the nozzle orifices enlarged, the feed passage in the injector body might become a bottleneck for fuel flow, so Scheid adds up to two extra feed passages with the EDM.



18 Removing material from the pintle tip increases lift, resulting in a bigger pulse width.



19 With higher fuel flow through the injectors, a higher volume fuel pump might be needed, such as this one for an 800-hp B-series Cummins.

changes, and the piston cup's configuration. For instance, a 12V Cummins has an offset cup, while the 24V is a center-cut, so the spray pattern must be adjusted accordingly.

"Generally, custom spray angles range from 130 to 160 degrees," points out Scheid's machine shop manager Todd Emmert, but he says this aspect demands another level of complexity.

So those figures are only an approximation. "It depends on how a customer wants to use fuel with airflow improvements," he points out. In other words, variables are involved, allowing for an interaction between air, fuel and performance parts to achieve an optimum trifecta for power delivery.

Overall, "EDM'ing allows us to focus on how to use air," Emmert notes. "Our emphasis is on producing a broad band of horsepower, with a proportionality of upgrades. So nozzle improvements represent one tactic that's part of a larger strategy of performance enhancements." **DW**

20 & 21 Scheid Diesel handles about 30 or more sled-pull trucks. The Super Ram shown here, owned by Rod Tarr, runs in the 3.0-inch Inducer class, and grabbed third place in ITPA points. To handle as much as 2,750 horses, Scheid adds substantial bracing around the Profab SQHD rearend.

22 This tip for a 12V Cummins uses a five-hole, sac-type nozzle that has proven to be one of the best all-around nozzles, Scheid says. It has supported 50-hp gains, and also dyno runs up to 800 hp when combined with twin turbos and other performance parts.

SOURCES

SCHEID DIESEL
800-669-1593
www.scheiddiesel.com