HEADS UP!

CUMMINS CYLINDER HEAD STUDS AND O-RINGS FOR MAXIMUM RELIABILITY

WHEN WE LAST LEFT PROJECT RUST BUCKET, IT WAS making 312 hp at the wheels on fuel, and 448 hp with stock re-torqued head bolts, 6x0.016 injectors, a single stage of nitrous, and a stock turbocharger with a 60mm High-Tech Turbo compressor upgrade. At this point, the truck had the potential to run 13-second quarter-mile times and still got about 20 mpg, all for a total investment of about $7,000—including the price of the truck. But there was more left on the table—a lot more.

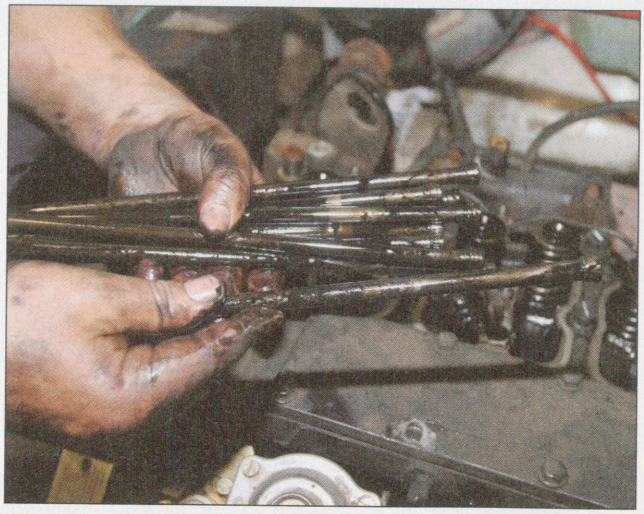
RUST BUCKET'S WEAK LINK

The problem was, our reliability was in question due to our stock head bolts and notoriously weak '89 Cummins head gasket. To rectify these problems, we decided to O-ring a '93 cylinder head and install it along with a 0.020 thicker head gasket courtesy of Pure Diesel Power, and a set of ARP head studs. With these modifications, we felt confident up to about 1,000 hp at the crankshaft, or about 700 hp at the wheels.

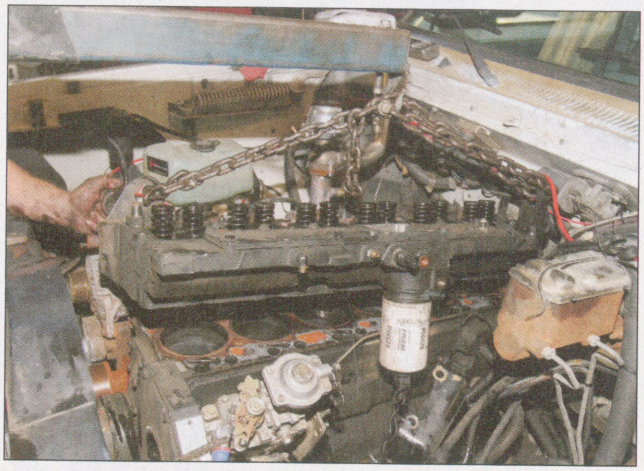
If you're thinking of tackling a job like this yourself, make sure you have a service manual for whatever year truck you're working on. It will save you a lot of headaches when you can't figure something out. As for us, we partnered up with J&H Performance in Redding, California, to do the job, since it had already built trucks that have made more than 1,000 hp with O-rings. For now, this story will be focused purely on the cylinder head upgrade. Keep in mind that the tips and tricks here will work on any '89 to '09 Dodge with the Cummins diesel engine.

In the next few installments of Project Rust Bucket, we'll bolt on the cylinder head, upgrade the turbocharger to a larger wastegated version, install a fuel system, and upgrade the nitrous to an NX two-stage setup. We'll also fix a few things that have been bugging us for a while, like our killer dowel pin, and a throttle linkage travel problem we've been battling. DP

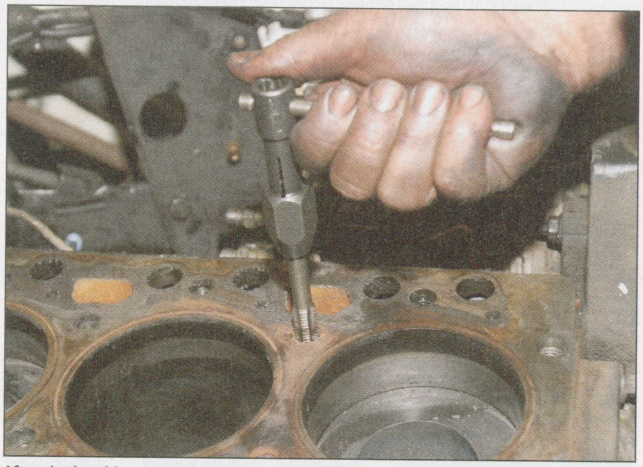
Before the Cummins cylinder head can be removed, everything else on top of it must be taken off. This means the intake horn, throttle linkage, coolant lines, and injector lines. When removing the injection lines, make sure to take them off at the pump and remove them in two pairs of three, otherwise they'll end up like spaghetti when you try to re-install them.



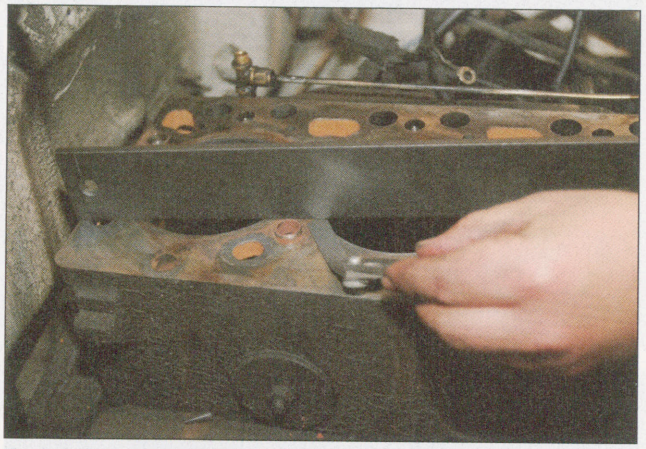
After the injection lines, the valve covers, pushrods, rocker arm pedestals, and head bolts must be taken out. Believe it or not, it's now time to remove the head!



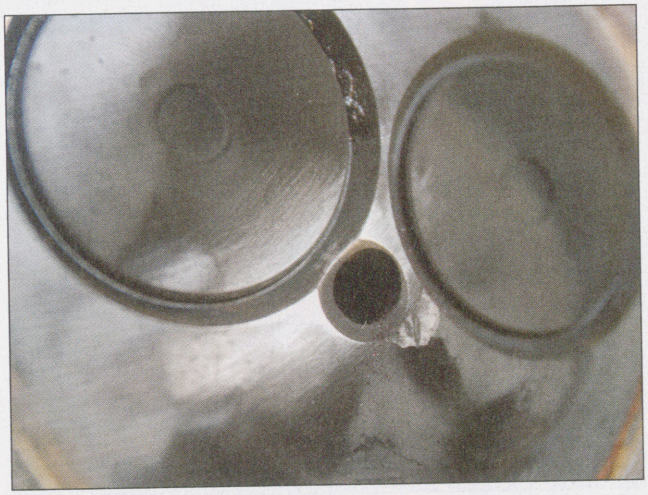
Don't even think about trying to lift the cylinder head off the engine unless you're a 300-pound gorilla. Cummins actually puts bolt-on tabs on the cylinder head, so you can remove it with a cherry picker.



After the head is removed, the deck should be cleaned with a razor blade. Make sure to avoid scraping debris down into the oil passages if possible. The threads in the block should be chased with a tap to ensure that the studs achieve maximum thread engagement.



The deck of the Cummins block should be checked between each cylinder for gaps. Anything more than 0.004 inch is considered too much, and the block will need to be resurfaced. Luckily for us, each cylinder deck came in at less than 0.004 inch, which meant we were good to go.



The '89 to '91 non-intercooled Cummins came with injectors featuring 9mm tips. After thousands of miles, the cylinder head can crack around these tips, rendering it unusable. After 200,000 miles, we could only find a single small crack on one of the injector bosses, which was still too small to have any effect on performance.

It's hard to describe a $450 port job in words, so we'll show a couple of pictures. Here is a stock exhaust port of a stock 5.9L Cummins head.

HOW (NOT) TO BLOW YOUR NEWLY INSTALLED HEAD GASKET

IN OUR TRAVELS THROUGH THE DIESEL PERFORMANCE world, we've run across quite a few people who blow a head gasket within days or months of the original install. Many people don't realize that if your engine is equipped with studs and O-rings, you need to be careful with how they proceed after you've fired up the truck. Here's a few tips to make sure you're not the one leaking coolant everywhere.

LET THE TRUCK WARM UP

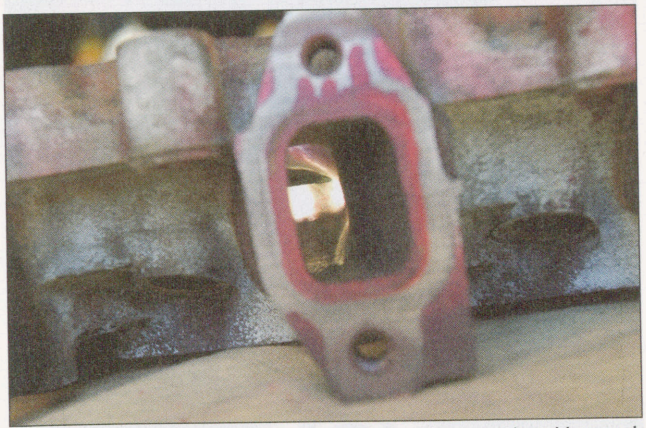
By this we don't mean let it idle in the driveway for a few minutes—let the truck get up to its full operating temperature before giving it more than a quarter-throttle. When the engine is hot, the metal expands, creating better sealing. Flooring it right out of the driveway is just asking for trouble.

RE-RE-RE-TORQUE

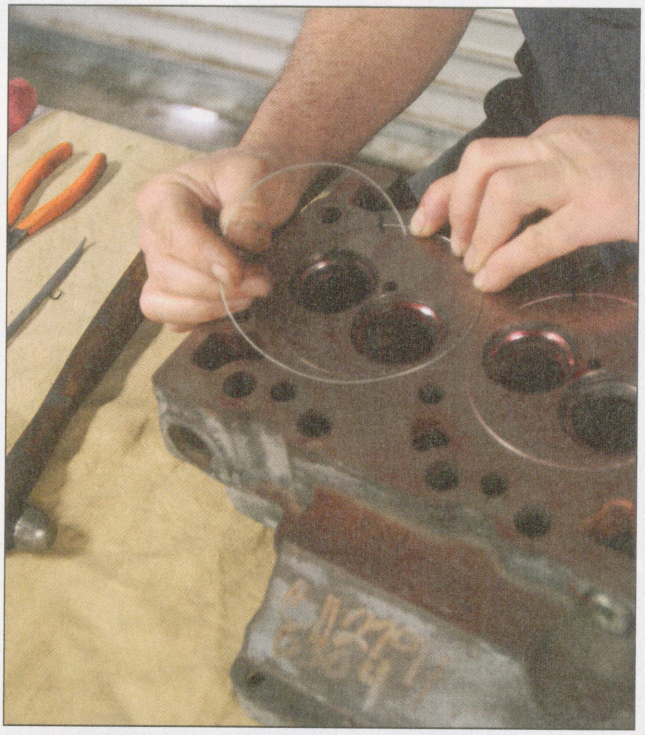
Doing one re-torque on the cylinder head 10 minutes after your studs are first installed just isn't going to cut it. ARP recommends three additional re-torques after the initial tightening sequence, and we'd do the last one hot to make sure maximum clamping force is available when the engine is up to temperature. It's also good practice to take it easy for the first few hundred miles, then re-check the torque specs after the truck has been driven for a few weeks. After that, about once every six months is a good time to do a re-torque on the cylinder head.

BAD O-RINGS

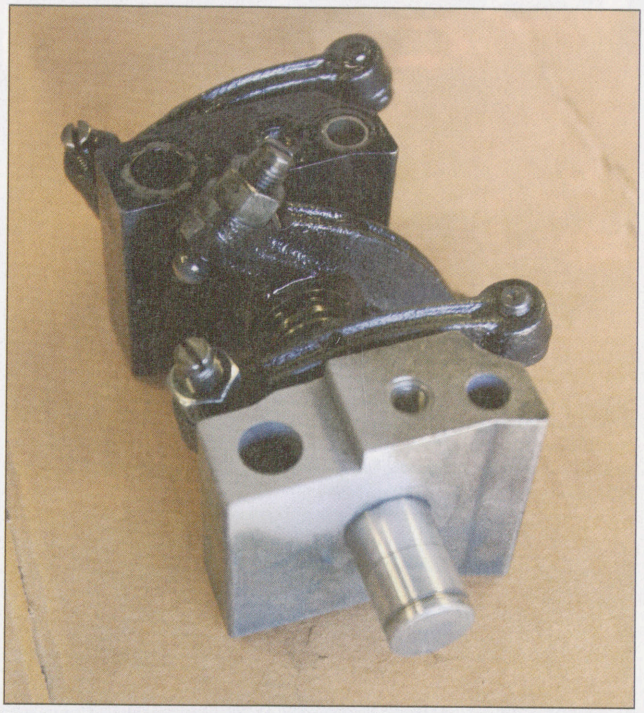
It is possible for O-rings to be installed incorrectly, which is why it's good practice to use a shop experienced with the procedure. If the O-ring is installed incorrectly, or the O-ring's receiver grooves are machined in the wrong place, there may be no other option than to redo the job on another cylinder head.



Here is our ported '93 head. Notice how smooth the exhaust port is and how much material has been removed. Not all sides of the exhaust passages were ported—some were left untouched to promote air swirl in and out of the engine.



After our head was ported, it was then cut for O-rings. The O-ringing process involves cutting a groove into the surface of the head and installing a thin stainless steel wire ring around where the head seals to the deck of the block. This is very meticulous work and requires very precise measuring and a steady hand to perform.



In order to install ARP studs, our rocker arm pedestals had to be machined down 0.200 inch. Any local machine shop should be able to perform this task. Our bill was $100 from Arden's Machine in Redding, California.

Brian Garbut, our O-ring guru, also installed a set of 60-pound valvesprings, which ensured no valve float would occur if our engine spun more than 3,200 rpm.

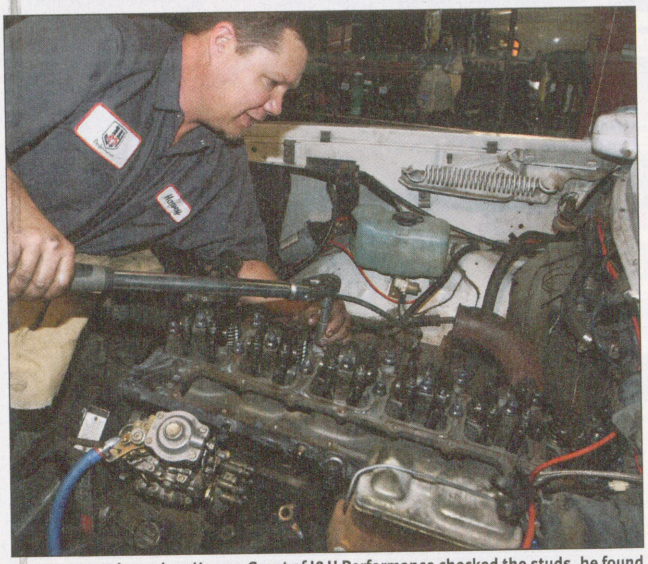
After the head was assembled and the O-rings were installed, the head was lowered onto two dowels in the block using two of the studs as guides. We used a head gasket that was 0.020 thicker than stock to give a little extra crush space for our O-ring setup.

Once the head was on, we tightened the studs down into the block by hand and installed the pushrods. When installing the pushrods, make sure they are all the way down against the lifter, or valvetrain damage can occur.

After the studs were installed, Harvey set the valve lash to 0.010 inch on the intake, and 0.020 inch on the exhaust. The lash is set extremely tight, so the feeler gauge barely fits between the rocker and the valve, even with a great amount of force exerted.

After the lash was set and the rocker arms installed, the exhaust manifold, turbocharger, intake horn, and throttle linkage were all re-installed.

Before tightening the nuts onto the studs, we coated them with lube from ARP and followed the factory torque sequence: 30 ft-lb, 60 ft-lb, and 90 ft-lb. After a short rest, we tightened them down to 125 ft-lb, then let the truck sit overnight.



The next morning, when Harvey Grant of J&H Performance checked the studs, he found it only took about 113 ft-lb of force to loosen them up, so each nut was taken off one at a time and re-torqued to 125 ft-lb following the previously described increments.

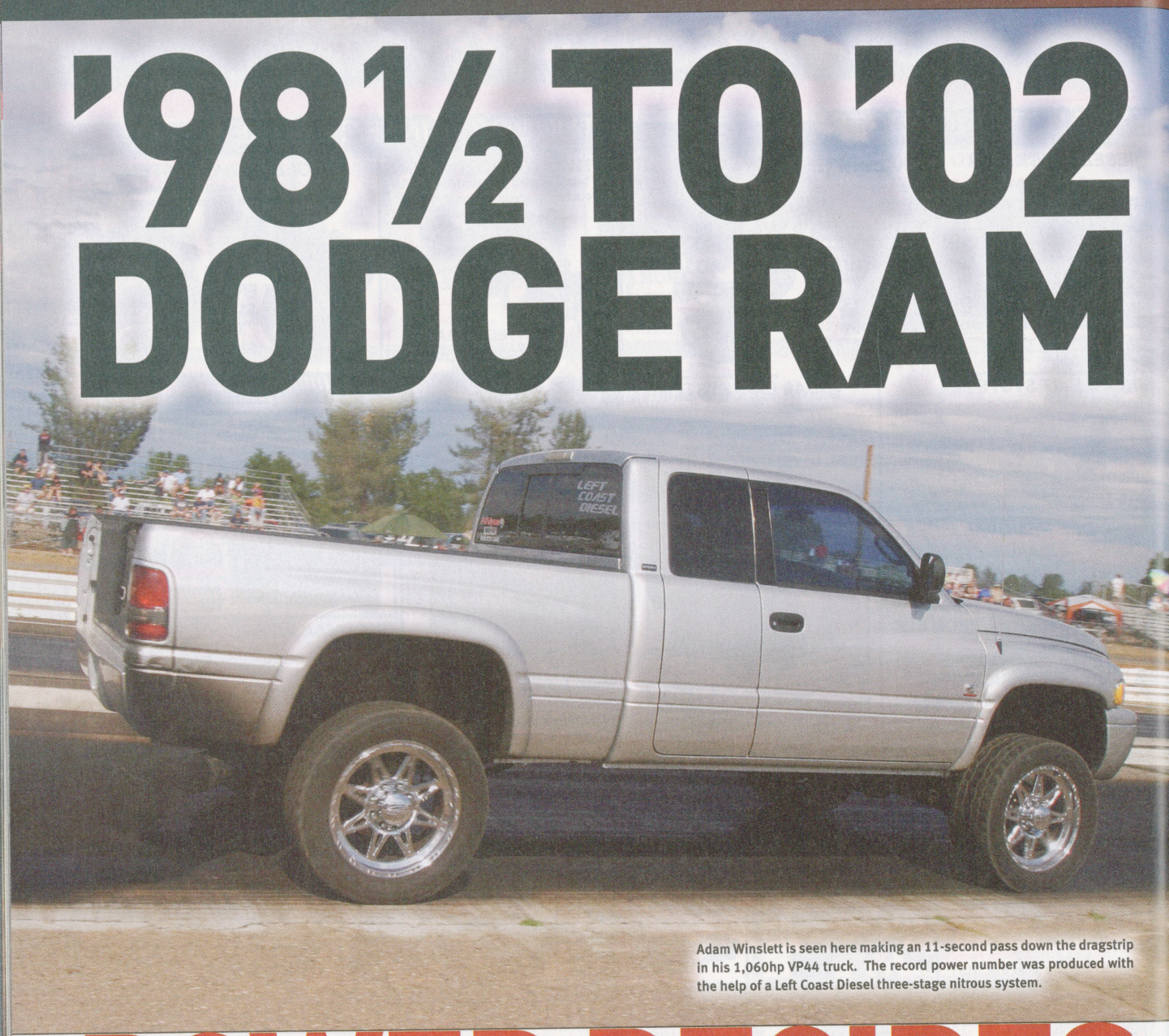
Even with everything installed, the project still wasn't finished. The truck was taken for a 20-minute testdrive to bring it up to operating temperature. Then the head studs were torqued a third time with the engine warm—this time to 140 ft-lb. Although this is past ARP's recommendation of 125 ft-lb, we wanted a little extra clamping force because of our O-ring setup and extra-thick head gasket. If you plan on going past 125 ft-lb, do so at your own risk. During the last re-torque, the feeler gauge would no longer fit between the rockers and valves, and measurements indicated our head had sunk down about another 0.005 inch. After two cold re-torques and one hot one, we were finally ready to hit the road.

Sources

ARP Fasteners
www.arp-bolts.com

J&H Performance
(530) 245-0176 • www.jandhperformance.com

'98½ TO '02 DODGE RAM



Adam Winslett is seen here making an 11-second pass down the dragstrip in his 1,060hp VP44 truck. The record power number was produced with the help of a Left Coast Diesel three-stage nitrous system.

POWER RECIPES

FOR $1,500, $2,500, $5,000, AND $10,000 BUDGETS

Perhaps one of the most overlooked model of Dodge trucks (besides first-gens) is the '98½ to '02 Dodges equipped with the Bosch VP44 computer-controlled rotary injection pump. We've seen these trucks make some pretty impressive power numbers with minimal modifications. The key to high horsepower numbers seems to be big injectors, which will provide all the fuel that the VP44 pumps can produce. Injection pump reliability is also a big concern, and it's our recommendation that if you have one of these trucks, you upgrade the fuel system ASAP. You'll see this reflected in all of our buildups, from $1,500, all the way to $10,000. While VP44 trucks don't have the mechanical simplicity of their earlier P7100 pump brothers, or the easy power of the later common-rails, they seem to bridge the gap between the two, and with the right parts, can make 500 to 600 hp within our top-tier budget. DP