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PERFORMANCE REBUILD: FORD/NAVISTAR 6.0

Part 3: Cylinder Head Installation With ARP Studs

BY JOHN STEWART

PHOTOGRAPHY: JOHN STEWART, BANKS POWER AND FORD MOTOR COMPANY

Our Story So Far:

This 6.0L V-8 came from an '03 F-350 that was running rough under all conditions. The owner brought it to Banks Power in Azusa, Calif., where the Banks Powerhouse shop performed a teardown and evaluation prior to making recommendations. A snapped No. 4 cylinder rocker arm accounted for the big miss in the engine. Additionally after testing, six of eight injectors proved to be out of spec. The owner chose to rebuild the engine, and make upgrades in the process, since the truck was in good condition. Last month, we showed you how the injectors were tested, how the heads were ported and polished, and received a three-angle valve job before reassembly. This month, we'll install the rebuilt heads using ARP studs and a new gasket set, and reinstall or replace valvetrain components as necessary.

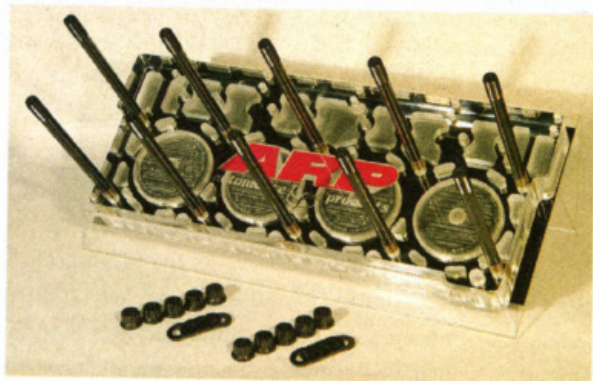
As we saw last month, head gasket failure was not the cause of the problems with this particular Ford/Navistar 6.0L diesel engine. In fact, upon inspection the head gasket was described as "pristine" by our mechanic at the Banks Powerhouse, although we managed to find a little bit of seepage in one area. Be that as it may, the decision was made to replace the standard torque-to-limit head bolts with ARP studs, which are designed to minimize risk of blown head gaskets in 6.0 engines.

The ARP studs are considered to be especially appropriate when high-performance, elevated boost levels or racing is part of the anticipated use. Using studs will make it much easier to

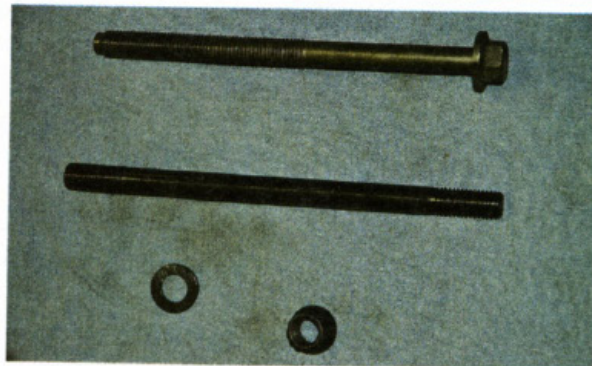
assemble the engine with the cylinder head and gasket assured of proper alignment. Studs also provide more accurate and consistent torque loading.

"There are a couple of reasons you would want to change a fastener," said Chris Raskey at ARP. "One is you want a clamping load to keep the gasket in; the other is you want to use it over again instead of buying a new set every time," Raskey told us.

As the urban legend says, the problem with 6.0L Power Stroke is the number of head bolts, or lack thereof, in comparison to other diesel powerplants. One mechanic, who rebuilds Ford engines for dealerships, told us the fact that the head



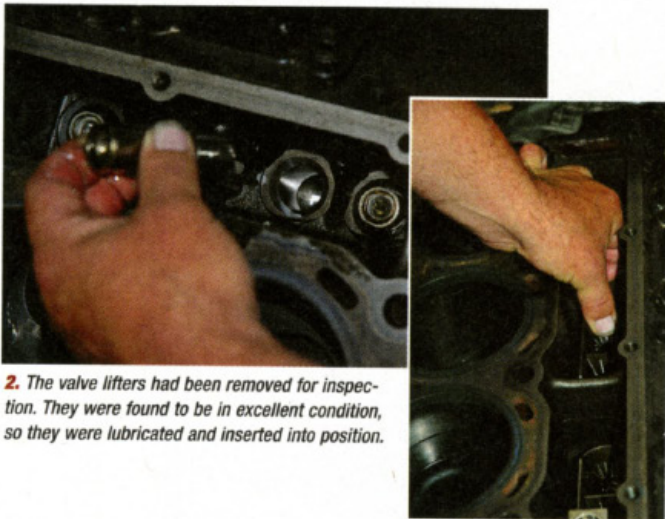
ARP cylinder head stud kits come with washers and 12-point nuts, and a black-oxide finish that protects them from wear and corrosion.



The standard Ford/IH head bolts are known as torque-to-limit bolts. They are designed to stretch when tightened to a specific torque limit, and cannot be reused. At bottom is an ARP stud, with washer and retaining nut.



1. This is what the left side of our 6.0 looked like after the heads and gaskets were removed.



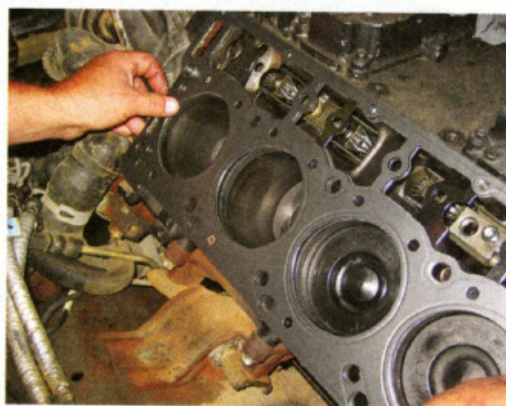
2. The valve lifters had been removed for inspection. They were found to be in excellent condition, so they were lubricated and inserted into position.



3. With the lifters covered, the threads for the new head studs were blown out to make sure there was no fluid inside that would prevent perfect thread engagement.



4. Just to be sure, our mechanic carefully chases the threads so that the studs will be installed with maximum thread contact.



5. With the locating dowels in place in the cylinder head, the new gasket can be installed. He takes care to avoid scratching the blue compound on the gasket, which should be installed with the part number facing upward.



6. Our mechanic installs the cast-iron cylinder head using screws installed at the ends of the rebuilt head as helpers. Then he removes the lifting screws.

bolts pass through an aluminum carrier is also problematic, because the two materials expand at different rates. Another mechanic pointed to leaking EGR coolers as one of the biggest causes of head gasket failure on the 6.0L Power Stroke.

Regardless of cause, it's clear the need for sufficient clamping force is critical. Ford and IHI became aware of the problem early in the 2004 model year and redesigned the EGR cooler. Later model-year versions of the 6.0 were much more reliable with respect to

head gasket issues, and when the 6.4 became standard in the Super Duty diesels, head gasket issues were fairly sorted out.

When developing the 6.4, International did their homework ahead of time. "International actually sent us a 6.4, because they appreciate their problem with the 6.0L, and they sent us one to do form/function study on it. So we've got parts for that," says Raskey. The ARP studs are made from 8740 chromemoly, fin-

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7. Before installation, the head studs should be lubricated with a special material supplied by ARP so they can be accurately torqued. Torque values are sometimes inaccurate because of the uncertainty in the coefficient of friction at the interface between the bolt and the rod. Using the lubricant supplied by ARP can minimize this inaccuracy.



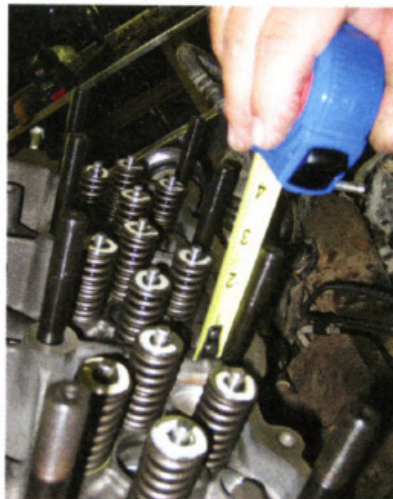
8. At this stage, the studs are installed finger-tight.



9. The studs are tightened enough to be sure the bottoms reach their ideal position in block.

ished in black oxide. Hardened flat washers are included in the stud kit. The studs are precision centerless-ground and thread-rolled to Mil-S-8879 specs.

There are, so far, no aftermarket rocker arms available to replace the part that did fail on this particular engine. Instead, all the rocker arms were replaced with new Ford parts. The



10. To be sure they are properly seated, the exposed part of each stud is measured for length. If any are higher than the others, chances are there is something in the bottom of the threaded bolt hole that needs to be cleaned out.



11. The aluminum rocker arm carrier has a press-in-place rope gasket. It can easily be fitted in by hand.



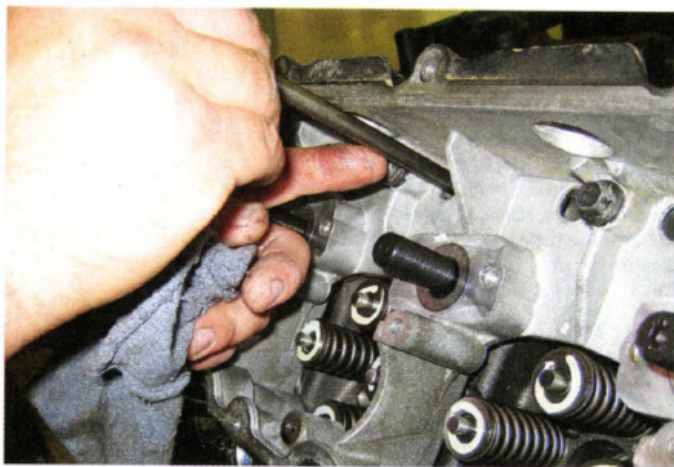
12. The rocker arm carrier is easier to install on the cylinder head using lifting brackets at either end.

pushrods were all measured for length and found to be within specification with the exception of one rod that had been gouged after the rocker arm failure, which then had to be replaced with a new Ford rod.

Next month, we'll drop in our fuel injectors and the turbo, and replace the original harmonic dampener with a Fluidampr.



13. The pushrods were all the right length and showed very little wear, with the exception of this one, which was badly galled and had to be replaced.



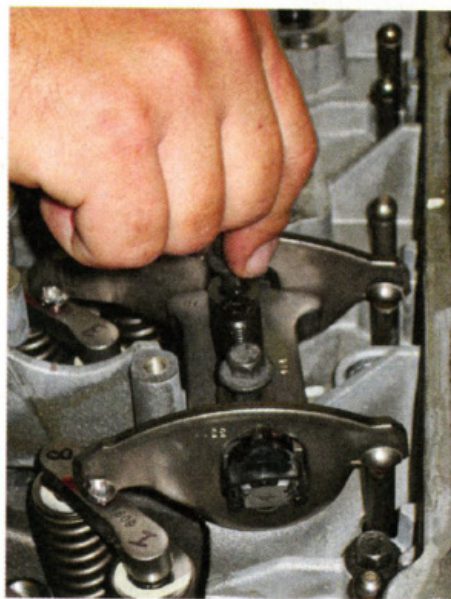
14. One by one, the eight pushrods are installed. They go in with the copper ends of the pushrods in the hydraulic roller follower sockets.



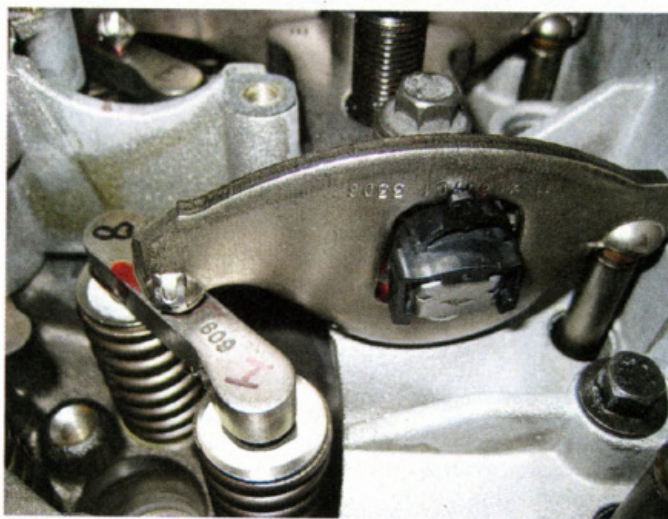
15. Next, the valve bridges are installed. They were marked with indelible pen when they were disassembled, so they can be reinstalled in exactly the same position.



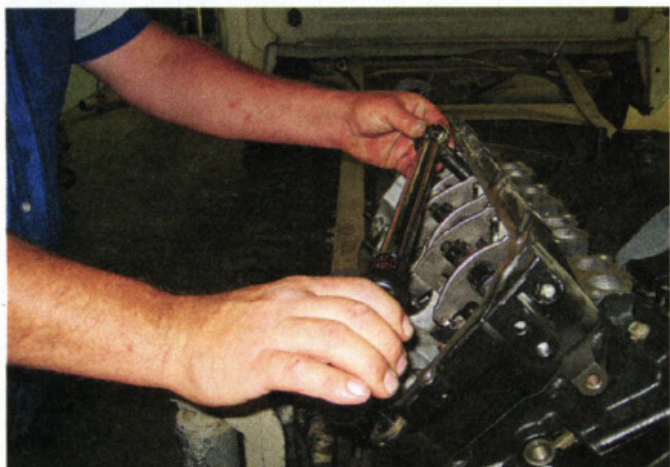
16. After rotating the crankshaft by the harmonic dampener so the locating notch is in the 6 o'clock position, the rocker arm assemblies can be installed.



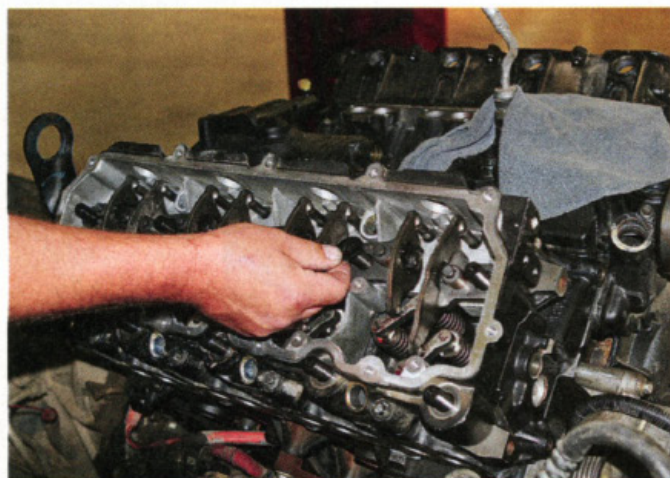
17. After dropping the rocker arm assemblies in position, the rocker hold-down bolt threads are lubricated lightly with engine oil and installed finger-tight.



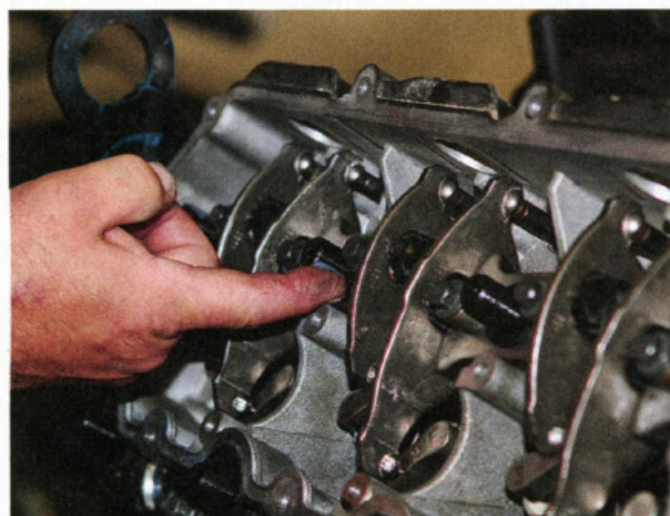
18. This is how the rocker arms will look when properly installed.



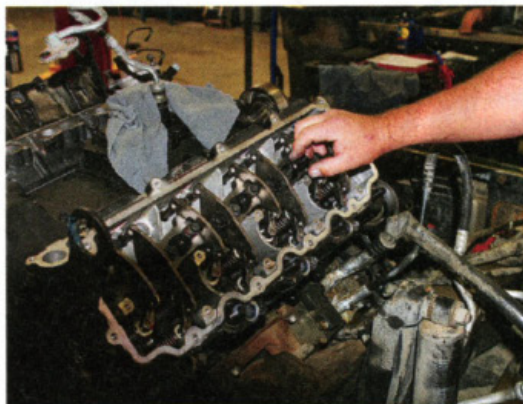
19. Each set has two bolts holding it down that was torqued to just 23 lb-ft, which is approximately finger-tight plus half a turn.



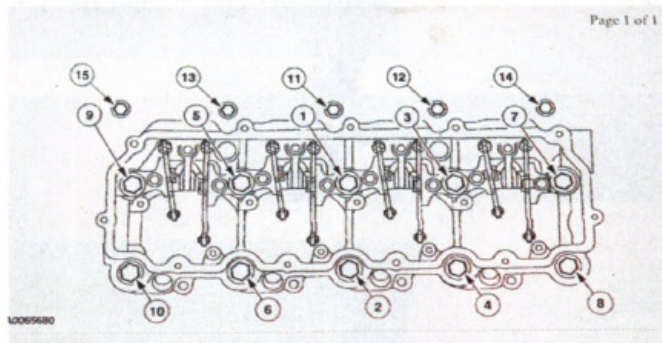
20. Now the heads can be torqued. First, the washers go on.



21. Next the ends of the studs receive ARP lube, which is used to help precisely duplicate all ARP fastener preload specs.



22. The nuts are carefully threaded on to each stud.



23. The torque sequence for the cylinder head bolts and studs is complex, and because we have replaced the Ford bolts with ARP studs, you'll want to use torque values as recommended by ARP for those studs. But in essence, the new studs are torqued in stages, starting in the middle and moving in a criss-cross pattern. First the ARP studs are tightened in three stages, then the outer bolts to a lesser specification. Final torque values for the ARP studs are in the neighborhood of 250 lb-ft.



24. After the inner cylinder head studs are torqued in sequence, the outer bolts are torqued in two stages. With this process and use of new parts, our 6.0 should keep its gasket in place. From here, what remains is to install the glow plugs, the fuel injectors, the intake manifold, EGR cooler and the turbo ... which we'll show you next month.

SOURCES:

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