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Performance Rebuild: Ford/Navistar 6.0

Part 4: Dressing The Engine

BY JOHN STEWART

PHOTOGRAPHY: JOHN STEWART AND COURTESY OF
BANKS POWER AND FORD MOTOR COMPANY



We forgot to show you what it takes to torque down ARP studs. That's a 4-foot breaker bar, which is what it takes to torque studs to 250 lb-ft, achieving far more clamping power than the stock torque-to-limit head bolts could ever tolerate. Banks mechanic Kevin Hannah definitely broke a sweat completing the torque sequence.

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 ugly miss in the engine, and 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's cabin and chassis were in fine condition.

Last month, we installed rebuilt heads using ARP studs and a new gasket set, replacing valvetrain components as necessary. This month, we do the dirty work: button up the engine, bolt on the manifold, EGR cooler, turbo, oil and fuel filters, and start making connections to remate the body and the chassis.

Reinstalling the exhaust gas recirculation (EGR) cooling system is not difficult, but it's a hard thing to do anyway. Early 6.0 EGR coolers have been the cause of failures of many head gaskets, warped heads and exhaust systems. Mechanics shake their heads just thinking about it.



We still have an ugly pile of pieces kicking around, including the intake manifold, injectors and fuel rail, turbo, EGR cooling system, valve covers and a bunch of gaskets. This ain't the fun part, but they gotta go back on.

In essence, the cooler is a round tube with fins inside through which exhaust gas is routed. Along the outside, coolant runs parallel with the exhaust, separated by a thin metal barrier. This allows it to absorb exhaust gas heat, which improves emissions performance and can help improve mileage. However, there is a history of the EGR valve clogging with exhaust soot, and after cleaning with carb cleaner or outright replacement, it promptly clogs again. But according to service bulletins we read, the valve is not always the source of the problem.

EGR cooler issues can often be traced to the engine oil cooler, which has narrow, flat cooling tubes that can fill up with casting sand left over from manufacture of the block. When the engine oil cooler gets clogged, it restricts the downstream flow of coolant into the EGR cooler. When not enough coolant is available to cool the hot exhaust gases moving through the EGR cooler, the coolant can flash-boil inside the EGR cooler, causing coolant to puke into the overflow tank. When the tank fills up, coolant is lost and the engine overheats. Making matters worse is a tendency for the fins inside the EGR cooler to become cor-

roded in the excessive heat. This breaks down the thin barrier between exhaust and coolant, allowing pressurized coolant to get into the exhaust system, leading to white smoke (steam) and a loss of coolant. This can also lead to blown head gaskets and cracked cylinder heads, and the moist exhaust can also cause the variable-geometry turbo vanes to stick. Many times, the head gasket was to blame for engine failure, when actually the EGR cooler – assisted by the oil cooler – was the problem.

Ford's fix for this was to design a new EGR cooler. The new coolers appear the same as before, except the internal design has round stainless steel cooling surfaces that do not corrode, and thus do not crack and allow coolant to mix with exhaust gas. These newer coolers have a much better survival record, especially when the oil cooler is replaced at the same time. (There are also better-than-stock aftermarket EGR coolers now available.)

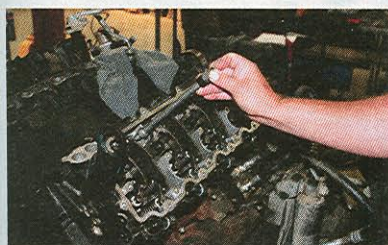
Another treatment, not authorized by Ford, is to block off the EGR valve. The technique can improve power, as exhaust flow to the turbo is improved, but coolant issues might still remain anyway. This treatment would likely cause a Check Engine light to come on, and buying the parts requires an "off-road use only" waiver to be signed, as it compromises federal emissions laws.

When it comes to practical solutions, most owners will have no choice but to make sure they have the newer EGR cooler, replace the oil cooler if coolant flow is compromised, and see that the EGR cooler and valve are clean and free of soot before reinstalling the parts. Installing a coolant filter upstream of the engine oil cooler – to trap casting sand debris before it gets into the oil cooler – is another good idea.

Following are the highlights from the engine reassembly sequence. We'd show you all of it, but that would take about 50 pages. Our goal for this episode is to show what you'd be getting into should you undertake this kind of job. Next month: The Banks billet torque converter transmission upgrade, Fluidampr and the dyno test.



1. This is the standpipe for the high-pressure oil/fuel system. These are generally discarded upon disassembly and replaced with new parts.



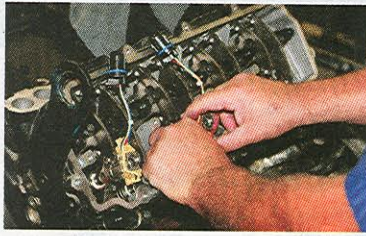
2. After installing a new O-ring, the standpipe goes in.



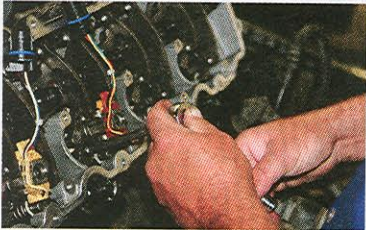
3. Tighten to spec (33 lb-ft).



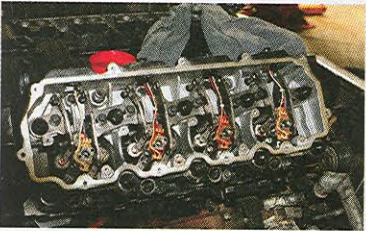
4. When the old injectors were found to be out of spec, eight new injectors were purchased.



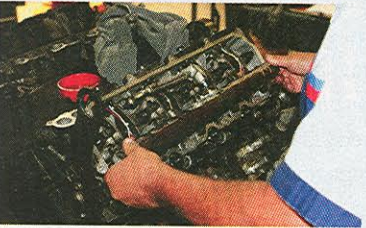
5. After lightly lubricating all injector O-rings, position the injectors in their holes in between the rocker arms, with the wiring plugs leading toward the engine valley.



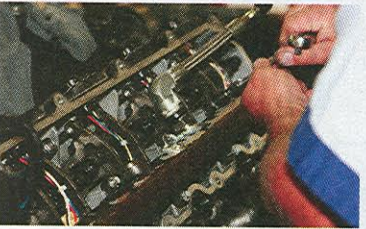
6. Tighten down the injector hold-down bolts using a torx bit and calibrated torque wrench. The hold-down bolt works with a little plate that slides into a groove on the injector to hold it down. The degree of torque on the injector-retaining bolt needs to be exact. Earlier engines require 24 lb-ft, and later trucks 26 lb-ft.



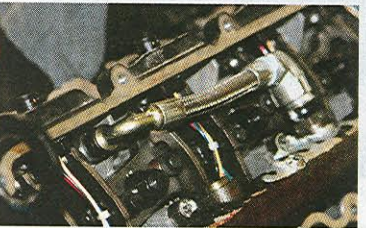
7. Run the wiring plugs through the plug mounting holes, where they will plug into the wiring harness.



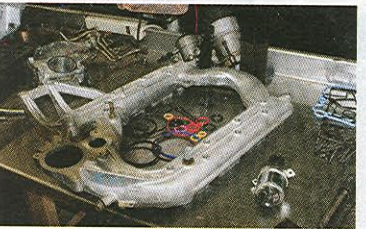
8. The high-pressure oil rail can now be seated in place by hand.



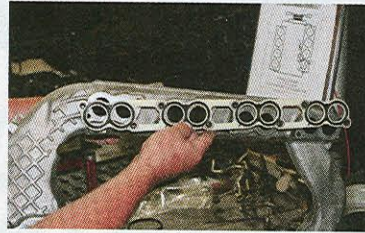
9. Tighten down the eight fuel rail bolts.



10. Attach the high-pressure oil feed line to the standpipe tube.



11. This is the intake manifold, after a thorough cleaning.



12. There are quite a few gaskets needed to seal the intake manifold and EGR cooler assembly, and every one needs to be carefully installed. This view of the bottom of the intake manifold shows the gasket between the manifold and the heads. The gasket kit alone runs \$270.



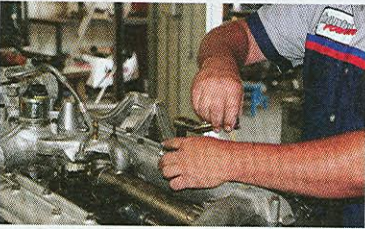
13. The EGR cooler can be positioned on the intake manifold now. This one is based on the newer Ford design. It was cleaned out in the solvent tank, removing a lot of soot and pressure tested before reinstallation.



14. Carefully position the intake manifold.



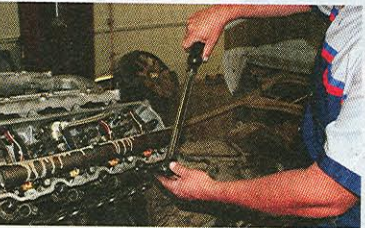
15. This is the largest of many O-rings in the gasket kit; it makes the seal between the manifold and one of the coolant passage tubes.



16. Here we see the manifold being tightened down with the EGR cooler in place.

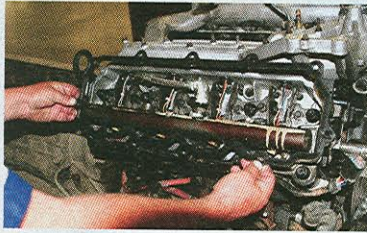


17. Glow plugs can now be installed.



18. They drop into their sockets, four on each side, and then are held down from the top. Eventually they will be connected to an electronic controller via their own wiring harness.

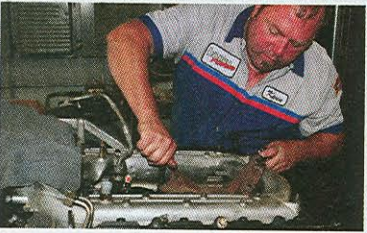
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19. Time to put on the valve covers. First, the new gasket.



20. Then the valve cover itself can be installed.



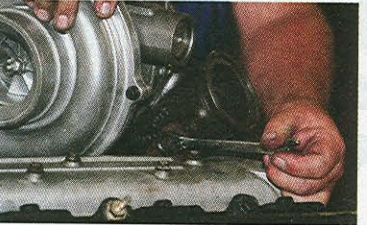
21. Next the turbo pedestal mount goes on.



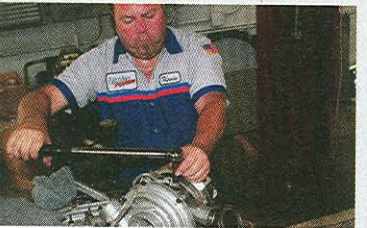
22. Don't forget the heat shield; otherwise the heat from the turbo can create a hot spot on the manifold.



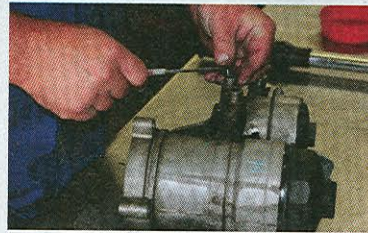
23. The original stock turbo, newly cleaned and balanced, goes back on the engine.



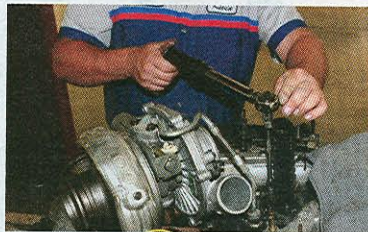
24. The mounting bolts are best tightened with an open-end ratchet.



25. Next the turbo oil feed line can be attached and torqued to spec.



26. New O-rings will be needed on the oil/fuel filter assembly connections. First, they have to be carefully removed as shown here, then the filters will be cleaned with solvent and blown dry.



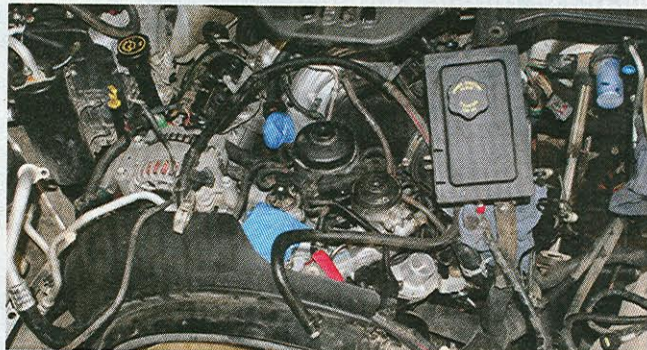
27. Install the oil filter return tube using the retaining bolt. Then install the oil filter housing.



28. There are three lines connecting to the fuel filter, each requiring a new O-ring. Two lines feed fuel in; the third is a fuel return line.



29. Now that the engine is largely done, it's time to lower the body closer to the chassis and think about making connections. It was necessary to slowly and carefully lower the cab, so as not to pinch or crush anything as it comes back together.



30. Here we can see a lot more lines and harness connections to be made, but at this point, the engine has been rebuilt with ported heads, new injectors, new valve lifters, ARP head studs and all new gaskets throughout. Next month, a Banks billet torque converter will be installed, and we'll backtrack a bit to show how a Fluidampr harmonic balancer was installed to replace the worn-out stock unit. Plus, we'll have the charts after the big day on the dyno.

SOURCES:

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