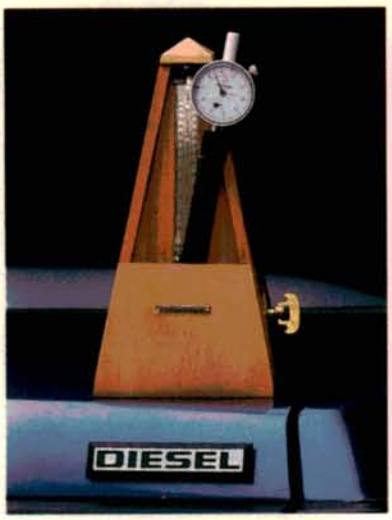


The VW Diesel

PART TWO

Last month we dealt with the basics of timing the Volkswagen diesel. We'd like to follow up this month with a look at a few more highlights of that diesel system.

This sequel is not intended to cover each and every aspect of diesel repair. We did, however, try to choose a few areas of repair and maintenance that require special tools, and emphasize a couple tricks you might otherwise overlook.

Please refer to the proper shop or repair manuals for specifics in terms of specifications and proper procedures, especially when replacing a head gasket. Don't forget to keep your eyes open for the causes of a head gasket failure. Take the time to thoroughly clean and inspect all parts for wear or damage. Check all mating surfaces for warpage.

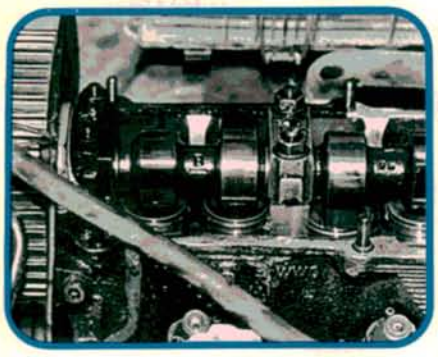
We *will* cover:

- Adjusting valve clearances with shim style cam followers.
- Selecting the proper thickness head gasket by measuring piston height above the deck.
- Disassembling, cleaning, and testing of diesel injectors.
- Proper tools and methods for retorquing cylinder head bolts.

We are assuming that the engine in question is mechanically sound. Bearings and valves are in good working order, and that the engine has enough compression to run properly. These procedures, like the ones shown last month, will only help improve the performance of a sound engine.

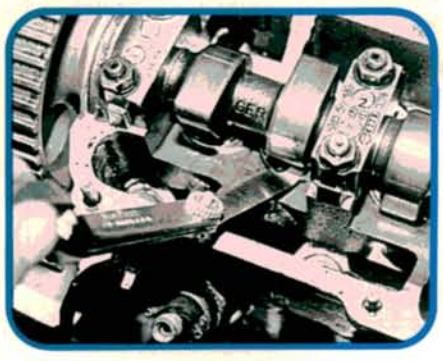
Basic mechanical problems will have to be corrected before *any* engine will run correctly.

Let's start with the valve adjustment. You'll need some special tools and an assortment of shims. Check valve clearance by measuring existing clearance with a feeler gauge. Then correct improper clearances by replacing the incorrect shim with one of the proper thickness.



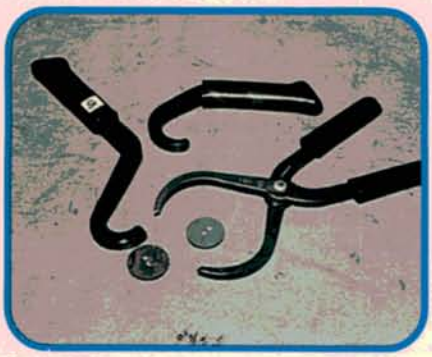
1

Run the engine until the cylinder head is moderately warm. Remove the valve cover. Roll the crankshaft to TDC of the number 1 cylinder. Turn it an additional quarter turn to get the pistons below TDC. This will prevent any valve/piston interference when we compress the cam followers.



2

Check the clearance between the cam and the adjusting shim. Warm intake clearances should be 0.20-0.30 mm (0.008-0.012 in.). Warm exhaust clearances should be 0.40-0.50 mm (0.016-0.020 in.). On number 1 TDC you can check number 1 intake and exhaust, number 2 intake and number 3 exhaust.

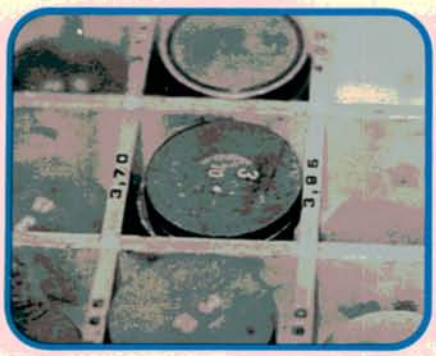


3

You'll need tools like these from Schley Products. The "J" shaped tools are used to compress the collars around the cam followers so you can remove the shims. The pliers are used to remove the shims. They are bowed out to go around the cam and grip the shims through two slots in the follower.

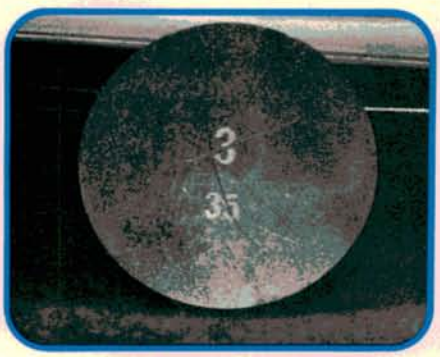
4

Two styles of cam follower depressors are available depending on the type of follower used. Most valve covers will have a sticker showing the correct tool. Using the correct tool, depress the followers, keeping the slots in the followers at a right angle to the cam. This will ease shim removal.



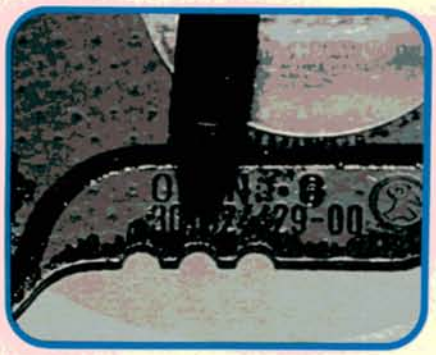
5

Adjustment shims are available in increments of 0.05 mm. Since this is half the allowable range for valve clearance, you'll want to select a shim that splits the difference between the high and low specs. Too much clearance? Use a thicker shim. Too little? Use a thinner one.



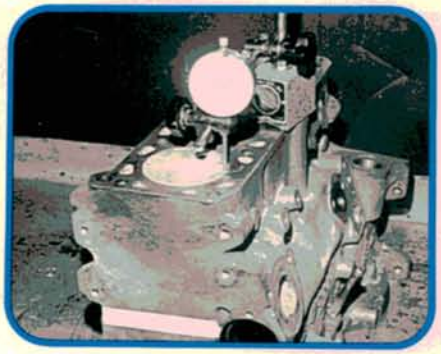
6

Now roll the crankshaft over to TDC on the number 4 cylinder (plus a quarter turn), and adjust the remaining valves as necessary. Shims are numbered on one side. Always place the numbered face down so the cam doesn't wear the marking away. Never re-use a scored or galled shim.



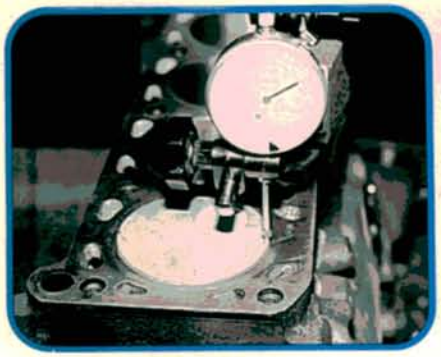
7

Let's move on to selection of the proper head gasket. Head gaskets are available in different thicknesses depending on the height of the piston above the deck at TDC. Head gaskets are identified by part numbers and also by the number of notches cut in their outer edge.



8

You'll need a setup like this to check for piston height. Whether you use a magnetic base holder and dial indicator, or a flat spacer and indicator, you'll want to zero the gauge on the deck surface, preload the gauge, and measure piston height above the deck at TDC.

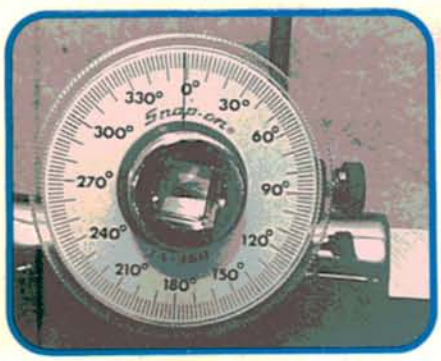


9

Roll the crank through TDC on the cylinder being checked and record the highest reading, less preload. Compare this to the specs for your engine. This particular piston rose 0.78 mm above the block deck. We chose a three-notch, 1.4 mm-gasket covering a lift range of 0.63-0.82 mm.

10

There are two types of head bolts commonly used in this engine. The older inner hex-head bolts are reusable if they're in good condition. Torque them as specified in the shop manual—in steps, in the proper sequence, and to the proper torque. The newer bi-hex bolts require a 12-point, 12 mm socket.



11

Never re-use bi-hex bolts. These are tightened to an initial torque and then turned an additional number of degrees to "stretch" and preload them. A torque angle gauge like this one will make this job easier. Again, follow the factory torque specs and never mix hex and bi-hex bolts on the same job.

12

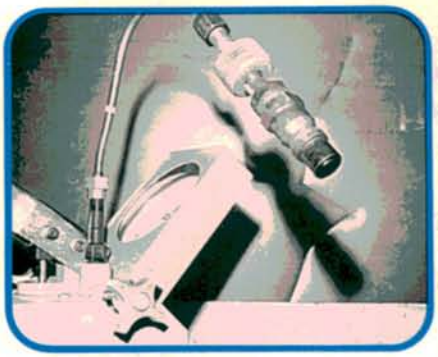
Let's move on to injectors. Bad injectors can cause a number of problems, namely: engine overheating, a loss of power, sooty exhaust, and a loss of fuel economy. One of the more unnerving possibilities is a loud knocking noise, like a rod knock in one or more of the cylinders. It'll get your attention.

13

You can sometimes diagnose injector problems by loosening the supply lines to the injectors, one at a time. That "rod knock" may just disappear when you crack the line on a faulty injector. If the knocking returns when you retighten the line, remove that injector for testing.

14

After removing the injector with a 27 mm deep-well socket, hook it to a pop-off tester like the Kent-Moore unit shown. Keep your hands away from the spray, which has enough force to penetrate your skin. The tester checks for correct spray pattern, correct opening pressure, and leakage.



15

Install the injector on the tester. Turn the knob to close the gauge. Operate the lever rapidly several times to remove any trapped air. Now move the lever slowly until the injector chatters and sprays atomized fuel. Next, open the gauge, pump the lever, and note the opening pressure.

16

Also check the injector spray for a cone-shaped pattern. There should be an even, atomized spray, not a stream or lopsided spray. Dirt or worn needle-to-nozzle fit will give an abnormal spray pattern. Injector cleaning or repair will be necessary to correct this problem.

17

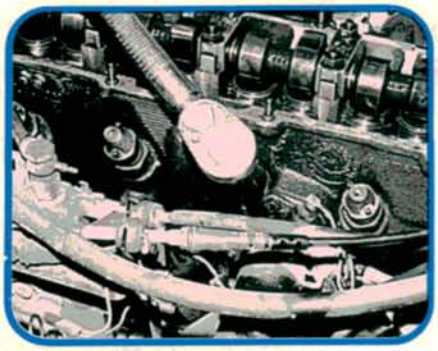
Here's a disassembled injector with the parts laid out in order from left to right: 1) upper body, 2) adjusting shim, 3) spring, 4) thrust pin, 5) spacer, 6) needle, 7) nozzle, and 8) lower body. Needles and nozzles beyond cleaning are available as repair parts and come as a matched set.

18

Clean the different parts of the injector to remove all carbon. If you use gasoline to clean away carbon, be sure to rinse all the clean parts in diesel fuel before reassembly. Check the needle/nozzle assembly for any signs of abnormal wear or signs of sticking or binding.

19

Each 0.05 mm change in the thickness of the spring washer changes injector opening pressure by about 5 bar. Correct and recheck opening pressure. Now hold *injector pressure* at about 10 bar less than opening pressure for 10 seconds. The injector shouldn't leak or drip. (This one still needs some work.)



20

Replace the injector shields, domed face upward toward the injector nozzle. Apply a thin dab of anti-seize compound to the threads and torque them properly. Clean the injector pipes and reinstall them and the fuel return lines. Run the engine and check for leaks.

—By Ralph Birnbaum