

# Wasserboxer

The Vanagon's owner complained that every time he drove it on the interstate, the temperature gauge would creep higher and higher. After an hour or so of 60 mile an hour driving, the little red "I'm too hot" light would start blinking its warning. This resulted in a stop for a burger and fries for the owner, and a jug of coolant for the Vanagon.

The Wasserboxer had a blown head gasket—sort of. But since there is no head gasket in the traditional sense of the term, let's say that a leak had developed between the combustion chamber and the cooling jacket. The wet sleeve cylinders in the flat four Boxer engine are sealed top and bottom by flexible sealing

rings. And the cylinder to cylinder head combustion seal is a thin aluminum washer.

The leak was small enough that it didn't cause a problem around town. But sustained high speed driving resulted in a loss of coolant that led to an overheat condition.

Now nobody likes to admit that they got thumped on by a repair job, but I'd be lying if I said that this first experience with a Vanagon's water cooled flat four was as easy as it looked. After all, it was just an overgrown bug engine with a radiator—right?

But there were a few things I didn't know that made a simple job a lot tougher than it needed to be.

## In the Van or on the Bench

Whether you decide to do this job in the Vanagon, or on the bench is strictly up to you. But having done it both ways, on the bench is my personal preference for a number of reasons:

- **The assortment of hoses, exhaust pipes, hangers, brackets, belts and pulleys is a true jigsaw puzzle.** There is a lot of "stuff" to remove before you reach the point where you can remove the heads. Heat shields, exhaust pipes, coolant flanges, and support brackets must be installed in the correct order for everything to line up correctly. That's why it's very important to pay close attention not only to component locations, but also to the order in which they must be



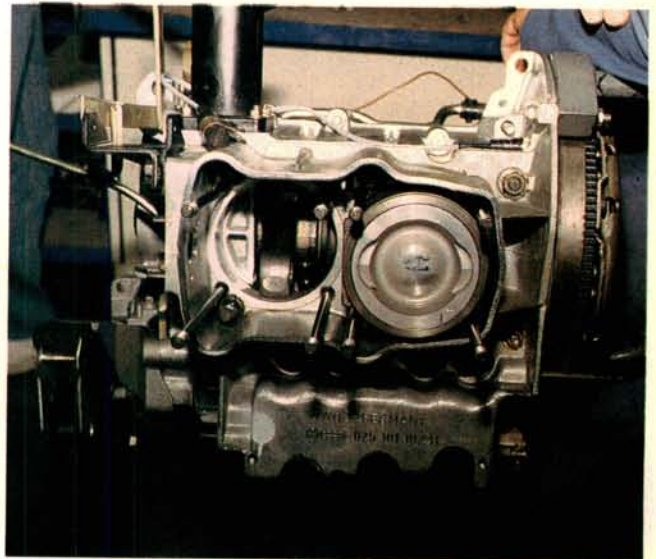
removed and reinstalled. Throw in a good dose of rust and corrosion, and doing the job in the vehicle means spending a lot of time working with your arms above your head.

- **Once you do get down to the cylinder heads, there are a lot of parts to be cleaned, checked and inspected.** It just seems easier to get the engine over on the engine stand under a good strong light, so you don't miss anything.

- **You have to rebleed the cooling system either way, so there's no time savings there.** Besides, disconnecting, inspecting, cleaning, and reclamping the coolant hoses is good insurance against a comeback.

- **Push rod installation is a little trickier than it was on the old bug flat-four.** It's easy to miss the center of the hydraulic lifters used in the Wasserboxer. If you don't get them centered properly, the push rods can stick off to one side of the lifter. In a worst case, you'll get a no-start and a bent push rod or push rods. It is far easier to install the push rods with the engine on a stand, turned 90 degrees from its normal position. That way gravity works with you, not against you.

- **The folks at VW say they are dead serious about the use of non-phosphate antifreeze/coolant in these engines.** When you see how thin the cylinder sealing rings are, you'll realize that any amount of pitting in the aluminum at the cylinder head sealing areas can lead to internal coolant leaks. VW claims that the use of antifreeze/coolant containing phosphates can lead to this condition.



- **The coolant bleeding procedure for the Wasserboxer is more complicated than most.** With the radiator and engine a long distance call apart, there are a lot of places for trapped air to hide in the plumbing system. For a detailed explanation of bleeding procedures on the Vanagon, please refer to the "Bubble Trouble" article in the February 1989 issue of *Import Service*.

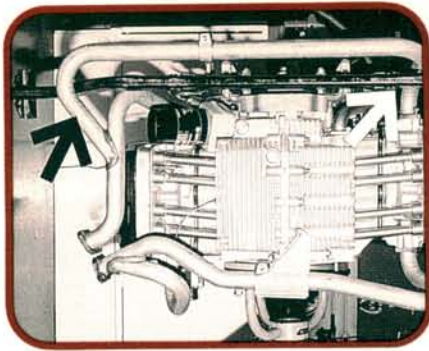
## On the Stand

Our article starts with the engine removed and mounted on an engine stand. We'll concentrate on the right side of the engine, although procedures for the left side are the same, with one exception. On the right side, you remove the coolant flange on the hose running from the water pump to the crankcase. On the left side, you'll need to remove the water pump to expose the piston pins.

We'll also include some extra photos to help you keep track of component locations in case you get lost along the way. One of the toughest decisions to make as you disassemble the engine has to do with what you need to remove, and what can stay. Sometimes it's easier to remove components for ease of access than it is to work around them.

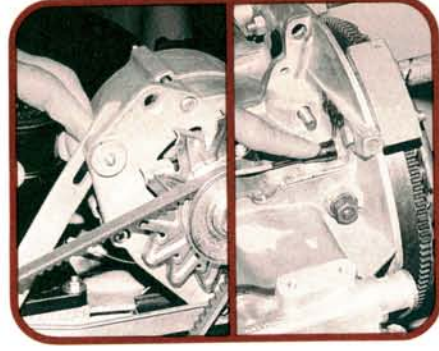
The special tools shown are available through Zelenda Tool Company. For more information **circle number 200** on the reader service card.

—By Ralph Birnbaum



1

This photo of the underside of the Wasserboxer gives you a good overall view of the exhaust routing and the general layout of crankcase and cylinder heads. The sheet metal below the push rod tubes is removed so you can see better. Note how the engine hanger weaves below one pipe and above the other (arrows).



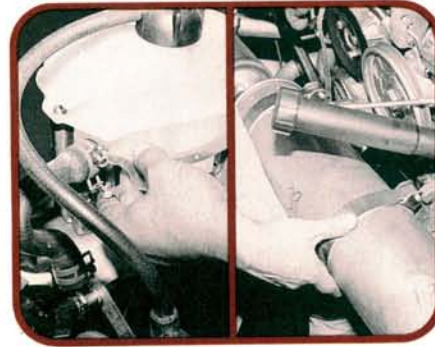
2

There are so many things to remember. Start by removing the accessory belt and the alternator. The black mounting bracket can stay bolted to the crankcase. Try to match bolts to assemblies as they're removed to help keep track of their locations. The flywheel sensor can stay, but be careful not to damage it.



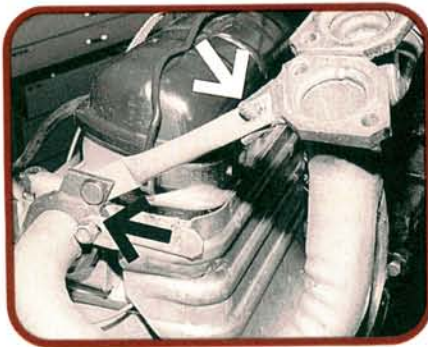
3

The intake manifold straddles the engine, and there's quite a bit of unbolting to do before the manifold assembly can be removed. Don't forget to remove the nut on the case stud holding the support bracket for the throttle body (arrow). Leave the injectors in the manifold horns and remove them as an assembly.



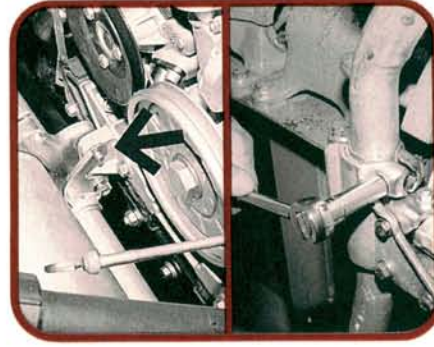
4

Disconnect the coolant line from the coolant recovery jug. Then remove the engine cover plate and jug as an assembly. Then you can start removing exhaust parts. The muffler/catalyst is held in place by bracket/strap hanger assemblies. The muffler/catalyst is fairly heavy, but can be removed as an assembly.



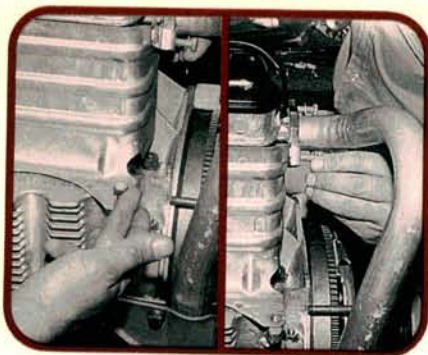
5

More potential confusion. Notice the "layered look." The exhaust slips onto a stud on the head, the mounting ear on the metal shield below the push rod tubes fits over the exhaust flange, and a support bracket acts as an outrigger for support. During reassembly doing things in the wrong order means doing them over.



6

There are other support points for the exhaust, front and rear. The left photo shows where the exhaust support bracket bolts to the case below the crankshaft pulley. The photo at right shows an additional support located on the bottom of the engine near the flywheel to support the crossover pipe. Look back at photo 1.



# 7

These photos show how the metal covers beneath the push rod tubes bolt to both the exhaust flanges and crankcase. Later, as you piece the jigsaw puzzle back together, start as many bolts as possible before tightening any of them all the way. That way you can wiggle exhaust pipes, shields, and brackets into proper alignment.



# 8

Drain any remaining coolant from the cylinder heads by removing these cheese head screws. This keeps any remaining coolant from draining into the cylinders when the head is removed. Clean the bolt heads and use a fresh socket as the sockets will strip out easily. Replace the coolant plug sealing ring when reinstalling the plugs.



# 9

Remove the valve covers. Loosen the locknuts on the valve adjustment screws and back the screws out until they are flush with the rockers. (You can do this later but it's easier to do now.) Remove the rocker arm assemblies and push rods. Keep the retaining nuts and washers for the rocker assemblies separate. They are special.



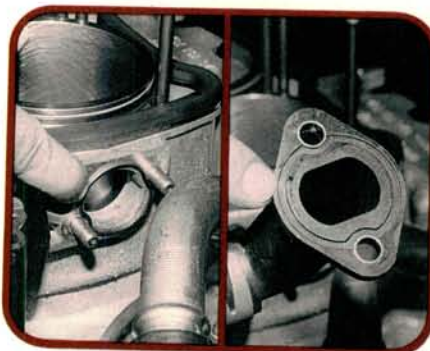
# 10

With the head unbolted and the push rods removed, lift the head off the crankcase. Then remove the push rod tubes. If your engine isn't as clean as this one, cover the valve lifter openings after removing the tubes to keep them clean. Remove the rubber gasket below the head.



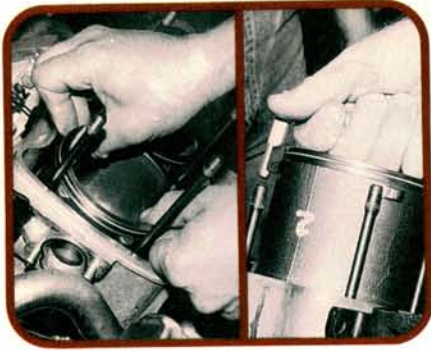
# 11

Before we can remove the piston/cylinder assemblies, we have to remove the crossover pipe and coolant flange. After positioning the pistons in the coolant flange opening, we will remove the piston pin retainer clips and piston pins through the hole. On the left side, we remove the water pump to access the clips and pins.



# 12

With so much external plumbing, and with so many gaskets, flanges, and connections, improper cleaning or the use of old gaskets and seals will cause external coolant leaks. This coolant flange is an example. Check the crankcase mating face for pits, clean the groove in the flange, and always install a new sealing ring.



# 13

To remove the piston/sleeve assemblies, place the piston at TDC. Grab the sleeve and rock it to break the lower seal loose. A special tool is available for stubborn cases. Raise the sleeve just above the piston pins. Pull too hard and you'll need a ring compressor to reassemble things.



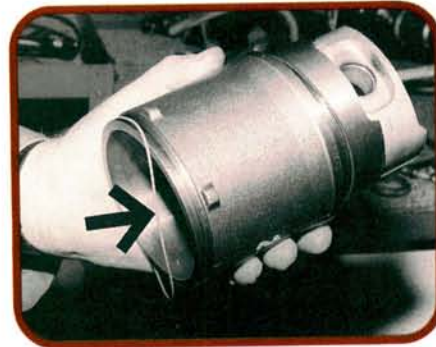
# 14

Now we'll reach through the coolant flange opening to remove the piston pin retaining clip. Remove the clip as shown. Then remove the piston pin and slide the piston/jug assembly off the rod. Clean a spot on the cylinder, and mark the piston/cylinder's number in the firing order with a paint stick for future reference.



# 15

This piston pin tool speeds pin removal and installation. The tool has a twist handle at one end. As you screw the handle tighter, rubber rings in the tool expand to grip the piston pin inner diameter. Pins can stick in the pistons since the piston pin retainer clip can raise a burr. A reamer is available to remove the burrs.



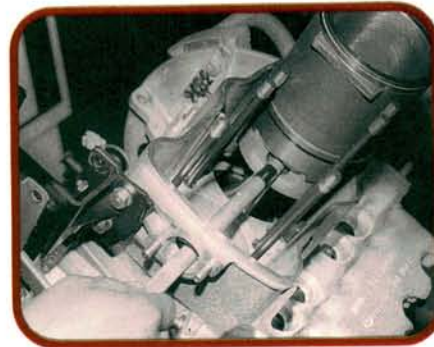
# 16

This thin, green seal fits between a groove in the cylinder and the cylinder head. Always replace these seals. No additional sealer is recommended, although the seals should be lightly lubed. Since the seals are so thin, the groove in the jug, and the mating surface in the head must be spotlessly clean at reassembly.



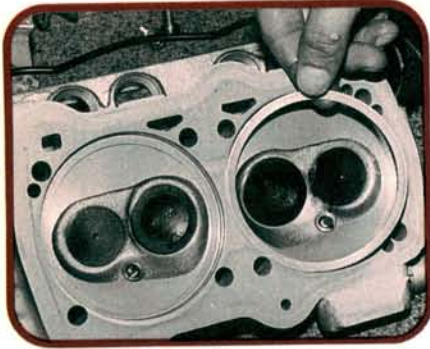
# 17

The seals at the other end of the jugs are black in color. There is no adjustment for jug height in the crankcase. Simply clean the jug lip and mating surface in the crankcase, and lightly lube the seals before installing them on the jugs. Get everything CLEAN. Any leftover debris can distort the seals and cause a leak.



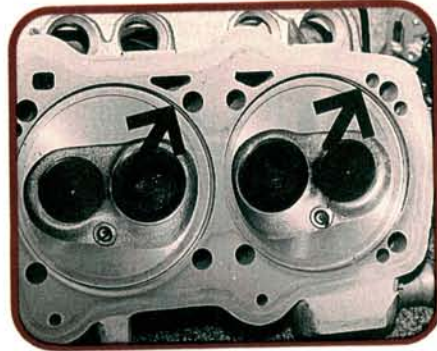
# 18

Repeat the sequence for the back cylinder. Lift the cylinder far enough to expose the piston pins. Then rotate the crankshaft until the piston pin is aligned with the coolant hole. Remove the circlip for the piston pin, the piston pin itself, and piston/cylinder assembly. Repeat these steps for the other side of the engine.



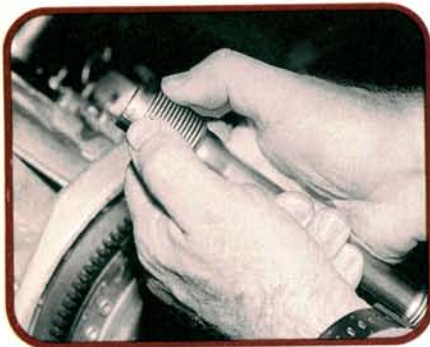
# 19

Since we don't have a traditional head gasket, we need aluminum rings to seal the combustion chamber. Always install new rings. On air-cooled engines, small leaks between the cylinder and head went unnoticed for a long time. But any combustion leaks on the Wasserboxer will cause cooling system problems in a hurry.



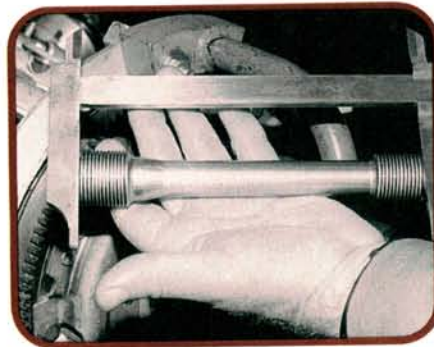
# 20

Also check the machined walls of the cylinder head recesses (arrows). Inspect the entire diameter of each wall for pits or flaws, especially in the areas where the cylinder seals ride. You saw how thin the seals are. Even slight imperfections can ruin the coolant seal between the cylinder and cylinder head.



# 21

This shot may be familiar. Used push rod tubes can be reused, but they have to be stretched a bit. Take the tube as shown and work the accordion back and forth while pushing away at the same time. This will preload the "accordions" so they push against the push rod tube seals when they're reinstalled.



# 22

Don't overstretch the tubes. This could weaken the tube metal and make cylinder head reinstallation more difficult. If you're not familiar enough with this procedure to do it by "feel," there is a spec for overall tube length. Take a large vernier as shown and stretch the tubes to 194 mm, measured as shown.



# 23

With new cylinder seals installed, reinstall the pistons. To keep the rods upright as you reinstall the piston/jug assemblies, grab the rod and rotate it slightly on the journal while pushing the rod toward the radius on the rod journal. Friction between the rod bearing and the journal radius will hold the rod upright.



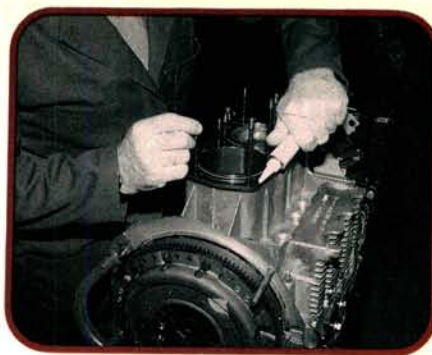
# 24

Cylinder sleeves must be installed with the flat bosses (arrow) on the cylinders facing inward. Pistons are installed so the arrow stamped on the head of each piston faces toward the flywheel. Reinstall piston/cylinders in their original locations. Don't forget to check that each piston pin retainer clip is reinstalled and seated.



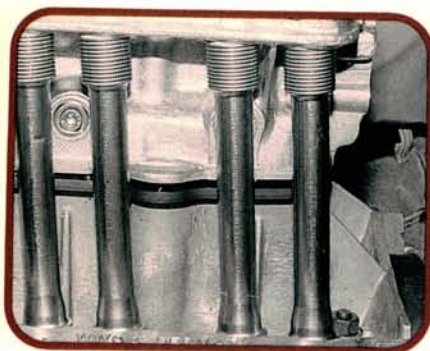
# 25

The large rubber gasket between the crankcase and cylinder head is grooved where it fits against the crankcase. This gasket does require a sealant (VW P/N D 000 400). Apply a thin bead of sealer on the flat face of the gasket facing the cylinder head. No sealant is needed in the grooved section facing the crankcase.



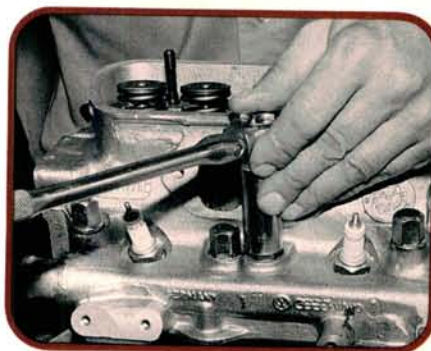
# 26

Lightly lube the thin green cylinder seals. Here we are applying the sealer to the flat face of the rubber seal. Install new sealing rings in the cylinder heads. Hold the sealing rings in the heads with petroleum jelly to keep them from falling out. We're almost ready to reinstall the heads.



# 27

Install new seals on the push rod tubes. Reinstall the tubes with the small ends pointing toward the cylinder head. Also make sure you can see the writing on the tubes. That puts the seam of each tube facing toward the cylinders. Most tubes don't leak at the seams, but putting the seams at the top is an added insurance.



# 28

Make sure all cap nut and stud threads are clean and burr free. VW says to coat the base of the cylinder stud cap nuts with AKD 450 000 02 sealer before installing them. Draw the head down evenly against the crankcase. Stop frequently to be sure the push rod tubes are properly seated, and compress without bending at the accordions.



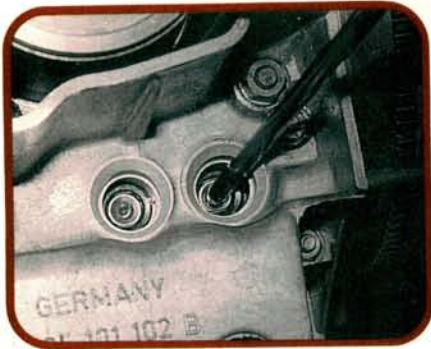
# 29

Forget about your clicker-style torque wrench and grab a beam-style wrench. Apply sealer to the base of each retaining nut. Tighten the head nuts alternately, in the proper sequence. Final torque is reached by raising the beam needle to the proper torque and holding that tension on the nut.



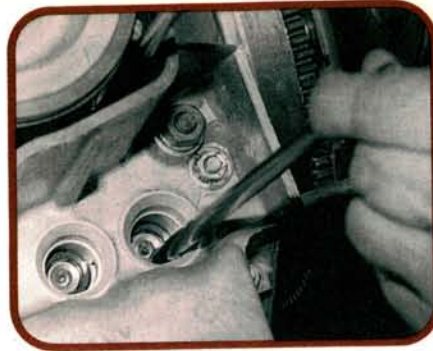
# 30

With the proper torque applied to the wrench, watch as the nut continues to turn. When the nut stops turning at that torque, release the wrench. You'll notice that the nut wants to spring back a bit. Your clicker-style wrench would have reached the initial torque, clicked and quit. The nuts wouldn't be tight enough as a result.



# 31

You can't see the lifters this well with the push rod tubes installed, so this photo was taken without the push rods tubes. Don't count on the push rods finding their way to the centers of the lifters. As you install the rockers, spin and wiggle the rods until they're properly centered in the lifters and rocker arm sockets.



# 32

If the push rod is installed off center in the lifter, there's a chance that it will stick off center. This can result in bent push rods and a good deal of noise. It's easier to install and center the rods by dropping them into push rod tubes standing straight up in the air, than to slide them into place with the engine flat.



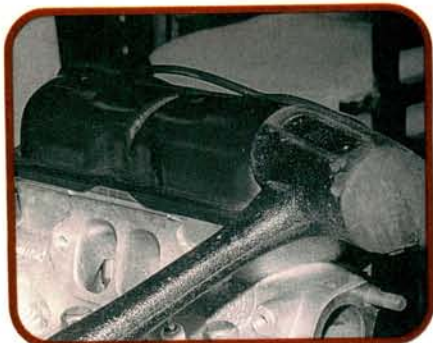
# 33

Even though the Wasserboxer has hydraulic lifters, there is a basic adjustment to make at the rocker arm adjusting screws. If you didn't do it earlier, back off the adjusting screws until the head of each screw is flush with the face of the rocker arm, as shown. Leave the jam nuts loose for now.



# 34

Install the rocker shaft so the slots in the pivot sleeves point toward the valves. Torque the nuts to 25 Nm. At TDC on number 1, tighten the screws until they just contact the valve stem, plus an additional 2 turns, then tighten the lock nuts. For each remaining cylinder, turn the crank 180 degrees and repeat the sequence.



# 35

Always use new valve cover gaskets. VW doesn't recommend the use of any additional sealer here, but the cover and cylinder head mating surfaces must be clean. After installing the valve covers, take a soft mallet and give the covers a rap from side to side. An improperly seated valve cover should snap down against the head.

## TORQUE AND SEALANT CHART

Cylinder Head—35 Nm

Rocker Shaft Nuts—25 Nm

Oil Pump Sealing Nuts—25 Nm  
(Special sealing nuts—seal faces inward toward pump cover.)

All 8 mm attaching bolts and nuts for coolant flanges, water pump, intake manifold bolts, exhaust attachment bolts, and oil filler neck—20 Nm.