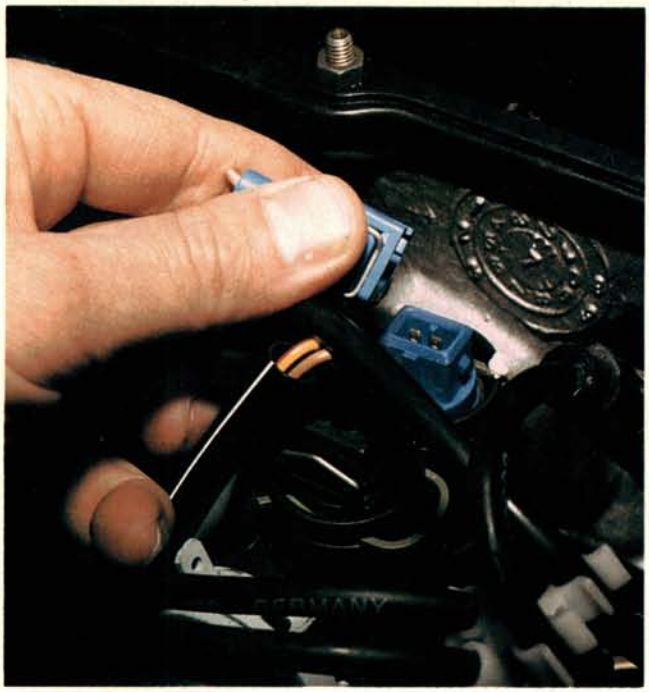
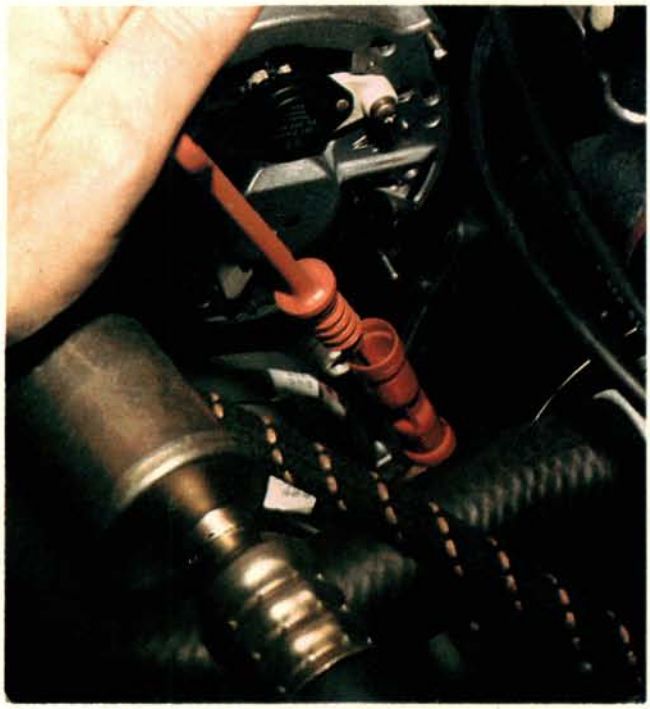
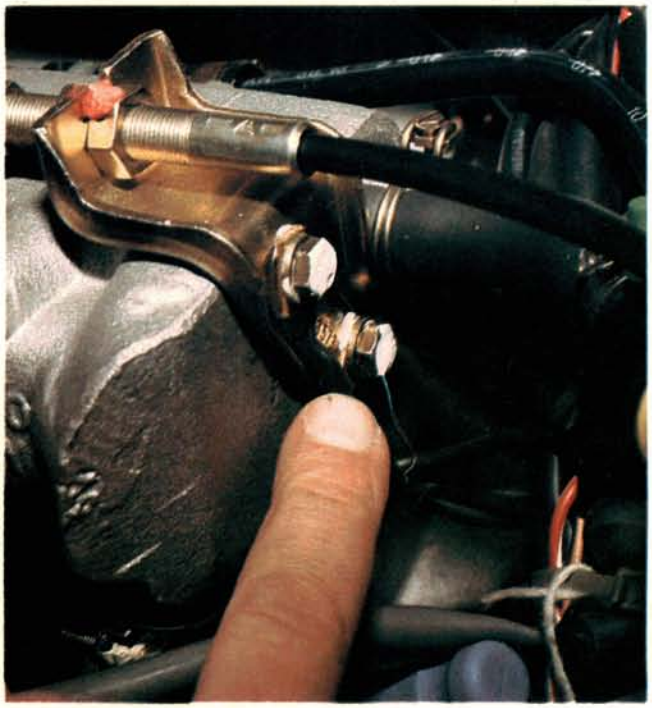
IMPORT SERVICE



VW Digifant

PART TWO





We began our look at Volkswagen's Digifant II engine management system last month with a system overview. This time around, we're going to cover diagnosis and repair techniques for this system. Before we do, we'd better set up a few ground rules. The Digifant II system may be advanced, but it can't work properly unless some very basic things are right.

Big problems can be caused by easily overlooked little things. Always begin your diagnosis with the obvious. Run through these simple visual checks first:

- Make sure all electrical connections are clean and tight. Pay particular attention to the fuel system's ground connections.
- Check all vacuum, crankcase ventilation, fuel tank ventilation, and air intake hoses for cracks, restrictions, or looseness.
- The Digifant II system is easily affected by vacuum leaks. A defective oil filler cap or leaking valve cover gasket can cause hard starting, poor performance, and hesitation.
- Check for adequate fuel supply, including fuel quality.

Basic Engine Settings

If your visual inspection doesn't turn up anything unusual, run through the basic engine settings next. The ECU does its best job of controlling system operation when these adjustments are correct. If they're not, the ECU has to constantly adjust its output devices. The system ends up fighting itself, and not working very well as a result.

Always check and adjust the basic engine settings in the following order:

- Ignition timing
- CO content
- Idle speed

The following conditions must be observed during all diagnostic testing and adjustments:

- Engine oil temperature must be at least 80 degrees C (176 degrees F).
- All electrical consumers should be switched off.
- The radiator cooling fan should not be running during testing.
- The idle switch must be functioning properly.
- The idle stabilization system must be operating properly (the valve should vibrate and hum while the engine is running).
- Engine CO must be measured at the tap upstream of the catalytic converter.
- VW's high temperature silicone hose (P/N 6006-0019) or an approved equivalent must be connected to the tap for CO testing. Using non-approved hoses may alter CO readings.
- Replace all hose clamps removed during fuel system testing with crimp-style clamps of the same design. Wormscrew-style clamps should not be substituted.
- Use a new sealing washer each time the fuel system pressure tap is opened.
- Lubricate new fuel injector o-ring seals with gasoline only during reinstallation. Never reuse old seals.

Hot Restart Program

Always rev the engine to at least 2100 RPM four times whenever the engine is shut off and restarted during basic engine setting and other diagnostic tests. Let the throttle switch close completely between revs.

If you skip this step, the hot restart program stored in the ECU's memory will keep the engine at a higher than normal idle RPM, affecting your adjustments. The restart program helps clean out unburned fuel and gets the engine running cleanly as quickly as possible for emissions purposes. Follow the restart procedure each time the engine is restarted during Digifant diagnosis.

ECU Damage Precautions

The Digifant II ECU can be damaged internally if these precautions aren't followed:

- Always properly insulate your test leads when tapping coil terminal 1. If your test connector shorts to ground, start checking prices on new ECUs.
- Check for poor or floating grounds at ECU terminals 13 and 19. Make sure the ECU ground connections at the intake manifold, the cooling system outlet fitting on the left side of the engine block, and the negative battery terminal connections are clean and tight.
- The ECU ground wiring at the intake manifold on some models may be too short. Engine movement can cause the wiring to fray or separate completely. Add additional wire of the same gauge if the ground wire is stretched too tight.
- Never disconnect the idle stabilizer with the engine running or the ignition switched on.
- Always measure the idle stabilizer valve's current draw on the multimeter's milliamp scale, never on the voltage scale.

Digifant Component Testing

We've included a chart which details resistance and voltage testing procedures for individual Digifant II components. Observe the following precautions (more precautions) during your testing:

- The ignition must be switched off.
- The multi-pin ECU connector should be disconnected.
- The high voltage coil wire should be removed from the distributor and grounded.
- Always switch your multimeter to the correct range before connecting it to component wiring.
- On Golf models, check total fuel injector resistance at the fuel injector wiring harness connector.

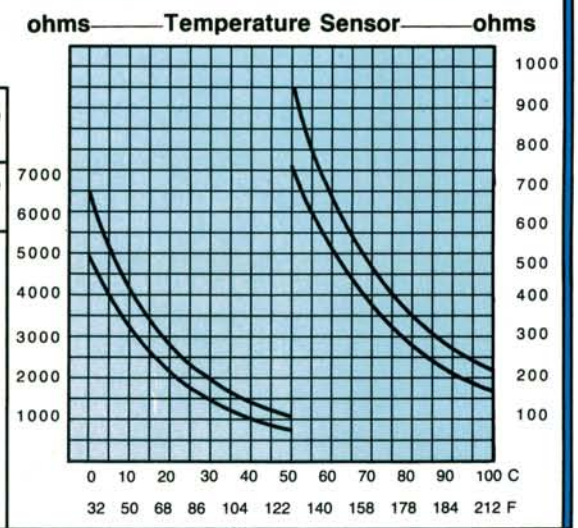
—By Karl Seyfert

DIGIFANT TEST VALUES

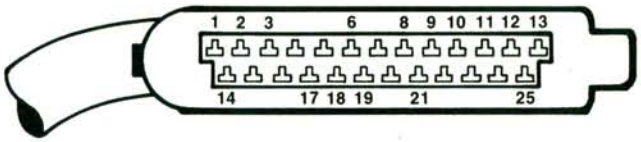
OHMMETER TO TERMINAL	COMPONENTS	CHECKS/TEST CONDITIONS	SPECIFICATIONS
2 and 13	Oxygen Sensor	• Connector Disconnected and Grounded • Connector Connected	0 ohms ∞ ohms
6 and 11	Throttle Switches	• Idle Position • Half Throttle Position • Full Throttle Position	0 ohms ∞ ohms 0 ohms
6 and 17	Air Flow Sensor	• Total Resistance	500 to 1000 ohms
17 and 21	Air Flow Sensor	• Resistance Through the Potentiometer	Ohms fluctuate as sensor plate is opened
12 and 14 (Jetta Only)	Fuel Injectors	• Total Resistance	3 to 5 ohms
Check at Components	Individual Fuel Injectors	• Resistance (Each)	14 to 18 ohms

TEMPERATURE SENSOR RESISTANCE CURVES

6 and 9	Temp. Sensor I (Intake Air Temp.)	• Resistance
6 and 10	Temp. Sensor II (Coolant Temp.)	• Resistance

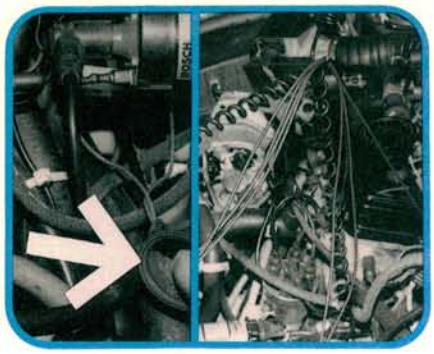


ECU CONNECTOR TERMINALS



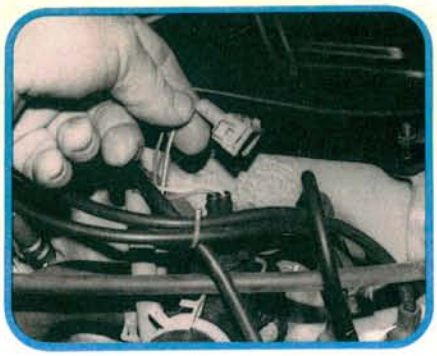
22 and 23	Idle Stabilization Valve	• Continuity	0 ohms
4 and 5 4 and 7	Knock Sensor Wiring	• Separate connector to knock sensor and bridge all 3 wires in connector	0 ohms
6 and 8 6 and 18	Hall Sender Wiring	• Separate connector to Hall sender and bridge all 3 wires in connector	0 ohms
#25 at ECU and #6 at Hall Control Unit	Wiring to Hall Control Unit	• Continuity (Connector separated from Hall control unit)	0 ohms
13 and Grd.	Control Unit Ground	• Continuity	0 ohms
19 and Grd.	Engine Ground	• Continuity	0 ohms

VOLTMETER TO TERMINAL	COMPONENTS	CHECKS/TEST CONDITIONS	SPECIFICATIONS
1 and 13	Wiring from Starter	• Voltage from Terminal 50 During Cranking (Starting Injection)	Cranking voltage (Min. 8 volts)
3 and 13 Bridged	Fuel Pump Relay	• Ignition ON	Fuel pumps run



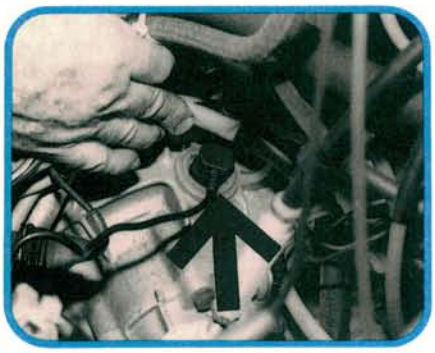
1

Don't take any chances with your test connections. This coil terminal jumper wire (left photo) is shielded at one end, preventing accidental grounding. The tachometer lead is attached safely inside the plastic shield. An elastic cargo strap (right photo) keeps test leads out of harm's way.



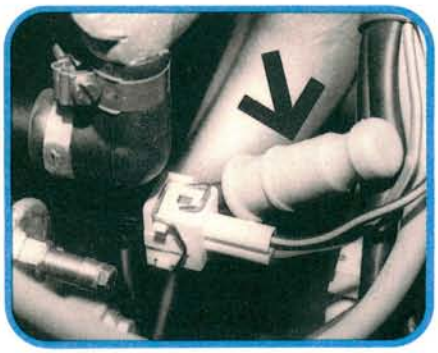
2

To adjust the ignition timing, start the engine and rev it four times as described in the introduction. Remove the coolant temperature sensor's blue connector to put the system into open loop. The black connector on newer models connects to the coolant temperature gauge.



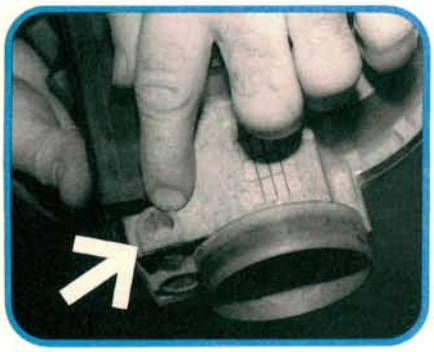
3

The inductive timing pickup on VW's engine analyzer fits this opening (arrow) in the transaxle case. Remove the adapter plug on stick shift models if you're using a conventional timing light. Automatics have a separate window. Timing should be 4 to 8 degrees BTDC at 2300 RPM ± 50 RPM.



4

Attach an approved silicone test hose to the CO tap (arrow). Raise the oil dipstick, then clamp the breather hose near the crankcase emission control valve. Adjust the idle speed to 800 RPM ±50 RPM, then check the CO. CO will vary with altitude, because the temp sensor is disconnected, keeping the system in open loop.

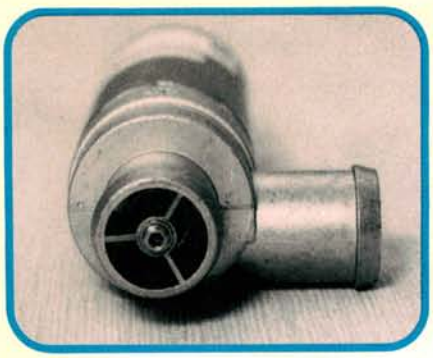


5

To adjust CO, carefully drill a 2.5 mm hole in the air flow sensor's tamper-proof plug. Thread a 3 mm sheet metal screw into the hole. Then remove the screw and plug using pliers. The adjustment screw takes a 5 mm hex wrench. Clockwise richens the mixture. Replace the plug when you're finished.

6

Reinstall the dipstick and remove the crankcase breather hose clamp. Set the base idle speed to 975 RPM ± 50 RPM. Reconnect the coolant temperature sensor. The idle speed should drop to 800 RPM ± 50 RPM. CO must be 0.7 percent ± 0.4 at any altitude. If idle speed is out of specs, check the stabilizer valve.

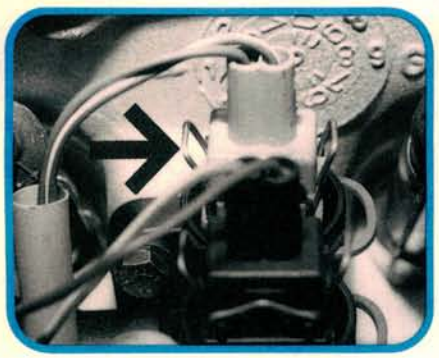


7

Check the idle stabilizer valve if the engine is hard to start without stepping on the gas. Internal deposits may cause the valve's plunger to stick closed. 1990 models use a piston operated idle stabilizer valve. The new style valve should be used to replace sticking stabilizer valves.

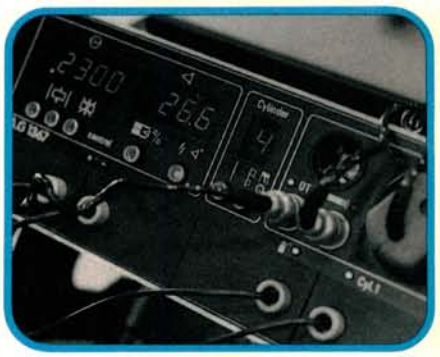
8

To test the ECU's control current to the stabilizer valve, install an inline wire tap at the stabilizer valve's connector and attach a milliamp meter. Control current on a warm engine must be 390-450 mA and fluctuating. Current should be a steady 430 mA with the temp sensor disconnected.



9

Poor engine performance may be caused by a defective knock sensor system. To check the system, engine temperature must be at least 80 degrees C, and the radiator cooling fan must cycle at least once. Rev the engine four times to cancel the hot restart program, then disconnect the temp sensor connector.

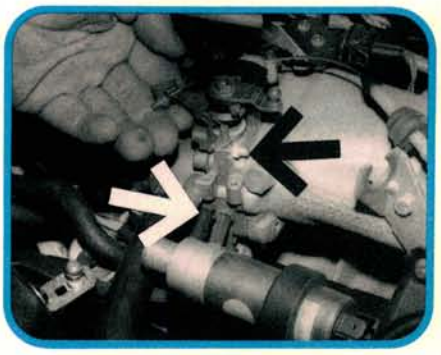


10

Increase the engine speed to 2300 RPM ± 50 RPM and record the ignition timing. Reconnect the temp sensor, then briefly raise the engine speed above 3000 RPM. Now hold the engine speed at 2300 and recheck the timing. The timing must advance by 30 degrees ± 3 degrees from the original setting.

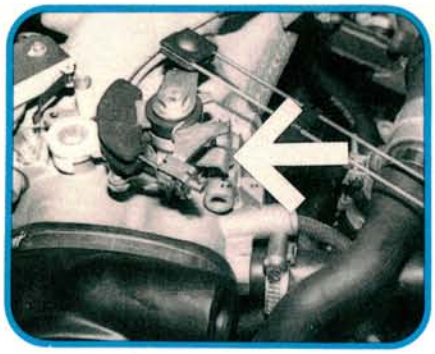
11

If the timing didn't advance, check the knock sensor system. Torque the knock sensor to 15-25 Nm, then check its wiring (arrow) to the ECU. Check the temp sensor's resistance, then check its wiring to the ECU. If no defects are found, substitute a known good knock sensor. If the problem continues, replace the ECU.



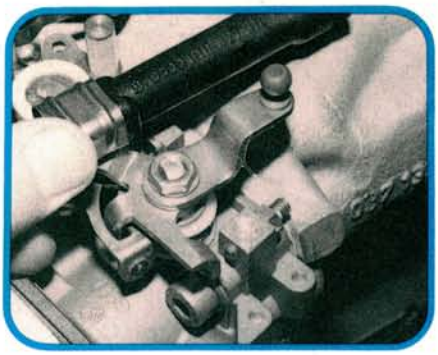
12

To check for proper idle stop screw (black arrow) adjustment, remove the carbon canister vacuum line (white arrow) and attach a vacuum gauge. Up to an inch of vacuum at the port is acceptable, although zero vacuum is preferred. Vacuum at idle will purge charcoal canister vapors, causing a rough idle.



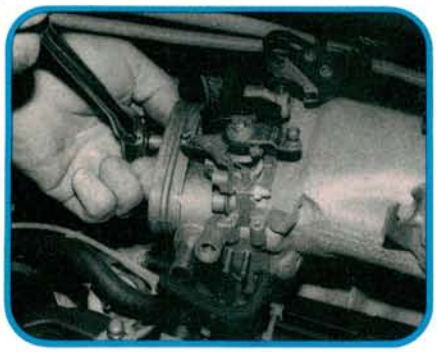
13

If the throttle stop screw is misadjusted, turn the screw out until there's a gap between the throttle levers (arrow). Place a piece of paper between the two levers, then turn the screw in until there's a slight drag on the paper. Turn the stop screw in an extra half turn, then repeat the vacuum test.



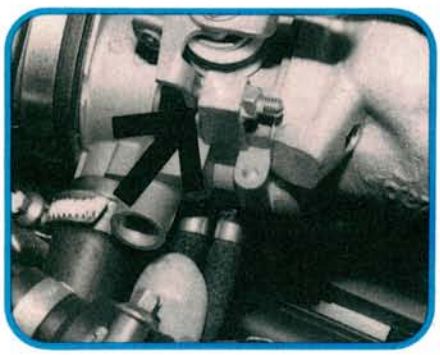
14

The idle switch may work okay manually, but not open and close when the pedal is depressed inside the car. Attach an ohmmeter to the throttle switch electrical connector. Resistance should be 0 ohms with the throttle closed, and go to an open circuit when the throttle is opened.



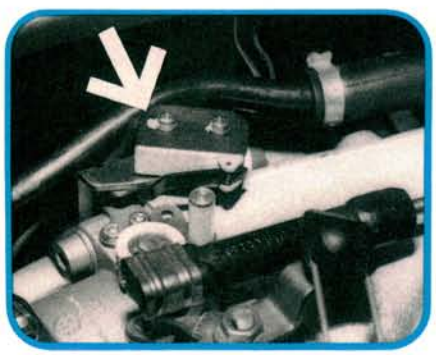
15

The idle switch opens with one degree of throttle opening. A misadjusted idle switch may cause the engine to surge at idle or cut out during light throttle application. The throttle housing must be removed to get to a non-functioning or misadjusted idle switch mounted on its bottom side.



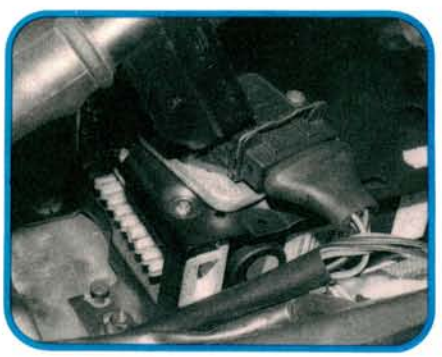
16

To adjust the idle switch, insert a 0.20 mm feeler gauge between the stop screw and throttle lever (arrow), then close the throttle. The throttle switch should be closed (0 ohms). Now open the throttle and insert a 0.60 mm feeler gauge. The throttle switch should be open (open circuit).



17

The throttle switches are wired in parallel. Attach an ohmmeter to the connector terminals, then slowly open the throttle to test the full throttle switch (arrow). Resistance should drop to zero about 10 degrees before full throttle. Throttle switch supply voltage from the ECU should be 5 volts.



18

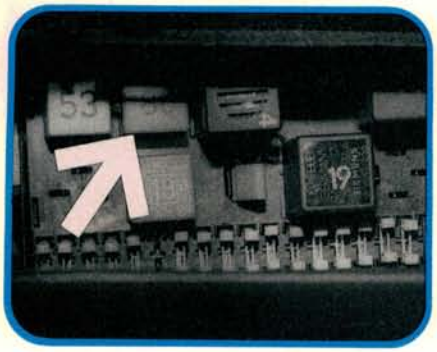
Only California Digifant II cars have self-diagnostics. Continuity and voltage checks are the order of the day on 49 state versions. The ECU is mounted under the hood, so you won't need ten foot jumper wires to test circuits. Always switch the ignition off before removing the ECU connector.

19

The Digifant system depends on precise fuel delivery for smooth operation. Rough idle, stalling, bucking, or poor acceleration during engine warm-up may be caused by injector clogging or carbon build-up on intake valves. The following tests will determine whether the fuel delivery components are working properly.

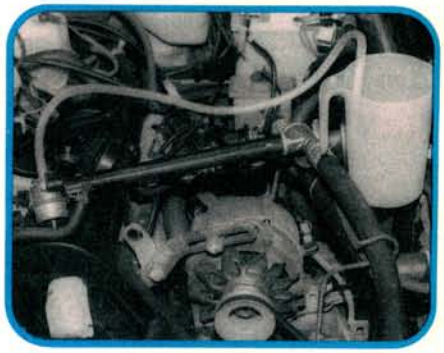
20

First we'll test the transfer pump's delivery rate. Remove the fuel filler cap, then remove the trunk cover from the tank sending unit. Remove the black feed hose and plug its end. Attach a hose to the sending unit and route the other end into a measuring beaker.



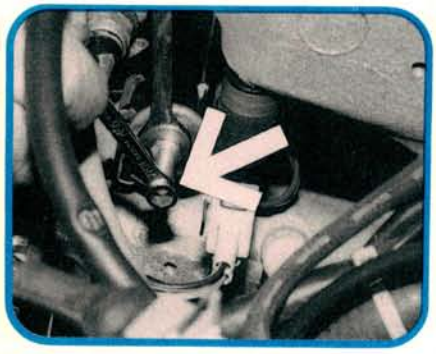
21

Remove the fuel pump relay (arrow). VW's US 4480/3 tool is recommended as an on/off switch between terminals 30 and 87 of the relay socket. A momentary contact switch equipped with the proper connectors will also get the job done. Switch the pump on for 10 seconds. Fuel delivery should be a minimum of 300 cc.



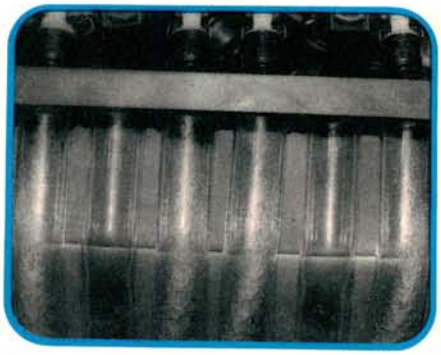
22

To test the main fuel pump delivery rates, disconnect the fuel return hose near the right shock tower. We had removed the fuel rail, so we attached a hose to the pressure regulator and placed the other end in a measuring beaker. Power the main pump at the relay socket. The pump must deliver 500 cc in 30 seconds.



23

Remove the fuel rail tap (arrow) to test fuel pressure. Pressure at idle should be 2.5 bar, and hit 3.0 bar when the pressure regulator vacuum hose is removed. A restricted return line or bad pressure regulator may cause high fuel pressure. Residual system pressure must hold 2 bar for ten minutes.



24

Remove the fuel rail with the injectors attached for volume testing. Place all four injectors in graduated cylinders like the unit shown. Use a jumper harness to trigger all four injectors at once for 30 seconds. Check the injectors for a uniform spray pattern and even fuel delivery volume.