Back to Basics: Bosch CIS-E Fuel Pressure Testing

Getting back to basics is not what it used to be. Simple troubleshooting for such things as a no-start or poor performance problems requires an understanding of how the particular system operates, and how to diagnose it.

In the case of the Bosch CIS-E fuel injection system, there is more than meets the eye. Something as simple as testing fuel pressures requires an understanding of how the system controls fuel pressure and mixture. We will give you a brief overview of the system and its functions, then show you the tools and techniques that are required to test the fuel pressures for this system.

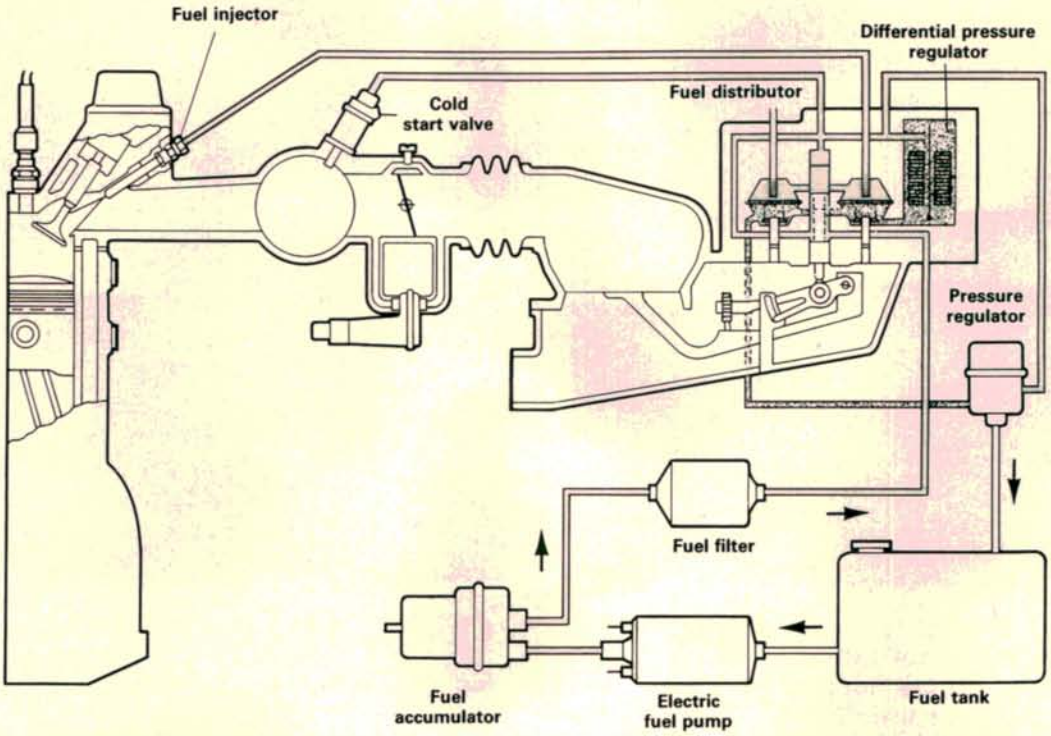
Bosch introduced the CIS-E (Electronic) fuel injection system in the early '80's on some Audi, Volkswagen, and Mercedes Benz models, as well as other European cars. The change to CIS-E followed the normal evolution of the fuel injection systems we had become familiar with—CIS, CIS-Lambda, then CIS-E. Stricter emissions standards were at least partly responsible for these changes. A more precise method of monitoring engine data and controlling fuel mixture and pressures was needed to meet these standards.

To accomplish this, the method of controlling system pressure and fuel mixtures was changed. CIS and CIS-Lambda controlled these functions through mostly mechanical means. The only electronic part of the CIS-Lambda system was the frequency valve, which was used to alter the fuel mixture in response to inputs from the oxygen sensor. CIS-E gets the job done almost entirely electronically (the fuel pressure regulator is still a mechanical design).

The system has continued to evolve through CIS-E II, CIS-E III, and CIS-E Motronic. The basic functions have remained the same, with refinements to mixture control, and the addition of engine timing management on later versions of this system.

Fuel pressures, which we will be testing in this article, are controlled both mechanically and electronically on the CIS-E system. A fuel pressure regulator is incorporated in the return loop, and uses an engine vacuum signal to maintain main system pressure at a specified value at all engine speeds. Fuel pressure increases as engine load increases (and engine vacuum drops), to assure an adequate supply of fuel during periods of high demand.

Mixture control, cold enrichment, and decelera-



CIS-E Fuel Supply

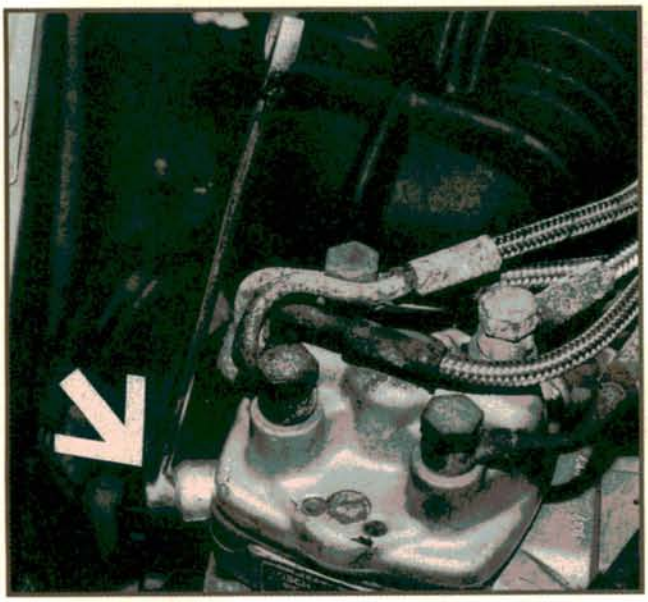
tion (fuel cut-off), are controlled electronically, through the use of the idle/full-load switches, temperature sensors, O_2 sensor, and the differential pressure regulator. The differential pressure regulator (or EHA as Mercedes Benz likes to call it) controls the pressure differences within the fuel distributor's upper and lower chambers, therefore controlling mixture.

The entire system is controlled by the ECU. After gathering data such as engine temperature, engine load, throttle position, and O_2 feedback, the ECU sends a specific current to the differential pressure regulator to control pressures, which affect the fuel mixture. Basic settings and pressures of the system are not adjustable, only mixture trim, idle speed (on some models), and timing can be changed or altered. For now, we will concern ourselves with the basic testing of system pressures and possible causes of incorrect system pressures. A future article will cover system adjustments.

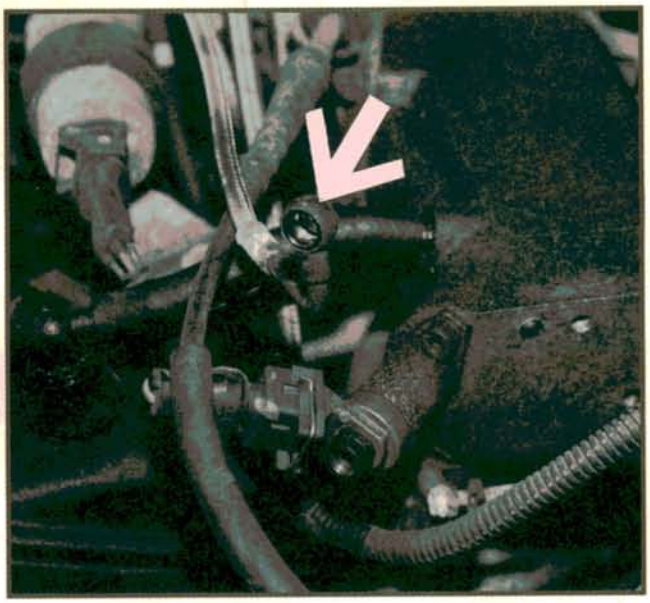
A few basic tools are necessary to do the job, including an accurate fuel pressure test kit with the correct adapters. We used the MATCO fuel injection test kit **(Circle Number 141),** the VW 1490 resistor block, and the VW 1315 A/1 adapter harness.

Once you understand how the electronics influence the system pressures, you will begin to see why things are not so basic anymore.

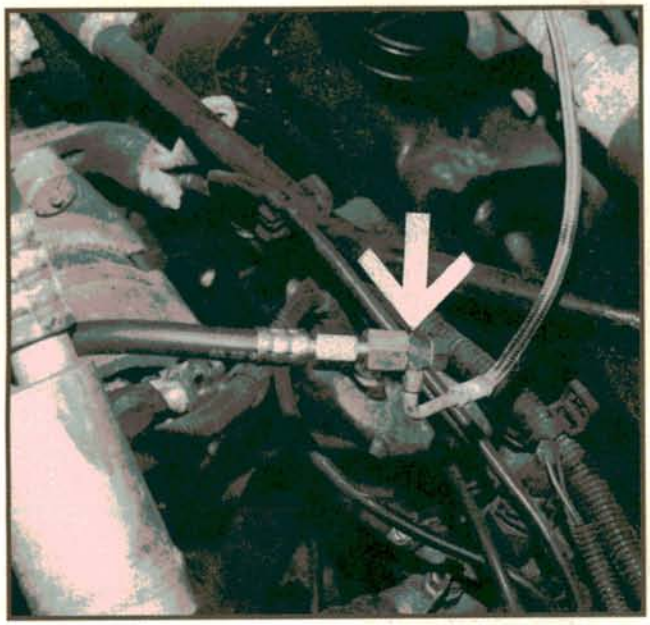
—By Pat Etzwiler



1 Let's begin by locating the Lower Chamber test port (arrow). Remove the 12 mm plug, then connect the proper adapter from your fuel pressure gauge kit, or use the VW 1318/5 set. Be sure to connect the proper end of the fuel pressure gauge line to the lower chamber plug (it's the one without the valve).

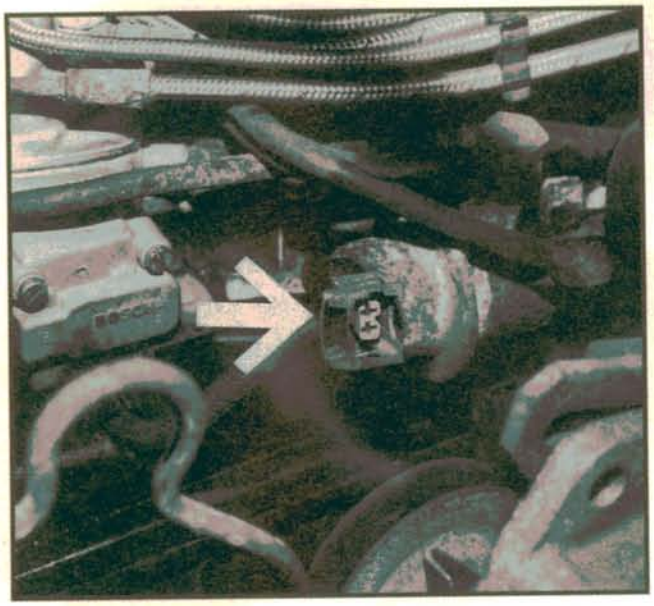


2 Next, remove the feed line to the cold-start valve, and attach the valved line from the pressure gauge set to the cold-start supply line. The cold start valve stays disconnected. This connection supplies the Main System Pressure reading. Be certain you have good, tight connections on all lines.

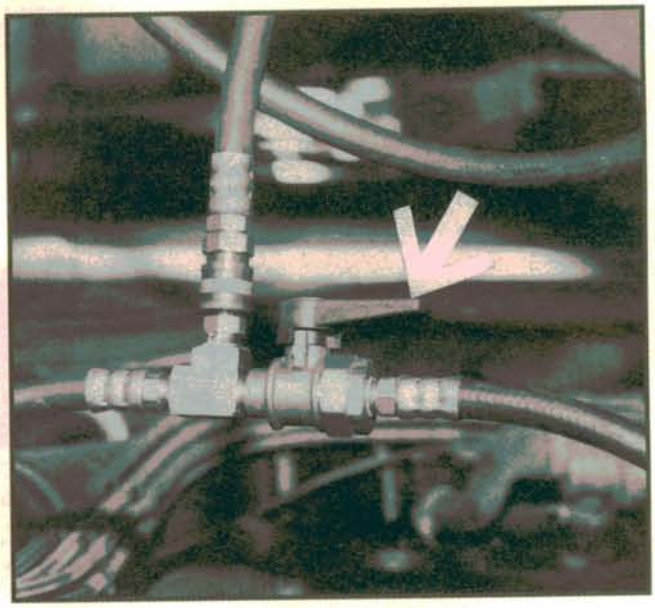


3 Select the correct adapter, then connect the feed line banjo fitting to the fuel pressure gauge line. Connect the pressure gauge to the fuel pressure gauge hose set, and turn the in-line valve to the OPEN position. Position the gauge in a vertical position to ensure an accurate reading.

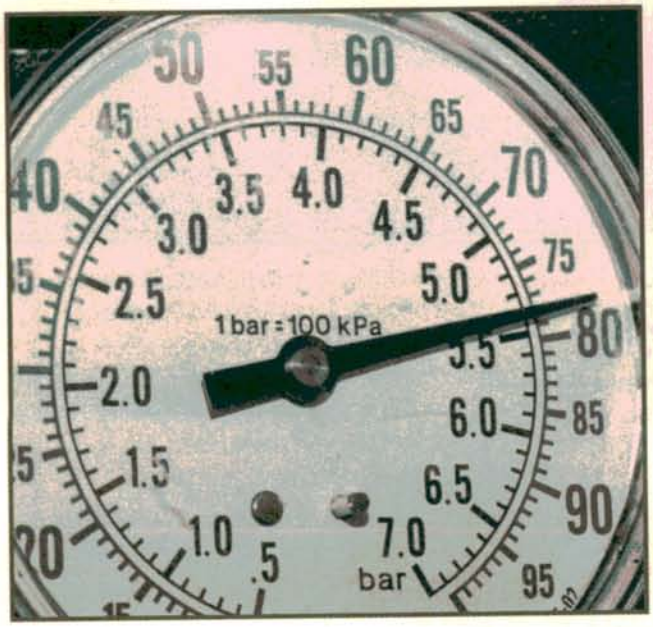
4 The other end of the fuel pressure gauge hose set attaches to the lower chamber test port in the fuel distributor. It is important NOT to confuse the gauge lines, as incorrect readings will result. We are now ready to begin testing the fuel pressures of the CIS-E system.



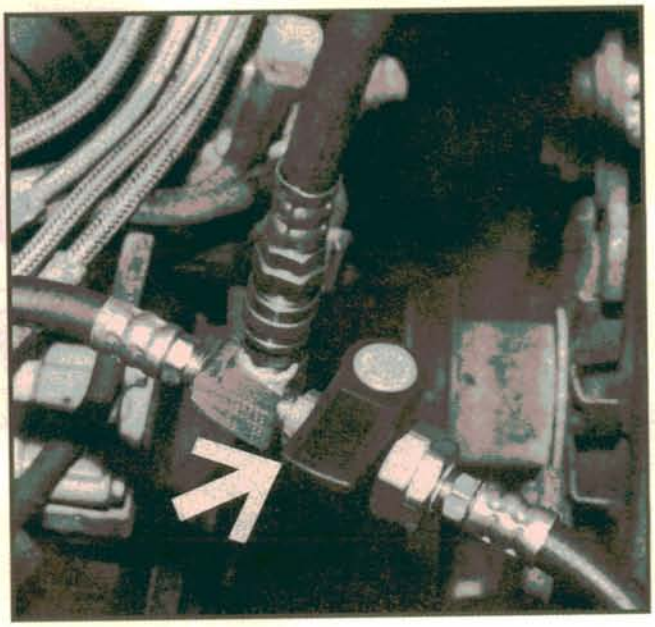
5 To properly test the lower chamber pressures, disconnect the harness connector from the differential pressure regulator. Also, remove the fuel pump relay from the fuse panel. Jumper the relay contacts with VW Tool US 4480/3 or equivalent, between terminals 30 and 87 of the relay socket.



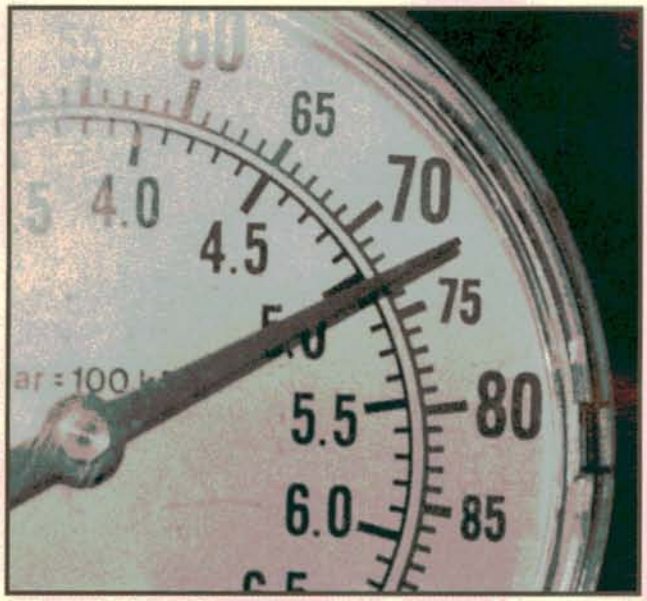
6 Turn the gauge set to the OPEN position (as shown), then activate the fuel pump with the installed relay jumper. System pressure should be 5.2 to 5.6 bar 75 to 82 PSI. If system pressure is incorrect, check for restrictions in the lines, filters, and the fuel pump delivery quantity.



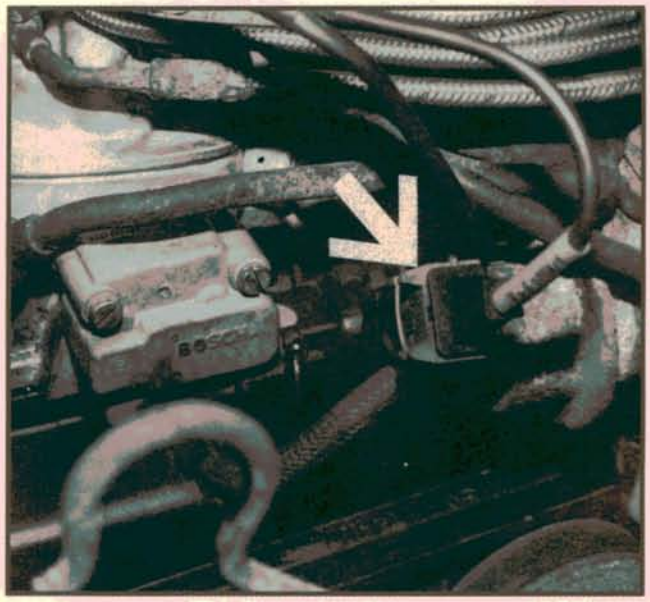
7 The gauge should remain steady and solid during the test. Any fluctuation or "flutter" in the gauge could mean a potential problem in the main pressuring supply. Take an accurate reading at this point and write it down. The next step is to measure lower chamber control pressure.



8 Disconnect the fuel pump relay jumper. Move the valve to the CLOSED position. The differential pressure regulator remains disconnected. Reactivate the fuel pump and observe the reading. Pressure should be 0.2-0.5 bar (2.9 to 7.0 PSI) *less* than the previously measured system pressure.



9 The pressure reading should be "rock-solid." Any fluctuation may spell trouble. If pressure is incorrect, replace the differential pressure regulator and re-test. If the pressure is still incorrect, replace the fuel distributor. This will make your customer *very* unhappy, as these units are quite expensive.



10 Connect VW 1315 A/1 or equivalent to the differential pressure regulator harness. Set a multimeter to the 200 mA range, then connect it to the wiring harness adapter. Remove the wiring connector from the coolant temperature sensor. We are ready to test differential pressure Part II. Having fun yet?

11 Plug the 1500 K ohm side of the resistor block into the temperature sensor harness connector. Turn the ignition ON, then energize the fuel pump. Differential pressure should be 0.7-1.2 bar (10-17.5 PSI) lower than the previously measured system pressure (now you know why you wrote it down).

12 The mA reading on your meter should be 50-80 mA. Ours read 61 mA. If the amperage is within specifications and pressure is not, replace the differential pressure regulator and re-test. If the readings are still incorrect, check all wiring and grounds. If all are okay, replace the ECU (more joy).