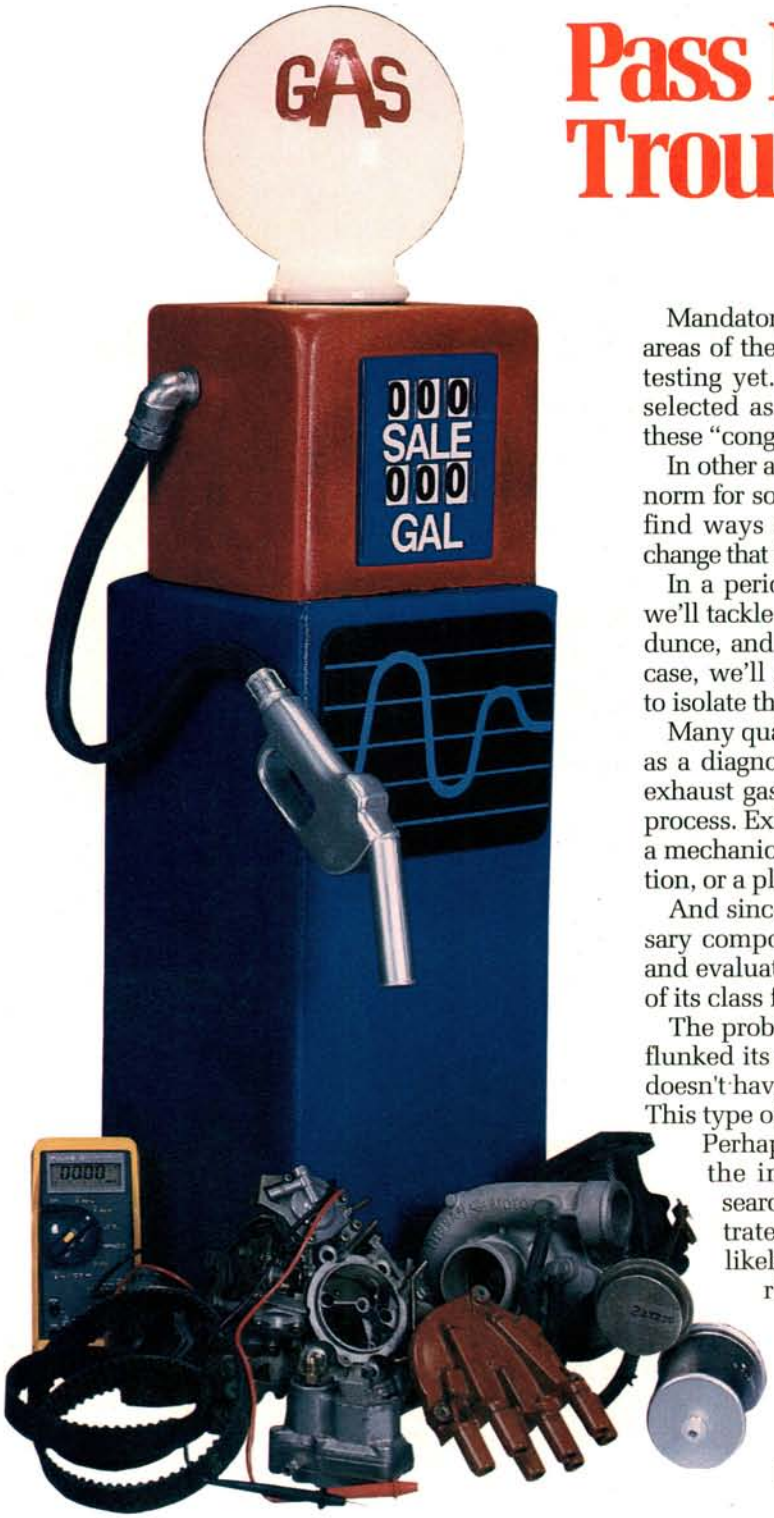
Driveability Clinic

Pass Fail Four Gas Troubleshooting



Mandatory emission testing is spreading to more and more areas of the country. Here in Ohio, we don't have statewide testing yet. But more of our metropolitan areas are being selected as EPA testing continues to show that the air in these "congested" areas isn't up to standards.

In other areas of the country, statewide testing has been the norm for some time. Either way, it seems that we all need to find ways to shortcut emission-related repairs needed to change that failing grade on an emissions test to a passing mark.

In a periodic series of articles over the next few months, we'll tackle several real cars which start their day as the class dunce, and end up as honor students. In each documented case, we'll go through standard troubleshooting procedures to isolate the cause (or causes) of unacceptable emissions.

Many qualified technicians are using the four gas analyzer as a diagnostic tool. There's a good reason. The content of exhaust gas is the result of all elements in the combustion process. Exhaust analysis is a dynamic test. If the engine has a mechanical problem, a fuel delivery problem, a weak ignition, or a plugged exhaust, it will affect emission levels.

And since the engine is running for the tests, all the necessary components of effective combustion can be measured and evaluated. That's why four gas is graduating at the head of its class for many diagnostics.

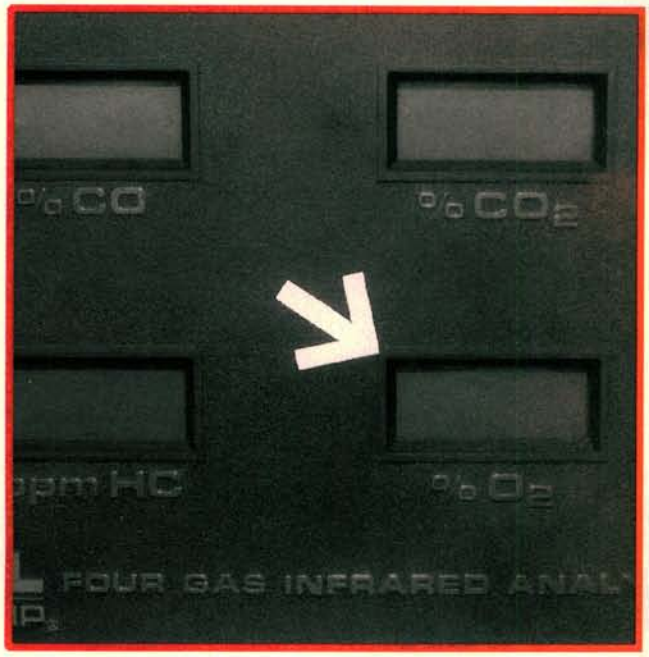
The problem car in question is a 1981 BMW 528i. The car flunked its sniffer test — badly. The fact that this is a BMW doesn't have a lot to do with our troubleshooting procedures. This type of problem could happen to almost any car.

Perhaps the most interesting part of this repair, is that the initial four gas readings helped us narrow the search for our problem. Then we were able to concentrate our troubleshooting procedures in areas most likely to cause our rich condition. This proved to be a real time saver in the end.

In addition to the four gas analyzer, the only tools used were a DVOM, and the wrenches needed to tighten a loose connection.

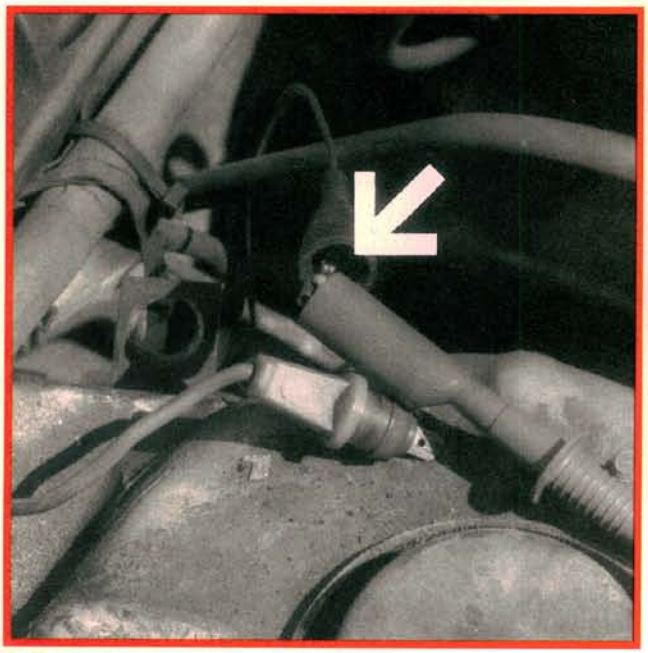
You may also find it interesting, that with the exception of a badly needed oil change, no new parts were needed to make this repair.

—By Ralph Birnbaum



1 The engine runs well when warm. It does want to stall, however, when the A/C is turned on. Upstream readings show that the CO is almost nine percent. Hydrocarbons are also high at about 500 PPM. But the real clue is that O_2 is very low. We start with O_2 because it tells us whether we're rich or lean.

2 The engine crankcase oil is clearly contaminated with fuel. The car is normally driven on short runs, and was stored all last winter. An oil change improves our readings, but HC and CO are still too high. The air filter is clean. Our rich mixture doesn't seem to be caused by a lack of intake air.

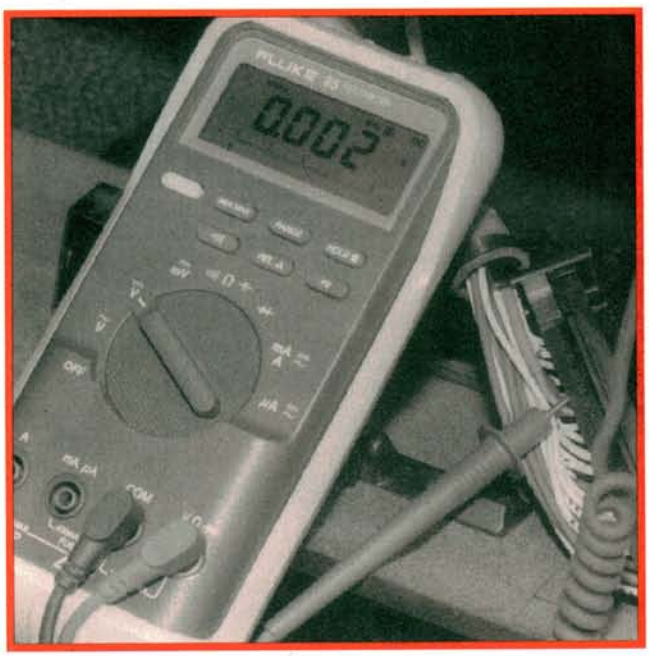


3 The four gas readings still suggest that our problem is a rich mixture affecting the entire engine. Our high HC doesn't seem to be caused by a misfire, but by the high CO. We hook up a fuel pressure gauge (just in case the pressure regulator is sticking), and connect a DVOM to the O_2 sensor.

4 Mother of all oxygen sensors! Fuel pressure is okay, but the O_2 sensor is pegged at full rich, and is sending one volt and then some. We substitute a rich signal by grabbing the battery positive cable with one hand and the O_2 sensor wire leading back to the ECU with the other hand.

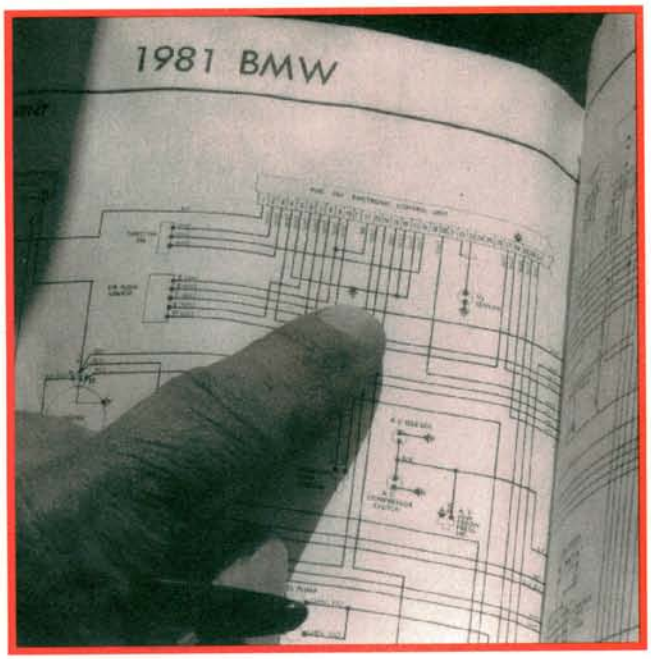
5 This simulated rich signal prompts the ECU to respond. It tries to force the mixture lean, but our CO and HC readings are still too high. Voltage from the O_2 sensor is also higher than normal, although it does drop off. The ECU is clearly trying to make an adjustment.

6 Next we check the reference voltage coming from the computer. Our reading is over five volts—not 0.5 volt mind you. A full 5.0 volts. Looks like our decimal point is in the wrong place! For one reason or another, the bias voltage signal from the ECU is 10 times what it ought to be.

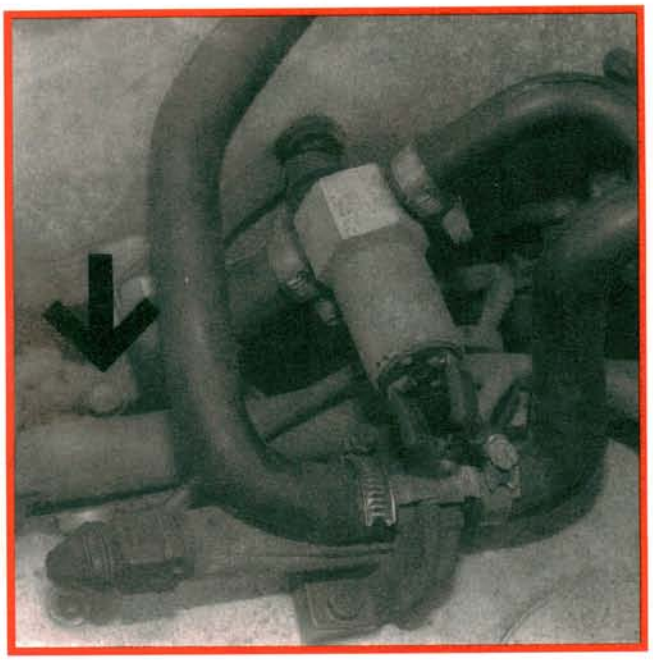


7 We drop the ECU, and disconnect the harness connector (ignition OFF). Maybe a short to voltage in the harness is "bleeding" voltage into the O_2 sensor wire. With the harness still disconnected we turn the ignition ON and test for voltage at the O_2 sensor pin. No voltage, no crossfeed.

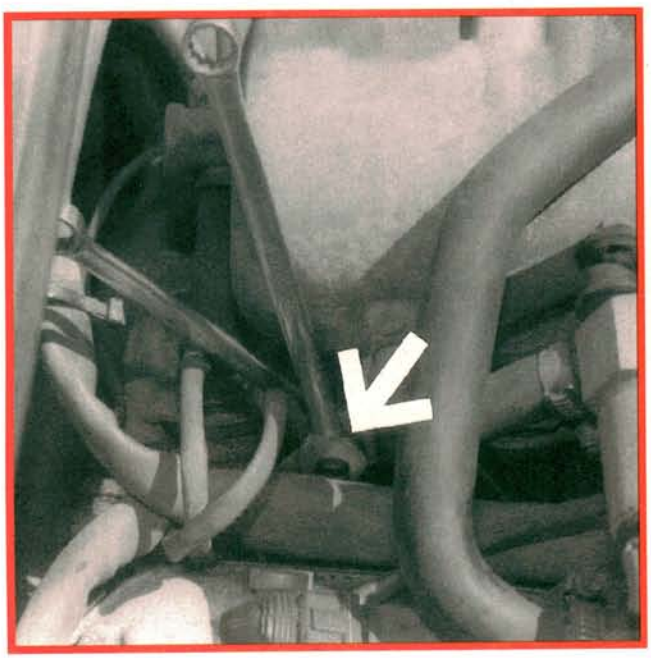
8 We turn the key OFF. Then we reconnect the harness to the ECU and turn the key ON again. When we backprobe the O_2 sensor pin, we get the same five volt reading we had out under the hood at the connector for the oxygen sensor. The five volt signal is coming from the ECU—maybe it IS bad.



9 I don't think so, Tim. Admittedly, the five volts coming from the ECU make it look very, very guilty. But it's time for us to shift our thinking away from the voltage side of the circuit and start checking grounds. The wiring diagram helps us locate the ECU ground terminal numbers.



10 Remember when we mentioned that the car stalled with the A/C turned on? The wiring diagram tells us that one of the ECU ground terminals shares a ground point on the engine with the A/C air bypass valve. The ground point is a wire that bolts to the intake manifold.



11 We have a voltage drop of over three volts at the ground, and this drop is also found at the ECU ground pins. The ground point is less than a foot from the O_2 sensor we were just checking. Sure enough, the connection is dirty. And worse yet, it's loose.

12 With the connector cleaned and tightened, we start the engine again to load the circuit. Then we double check the voltage drop at the ECU ground. That's better. The voltage drop test shows us that we have restored the ground. We turn on the A/C to add the stabilizer load to the circuit and check again.

13 Even with the full stabilizer load, the ground circuit holds its own. If we hadn't used the diagram to locate all the loads hooked to the ground, we wouldn't have known which loads to power up to fully load the ground circuit. By the way, the car doesn't stall any more when the A/C is switched on.

14 A final test of the bias voltage from the ECU shows that we're back to 0.5 volt. After a spirited drive in search of coffee and donuts, we find that 0_2 sensor voltage is also back at midrange, and fluctuating. Our four gas readings are back in specs. The car passes its test.