Before You Dig...

You've probably seen the warning stickers on junction boxes for underground phone and power cables which warn construction crews to be careful where they dig. Your local public utility's worst nightmare is a guy with a backhoe who doesn't heed the warnings.

This month's question is: Are you making the same mistake when you diagnose internal engine problems? Do you spend enough time checking the engine while it's still in the car and running? Or are you digging right in, disassembling the engine, and then trying to find the problem with a piece-by-piece analysis?

An incorrect or incomplete diagnosis has never been cheap, either for the customer, or for your bottom line. A misdiagnosis or incorrect diagnosis can quickly become a financial disaster.

We hope to offer some basic procedures which will do the following:

1) Prevent you from removing an engine which can be fixed in the car.

2) Prevent you from needlessly disassembling an engine.

3) Isolate problems in the fuel, ignition, cooling, lubrication, and exhaust systems. In many cases, a fault in one or more of these systems may be the true cause of poor performance, overheating, or noise. In extreme cases, the failure to correct subsystem problems has already led to a mechanical failure of the engine.

If you don't find and correct subsystem failures, they will soon destroy any mechanical repairs you perform.

We hope you take three things away with you after reading this article:

1) Proper diagnosis of a running engine (even a badly running engine) can often tell you more about the engine than a complete teardown.

2) There are a number of important tests which can ONLY be done with the engine in the car.

3) The tests are simple, and rely more on your powers of observation than they do on expensive test equipment.

—By Greg Boyd

Only When It's Running.....

How important are tests of a running engine? Here's a quick list of tests you cannot perform with the engine sitting on a skid.

1) Ignition timing and advance

2) Complete cooling system check. This is especially important when you're checking for internal coolant leaks, thermostat opening temperature, coolant temperature sensor problems, and cooling fan operation. Try thinking of the radiator, coolant pressure cap, water pump, and hoses as vital parts of the engine.

3) Oil pressure tests

4) Power balance tests

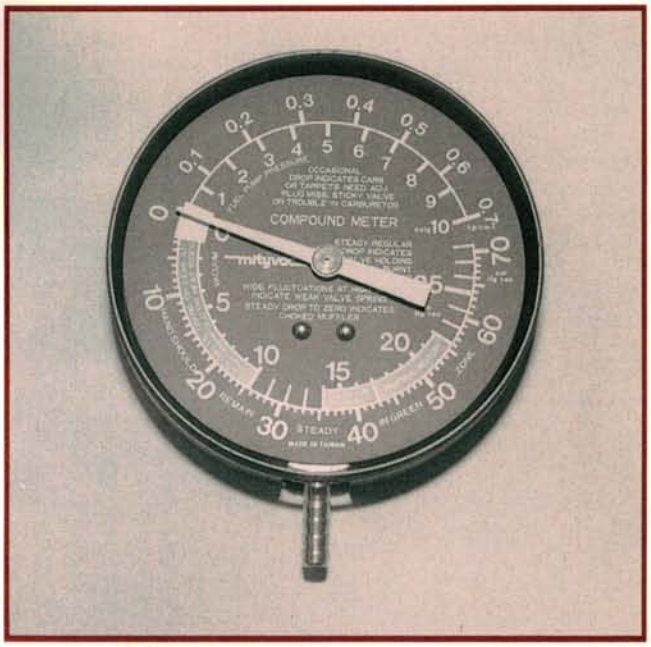
5) Engine vacuum tests

6) Exhaust system tests (including back pressure)

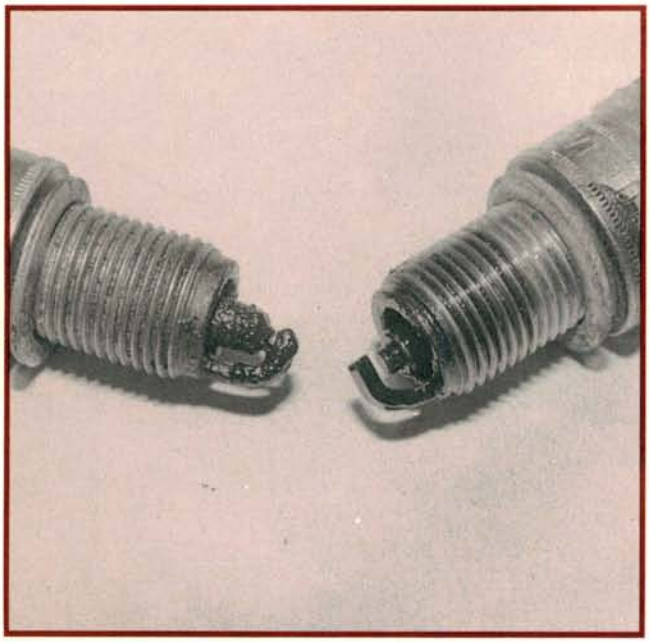
7) Tests for oil leaks

8) Tests for noises (internal engine versus accessory noises for example)

9) Road testing (one of the most important of all tests)



1 It's cheap, it's easy to use, and everybody has one stashed away somewhere. It's called a vacuum gauge, and it can pinpoint problems like leaking rings and valves, vacuum leaks, improper fuel mixtures, open EGR or exhaust restrictions, ignition failures, and improper valve and ignition timing.

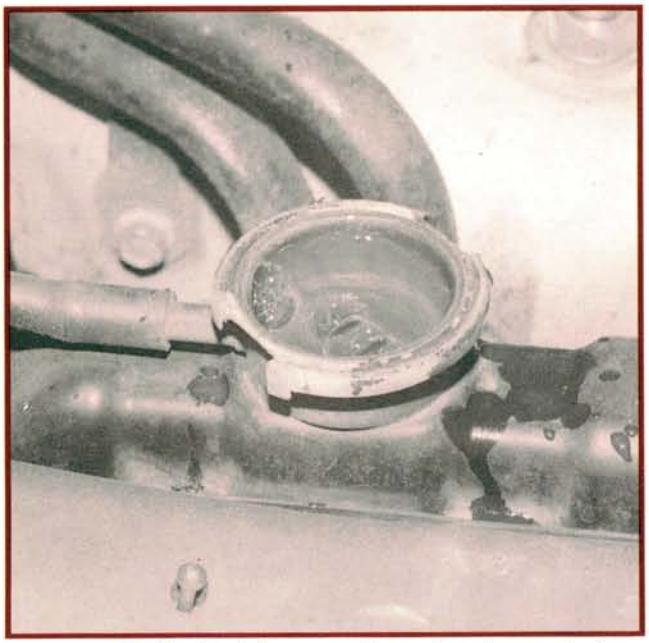


2 Spark plugs have a front row seat in the combustion chambers. If their noses are blackened by excess fuel, or caked with oil, they're telling you a lot. Check all the plugs to see if one is suffering more than the rest, or if you have a general problem which affects combustion in all the cylinders.

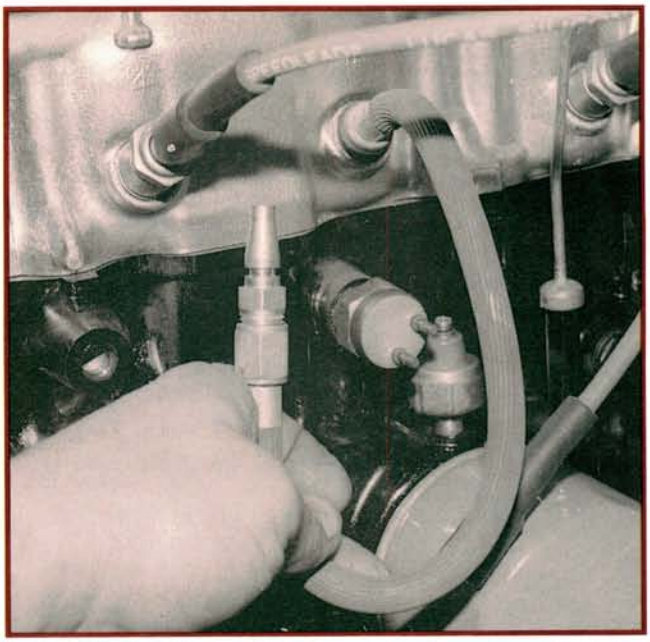
3 Maybe high oil consumption is being caused by that gooey mess in the crankcase that was once oil. Pulling the dipstick for a look may seem like a low-tech, no-brainer test. But badly contaminated oil can cause high consumption, poor performance, and noise when there's more water and gas than oil in the crankcase.

4 The fudge-like emulsion formed when coolant and crankcase oil mix may be a sign of a blown head gasket. But don't jump to the wrong conclusion without checking further. Loose timing chains can cut through timing cover water jackets, and aluminum plugs in cylinder heads do come loose on occasion.

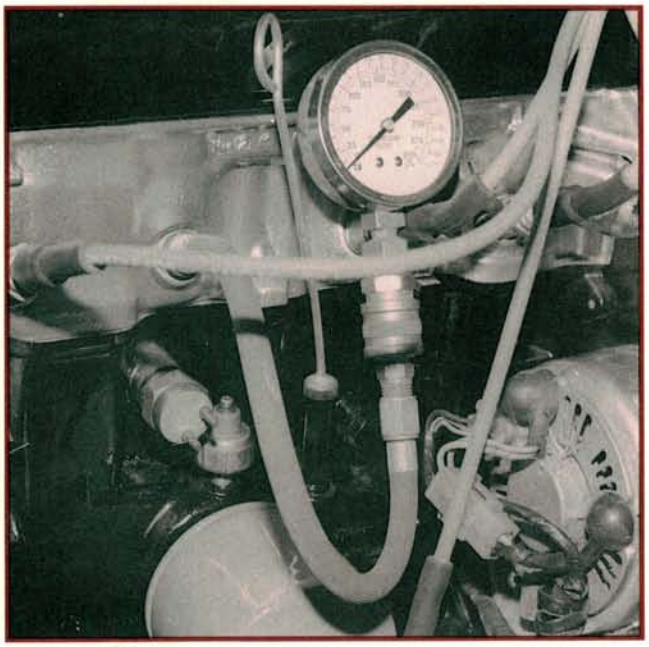
5 Even if the oil in the crankcase is clean, is it the right oil for the engine? Does it meet the recommended service specifications? Is the oil the right weight for your climate and vehicle use as recommended by the manufacturer? Using the wrong oil can lead to consumption problems even in good engines.



6 Coolant loss can be a tough one to isolate, especially if you don't see any puddles beneath the car. Small leaks can evaporate on a hot engine surface before they hit the ground. No external leaks? Try pressurizing the combustion chamber through a plug hole. Then watch the radiator fill neck for bubbles.

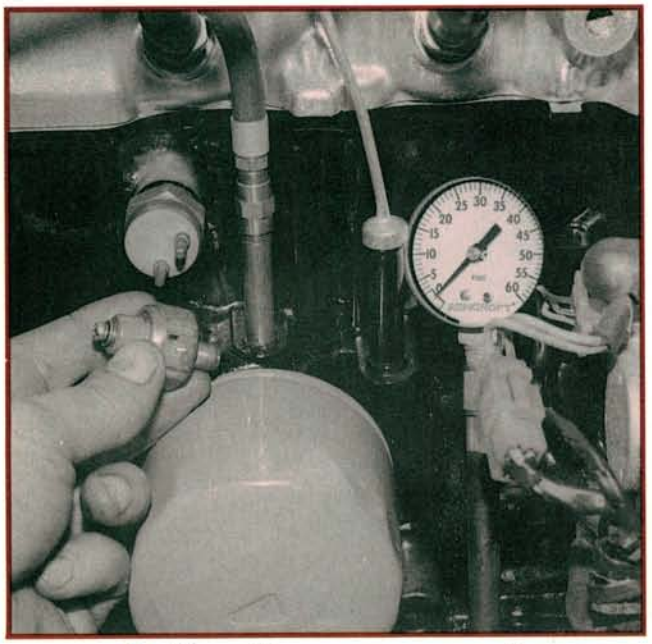


7 Pressurizing a cylinder can also help you find leaking valves and piston rings. With both valves closed, pump shop air into the cylinder. Escaping air at an open throttle (intake valve), tailpipe (exhaust valve), or oil filler cap (rings) will send you in the direction of a compression leak.

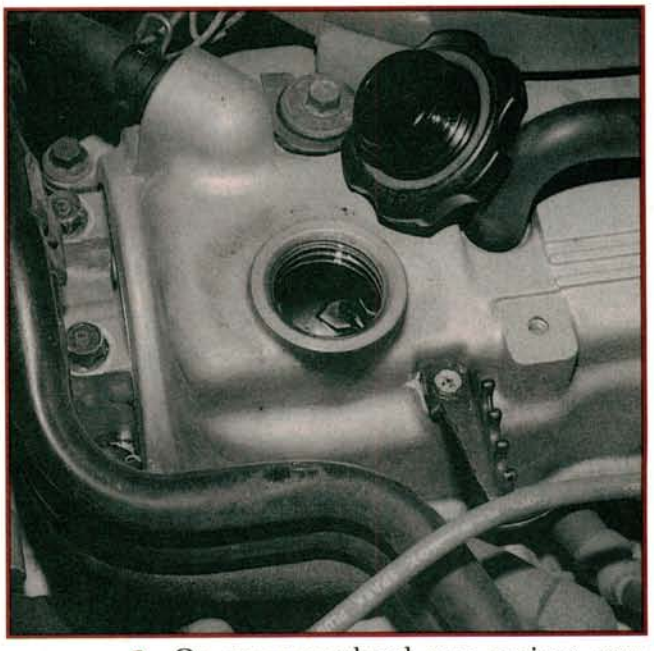


8 Compression tests are still useful. Uniformly low compression on all cylinders can lead you to a valve timing problem. When we get a low reading on one cylinder we usually think of bad rings and valves. But a trashed cam lobe can also cause low compression when valves open late and close too soon.

9 Oil pressure tests can be a bit more complicated. An engine with a good oil pump can still have low oil pressure readings if the pump pressure is bled off at loose bearings along the way to the test port. The wrong oil, oil thinned by gas, and general engine overheating will also cause low oil pressure.

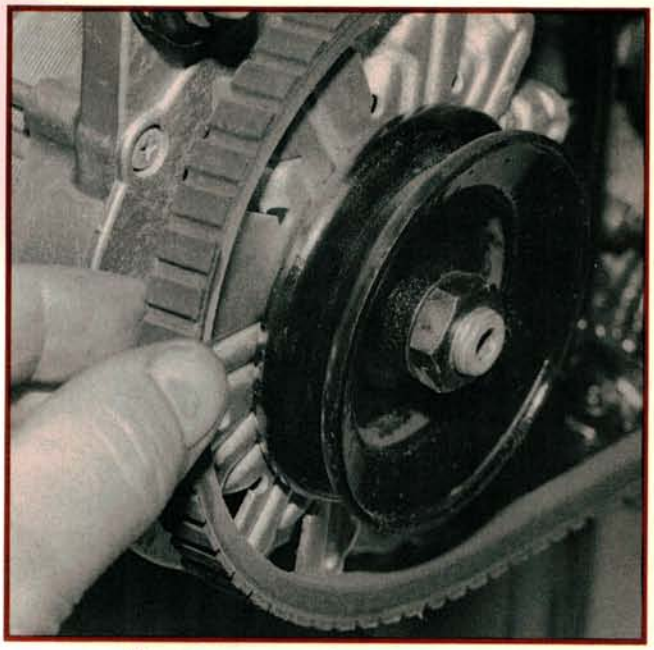


10 Normally, we screw our oil pressure gauge in place of the oil pressure sending unit. If the sender is in the head, at the end of the line, readings will reflect oil pressure in the entire system. If the sender is in the block, obstructed flow to the top end may not show up as a low reading, so be careful.



11 On some overhead cam engines, you can check top oiling and timing chain oiling by removing the oil cap while the engine is running. Don't worry, if it's oiling, you'll know it in a hurry as the oil makes a quick mess of the valve cover. Good oilers will also lube your shirt and safety glasses!

Let's move on to noises. To put it bluntly, noises are the pits. Noises travel through sheet metal and seem to show up far from their source. Your job is to isolate the source of the noise. Whenever possible, start with a test drive and carefully note when the noise occurs, and under what conditions.

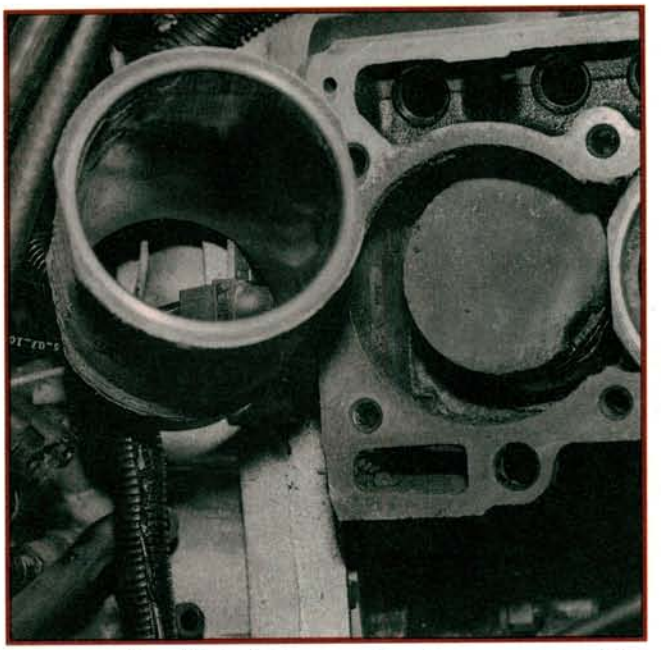


Sometimes, hang on accessories and not the engine are the source of a noise. Water pumps, alternators, air pumps, A/C compressors, and power steering pumps are possible noise makers. Disconnecting the accessory belts and running the engine briefly may save a lot of wasted checkout time.

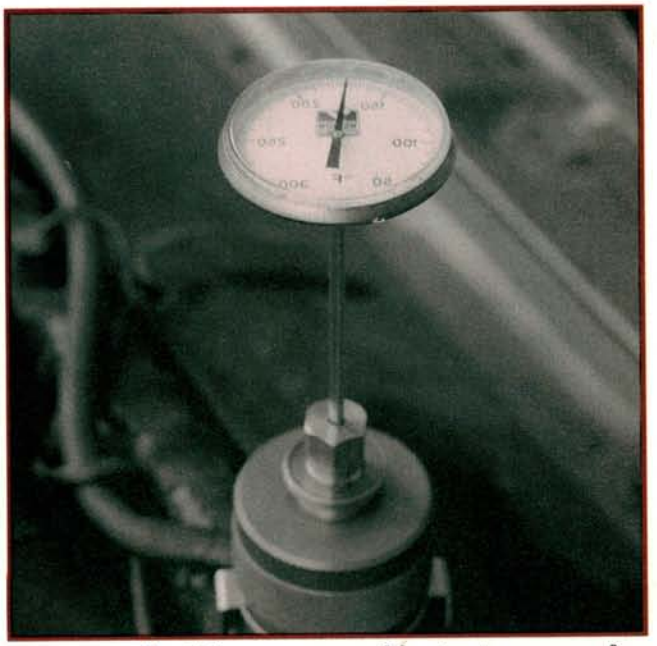
Pinging can have several causes. Check ignition timing. Check for proper operation of the EGR system. Overheating and poor quality gasoline are other suspects. Carbon deposits in the combustion chamber can cause noises ranging from pinging to a deep knock which sounds like a bad rod bearing.

Bottom end or crankshaft noises in engines with good oil pressure can be the result of worn thrust bearings. You may need to check crank end play to be sure. Other bottom end noises not related to bad engine bearings include loose torque converter bolts and damaged (or loose) harmonic balancers.

16 You say you do have a bottom end knock? Using a method approved by the vehicle manufacturer, alternately short the spark to each cylinder. If the knock gets quieter when a cylinder is shorted, suspect a bad rod bearing. If the frequency of the noise doubles, it's probably a wrist pin noise.



17 This brings us to damage caused by higher than normal combustion temperatures. This piston and cylinder, shown in last month's Renault article are a good example of heat damage caused by a lean mixture. In some cases, incorrect ignition timing will combine with a lean mixture to make things even worse!



18 Whenever possible, try to cross reference your tests. For example, if you suspect that overheating is causing low oil pressure, measure coolant temperature and oil pressure as the engine warms. If oil pressure stays normal until the coolant overheats, the cooling system, not the engine is to blame.

If It's So Simple.....

Some of you may think that this review of basic tests is "old stuff." But our experience in the shop keeps reminding us that a lot of needless time, effort, and money are wasted by an incomplete diagnosis.

Several weeks ago we were asked to look at a late model RX7. The complaint? After a hard drive on the highway, the low coolant buzzer came on. If you've ever heard this buzzer, you know it's not easily ignored.

The car's owner had the radiator rebuilt, and had installed a new thermostat, and fresh hoses and clamps. After performing tests for internal and external leaks, we were satisfied that the coolant wasn't falling to the ground or blowing out the tailpipe.

We checked the one thing that had been ignored to this point, the coolant pressure cap. It looked okay, but repeated pressure tests proved that it wasn't holding any pressure at all.

We filled and bled the cooling system and installed a new cap. The customer later verified our suspicion that the coolant recovery jug had actually been overfull on several occasions, even though the radiator had run low.

Several hundred dollars of needless parts had been installed because of a 15 dollar pressure cap.

(Editor)