

# Valve Train

Recently, I spoke with a former machine shop owner about valve train diagnosis and repair. He noted that many repair shops had fallen into bad habits when diagnosing possible valve train problems. They simply removed suspect cylinder heads and brought them to him for repair without a proper on-the-car diagnosis.

“Not all compression problems are valve problems,” he noted. “A cylinder head works with a lot of other engine parts during the combustion cycle. It’s usually a lot better to do a thorough diagnosis of suspected valve train problems *before* you remove the cylinder head. That way you can evaluate how all the different parts of the engine are working—or not working, with the valves.”

When people think of valves, they sometimes forget that valve sealing is only a part of good compression. Whether there are two, four, or 40 valves per cylinder, certain principles still apply. And thorough on-car testing of valve train efficiency can save you the time, aggravation, expense, and embarrassment of a needless cylinder head removal, replacement, and repair.

We’d like to go through some tests and diagnostic procedures that might help you zero in on valve train problems.

## Valves Are Still Valves

Let’s list some basics before we start:

- **Valves need to open and close at the right time.** Simple? You bet. But you’d be amazed at the number of cars I saw over the years that ran badly because a camshaft drive belt was improperly installed, or had jumped time because the belt was loose or damaged. You’d be even more impressed if you knew how many of these cars had already gone through fixes that included re-jetting of carburetors, radical distributor twisting, and prayer meetings.

- **Valves have to stay open for the right period of time.** You may call this duration. If valves don’t stay open long enough, you don’t let enough fuel/air mix in. Or you don’t let enough exhaust gas out.

Valves also need to stay closed for the right amount

of time. If valves don't stay closed long enough, the cylinder head doesn't have a chance to act like a heat sponge and absorb some of the heat that could burn the valves.

• **Cylinders have to breathe in and out like you and I do.** Plugged air filters on the intake side, and plugged mufflers and catalytic converters on the exhaust side can affect compression. If you've ever had a severe head cold, you know what I mean.

• **Valve train diagnosis is a little like solving one of those whodunit mystery novels.** You need to gather information, and then piece it together until you solve the mystery. Be careful not to overlook the obvious.

• **Start by listening to the engine.** How does it run? Is the valve train noisy?

• **Make sure you don't have a fundamental ignition problem.** It's no fun admitting that you've been

snookered by a cracked distributor cap or a dead spark plug.

• **Connect a vacuum gauge.** Still one of the most under-used, neglected tools, the vacuum gauge can tell you a lot about fuel mixture, valve timing, excessive exhaust back pressure, vacuum leaks, and so on. Unlike compression and leak down tests, vacuum gauge readings are done with the engine running. And unlike compression and leak down cylinder tests, vacuum gauge tests measure the performance of fuel and ignition system operation too.

• **Don't just settle for one test.** Use all your tools and experience. Use vacuum gauge readings, cylinder balance tests, compression tests, and cylinder leak down tests and compare your findings.

If you use only one test, you may get fooled.

—By Ralph Birnbaum



1

Please look back to our article on vacuum gauge readings in the November 1988 issue. Your vacuum gauge can diagnose everything from leaking valves and guides, to retarded camshaft timing and high exhaust back pressure. If you don't have this nice high, steady vacuum something is amiss (pun intended).



2

The time-tested compression test is still valuable. A cylinder power balance test or an oscilloscope are also useful. But be careful about simply yanking plug wires with the engine running. You can damage new, high-energy ignition systems, not to mention the likelihood of getting a nasty jolt.



3

A fouled plug means incomplete combustion, no matter what the cause. On a road call with only a pocket full of tools? Check the distributor cap for cracks. Swap the fouled plug and its plug wire with a plug and wire from a working cylinder. If the miss "moves" with the plug and wire, bingo.



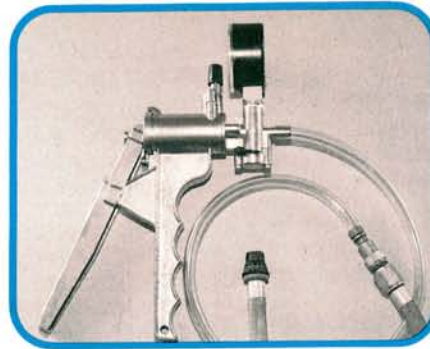
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If compression readings are all even, but way lower than normal, there's a good chance that camshaft timing is the culprit. A cranking vacuum test will help point this out. This situation will also cause lower than normal vacuum gauge readings with the engine running.



# 5

On some engines, like this older VW four-cylinder, you can check cam timing with your timing light. Shine the light against the backside of the camshaft sprocket after you set ignition timing. With the engine running, the punch mark on the sprocket should align with the ledge on the valve cover (arrow).



# 6

Sometimes you want to check for cylinder leakage on an engine that's out of the car or not running. And you may not have access to an air compressor line. A portable air tank is one possibility. Your handy hand-held vacuum pump is another. Remove the spark plugs. Then find TDC on any cylinder.



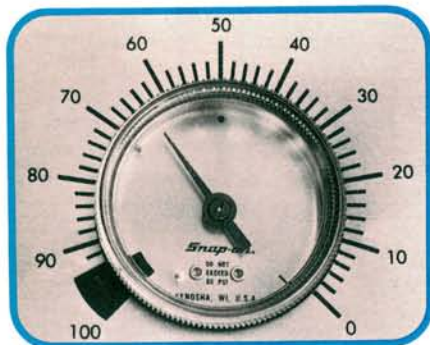
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Screw an adapter into the plug hole. Stroke the pump and watch the vacuum readings. Two or three strokes should give you five inches of vacuum if the cylinder is sealing. A good cylinder should hold about 15 inches of vacuum. You can also wet-test with the gauge if rings are suspect.



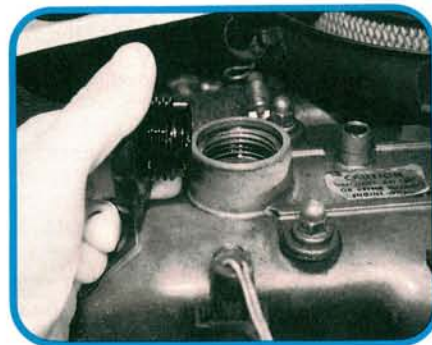
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Some cylinder leakage testers have two regulators and two gauges. One side of the tester regulates and measures the amount of shop air going into the tester. The other regulates and measures the amount of air the cylinder holds. This tester has only one gauge and reads a percent of cylinder leakage.



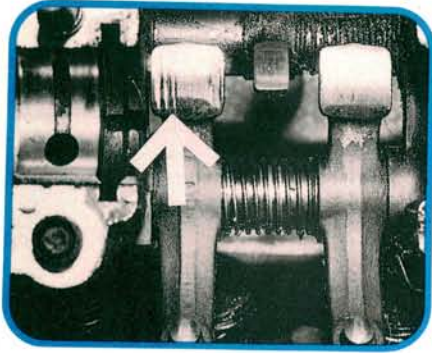
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Cylinder leak testers should be used with your other diagnostic tools, never in place of them. This cylinder has a major leak, but even if a cylinder holds pressure it simply means that valves and piston rings are sealing. It doesn't tell you anything about valve timing, lift, or duration.



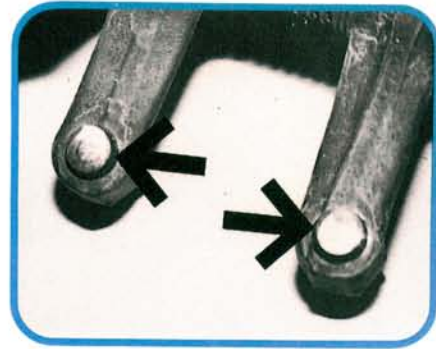
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Cylinder leak testing will help you find the source of a leak, however. Hissing at the carb or throttle body means an intake valve is leaking. Check exhaust valves by listening at the tailpipe. Air escaping from the oil cap is leaking past the rings, into the crankcase, and back through the oil return passages.



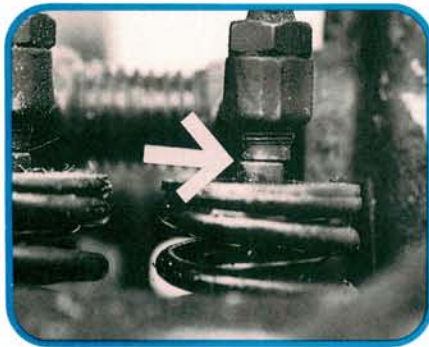
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Cylinder leak tests won't diagnose trashed cam lobes and followers or a launched push rod. Just because the valve is closed and sealing well enough to pass a leak test doesn't mean it's opening. Lift the valve cover and check for good valve action and proper valve lash adjustment.



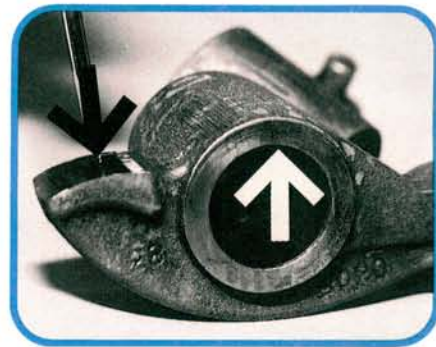
# 12

Excessively worn adjustment screws can pose a real problem, especially on oil starved engines that have run a long time with too much valve lash clearance. Simply readjusting valve clearances using the old screws can result in noise, improper valve rotation, and an improper, or short-lived adjustment.



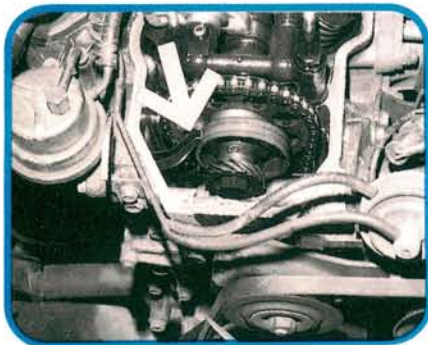
# 13

Speaking of valve rotation, some manufacturers will ask that you maintain a certain amount of offset between the head of the adjusting screw and the valve stem. This offset causes the valves to rotate slightly each time they open. Forget the offset and you'll shorten valve life.



# 14

Valve geometry is also an important consideration. When you have to back the adjusting screw flush with the face of the cam follower, check valve stem height. Valve train geometry can also be affected by excessive wear at the cam follower pivot, pivot shaft, or cam follower face.



# 15

Even though noises can tell you a lot about valve train operation, you have to be careful about pinpointing the source of the noise. Some overhead camshafts drive the fuel pump. A broken return spring in a diaphragm pump may sound like a valve noise. Don't be fooled.



# 16

If the complaint is high oil consumption and a lot of blue smoke, don't run straight to the valve seals and rings. Plugged oil return passages or a faulty crankcase ventilation system can leave you with an oil traffic jam in the valve cover, and enough crankcase pressure to force oil past good seals.



# 17

Overhead camshaft engines have started using hydraulic lifters. Sludged up oil passages can keep the lifters from doing their job. The tiny lifter at the left is dwarfed by an old standby from a larger domestic engine. It sits in the end of the cam follower where the adjusting screw used to ride.



# 18

Rock and roll is here to stay. In fact, once camshaft end play gets out of hand, rock and roll only accelerates wear. When the heat is on, steel camshafts will always win out over bearingless aluminum cylinder head bores. Don't forget to check camshaft end play as part of a good diagnosis.



# 19

One way to check the camshaft drive belt or chain is to turn the crank back and forth by hand, just a few degrees in each direction. If the rotor just sits there with a blank look on its face, something is loose. Check camshaft belt or chain tension.



# 20

We're hearing many reports about a rattling noise from the distributor area on different engines with loose rubber camshaft drive belts. It sounds like marbles rolling around inside the cap. More than one distributor has been pulled and replaced because of this. The noise remained, however.