

Compression vs. Leakdown Tests

by Mike Nixon
Instructor/Instructional Designer

No doubt you do compression tests so routinely you hardly even think about it. And perhaps by now even the more sophisticated cylinder leakdown test is common in your shop. That's great! However, you may not be getting the full benefit from either of these tests if you haven't "thought outside the box" a bit about them. Let's explore the unique benefits of each, and how compression and leakdown tests can be used together. Before you start, it may be helpful to review the 4-Stroke Engine Diagnostics portion of the Kawasaki Technical Fundamentals DVD, Volume 1 Version 2 (P/N 99973-0031-01).

The Compression Test

Everyone remembers how to do a compression test: Screw in the

tester, disable the ignition system to prevent sparks and system damage, hold the throttle wide open, and press the starter button (or kick). The cylinder takes in air and compresses it, the tester traps it, and the maximum is reached when the gauge holds as much pressure as the engine can produce.

Not too difficult, right? The weakness of the compression test however is that throttle position, engine temperature, ambient air temperature – even battery condition -- can make its results vary considerably. What's worse, a compression test checks too many engine components at the same time. A poor reading can indicate so many things, it's hard to tell which engine part is at fault without doing other tests. One of those tests is of course the classic squirt of oil in the cylinder. If a subsequent test yields a higher reading, the cylinder or piston rings are indicated as the problem area, and not the valves.

The Leakdown Test

A leakdown test is very different however, and here's how to do it.

Raise the piston in the cylinder to be tested to TDC compression.

Plug your tester into an air compressor line and adjust the regulator to get a "0" reading. Screw the hose into the spark plug hole, then connect the tool to the hose.

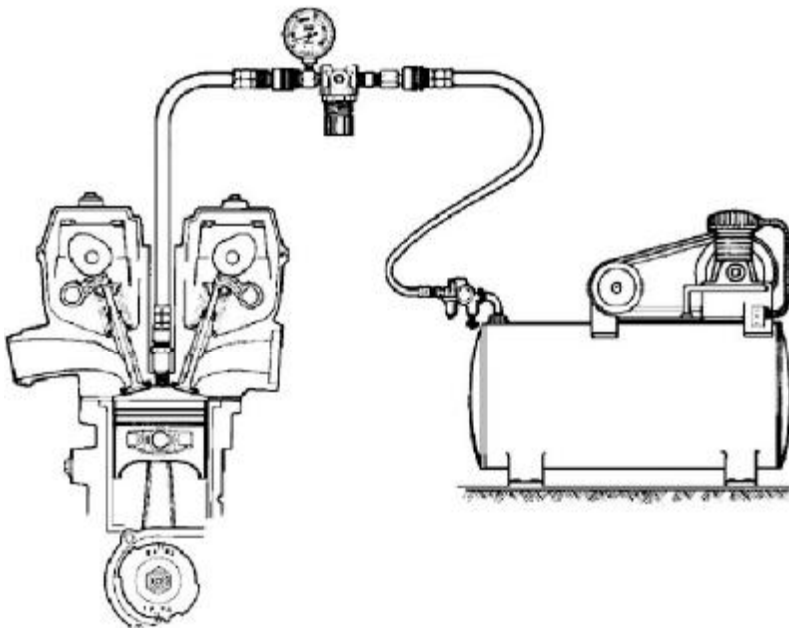
If the crankshaft turns or you hear air rushing out of an obviously open valve, the cylinder wasn't set exactly on TDC compression. Try again. When you get it right, the piston will stay put and the tool will indicate the amount of air that is escaping from around the rings, valves, and head gasket of that cylinder.

You can see that a leakdown test works differently from a compression test. Air is pumped into the cylinder from an outside source, instead of by the cylinder from within, and the gauge reads the percentage that escapes, not what accumulates. This eliminates the afore-mentioned variables, and as a bonus makes it easy to pinpoint the source of the leakage by simply listening to the engine while the test is still underway. High readings accompanied by hissing in the carburetor indicate burnt, tight, or carboned-up intake valves. The same thing in a muffler points toward -- you guessed it -- exhaust valves. A breeze coming out of the dipstick hole indicates a worn cylinder or worn piston rings. And, air escaping from an adjacent spark plug hole or from an opened radiator pinpoints a blown head gasket.

Sometimes a high reading may be the result of carbon on the valves, and not valve or valve seat wear. It's easy to verify this.



Use quality tools when making critical engine tests.



During a leakdown test air is pumped into the engine from the outside.



Remove the valve cover and, with a hammer and drift, carefully tap on the valve followers for that cylinder, watching the gauge as you do so. This will often loosen carbon from around the valve and the reading will drop to a reasonable level. In that case, the leakage is only temporary, and a good hard ride will fix it. If on the other hand shaking loose the carbon doesn't lower a high leakage reading, well, time to get that engine fixed.

But what is a high reading? All cylinders leak a little, and large ones leak more. Production engines in good condition commonly leak 5 percent and less, but the limit is 10% before engine work is needed. If you're testing a big bore single or twin, get help holding the crankshaft because there won't be enough friction in the engine to resist the compressed air, even at exact TDC, and the crankshaft will turn under test pressure. Just as importantly, for cylinders over 100mm in diameter, allow a bit more leakdown, up to 15 percent instead of the usual 10 percent, before condemning it.

But consider a different way of using your leakdown tester. Let's say you have a four-cylinder street bike that produces good compression readings but smokes out the exhaust. All four cylinders leakdown less than 10 percent, but one of the spark plugs is oil-fouled, and this same cylinder oil-fouls a replacement plug put in as a double-check. So you know the problem is limited to one cylinder, but what is the problem? Not very likely that just one valve guide is cracked, is it? Grab your leakdown tester, and lower the pressure setting on the instrument about halfway down so that not so much force is going into the cylinder that the crankshaft wants to rotate. Now repeat the leakdown test in our suspect cylinder, only this time lower the piston down in the bore a little. Aha! Now the gauge now reads 60% leakdown when the

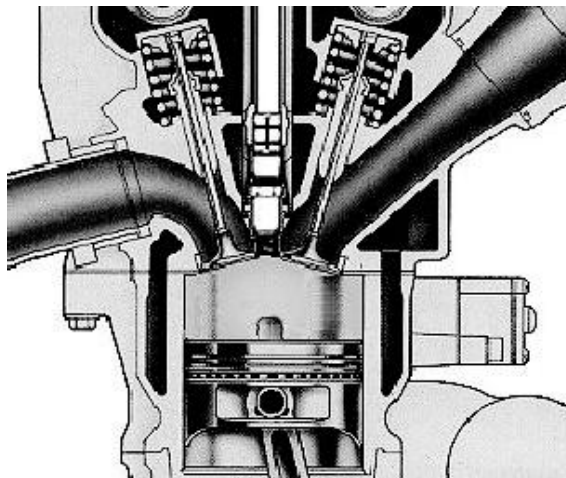
piston is halfway down the bore, indicating cylinder damage. When you do the teardown you find that a wristpin circlip has come out of its groove and the wristpin has rubbed a handsome trench into the cylinder wall. Neat, huh? You already know why the high-pressure leakdown test didn't find this problem, because the piston was at TDC, well above the trench. But why didn't the compression test find it? Similarly, the compression test didn't show it because there was still plenty of cylinder area above the trench in which to build adequate pressure during a compression test. The fact is, one of the drawbacks of a compression test is that very little movement of the piston is required to build maximum cylinder pressure. But a low-pressure leakdown test picked up the problem instantly.

Comparing Compression and Leakdown Readings

But it's using the compression tester and leakdown tester together that really tells the story. Let's say you do both compression and leakdown tests on an ATV engine. The compression is lower than normal, causing you to think of internal engine wear. However, the leakdown test shows the rings and valves to be sealing well. How can that be, you ask? Check the cam

timing. Retarded (late) cam timing will dramatically lower compression, and yet leakdown will be unchanged. In the case of our example ATV engine, look specifically for a very worn cam chain causing the shift in cam timing, a fairly common occurrence due to dirt ingestion into these engines. Alright, that makes sense, but now let's throw a twist into this thing. What if the compression was instead higher than normal, the leakdown good, and you have no evidence of carbon buildup? What's the problem? Think cam timing again, only this time, advanced timing, which will increase compression but could only happen from incorrect engine assembly.

So we've reviewed using both the compression tester and leakdown tester in ways you may not have thought about before, including using them together to get a more accurate picture of engine condition. Kind of leaves you with a new respect for these common tools, doesn't it? Choose quality examples of each tool, treat them right, and don't be afraid to try something new. It will help satisfy that customer, and may result in better earnings and professional potential for yourself. Let the good times roll! ♦



This engine had both good compression and leakdown until the piston was lowered. Can you see why?