COMPRESSION AND VALVES

Whether your bike is just-acquired, has been sitting for extended time, or is a daily rider that's running poorly, there's a lot more to consider than presuming that a carb refresh will do magic. I always tell people, only half-facetiously, that I'm happy to take your money but let's make sure that my carbs solve your problems instead of reveal new ones.

Beginning inside the combustion chambers, we work outward through diagnostic steps methodically rather than take a scattershot approach or, worse yet, leap to conclusions.

I'm going to leave electrical issues out for now because this comprises an entirely different universe of diagnostics and right now we're only concerned with engine and carburetor-related issues.

Compression

The one thing I preach to everyone about is to check your compression. If it's good everything will fall in line behind it; if it's poor you could dump a king's ransom into the bike and you'll go nowhere but broke.

The signs that you may have compression-related problems, assuming that your bike is running, are similar to what you'd see in an overly-rich condition: hard starting (and worsening when hot), black smoke, low power, and fouled plugs.

The results of fat carburetor jetting can be annoying, but they run cool and so you can't do any real harm to the engine.

But the place where low compression really distinguishes itself as an engine killer resides in the fact that it leads to excess heat accumulation.

I can't tell you how many folks have remarked that their 70's or 80's bike has low, low miles on it and therefore doesn't need the compression tested.

Ironically, the opposite is true because an engine that has sat unused (read un-"exercised") is prone to attack from moisture infiltration. No matter how the crankshaft came to rest when last shut off there are always at least two combustion chambers wide open to atmosphere through the exhaust valves. Natural expansion and contraction of air over the seasons has pulled humidity into them such that it's anyones guess what's happened to the cylinder walls—at least until you attach the gauges. I dread to have a person call back the next day and ask, "Um, is 35 psi okay?"

This is a test that should be performed cold. You can certainly test a hot engine to compare results but the cold test is more valuable. Check and record the values for each cylinder.

The procedure itself couldn't be more straightforward:

1) Remove *all* of the spark plugs.
2) Remove the primary wires from the coils. This will prevent them from heating up during extended cranking.
3) Jumper the bikes' starter solenoid with your car battery—this will give you tons of cranking power for a more accurate read.
4) Begin at the #1 cylinder, farthest left as sitting on the bike, and work your way across. *Record values as you go.*
5) If the carbs are still mounted, ***hold the throttle wide open as you crank the engine. This is important!***
6) Watch the gauge and keep cranking until it's gone as high as it's going to go.

If you find that your values are below spec, perform the “wet test”:
7) Put ¼ tsp of motor oil down each spark plug hole and retest.

If it jumps up significantly, this points to bad rings; the oil is sealing them, if only for a few moments.
If it remains unchanged you've got valve problems; oil can't seal the seat and valve face like it does with rings.

Let's say, for the sake of illustration, that your compression is roughly the same on all but one cylinder and the wet test reveals valves. Before you start thinking, "Hmmm, college fund or top end job?," have a look at the valve clearances.

You may just find that they're off, which is actually good news in a way because in the majority of cases you can recover at least some of the lost compression by resetting the clearance to spec.

We've seen instances where cold valve lash was *negative*; the adjustment was so out of whack that it couldn't close all the way even at rest.

VALVE LASH

What's all the fuss about?

Valves are made of steel, which has unique and predictable properties.

The cams tell the valves when to open, how far to open, how long to stay open, and the speed by which they open and close. A gentle slope on a cam will move the valve slower, a steep slope will cause it to move more quickly. Generally, cams are steep on opening and more gradual on closing.

The cams on most stock engines are designed to “scavenge” a certain amount of exhaust—the exhaust valves close before the piston is at TDC on the exhaust stroke so the trapped (hot, contaminated, oxygen-depleted) gases can be re-burned. I know, go figure. But it's what the air pollution folks wanted and they had authority to say when a bike was fit to import.

The main idea here is that for smooth, trouble-free running we want all of the valves to be at the most optimal setting and for them all to behave in *exactly* the same fashion.

A “lazy” valve, one with less lash, doesn't open as far and will remain open for a shorter duration than its neighbor.

The result is many-fold:
If it's on the intake side, our lazy valve is generating less vacuum and subsequently pulling less fuel through the carbs.
If the lazy valve is on the exhaust side, scavenging—and thus heat—increases proportionally.
If both, well you get the idea.

A truism among engineer types is that if you're going expend precious energy to put something in motion it had better be doing some work, else it's a parasite.

In the “theoretical model” there is no waste; components will go to work instantaneously with no delay stemming from loose tolerances.

Practical reality intrudes on this utopian universe in the form of different rates of expansion and contraction of metals when heated.

The engineers take these variables into account and design the system to function best at *normal* operating temperature.

The solution is simple arithmetic. If we want the valve when hot to move in perfect unison with the cam according to the theoretical model, we have to leave a little space between the top of the valve stem and the face of the rocker in the cold state to allow for heat expansion *in the future*.

If lash has become smaller or larger (rare but it does happen) over time we see significant differences in *workrate,* in the theoretical model sense.

Now we add a lesson from real life:

As valves “bed” into their seats, they “rise” in relation to fixed components in the cylinder head. Thus lash shrinks.

So let's look at our lazy valve with new understanding.

Let's say that its stem when heated increases in length by 0.06 in. The trouble is that we only have ***0.04 in.*** of lash, which leaves us with a 0.02 in. deficit. Since there's no “give” at the rocker end, a 0.02 in gap appears between the valve face and the seat.

It shouldn't come as a surprise to anyone who knows just this little bit of engine theory that a bike afflicted with any combination of compression and valve issues is *going* to have trouble ranging in severity from merely annoying to “now I know why it's been sitting for all these years.”

Don't blame the poor bike. Get out the toolbox.

Referring back to my comment about recovering compression, we can reasonably anticipate that resetting our lazy valve will result in improvement. There is very probably some carbon buildup at the valve seat but it'll blow away over time—provided of course that we haven't permanently burned pits into the face or seat.

I'll close with an anecdote.

I have personally seen compression go from near-zero to near-normal by adjusting the valves. It took some time to get there to be sure but it's a real-life instance that ilustrates the phenomenon perfectly.

Krystof sent us his carbs (CBX) without having performed some simple diagnostics. Hey, we can't be everywhere at once. Once they were fitted up he complained that it ran marginally better but was still acting up same as before. Naturally he assumed that we missed something in the carbs.

He lived nearby so he trailered it here at my pleading and shortly we made the discovery that compression was all over the map. One cylinder was flatline.

A quick look at the valves told the tale. On the cyinder with zero compression we couldn't get even the thinnest feeler gauge through and on further examination we saw that the intake valve wasn't closing all the way even in the cold state. *Negative* valve clearance. Yikes.

After much hand-wringing, and encouragement from us, he opted to take a gamble and invest in reshimming but no more; if it still ran poorly he'd have the engine overhauled.

Once done the PSI jumped up to the low 100's across all six and after 500 miles of steady incremental improvement we declared the patient healed in full. He wasn't heard from again—until he needed carbs worked on for another of his bikes.