TUNING WITH DUAL VACUUM GAUGES
VERSUS SYNCH'ING WITH A TWINMAX
2009 January 14
Ben Barkow
Toronto

Drive a boxer? Do your mirrors shake at any time?

Tune on the road and under load, not in your driveway
Before talking about dual vacuum gauges and TwinMaxs, I'd like to clarify why synch'ing in your shop or driveway (rather than under load) usually makes no sense.

If really great idling is your goal in life, then driveway tune-ups are for you because you are working under good simulated conditions (well, esp. if you like to idle for long times).

Even if you kick the engine up to 4000 rpm (remember, you are out of gear), you've only cranked the butterfly or slide a tiny distance and the engine is pumping only tiny power – that's bears no useful relationship to scooting down the highway doing 80 mph while spinning at 4000 rpm and delivering 60 HP. True, you've moved the throttle cable system off the idle stop and drawn through the *some of* the throttle cable system slacks, but you haven't checked the engine while under sail or even really tensioned the half-dozen pieces in the cable system or gotten the air intake system flowing or put some breeze into the intake bell or cooled the oil or… you get the idea.

Parenthetically, over the years, I've become more skeptical of the value of dyno testing. Testing by running up in 4th gear, as dyno guys tend to do mostly, is just not representative of my riding in ways that count. But I suppose you could do the synch under load on a dyno and that's better than idling in the driveway.

On a good day, confirming good synch at idle and at first crack of the throttle may be all you need to do. But for me, I like to see what is happening vacuum-wise inside my intake manifolds and to ensure that are acting in parallel under all conditions.

Dual vacuum gauges can be mounted on your bike and you can go riding (see picture). Of course, the TwinMax, esp. the newer 9-volt internal-battery model, can be mounted on your bike too but I'm not too certain the cheap meter movement would survive the vibration for long. Either VGs or TMs, but testing on the road is very important.

The red fuel hose clamp is used as an oscillation snubber on the left gauge. All but the cheapest gauges (mine) come with built-in snubbers. As you see, pretty easy to mount the VGs on an R1100S and go riding. Pity you can't see my great Fiamm-clone air horns tucked down below.

My comments are pretty much as applicable to carbs (slide and butterfly) as to throttle bodies. With carbs, proper synch'ing (and avoiding false compensating) is more important than with TBs due to the location of the low-speed fuel progression holes under the butterfly, otherwise unobservable CV slide/needle behavior, and/or other precision bits and pieces that need to be set up right.

A balance meter is not the same as two vacuum gauges

The essential difference between a TM and VGs is that a TM tells you nothing but the difference between two intake vacuums on an unknown scale of magnitude and time response and the VGs tell you everything about the state of vacuum in the two tracts separately but simultaneously.

Why I prefer to eyeball dual vacuum gauges

Some riders think there is only one thing they are synch'ing at a time. That single thing maybe matching idle by-pass screws (either air or fuel), idle stop, cable pull, and cable slack. Perhaps in a perfect world that is true – but then bikes don't go out of tune in a perfect world.

In fact, all kinds of things influence vacuum (quality of combustion, exhaust scavenging, valve lash, valve sealing…), these things might change with speed, temperature, gear,

and/or whether you are accelerating or braking or cruising, and the interactions are complex. I'm not saying this is beyond human comprehension, but I do think you ought to "look" at your intake manifold with something more insight-producing than a simple-minded balance meter, however simple it is to use.

There are quite a variety of engine operating conditions that interest me when riding around with dual VGs.

- Idle
- Acceleration – the vacuum goes way down
- Engine braking from highway speeds – the vacuum goes very high and this tells a lot about the state of the butterflies or slides, maybe more diagnostic than idle vacuum
- Regular chugging along the road at different speeds – helps to mark your throttle grip with White-Out correction fluid so you'll know how far advanced the throttle is since it is hard to sense this and the degree of throttle twist bears little relation to the engine speed across gears.

Almost needless to point out, with a TM, you have no idea at all what the absolute vacuum is, high, low, or anywhere. You know just the degree of imbalance, sort of. After all, the little TM meter has no calibration. Even knowing the degree of imbalance sort of, you have no idea if that imbalance is large or small relative to the absolute vacuum. For example, being an inch of Hg off during engine braking would be immaterial but at idle, it would be a major imbalance.

You want to see both the static vacuum level as well as, in some cases, the speed at which that level is reached. Naturally, to judge the speed, you have to have your snubbers pretty well matched too but that isn't hard to do since the ballistics of the meter pointer are important feature.

For the engine to work right, the cylinders have to work in unison under all conditions absolutely or as far as I can see. With a TM, you can be achieving what appears to be good synch, but you may be compensating for one deficiency by exaggerating another… and you will never know you are screwing-up this way.

But after you've ridden around with VGs, you have a better idea how to work with a TM in the future, at least when you just want a quick synch (see below).

Vacuum gauges are accurate and better in practical aspects

In use, the VGs have a large round scale that encompasses the full range you are likely to see (rarely over 20 inches, generally under 5) and the gradations on the meter are finer to discern than on a TM set at max sensitivity (see below). So, unlike the TMs, you aren't adjusting the VGs.

The main difference in ease of use is that you need to keep an eye on two scales with the VGs. In practice, that's no obstacle. But the TM is a faster tool for mindless synching or checking synching (and there are days when I like to use my TM, mindless or not).

BTW, you aren't done synching with a TM until the needle stays right close to zero at all times at max sensitivity.

Absolute accuracy means little and it is trivial to check the matching of two gauges using a tee (car windshield washer rack). You can buy three and return one and you'll have a matched pair. The VGs are more sensitive in the sense that each easy-to-eyeball scale gradation is one inch of mercury and likewise on the TM except that the TM has tiny markings and a real cheap meter movement with some of stiction and needle vibration. You also can modify the oscillation snubbers on the VGs to your preference but no such adjustment possible on the TM which has its own immutable electronic averaging.

I bet you never tested your TM, eh? If so, I admire your faith if not your judgment! Given the exigencies of business profit, I thought a TM would be kind of poorish. My surprise when I found the TM needle to stay pretty darn close to the zero mark when I tested it like the VGs (as pictured below). The VGs are really precisely tracking, eh.

Free hint: make your own TM with a Freescale Semiconductor (formerly known as Motorola) MPX2100DP, about us$10…. Haven't explored inside my TM, but that's prolly what's in it.

The next picture is an un-re-touched close-up of the scale faces.

Mityvac test: looks close enough for me. Beats me why people are always badmouthing the accuracy of VGs, esp. the cheap kind that I buy (these were bought at Canadian Tire (AKA Crappy Tire) around 1970, certainly the cheapest on the shelf). Seem OK.

Final thoughts

For sure, the best of synch'ing deteriorates over time (sometimes within a block) and is never perfect to start with. Therefore, a very helpful move is to install balance pipes between/among the intake manifolds or enlarge all already present. It is easy to underestimate their value as long as you imagine your system running along at WOT. For most running, the crossover pipe cross-section is commensurable with the teeny butterfly or slide opening we mostly ride around with and is bound to help some. Hard to test though since a well-synch'ed bike will have nothing flowing in the balance pipe and with a poorly running bike, not easy to tell the effect by pinching the balance pipe closed.

Final thought. We use manifold vacuum as an indicator that *most stuff* about the cylinders is parallel. In the perfectly instrumented world, it may be that some other parameter like BMEP (cylinder internal pressure) reflects this equivalence better than the state of vacuum in the intake manifold.