Rent or own

Dobeck Performance has developed an AFR measuring tool

By Cole Boehler

It takes fuel mixed with air, compression and ignition to create force that will move you down the road.

Carburetors used to do the air/fuel mixing job, relatively inefficiently, before the advent of modern fuel injection.

Computers and electronic sensors, coupled with sophisticated electronic fuel injection systems, now allow internal combustion engines to be fed a calculated air/fuel mixture for all prevailing conditions. Done right, power is maximized while fuel is burned efficiently with clean emissions.

The Dobeck Performance SAFR unit is available for rent or purchase. See the air/fuel ratio, then decide if corrections are necessary.

But pity the engineers who must design a fueling system that meets the demands of drivers while meeting government regulations for mileage and emissions. Talk about compromises!

The unfortunate result is that engines that meet Environmental Protection Agency (EPA) emissions standards often suffer from drivability issues. To get a clean burn with low emissions, the air-to-fuel ratio (AFR) will sometimes be set too lean by the manufacturer – not enough fuel relative to air for the engines to run well in all circumstances.

Most motorcycle riders understand some of this.

Bikes may come from the factory with "lean spots" in the RPM range where power takes a noticeable dip. Engines may idle roughly, or "surge" at steady throttle settings where the power seems to switch on and off at the fueling system's own volition.

These less than optimal engine behaviors are usually the result of engineering compromises to satisfy the EPA.

The engine control units (ECUs) are computers that run with computer code "maps" telling the electronic fuel injection system how to respond to changing conditions, especially a twisted throttle.

In addition, many owners wish to increase performance through engine modifications, primarily through intake and exhaust changes. These may require a corresponding change in how the fueling system is programmed to operate.

As motorcycle owners and riders, do we have to put up with fueling compromises and poor drivability issues?

Not necessarily, said Dillon Binstock with Dobeck Performance, Belgrade, Mont.

Dobeck Performance is taking a somewhat new tack and one component of that new direction is an exceedingly user-friendly device developed by Dobeck called the "SAFR" or "Standalone Air Fuel Ratio" diagnostic tool.

The company says, "The days of dyno dependency are over. AFR data viewing in real driving situations is the new standard. Troubleshoot in minutes with the SAFR, a plug-and-play diagnostic tool." The company says it works with carbureted and fuel injected engines, and both two- and four-stroke designs.

Simply stated, it is an analog gauge that, tapped into your bike's exhaust, will read your AFR values under a wide range of conditions and load modes such as idle, cruise, acceleration and full throttle.

The gauge will show AFRs from 10:1 to 16:1, that is 10 parts of air to one part fuel (very rich), up to 16 parts air to one part fuel (very lean), based on wide-band readings of the chemical composition of the exhaust.

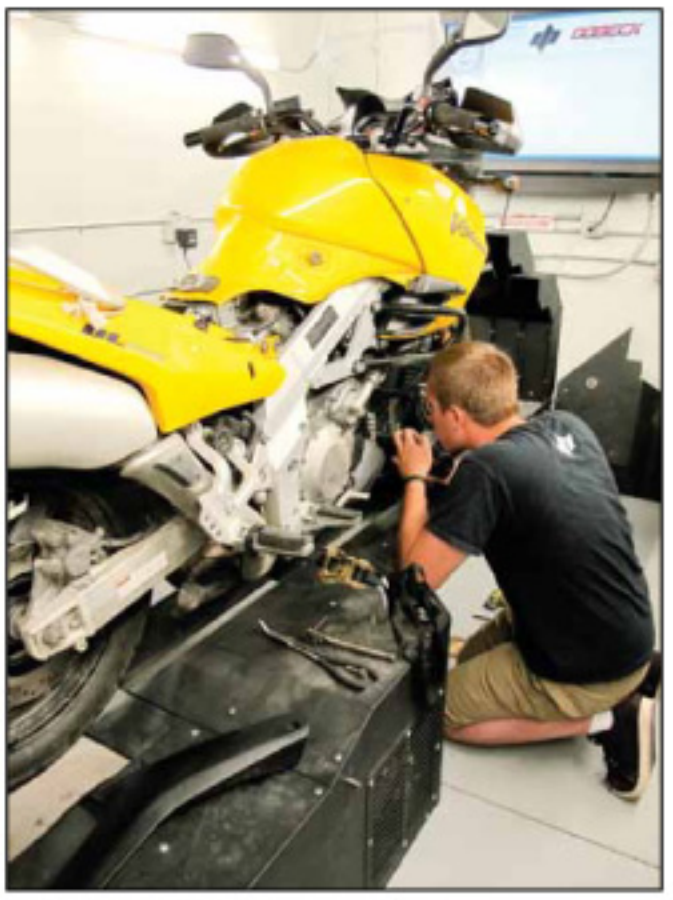
The SAFR system consists of a Dobeck gauge and wideband controller, a Bosch wideband exhaust oxygen sensor, a Dobeck oxygen sensor chamber and exhaust probe, and various installation bits.

The SAFR kit is basic and designed to be user-friendly. The company web site has instruction.

The system can tap power via a cigarette lighter socket, direct to the battery, through a Battery Tender type pigtail, or another power extension. The harnesses are provided.

Okay, now that we understand the effects of widely varying AFRs, perhaps we can use the SAFR tool to read our current bike's AFRs across a broad range of conditions and demands.

Dobeck's Binstock said, "People use the SAFR to see what AFRs their bike runs at currently. Maybe the stock AFRs are good, maybe they are trying to pinpoint a lean spot, exhaust leaks, whatever.



Dobeck's Dillon Binstock drills the exhaust header for installation of an exhaust probe.

"With the SAFR, you can find out how your bike is running and determine if you even need a fuel tuner. If it is carbureted, you would use the SAFR and change the jets to dial it in."

Excessively rich or lean conditions may indicate a fuel tuner, available from a wide range of sources, is needed.

The company offers a few definitions to aid understanding:

Wideband vs. narrowband sensors – A narrowband O2 sensor is only calibrated to know whether the current AFR is rich, lean, or "Stoich" (considered to be "ideal"; see sidebar for the definition). A wideband O2 sensor is much more sophisticated and can supply the exact AFR measurement across a wide range of possible AFR values.

Open loop vs. closed loop – Open loop means *no* fuel trimming is occurring based on the O2 sensor signal. Closed loop is using the O2 sensor input signal to react rapidly to the changing conditions and make fuel trims to match the desired air-fuel mixture.

Dobeck oxygen sensor chamber is attached to the Bosch wide-band exhaust oxygen sensor probe.

In essence, a hole is drilled into the exhaust header pipe and a nut insert is pressed into the hole. The exhaust probe is mated to the nut insert and the oxygen sensor chamber threads to the probe.

The PAIR system should be plugged to make AFR readings most accurate. "PAIR" means "Pulsed Air Induction Reed" valve. This system allows additional air to be introduced into the exhaust header to help fully burn

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any residual fuel that may have left the combustion chamber on the exhaust stroke.

Find a spot to mount the gauge using the suction cup provided (top of fuel tank usually works). Plug the gauge into the wideband sensor and power it up. You can now see your AFR values under a wide range conditions and decide upon modifications that can improve drivability, performance or fuel efficiency – maybe some combination of the three.

When you're done, reverse the installation, threading the provided screw into the nut insert to seal the exhaust system.

Now here is a unique Dobeck angle to acquiring and using the system: rent or own!

If you have one or multiple engines that would benefit from fueling analysis and possible subsequent adjustments, you can rent the system, including shipping both ways, for just $46 per week. When you're done, send it back.

On the other hand, if you're the type that wants his/her tools on hand at all times – perhaps you're a commercial shop – acquire the complete system with a one-year warranty for $325. Rental fees can be counted toward a purchase price. An EFI controller is separate.

So, what is your objective? Better horsepower and torque, better economy, eliminate exhaust popping on deceleration, a smoother, cooler, more pleasant and drivable power plant?

Check with Dobeck. Learn more at <www.dobeckperformance.com>.

Dobeck Performance's Binstock discusses AFR ranges

Dillon Binstock, speaking for Dobeck Performance (DP) of Belgrade, Mont., says the company's objective is to "make fuel tuning easy and affordable for everyone."

In that quest, the company "focuses on educating enthusiasts about fuel tuning to empower them to make good decisions and show them how easy tuning can be," Binstock said.

"Fuel tuning is as simple as targeting certain AFR values. It doesn't have to be a task that costs big money and requires a specialist to get it right. Anyone can do it" with the right tools and instruments.

He continued, "These days, fuel economy is becoming more important to riders over having maximum horsepower and torque. The trade-off of performance for fuel economy has always been a battle, but it is becoming easier to achieve with fuel injection.

"Tuning your bike to run at certain air-to-fuel ratio (AFR) values at different RPM ranges can create a tune-up specifically for fuel economy, for performance or a mixture of both," Binstock said.

The AFR values listed in the accompanying graphic can give you an idea of what AFRs a rider can target to develop a tune-up specific to his/her riding needs.

"The air/fuel ratio is the mass ratio of air-to-fuel in an internal combustion engine," Binstock explained.

"'Stoichiometric,' or 'Stoich', is 14.64:1 AFR, 14.64 parts air to one part fuel. It is the chemical AFR where, theoretically, at idle all air and gasoline are consumed. For emissions regulations, EPA usually targets a Stoich AFR.

"Optimal AFR values will vary depending on vehicle make and engine configuration. You may want to target other AFR values, but these AFRs (in the graphic) can give you a good idea of what to look for in your tune-up.

"At Dobeck Performance, we like to break your tune-up into three fuel ranges depicted by Green, Yellow and Red.

"The Green Zone represents Idle, low rpm and light load cruising," Binstock said. "EPA likes to target this zone to set emissions regulations. This zone has the largest effect on fuel economy since this where most riders spend their time riding. The motor can run at leaner AFR values during these driving conditions because the engine load is minimal while cruising at steady throttle down the road."

Binstock adds, "The optimal AFR at Idle may vary; choose an AFR that makes your bike idle the smoothest."

"The Yellow Zone represents acceleration and mid-range RPM, while the Red Zone relates to wide-open throttle and high RPM running. These are your performance fuel zones. You can choose richer AFR values for good power and torque in these zones.

"The 'Economy AFR' values will give you a decent running bike and good fuel economy, but are not too lean to cause damage to your motor," Binstock said. "Performance is minimal."

"The 'Good Performance AFR' values will be all-around good AFR values to target. You will not be wasting fuel, but will still have good performance.

"The 'Full Performance AFR' values will provide optimal performance but you will not have good fuel economy. Target these AFR values for maximum horsepower and in racing applications," Binstock concluded.

These AFR values listed are for naturally aspirated engines. Forced induction engines will require different AFR values for optimal performance.