By Tracy Martin

DYNOJET POWER VISION

A manual or fully self-adjusting air/fuel mixture tuner for all Delphi EFI systems

In the August issue of *AIM*, we ran the first of a series of articles on how various EFI tuners work with fuel-injected Harley-Davidson motorcycles. This month we'll cover Dynojet's Power Vision (PV) flash tuner ($549). Since 1972, Dynojet has been a leader in providing ways to modify fuel systems on all types of bikes. If you're old enough to remember motorcycles that were subject to early emission controls, one characteristic that plagued them was poor running at low engine speeds. Throttle response was slow, engines surged at part throttle, and the exhaust popped on deceleration. These problems affected all types of motorcycles including Harley-Davidsons. Dynojet provided an answer to these fueling problems in the form of jet kits that modified the stock carburetion. Dynojet is also credited with developing the first "rolling road" or motorcycle dynamometer, so it was one of the few aftermarket manufacturers that could back up its claims of increased horsepower and a better running engine by actually measuring the results of fuel system modification. In the mid-1990s, Dynojet started making the transition from producing jet kits for carburetors to modifying electronic fuel injection systems. Today the company has 160 employees and a presence in 60 countries worldwide. Its latest offering for Harley-Davidson electronic fuel-injected motorcycles is called the Dynojet Power Vision. Let's take a close look at what this technology can do for your Harley EFI bike.

The Dynojet Power Vision can flash-tune all Delphi EFI Harley-Davidsons. The unit features a touchscreen display, and its compact size allows for permanent mounting on the bike. Or you can use it to flash-tune a bike, run diagnostics, and then unplug it from the motorcycle.

Flash Tuner

Dynojet's Power Vision is a flash tuning interface that can be used on or off the bike. What is flash tuning? The electronic control module (ECM) used on The Motor Company's EFI engines has a look-up table (fuel map) that assigns a value for each engine rpm and throttle opening throughout the engine's operating range. Flash tuning takes place when a new fuel map is uploaded to the motorcycle's stock ECM and modifies this table. The new, electronic information is "flashed" to the ECM's memory, similar to receiving an update from Sprint or Verizon for your smartphone. This is the same process used when an H-D dealer performs a factory update to a bike's ECM. Power Vision is a performance tuner and data monitor that offers the latest flash-tuning technology and can tune any fuel-injected Harley-Davidson equipped with the Delphi EFI system, including 2013 models. The device uses a simple touchscreen display and does not require the use of a computer to flash a new fuel map to your bike.

The unit is loaded with preconfigured tunes (tuning maps) that have been developed by Dynojet. Because the company is continually updating its database of tunes based on new aftermarket pipes, air cleaners, cams, etc., the Power Vision can be connected to a computer and updated with the latest tune configurations from the Dynojet web site. The Power Vision can be mounted on the bike using the Techmount hardware that comes with it, or it can be connected temporarily for tuning only. The connection is simple as it uses the stock diagnostic connector. The Power Vision user guide provides the

specific location for these connectors. For example, 2001-13 Softails hide the connector under the seat while 2004-13 Dynas have their connector under the left side cover. Connector locations for Sportsters, V-Rods, and Touring models are listed in the instructions as well.

Uploading Tunes

ONCE THE POWER VISION IS CONNECTED to the diagnostic connector and the bike's ignition key is turned on, the Power Vision is "locked" or married to that specific motorcycle. This particular Power Vision unit can only be used on this one motorcycle from that time on. The PV's software interfaces with the bike's ECM, and the two units can exchange electronic data. The Power Vision downloads and stores the stock ECM calibration, and lets the user select up to six different tunes that are stored on the device. The types of tunes include Dynojet Preconfigured Tunes, Custom Tunes, Copy of Original Tune, and a Copy of Current Tune.

Dynojet Preconfigured Tunes are for a specific bike, and they are preloaded on the Power Vision device. After the Power Vision identifies the motorcycle's information it automatically sorts through hundreds of dyno-tested tunes for that motorcycle, which the user can choose from. These tunes are developed by Dynojet for combinations of aftermarket parts on all the Harley-Davidson models that work with the Power Vision. Custom Tunes are loaded by a custom tuning shop, or received via email and loaded on the device via a USB cable. A Copy of Original Tune is a version of the factory original tune that was saved when the Power Vision was married to the ECM. A Copy of Current Tune is what is currently running the bike. If the owner is more or less happy with the way his bike runs and only wants to make minor adjustments to the current or factory tune, they can be made directly from the Power Vision — no need for a laptop.

If you choose to use the preconfigured tunes, the PV will identify the specific motorcycle that it's connected to, the ECM strategy, and software level of the stock calibration. It will then automatically sort applicable tune files in groups of relevant modifications for the bike that the Power Vision is locked to.

This screen shot shows a preconfigured tune for a 2011 Touring model that has a SE air cleaner and Rush True Dual exhaust installed. The tune information even recommends the gasoline octane rating for this tune and parts combination.

Hundreds of tunes are available, and they're organized into relevant categories, such as stock improved, air intake kits, slip-ons, full exhaust systems, cams, etc., for ease of customer use. The Power Vision holds up to six tunes (any combination of the three types) for the user to choose from and these can be replaced as many times as you like with updated tunes from the Dynojet web site.

Once the tune is flashed to the bike's ECM, the Power Vision can be removed, or left mounted on the handlebars. If the PV is mounted on the motorcycle, tunes can be swapped or edited using the Power Vision touchscreen.

Wide vs. Narrow Band

NARROW BAND, WIDE BAND, THESE terms are often used interchangeably to describe the oxygen sensors used for engine management systems on motorcycles. Though these two sensors perform the same functions they are very different in the specifics of what they can do.

Narrow band O_2 sensors are installed on every Harley-Davidson that uses a catalytic convertor to reduce exhaust emissions. The sensor is manufactured using a compound called zirconium dioxide and is often called a zirconia O_2 sensor. The design of the sensor is based on a solid-state, electrochemical fuel cell called a Nernst cell, which has two gas-permeable electrodes that produce an output voltage. This voltage signal represents the amount of oxygen in the exhaust gas relative to O_2 content in the atmosphere.

Here's how the sensor works when the engine is running: when O_2 content in the exhaust gas is low (a rich air/fuel mixture), the difference between the level of exhaust gas O_2 and the level of O_2 in the atmosphere is high, which causes the sensor to produce a relatively high voltage (0.5-1.0 volts). Conversely, when the O_2 sensor detects a high exhaust gas O_2 content (a lean air/fuel mixture), the difference between the level of O_2 in the atmosphere is smaller so lower voltages are generated (0.1-0.45 volts). As the motorcycle's ECM receives the O_2 sensor voltage signal, it changes the air/fuel ratio (AFR) to match the target AFR of 14.7:1, also known as the stoichiometric point. The interaction of the ECM, O_2 sensors (one for each cylinder on a V-twin), and fuel mixture is called *closed loop operation*. In this mode, all the fuel and oxygen in the air/fuel mixture is burned, which helps the catalytic converter work efficiently at idle or steady cruise conditions. The AFR range that the stock O_2 sensor can detect is 14.2:1-15.3:1, which is a narrow range of fuel mixtures, hence the name narrow band O_2 sensor.

HOW IT WORKS

A wideband O_2 sensor does the same thing as the narrow band sensor, but it can detect a wider range of AFRs: 10:1-18:1. Because gasoline engines make full power with a 13:1 AFR, only a wide band sensor can be used for power-tuning purposes. These sensors produce a signal between 0.1 and 5.0 volts, which is outside the range that the bike's stock ECM can read so an aftermarket controller must be used for tuning purposes. Dynojet's Autotune Pro Kit uses wideband O_2 sensors and a control module that interfaces with the Power Vision unit and stock ECM.

There are some things to be careful of when using a wide band O_2 sensor on a motorcycle. Racing gasoline will severely limit the sensor's life, and you'll be purchasing another in short order. Engines that burn oil or have an overly rich mixture (exhaust blowing black smoke) will limit the sensor's ability to accurately read AFR. While usually not a problem, excessive exhaust backpressure will affect sensor readings. And, finally, always make sure the wideband sensor's heater circuit is working whenever the engine is running. Without power to the internal heating element, hydrocarbon residues from the exhaust may clog the sensor, and it will have to be replaced.

Autotune: The Process

DYNOJET DEFINES ITS AUTOTUNE OPtion as both a process and a product. The process has been used by automotive manufacturers since the early 1980s, but only in the late 1990s did motorcycles start to use this technology. Here's how the process works. Any Harley-Davidson fitted with factory O_2 sensors also has a catalytic converter. The job of the O_2 sensors and ECM is to keep the air-fuel ratio (ARF) within a narrow range: 14.3-15.2. For example, 14.3 means there are 14.3 times as much air as there is fuel in the air-fuel mixture being sent to the engine. This keeps the catalytic convertor in the stock exhaust system working efficiently, which reduces exhaust emissions. The factory O_2 sensors, which are narrow band O_2 sensors, measure the oxygen content in the exhaust fumes leaving the engine and send a signal to the bike's ECM. The ECM then adjusts the bike's air/fuel mixture ratios to its target range of

The Autotune Pro kit comes with two wide band O_2 sensors, cables, and a wide band controller.

14.3-15.2. This process is also known as a *closed loop system*. The opposite of closed loop is, of course, an *open-loop system*. Any engine parameter outside of a steady cruise or idle throttle operation is considered open loop. The bike's ECM and stock O_2 sensors do not "talk" to each other when the system is in open loop mode.

In the Basic Autotune mode the Power Vision forces the ECM to use the factory narrow band O_2 sensors in all operating conditions for fuel economy. Autotune Basic works with all models equipped with factory O_2 sensors but it is limited in what it can do for enhancing an engine's tune. The narrow band O_2 sensors can't read the max power AFRs that occur around 13:1. In other words, if the throttle is wacked open (open loop operation) the stock O_2 sensors have no idea what the AFR is and auto tuning is not possible.

Autotune Pro

DYNOJET'S AUTOTUNE PRO ACCESSORY kit removes the narrow band O_2 sensor's AFR monitoring limitation because it uses wide band O_2 sensors instead of narrow band. Wide band sensors work in a broader range of AFRs (10:1-18:1) and can read AFRs in the engine's power range. The idea is to match the ideal ARF at all engine rpm and loads with the pipes, air cleaner, cams, etc., that have been installed on the motorcycle. Professional tuners rely on wide band O_2 sensor data to adjust AFR tables in the bike's ECM with the goal of achieving a balance of fuel economy and best power.

When in the Autotune Pro mode, target AFRs are set up in the Power Vision. The data received from the wide band O_2 sensors allows the Power Vision to adjust the tune loaded in it so that fuel delivery signals to the fuel injectors "fix" the AFR to match these target AFR numbers. However, this does not happen instantaneously. This process occurs over time as the motorcycle's engine is ridden in various load and rpm ranges. The user can adjust the amount of correction learning time as well as uploading the corrections to the ECM from the PV. In addition to tuning the fuel map, Autotune can use the ECM's ion sensing knock control strategy to adjust the ignition timing to prevent engine knock (detonation). As the engine starts to ping, the knock sensors send a signal to the Power Vision to back off the ignition timing only where the knock occurs. This is a powerful tuning tool that can save an engine from serious damage, like a hole in a piston. Neither Autotune Basic, nor Autotune Pro require the use of a computer for operation. The Power Vision sets up the tune, monitors and logs the data, and then corrects the tune to ensure what is requested in the AFR table is what is ultimately delivered. The Autotune Pro Accessory Kit sells for $429 and comes with two wide band O_2 sensors, cables, and controller to interface with the Power Vision. Essentially Autotune is like having a full-time pro-

fessional tuner along for every ride.

Conclusion

IN ADDITION TO FLASH TUNING AND AUtotune, the Dynojet Power Vision does a lot more including displaying customizable virtual gauges to monitor engine data as you ride, setting alarms for knock sensor or cylinder head temperature values, checking and clearing diagnostic codes on any compatible Harley (Power Vision doesn't have to be married to the bike for this function), resetting adaptive fuel trims, and adjusting the idle speed with the engine running. Free online support via email and instructional videos are all available on Dynojet's web site. In the end, the Power Vision is a flexible tuning and diagnostic tool that can be used on or off the motorcycle. It provides an owner with a gateway to his motorcycle's electronic fuel management system where he can perform basic or complex adjustments in the garage or out on the road. **AIM**

Air-Fuel Ratio (Stoich)
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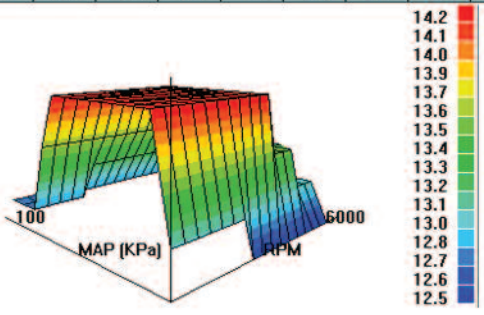
RPM	MAP (KPa)											
	20	27	30	40	50	60	70	80	85	90	95	100
750	13.0	14.2	14.2	14.2	14.2	14.2	14.2	14.2	13.6	12.8	12.8	12.8
1000	13.0	14.2	14.2	14.2	14.2	14.2	14.2	14.2	13.6	12.8	12.8	12.8
1125	13.0	14.2	14.2	14.2	14.2	14.2	14.2	14.2	13.6	12.8	12.8	12.8
1250	13.0	14.2	14.2	14.2	14.2	14.2	14.2	14.2	13.6	12.8	12.8	12.8
1500	13.0	14.2	14.2	14.2	14.2	14.2	14.2	14.2	13.6	12.8	12.8	12.8
1750	13.0	14.2	14.2	14.2	14.2	14.2	14.2	14.2	13.6	13.2	12.8	12.8
2000	13.0	14.2	14.2	14.2	14.2	14.2	14.2	14.2	13.6	13.2	12.8	12.8
2250	12.5	14.2	14.2	14.2	14.2	14.2	14.2	14.2	13.6	13.2	12.8	12.8
2500	12.5	14.2	14.2	14.2	14.2	14.2	14.2	14.2	13.6	13.2	12.8	12.8
2750	12.5	14.2	14.2	14.2	14.2	14.2	14.2	14.2	13.6	13.2	12.8	12.8
3000	12.5	14.2	14.2	14.2	14.2	14.2	14.2	14.2	13.6	13.2	12.8	12.8
3500	12.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.6	13.2	12.8	12.8
4000	12.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.6	13.2	12.8	12.8
4500	12.5	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.6	13.2	12.8	12.8
5000	12.5	13.0	13.5	13.5	13.5	13.5	13.5	13.5	13.5	13.2	12.8	12.8
5500	12.5	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	12.8	12.8
6000	12.5	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0	12.8	12.8



If you chose to, the software that comes with the Power Vision provides a more detailed method to tune the bike's fuel map. Engine load is across the top of the chart and rpm values are on the left. The numbers in each of the cells are the target air/fuel ratios.

drag batteries