



Tech Articles

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DIY Tuning, Part 4 (Final)

In the last three issues of Fiero Focus, we discussed what hardware and software you need in order to do your own ECM tuning; how to get started with tuning for cold start and idle fuel; and how to tune the main fuel and spark tables. If you missed those articles, I recommend you obtain them because they contain valuable information needed to understand and use this final part of the series of Do-IT-Yourself Tuning articles I am writing for our friends at Fiero Focus. These articles should be considered to contain basic instructions on how to perform the task of tuning. There are different and more advanced ways to tune, but in the interest of our general reader, I will try to keep things as simple to understand and follow as possible.

Now up until this point you should have gotten your cold start, idle, and part throttle tuning done so your engine runs well and the scan data looks good. If you have not done this, you should get it wrapped up before tuning on the full throttle (WOT, or wide open throttle) fuel and spark table values as changes made to the part throttle fuel and spark tables can influence what happens at full throttle. When you push the gas pedal to full throttle, or near full throttle (very heavy throttle), this causes the computer to go into PE, or Power Enrichment mode. In this mode, the computer freezes the fuel trims (INT/BLM) and ignores the O2 sensor signal input even though the scan data may still report the system is in "closed loop".

Depending on the type of computer/programming you are working with, there may be some settings or a whole table devoted to telling the computer when to enable PE mode based on throttle position. Some systems (like trucks) also have what's known as a PE delay mode, which introduces a delay before allowing PE mode to kick in. This is probably done because GM considers that the vehicle might be used for towing or hauling and they didn't want the PE mode to kick in too quickly and waste fuel. If your computer has these settings available for you to tune, you can play around with them a bit to see if you can increase performance or alter the behavior of your engine to your liking.

Some systems also have separate PE mode timing advance tables. If your system has these tables available for you to tune, be sure to keep in mind these tables will only be used while in PE mode. And most of the time these are just spark adder tables where the computer calculates total spark advance by adding the value in the main spark table to the value in the PE mode spark adder table to come up with the total spark advance commanded. If your system does not have separate PE mode timing advance tables, then chances are it just uses the main spark table values to determine how much timing advance to command. As with part throttle spark timing tuning, you typically want to give the engine as much timing advance as it can handle without producing detonation. If you are working with a relatively low compression engine (not running boost), then it may not produce detonation with too much timing advance – but rather it will suffer a loss of power. You may just need to try different amounts of spark advance to see what makes the engine feel like it is producing the most power (here is where a dyno tuning session really becomes useful).

Concerning PE mode fuel tables, different systems have different ways of calculating PE mode fuel. For example, the Fiero 2.8L ECMs calculate PE fuel using the PE Fuel AFR constant taking into account values in all of the other fuel tables. In the Fiero 2.8L ECM programming, there is a VE adder table which influences fuel based on RPM up thru 6400rpm. The main VE table in the Fiero ECM programming is limited to 4000 rpm. So you can use the VE adder table to make changes to your WOT fuel above 4000 rpm. The main VE table uses RPM and MAP to determine fuel settings. And at full throttle your MAP is probably 90-100kpa depending on how restrictive your induction system is. So you should change the settings in these MAP columns to influence WOT fuel changes per RPM below 4000 instead of making those changes in the VE adder table. If you make changes in the VE adder table for 4000rpm and lower, this could also influence part throttle and idle fueling. On cars that have Mass Air Flow (MAF) sensors, the MAF sensor signal is the primary input used by the PCM to determine fuel delivery, and the PE mode fuel tables simply act as "adders" (in most cases) to help the PCM calculate fuel delivery.

For tuning WOT fuel, you should really get yourself a Wideband O2 sensor setup. Stock, OE replacement, and

aftermarket narrow band O2 sensors are designed to measure just rich or lean of stoichiometric (14.7:1 AFR for gasoline). Now in most cases I have been able to install a wideband O2 sensor in conjunction with the factory narrow band and use the wideband to tell me what AFR values produced what voltage signal out of a given narrow band O2 sensor (at AFR values outside of 14.7:1). But, again, the factory-type, narrow band O2 sensor wasn't designed for this so it should not be relied on to measure PE AFRs.

The industry-accepted AFR for maximum HP at WOT on gasoline engines not using boost is about 13.0:1; for boosted engines it is about 12.0:1. But for street applications, I recommend a target AFR value of at least 0.5-1.0 AFR richer (no boost: 12.5-12.0:1, with boost: 11.5-11.0:1) than these "magic" numbers to give yourself some margin for error. Going too lean at full throttle can lead to engine damage, especially if you are running boost. Most factory chip programs already have the PE mode fuel AFR set richer than it needs to be, but this was done for engine protection and liability reasons. Newer systems have PE mode fuel and spark tables that are based on RPM and time spent in PE mode. Generally, the PE AFR is richened up more and more as more time is spent in PE mode; and ignition timing advance is usually retarded more and more as time is spent in PE mode. GM did this to discourage too much heat from building up in the pistons and the engine during extended periods of operation in PE mode in order to prevent the engine from quite literally melting down.

If you are using a stock Fiero ECM and you want to richen up the WOT/PE mode AFR across the entire RPM range, you can simply lower the PE mode AFR constant in the programming. But, if you only want to increase the PE mode AFR across a select RPM range, then you should make your changes to the Main VE or VE adder tables depending on what RPM ranges you wish to alter the PE AFR values at. Making the values in either one of these tables larger will increase fuel (richen) while reducing them will decrease fuel (lean it out) which is opposite of what changing the PE mode AFR constant does. It is important to note what type of value you are working with in a given constant or table - whether it is a VE or AFR number; because they work oppositely.

As with the other tuning changes discussed, it is a good idea to make a small number of changes and test your results and to not make a lot of changes in one chip programming revision. It is always easy to go back and reverse a small number of changes and find out what caused an issue if something doesn't react the way you intended. If there is one lesson I would like you to take away from these articles, this would be it. I hope this information helps you understand how the tuning process works. Tuning a fuel injection computer is not for everyone. But for those wanting to learn, these articles should give you a good starting point that will help you get started doing it yourself.

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