

AutoTeacher News

News and How-to Articles for Automotive Teachers
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Fuel Trim Instruction

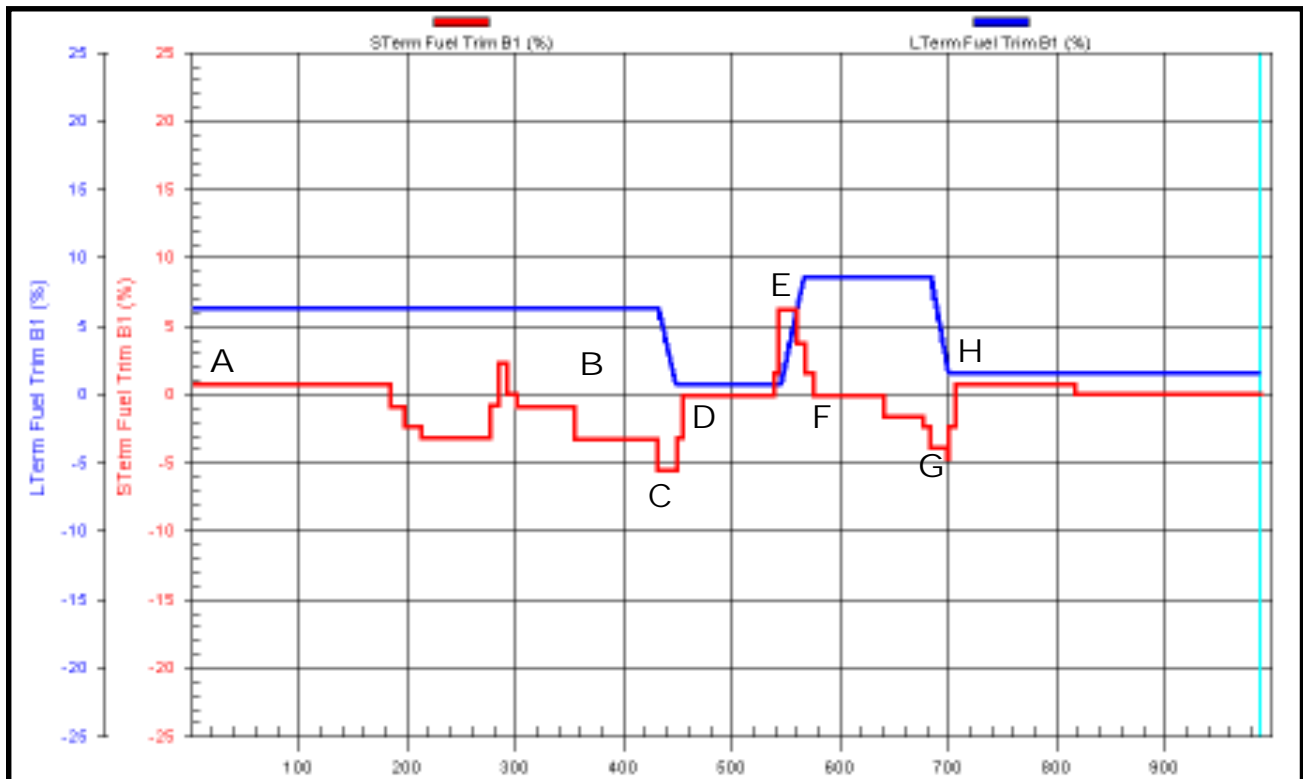


Figure 1

The understanding of fuel trim operation on today's vehicles is extremely important to the repair technician. If the vehicle's emission gases are out of specification, one of the first items to check for clues is fuel trim. But, it is one of the least understood engine management operations by both technicians and instructors. One reason this is true is fuel trim operation on an operating vehicle is very difficult to demonstrate. How do you show a student engine management functions in actual operation? This was the problem presented to ATech by an OEM some years ago. ATech's response was the development of the Engine Performance System Demonstrators. The original Demonstrators were wet systems, which means they included the actual fuel rail and injectors along with a tank to hold a fluid for injection. While great for class room demonstrations, they were large, heavy, difficult to move and store. Teachers liked them but wanted a smaller package - portable if possible. In response, ATech has developed the General Motors OBDII system in a locking suitcase. The complete unit is 30 inches wide, 21 inches high,

and 10 inches deep. It weighs approximately 40 pounds.

As shown in figure 1, the demonstrator/trainer allows the instructor and/or student to change the fuel control oxygen sensor feedback to produce controlled and reproducible changes in both short term and long term fuel trim. In figure 1, from point A to point B, short term fuel trim varies as it normally does but it never exceeds 3% in either the plus direction or the minus direction. An increase in the plus direction means the amount of fuel is being increased by increasing the fuel injector pulse width. An increase in the minus direction means the amount of fuel is being decreased by decreasing the fuel injector pulse width. At point C, the short term fuel trim goes more negative than 3%. Long term fuel trim immediately starts going negative. The value of long term fuel trim reduces the short term value until short term returns back close to zero. The fuel injection system has now been trimmed for the set of operating conditions that existed at that point. The value of

long term fuel trim is placed in the computer's memory. When the vehicle returns to the same operating conditions in the future, the new value of long term fuel trim will be used as the fuel injector pulse width value. The same type of operation is shown at points E & F and G & H. The chart shown was taken at idle in Park on the GM suitcase trainer. System response to short term fuel trim changes is very rapid at idle and light loads. Response is slower at heavier loads and higher RPM. The oxygen sensor bargraphs and the Fuel Trim Control Pot are shown in figure 2.



Figure 2

The ability of the engine management system to adjust long term fuel trim and store the value for future use is called “learning”. As the vehicle is driven, the PCM/VCM engine controller “learns” the necessary operating parameters for the conditions it encounters. If the vehicle has never been driven at a certain set of conditions, i.e. pulling a trailer, the controller will use the factory operating parameters and continue to adjust them as necessary.

From the discussion so far, it is logical to assume that a malfunction in a system component or a mechanical problem could cause the computer to “learn” incorrect values. This can be very easily demonstrated on the trainer. Increase the RPM slightly with the throttle control and use the trainer's Fuel Trim Pot to add additional long term fuel trim. Reduce the throttle and reset the Fuel Trim Pot. If you increase the throttle to reach the RPM you used previously, you will see the incorrect fuel trim value that you caused the PCM to “learn”. Watch closely as it will start to correct this wrong value immediately. The Fuel Trim Pot on the trainer actually allows the instructor/student to take control of the upstream oxygen sensor (fuel control) signal.

How do you teach the relationship between; engine RPM and number of injector pulses per second, engine load and injector pulse duration, closed loop

control and injector pulse “on” time, cold start and fuel volume, short term fuel trim control of injector pulse width?



GM OBDII Suitcase Trainer

Figure 3 shows an actual injector pulse from the trainer as seen on an OTC Perception scope. Using any automotive scope and the trainer, you can illustrate all of the factors affecting the injector pulse. Because this trainer uses an actual PCM, these relationships are identical to what occurs on the vehicle.



Figure 3

Figure 4 shows the faulting/demonstration panel that is standard on the trainer. This panel has some typical “hard” Comprehensive Component Monitoring failures and also OBDII Monitor failures. Set the upstream oxygen sensor to act like a contaminated



Figure 4

sensor with slow response, run the service manual OBDII Drive Cycle, and the PCM comes up with a bad oxygen sensor fault code. What takes seconds to illustrate on the trainer is almost impossible to show on a vehicle.

What does it take to win the Automotive Industry Planning Council Award of Excellence in Automotive Education?

I first learned about the AIPC Award of Excellence when someone in the administration placed the application in my mailbox. After studying it and thinking about how much work it would take to complete the application, I filed it in the recycle container by my desk. I knew we had a good program that was meeting the needs of our students and the repair industry but felt that we wouldn't stand a chance against the mega schools. After all, we were a small school with only two full time instructors. Later I saw in the NATEF newsletter the year's winners. I visited www.autoipc.org, the AIPC web page and reviewed the list of national winners, runners-up and state winners. I examined some of their web pages and noticed that a small school had been recognized as a national winner. I believed that our program was equal to or better than other programs in our category in our state. I also realized that most of the information required for the application was readily available and to submit an application would involve little more than coordinating it into the application format.

After enlisting some help from colleagues, we decided to try to win for our state. Using the form downloaded from the AIPC web page as an outline, it was very easy to insert the documents required, and

writing about the program was no challenge at all. If you believe in what you are doing, it is very easy to brag about it! We knew that even if we didn't win, some of the information gathered would be useful for recruiting brochures and reports. We were rewarded for the effort by not only being the state winner but also by being one of the two national runner-ups in our category.

The recognition and awards we received only enabled us to become better and more motivated. The knowledge gained in the first year and the success we enjoyed compelled us to improve our application. It also brought us offers of help from talented people within the college that we weren't even aware of. Our next application while fundamentally the same (facts are facts), but it had a more professional appearance and included increased documentation. The improvements in the application netted an improvement in finish, and Trident Technical College was named as the First Place Winner in the Post Secondary – Generic category.

I have been asked what makes our program deserving of this award. I think it is the same thing that makes any program better than average: an experienced and dedicated faculty with a love for cars that believes the automotive repair industry is an excellent profession filled with honorable people. Those faculty, when supported by an administration with the same belief, will impart to qualified students the skills required to succeed and meet the needs of employers and customers.

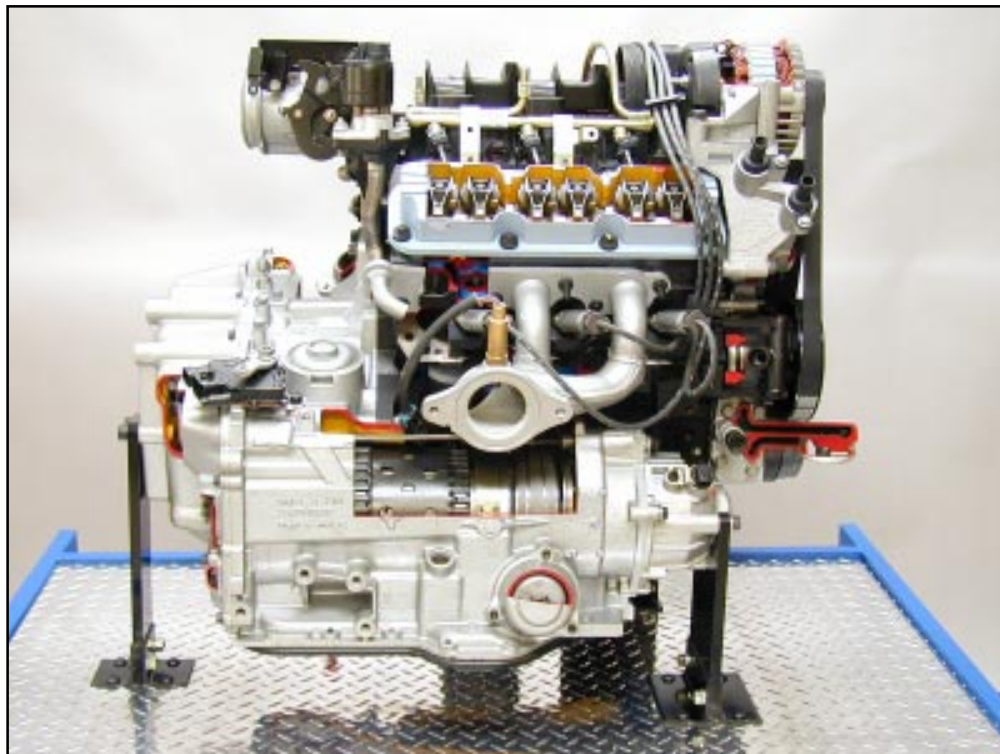
I congratulate the Automotive Industry Planning Council and its partners, The National Institute for Automotive Service Excellence (ASE), The National Automotive Technicians Education Foundation (NATEF), The Association for Career and Technology Education (ACTE), and The Alliance of Automotive Manufacturers (AAM) for providing this recognition to training programs that are often not highly regarded but whose services are needed by everyone. Our program is ineligible for this award again for 5 years as are all previous winners. I would encourage every eligible automotive training program to enter. You can't get the recognition you deserve without telling someone what makes you deserving. It sure was a good decision for us. What does it take to win? You have to begin by entering the competition!

Article by Dan Perrin, Trident Technical College in Charleston, SC. - 2001 Award Winner



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