Eco Fuel Saver Technical Details

Understanding Adaptive ECUs and using fuel additives

Most modern engines use an ECU to monitor and recalibrate a number of settings. This is done to keep the engine performance operating within design specifications for the manufacturer. The standard ECU measures engine condition and can control a number of areas within the engine to maintain performance.

- ***Fuel flow volume and fuel delivery timing:*** Controls the fuel put into the intake/combustion chamber, timing the rate of flow and when it flows relative to the engine's cycles

- ***Ignition timing:*** Defines when the spark plug should fire for a cylinder.

- ***Rev. limit:*** Defines the maximum RPM that the engine is allowed to reach. After this fuel and/or ignition is cut. Some vehicles have a "soft" cut-off before the "hard" cut-off.

- ***Water temperature correction:*** Allows for additional fuel to be added when the engine is cold (choke) or dangerously hot.

- ***Transient fueling:*** Tells the ECU to add a specific amount of fuel when throttle is applied. The term is "acceleration enrichment"

- ***Low fuel pressure modifier:*** Tells the ECU to increase the injector fire time to compensate for a loss of fuel pressure.

- ***Closed loop lambda:*** Lets the ECU monitor a permanently installed lambda probe and modify the fueling to achieve stoichiometric (ideal) combustion. On traditional petrol powered vehicles this air: fuel ratio is 14.7:1.

- ***Waste-gate control:*** Sets up the behavior of a turbocharger's waste-gate, controlling boost.

- ***Banked injection:*** Sets up the behavior of double injectors per cylinder, used to get a finer fuel injection control and atomization over a wide RPM range.

- ***Variable cam timing:*** Tells the ECU how to control variable intake and exhaust cams.

- ***Gear control:*** Tells the ECU to cut ignition during (sequential gearbox) upshifts or blip the throttle during downshifts.

- ***Automatic Transmission Shift Point:*** An automatic transmission shift points can be raised in RPM to address sport driving needs, or lowered for long distance economy driving.

- ***Fuel Type:*** The ECU will calibrate engine settings relative to the fuel commonly used within an engine.

Using EFS in engines with adaptive or programmable ECUs
Engines differ by type, but this is generally accurate.
An adaptive ECU is meant to protect the operating condition of a vehicle. This means that the car always runs the same, within factory specifications, plus adaptive adjustments for environmental conditions - like an aggressive driver and routinely bad fuel.

Why reset the ECU?

The ECU may be used to the swill that the engine has been barely burning for years. EFS modifies a few things in the fuel.

- ***Octane -*** EFS stabilizes how the fuel burns under pressure, effectively raising the research octane number over 10%. 86 octane would burn like 95 octane with EFS.

- ***BTU -*** EFS elevates the available energy in the fuel by over 10%.

Many new engines will calibrate themselves to work with the fuel being used with regularity within a vehicle. Fuel may change over time - like winter versus summer blends. The ECU will calibrate the engine settings to work with the fuel provided. The ECU recalibration is based on an ongoing sampling process, and smoothes the performance based on the samples from numerous driving sessions.

Many engines will NOT show a benefit from irregular uses of premium fuel, since the ECU is managing to the average fuel type across a number of sessions, so the fuel from a single session that is outside the average is more of an anomaly. To benefit from a fuel change, the fuel change must be instituted over a number of driving sessions, or the ECU needs to be reset.

By resetting the ECU, a vehicle can appreciate the benefit of more energetic fuel that can handle more compression and timing advance. The engine can operate under higher performance settings - timing advance, leaner fuel delivery - once it is calibrated for a fuel change. It is possible to see an increase in mileage quicker after a proper re-calibration of ECU.

1. In general, an ECU will adapt new fuel settings based on a consistent sample set of 3 - 10 full runs. This seems to be able to be translated to driving sessions, or a minimum of at least 4 hours of run time, but there are some provisions. To force an ECU recalibration, the manufacturers suggest in applications such as a Vehicle , driving it for extended sessions - 5 - 10 times, Drive hard on the throttle, high speed, hold the shift points high, force the engine to work.

2. Translated, what this means is that adaptive learning ECUs can either be cleared, and set to factory settings, or recalibrated. To reset, each manufacturer has a technique for this. It will put a car into factory new settings.

3. To perform any comparative test on a car with an adaptive ECU
    a. Establish a baseline. Drive a tank of fuel through the car over 5 different driving sessions. The driving has to be on an established route, primarily highway driving. Drive in a manner to maximize mileage - so no powering away from a stop sign and aggressive driving. Log the mileage.
    b. Reset the ECU again.
    c. Add EFS to a new tank of fuel. Drive that tank of fuel through the car over 5 different driving sessions. Log the mileage.
    d. Repeat step 3.
    e. Compare the results.

    The reason to force highway driving is that this helps the ECU, and eliminates the variable road conditions that would otherwise alter the results of real world testing. Two tank fulls with EFS allows the system to recalibrate, and sets a realistic timeline for recognizing change.

Is it possible to run performance fuel or EFS without ECU recalibration?

Of course. The ECU averages out changes from the norm and maintains an operating condition. If you make the new fuel the norm, the ECU will adapt over time. This also clarifies that it is likely that a user would see no immediate benefit from using EFS.

What about big trucks and commercial diesel engines?

Diesel fuel is modified with cetane and anti-gel additives, more so for the colder temperatures. Adding BTU to diesel fuel replaces energy that was lost with the other additives. A winter diesel is commonly only 75% as energetic as a summer fuel. EFS can replace some of that lost energy. A properly calibrated ECU, even on diesel, can help to maximize the benefit of the fuel in the engine.

Finally, EFS does help diesel engines remove the soot from exhaust while supporting an increase in performance settings. This allows diesel users to optimize performance while reducing emissions, even with seasonally variable fuel.

In gasoline engines, combustion is suppressed as pressure and heat increases. This is addresses indirectly the anti-knock index. In diesel, smooth flame front is supported. Combustion must start earlier in the stroke, and the flame needs to be maintained .EFS does help diesel engines remove the soot from exhaust while supporting an increase in performance settings. This allows diesel users to optimize performance while reducing emissions, even with seasonally variable fuel. So, EFS enhances oxygen rich, fuel lean hot combustion.

Additional Notes

- ***Inhibit fungus growth for diesel fuel -*** With the addition of EFS into diesel it now repels water and prevents fungus growth in diesel tanks

- ***Octane -*** In gas, combustion is suppressed as pressure and heat increases. This is indirectly the anti knock index. 87 octane with EFS can be used in place of 92 octane fuel.

- ***Cetane -*** In diesel, smooth flame front is supported. Combustion must start earlier in the stroke, and the flame needs to be maintained. Doing this properly reduces smoking and residual deposits.

- ***Octane details -*** Octane is a relative comparison of fuel computation performance under pressure in relation to Heptane and Octane. There are observed and derived ways to get the number. These are guidelines for a specific use under a precise set of conditions. EFS has performed well on fixed engine and chassis dyno tests, in conditions where the baseline was regular fuel, and the engines were optimized for EFS. The performance was comparable, and in some cases exceeded, the performance of 91 octane fuel.