OVERVIEW
EFI ELECTRONIC FUEL MANAGEMENT SYSTEMS

There are many different variations of electronic fuel injection systems manufactured by a number of different specialist companies like Bosch, Bendix, Rochester, Weber etc. as well as hybrid systems developed by engine manufacturers themselves such as Toyota, Mazda, Renault --- and they are being modified and improved daily so we can only speak in general terms.

The information required by the on-board fuel management system is provided by a number of sensors located throughout the engine and this information tunes the engine for cold starts, altitude, high and low speed, fuel surge, rapid acceleration/deceleration etc.

The sensors in a typical modern fuel injection system include.

- Intake Air Temperature Sensor
- Intake Air Flow Sensor
- Exhaust Temperature Sensor
- Manifold Pressure Sensor
- Fuel Pressure Sensor
- Barometric Pressure Sensor
- Throttle Plate Potentiometer Sensor
- Engine Speed Sensor
- Intake Air Flow Sensor
- Oxygen Sensor

An oxygen sensor mounted in the exhaust of the engine measures the oxygen left after combustion to determine if the air/fuel ratio going into the combustion chamber is too rich or too lean. The signal is sent to the engine management computer and the mix is adjusted accordingly.

An oxygen sensor can prevent fuel saving technologies that create a leaner mix from working. Creating a leaner mix may save fuel but sacrifice power or reduce engine performance in various ways or affect the catalytic converter so the oxygen sensor is an important part of the fuel management system.

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If the sensor detects a lean mix it will (in most injector systems) increase the injector pulse time to allow more fuel into the engine, thus keeping the air/fuel ratio at the pre-set value. On most vehicles this ratio is set at 14.7:1 and is the constant target ratio for optimum fuel use and exhaust emissions control.

The oxygen sensor measures the oxygen left in the expelled gasses to determine how lean the mix is. It does not measure how rich the mix is so, in other words, it is constantly reducing the amount of fuel injected into the cylinder until it detects that it is too lean, then increases it slightly.

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The ideal air to fuel ratio has been determined to be 14.7 parts of air (oxygen and nitrogen) to 1 part petrol vapor (consisting of hydrocarbons, wax, carbon solids, sulphur and numerous other impurities.)

For various reasons (which experts are studying and trying to improve on all the time) the efficiency of an internal combustion engine is very low. Only about 27% of the potential BTUs are utilized to produce engine power and the rest goes out the exhaust as –

HC - Hydrocarbons (non combusted fuel vapor) measured in parts per million
CO - Carbon Monoxide measured in percentage
CO_2 – Carbon Dioxide measured in percentage
NO_x – Oxides of nitrogen measured in parts per million
O_2 – Oxygen measured in percentage

Combustion can not take place without oxygen so a sufficient amount must be in the compression chamber to detonate each fuel charge with a bit left over.

If the air and fuel went into the cylinder and there was no ignition, the exhaust reading would be roughly 20% oxygen content and the balance nitrogen and virtually 0 ppm HC gas because it would not be vaporized.

To simplify the measuring process, the engine only measures the 0_2 content of the exhaust gas. The other gasses are only monitored by external workshop equipment for tuning purposes.

In the ideal ignition (with a specific octane rating fuel) the fuel system designers will have determined that after the ideal 14.7:1 fuel mix has been ignited, there is still a constant percentage of 0_2 in the exhaust gas. This can be controlled during the tuning process by the air intake design and air flow monitoring sensor.

If there is too little fuel in the charge (less than 14.7:1 ratio) the fuel will be burnt up before the oxygen is used so the 0_2 reading will be higher to indicate a lean mix.

If there is too much fuel in the charge (more than 14.7:1 ratio) the fuel will use up more oxygen to burn and the 0_2 reading will be lower to indicate a rich mix.

Remember – the other gasses are not being measured by the system.

The electronic fuel injection system is designed to use the fuel supplied to it in the most efficient manner so it becomes obvious that anything we do to alter that mechanical process will, in all likelihood, upset the fuel management system. These systems are designed to make the best use of a given readily available fuel with a specific BTU rating.

To increase the fuel efficiency of a modern fuel injected and monitored engine is a simple matter. Leave the fuel system as it is designed and increasing the efficiency of the fuel being introduced to the engine so, in other words, produce more power from the same fuel charge – or – produce the same amount of power with less fuel.

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Cybersizzle fuel conditioner does exactly that. The fuel is conditioned so each charge of fuel is burnt more efficiently and therefore produces more BTUs.

Now, going back to the oxygen sensor – if we burn the fuel more efficiently we must use more oxygen. The computer will then think the charge is too rich so it will reduce the amount of fuel injected into the cylinder to compensate but it will balance itself out until the new smaller fuel charge is using the designed amount of oxygen in each charge.

Because we are burning each fuel charge more efficiently, we are producing more BTUs which in an internal combustion engine relates directly to more power.
The electronic ignition and fuel monitoring system is happy because the air/fuel ratio is nicely in balance but the engine is producing more power with less fuel.

So now it is up to the driver – use that additional power to go faster and quicker or drive as normal and save fuel.

Cybersizzle fuel conditioner has no effect on the fuel management system, fuel sensors, gaskets, seals or catalytic converters. It is formulated to improve the burn rate of the fuel without upsetting the balance of the engine air/fuel ratios. In some systems, the air/fuel ratios adjustment takes longer than others so a rich fuel mix may be experienced for a short time while the system re-tunes itself to the new conditioned fuel.

Diesel engines use a completely different system whereby they simply inject a measured amount of fuel dependant on the throttle opening. This fuel is either burnt or gets pumped out the exhaust as smoke. New fuel monitoring systems are being developed for diesels now but this is mostly to stop over fueling and does not use sensors to the extent patrol fuel management systems do. By adding Cybersizzle fuel conditioner to the diesel, we are making it burn hotter and faster so we reduce the un-burnt fuel and produce more power.