STAFOR HHO

FOR CAR · ДЛЯ ЛЕГКОВОЙ АВТО · VIEGLAI AUTOMAŠĪNAI

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STAFOR HHO lambda sensor extender.
Installation manual.

HHO hydrogen on demand dual fuel systems

HYDROGEN SYSTEMS
STAFORHHO.com

Ecologically clean – lowers CO and CO2 emissions

Installing of lamda sensor extender

Basic information

Also called oxygen sensors as it measure the amount of the oxygen in the exhaust gases. This information is used by the engine´s computer system to control engine operation. There are few types of lambda sensors available, but here we will consider most commonly used - voltage-generating type.

Normally the lambda sensors are presented in all petrol cars after 1992. In diesel cars only in the last years these sensors have been installed.

The lambda sensors can be found in a variety of places, depending on the vehicle make, model and engine type. The accompanying illustrations depict some of the more common locations. As a general rule, each exhaust manifold has at least one pre-cat sensor. Most vehicles manufactured since the early 1980s are equipped with pre-cat sensors. With the advent of Onboard Diagnostic Systems II (OBDII) in the mid-1990s, Lambda sensors were positioned both upstream and downstream of the catalytic converter.

Lambda sensors

Front (upstream) lambda sensor located in the exhaust manifold or in the downpipe before catalytic converter. It monitors the amount of oxygen in the exhaust gases and provides the "feedback" signal to the engine computer. If the sensor senses high level of oxygen, the engine is running too lean (not enough fuel).

The engine computer adds more fuel. If the level of oxygen in the exhaust is too low, the computer decides that the engine is running too rich (too much fuel) and subtracts fuel accordingly.

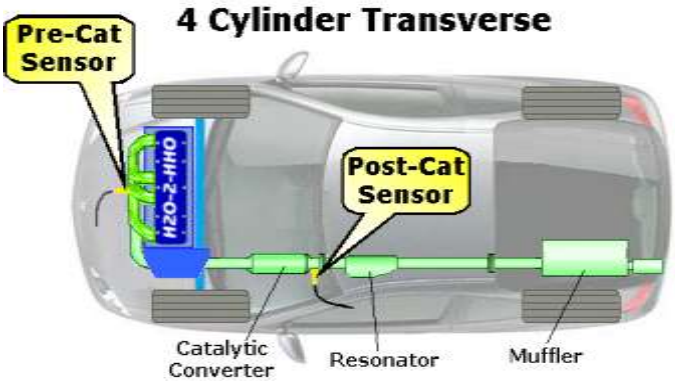
This process is continuous - the engine computer constantly cycles between slightly lean and slightly rich to keep the air/fuel-ratio at the optimum level. If you look at the front lambda sensor voltage signal, it will be cycling somewhere between 0.2 and 0.8 Volts.

For these sensors we should install the lambda sensor extender and also isolate the sensor body.

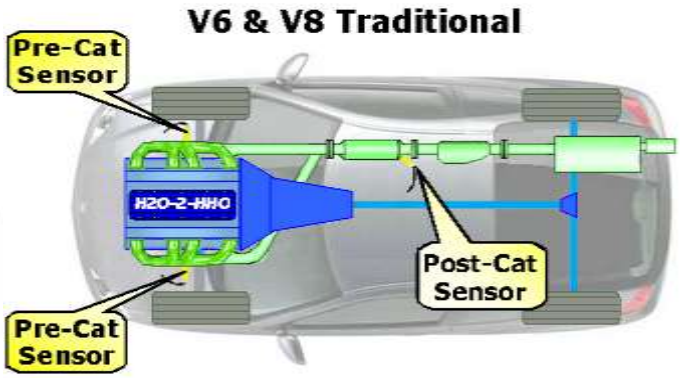
Rear (downstream) lambda sensor. Rear or downstream lambda sensor is located after catalytic converter. It monitors the efficiency of the catalytic converter. In the past, and in most cases the downstream sensors are not used in air/fuel ratio calculations. Therefore they do not need to be treated. But we are finding quite a few cases where that's not true anymore. Some car manufacturers are using the rear sensors as part of their air/fuel ratio calculations. It is now a primary suspect when fuel mileage is not being achieved when the steps above are all found to be in.

Location of lambda oxygen sensors

4 cylinder transverse



Traditional V6 and V8



Resetting the ECU

The ECU of your car is the brain using mapped data to work out the optimum control conditions for the engine. According to the day to day driving conditions the ECU builds a memory data base that helps it to decide the course of action that should be taken by the engine to ensure an ideal drive. Even though you have made modifications in your car, the ECU still continues to get an input of the old data which is stored in its memory. This old data no longer is credible as it pertains to conditions that existed before the modification. The input data to the ECU should pertain to the post modification situation of the components and parts introduced, while making the modification.

IMPORTANT

We recommend to all our customers to reset cars ECU (computer) to provide best fuel saving from HHO system.

This means that you have to erase the old data from memory and new data pertaining to post modification should be logged into the ECU memory by mapping in new readings. This is the reason why ECU resetting is essential for optimum performance after any modification has been carried out in your car. The moment you have carried out the modification you should purge out existing data in your ECU's memory. You should then feed in fresh data pertaining to the conditions that have come into existence post modification. The ECU has to operate on the newly acquired data as this new data reflects the true conditions post modification.

Resetting the ECU when you choose to boost Octane with HHO gas becomes necessary because your ECU has a memory bank for octane. This means that if you've been using lower octane, the response of ECU will correspond to lower octane with the booster matching lower octane performance. The ECU response will continue to correspond to lower octane even though you have started using higher-octane fuel. This is because the ECU has not been reset for higher octane. Thus even though higher octane is in actual use, the data in ECU memory still corresponds to that of lower octane. This mismatch affects performance, as you are unable to derive the benefits of boosting the octane. **Therefore you should reset your ECU periodically after filling up full tank in order to ensure that ECU adjustments for its octane memory are made afresh corresponding to the octane actually in use.**

Options for ECU (car computer) reset

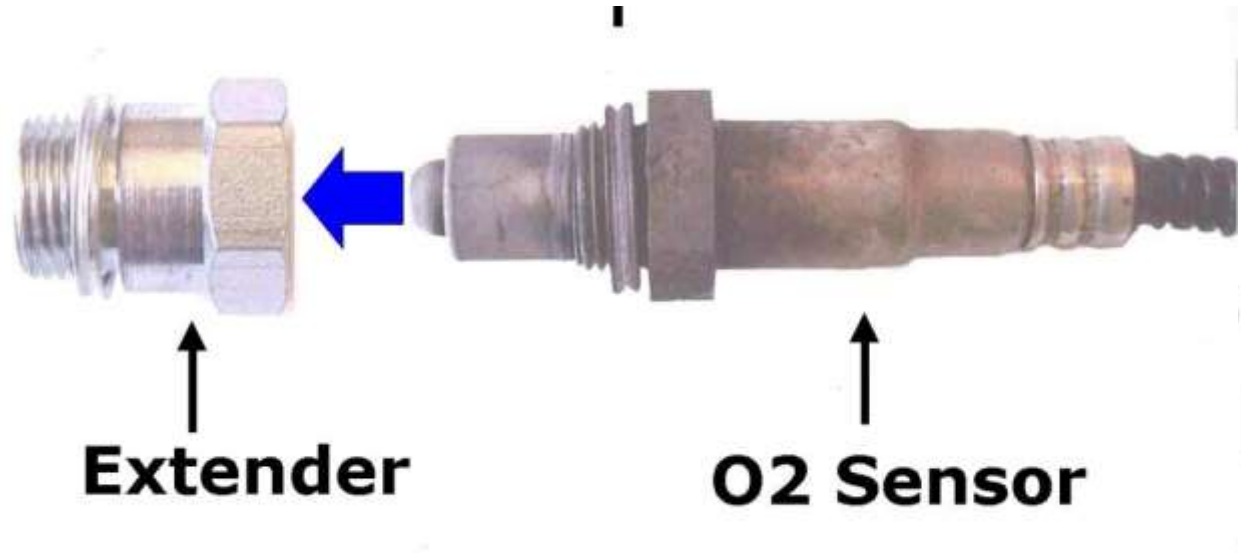
1. **To reset the ECU you simply have to unplug the negative battery cable connection.** Theoretically it is best to leave it in this disconnected condition for as long as you can. Practically leaving it disconnected overnight is more than enough. After having left the cable disconnected for sufficient time you have to connect back the cable. Start the car and keep it running so that it warms up. This would not take more than 10 minutes at the most in summers. Once you have done this you have accomplished the ECU resetting. Shut off the engine. You can now use your car whenever you feel like. ECU resetting is over.
2. **You may also reset the ECU by simply unpluging both the negative and positive battery cable connections and after connect them both together.** Leave them connected around 40 minutes and then connect back the cables to the battery. Start the car and keep it running so that it warms up. This would not take more than 10 minutes at the most in summers. Once you have done this you have accomplished the ECU resetting. Shut off the engine. You can now use your car whenever you feel like. ECU resetting is over.

Installing the lambda sensor extender – Pre-Cat Sensor

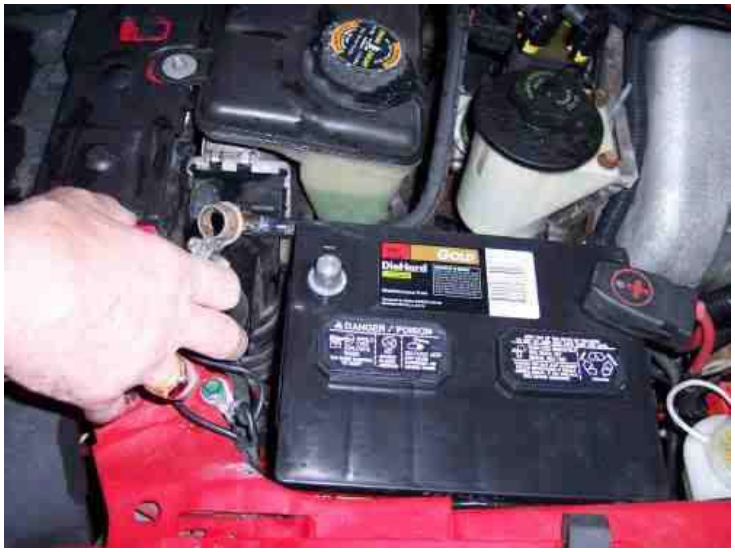
Lambda sensor extenders are used in conjunction with HHO systems. In this type of system the extenders effects a correction voltage back to the vehicle ECU, so that the ECU does not deliver excess fuel to the engine as it tries to compensate for the increase of oxygen in the exhaust - which is a result of burning clean fuels, such as hydrogen.

In practice, this extender stands-off the Lambda sensor from its normal position making the sensor less sensitive to the increased level of oxygen in the exhaust that results from the burning of supplemental (HHO) gas. Only first lambda sensors located between the engine and the first catalytic converter, in each exhaust pipe, needs to be fitted with an extender.

Each Lambda sensor upstream of the catalyzer needs to be mounted on an extender as shown here.



1. Before installation of the extender you should disconnect the battery, making sure any radio and security codes are available to re-enable affected systems once power is restored. If unavailable, the codes are obtainable from a dealership. Disconnect the negative (black) cable from the battery like when you reset the ECU.



2. Unscrew the pre-cat Lambda sensor from the exhaust using an lambda sensor socket or a 22mm wrench. Be careful not to lose the compression washer. Apply penetrating oil around the threads to loosen a stubborn sensor. Inspect the sensor probe. If it is cracked or contaminated, replace it with a new one.

3. Thread the extender into the exhaust, in place of the sensor. Tighten to 50 Nm (37 ft-lbs) maximum. If a torque wrench is not available, tighten until the compression washer starts to crush.

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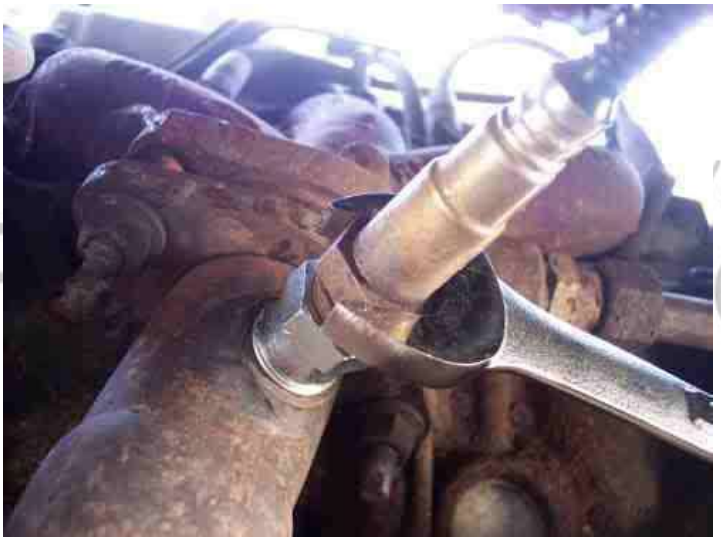

5. Reconnect the negative battery cable. Re-enter any codes. It may take a few days of driving for the ECU to relearn the new sensor position. It is okay if the check engine light comes on while the ECU relearns.

Note: It is good practice to apply a small amount of anti-seize compound (available at most auto parts stores) to the threads of both the extender and sensor before installation.

Use great care in handling Lambda sensors to avoid damage; do not touch, or otherwise contaminate the sensor probe, or element, with compound, oil, etc. Proper sensor function is crucial to good performance and fuel economy.

Isolating the lambda sensor body – Pre-Cat and Pos-Cat Sensors

In the past the downstream lambda sensors were not used in air/fuel ratio calculations. But we are finding quite a few cases where that's not true anymore. Car manufacturers (Dodge/Chrysler, Honda after 2002, Jeep) they are using now also the rear sensors as part of their air/fuel ratio calculations and to control the good performance of the first lambda sensor. So we will need also to make some changes in these sensors.

Test run and checking your work

Start by checking all your connections. Make sure your inline fuse has been installed and everything is in the right position. Now start your engine. While it's running, watch for bubbling action inside the hose coming from the dry-cell and back to the water tank.

Please check the amperage in your system. The generator was made to run maximum at 25A without overheating. If you have a higher amperage values (than indicated in regulation table) you must remove some water+electrolyte from the water tank and add only water, in order to reduce the concentration and, consequently, the amperage. Please verify the starting amperage settings presented previously according to your engine size.

If there is a high variation of the amperage readings then there is some problem causing hydrogen to have difficulties getting out of the cell. Please verify the cell and hoses good positioning.

Please verify if there is not too much foam being produced. In the beginning you may need to change the water after sometime having the generator working.

If you have done everything right, within a short time, you will notice that the engine starts to sound different. It will sound smoother and quieter. Your RPM's may be unstable for a couple of seconds. This is normal, the HHO is starting to change the combustion cycle and the engine is now adjusting to the addition of the mixture. Your RPM's should now normalize after a couple of minutes.

Maintenance

REGULAR MAINTENANCE: Depending on your driving, every week you should check the water level inside the water tank and also the amperage. Refill with destilled water. Refill with water and add a little more electrolyte (if STAFOR HHO PWM electrolyte concentration indicator is low – showing MIN) to allow amperage to be at normal operational values. Verify that all parts are of the system are perfectly placed and in good working conditions.

ANNUAL MAINTENANCE: Every year you should clean the water tank and drycell and remove all deposits. Add 50% isopropyl alcohol to the water solution and leave it in the system without working for 24 hours. Flush the system and add some fresh water to remove all deposits.

Check-list for HHO system debugging

Important information

HHO will improve combustion efficiency. This is a scientific fact. When introduced into the engine along with the petroleum based fuel, it causes the flame speed to increase. This allows more of the fuel to burn during the power stroke. This will just happen. And it will be a dramatic increase over the combustion without the HHO. After the combustion efficiency is improved, the ECU is often fooled by the reduced quantity of unburned hydrocarbons and increased oxygen content, and often will add fuel to compensate. This can ruin your mileage gains.

The simplicity of what we have to do to have a successful HHO installation is get some HHO into the engine and adjust the sensor inputs as necessary so the ECU is not blocking the gains. That's all.

If we can do those 2 things, we will always get vastly improved fuel economy and vastly improved (decreased) emissions. While this checklist was written with HHO users in mind, it will work for any other technology that improves combustion efficiency. You will find that you can adapt many of these steps to apply to whatever technology you are using to debug your project. Other combustion technologies include (but are not limited to): water vapor injection, fuel preheating, fuel vaporizers/atomizers, fuel cracking technologies (using additives to break down the fuel), etc.

You should check out these items working from the top down. They have been ordered this way on purpose so that the most likely problems are higher on the list. Also, the problems that are the easiest to test appear higher on the list than those that are difficult and/or expensive to test for.

The thing you have to realize is that the technology works. And because it does, all vehicles can be solved. If you are having a hard time getting the results you should, you just need to go through these items and find the reasons your gains are being blocked. If you keep at it, you will find the problem and you will get the gains you are seeking.

Check-List

1. **Is your device making HHO?** The most common bug we encounter trying to debug systems is that HHO is not being produced, or is not getting into the engine for some reason. Check your system. Measure the output of your HHO cell by doing a water displacement test. Remember that the system should provide HHO in accordance to regulation table showed at beginning. See if you are meeting that standard.
2. **Is the HHO gas getting into the engine?** We have seen cases where a leak in the system was keeping the hydrogen from getting into the engine. A split hose can cause this, or one that is not attached at all. A check valve oriented in the wrong direction can block the HHO from getting to the engine. One time we found that the lid to a dry cell's reservoir had a leak and when this was fixed the situation resolved completely. Spray your hoses and connections with soapy water to expose any leaks in your system. Check if the water cap is tight (Main reason for problems). Fix any that you find.
3. **Is the amperage on your generator to high?** Another thing that should be checked here is whether your unit is making HHO or steam. Some of the early cell developers would run their units with so much amperage that the unit was producing more steam than anything else. If your unit runs hot to the touch, you must suspect that at least part of your output is steam. One way to test for steam is to run your gas outlet over some ice. If you get significant amounts of fog forming (water droplets), you know that at least part of your output is steam.
4. **Have you reset the ECU?** Old cars do not require any special changes besides tuning the fuel injection pump. But all other fuel injected engines will need to have its electronics handled to get the gains of an

HHO system installation. Normally resetting the ECU will allow good fuel savings. But you may need to handle also the MAF/MAP sensor enhancer and/or the oxygen sensors upstream and downstream of the catalytic converter. Some computers are able to "learn" and adapt to the conditions that exist in your engine. Since you have made a major change by adding an HHO system and EFIEs, you may need to reset the computer to erase what it learned about the system when it was inefficient, and start over again with the new improvements installed. You can reset your computer by disconnecting your battery ground wire from the car, and leaving it off overnight, then reconnecting it again.

5. **Have you tuned the fuel injection pump rate?** Vehicles with carburetors and some diesels (Euros modules I, II and III) do not require any changes except to tune the fuel injection rate to the new air/fuel mixture.
6. **Do your lambda sensors need to be replaced?** Lambda sensors wear out. I have seen estimates that say you should replace them after 50,000 km. In my experience they can get many more miles than this, but if you 100,000 km or more on your lambda sensors you must replace them. It is likely that replacing them will give you a good increase in fuel savings all by itself. We have seen a number of projects completely debug by doing this step alone.
7. **Is there something else mechanically wrong with your engine?** If your engine is working properly, adding an HHO system will not correct that. You will often find that if your engine is not working properly, just fixing it can give you a dramatic increase in fuel savings all by itself. If you had any kind of check engine light before starting the project, you should get this fault explored and handled. If you're not sure, reset your computer, turn off all of your HHO, extender and any other added modifications, and see if you still get a fault code. If so, get it fixed first, before adding your modifications.
8. **Do you need to treat your downstream sensors?** In the past, and in most cases the downstream sensors are not used in air/fuel ratio calculations. Therefore they do not need to be treated. But we are finding quite a few cases where that's not true anymore. Dodge/Chrysler and Honda from about 2002 forward have documented that they are using the rear sensors as part of their air/fuel ratio calculations. Jeeps are doing this also. We have also debugged projects by treating downstream sensors on Ford F-150s and Mercedes, even though there is no documentation that the downstream sensors are used in air/fuel ratio calcs. It is now a primary suspect when fuel mileage is not being achieved when the steps above are all found to be in.
9. **Do other sensors need adjustment?** After treating the oxygen sensors, the most likely sensor still needed to be treated is the MAF or the MAP. In most vehicles you have one or the other, but not both. In some vehicles you both, and when you do, you want to treat the MAF. There is a circuit that will work for this that can be found in A Simple MAF/MAP Enhancer. Note that Ford MAPs usually have a frequency type of output to the ECU. However, in these cases you will usually find they also have a voltage based MAF that you can treat. After treating the MAF or MAP, the other sensors that can be tuned with profit are the IAT (Intake Air Temperature) and CTS (Coolant Temperature Sensor). These are even more easily tuned and this is covered in Tuning For Mileage.

IMPORTANT

All vehicles can be solved. Some of them are a little tougher than others due to the way the ECU was programmed. But they can all be solved. The technology works. If you have gotten to this point and your vehicle is still not been solved, one of the above steps is still out. You need to find it and get it corrected. And then your results will shine through.

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