Heating the 'C' version HyZor
~Version 2~ September 24, 2008
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INTRODUCTION

This is an upgrade option to the version 'C' ER HyZor. If you are unsure of your model type, check the letter in your serial number found on the sticker attached to your ER HyZor after 'ERHZ'. *If you have a model 'A' or 'B' HyZor this upgrade can also be applied and it will raise the electrolyzer efficiency thereby seeing greater mileage gains*.

This document supplements the current instructions included in your 'C' HyZor kit. You now have the option of building one of **two different versions**. Please read all directions carefully before beginning any work. Both versions can be built from the current kit, but you will need to decide which one best fits your needs and application. Converting from one version to the other would require you to cut up the current version and build the other version by reusing the internal plates and purchasing new PVC pipe and fittings.

BACKGROUND

Some of you who have purchased 'C' version HyZors may have already done a gas flow test and found low amperage, resulting in low liters per hour. This is because the 'C' HyZor has 'advanced' built in amperage limiting. This amperage limiting is accomplished by temperature control of the HyZor. The lower the temperature the higher the internal resistance (of the electrolyte) so less amperage is drawn and less gas produced. The higher the internal temperature the lower the internal resistance so more amperage is drawn and more gas produced.

We do not yet know the optimum quantity of Brown's Gas (aka HHO) for any particular application, but we have found, with our HyZor Technology, that the Brown's Gas produced with about 1 amp per liter of engine displacement to be a good rule of thumb. Too much Brown's Gas will actually cause a LOSS of fuel mileage (see the HyZor Technology book for more details).

Most electrolyzers on the market use inefficient methods to control 'amperage runaway' (caused by the 'negative resistance' of electrolyte). The HyZor Technology book gives three efficient methods. The 'C' version HyZor uses the one method that is *designed* to take advantage of the 'negative resistance' characteristic of electrolyte. It allows us to add one more cell (so we have 7 instead of 6) and thus get over 15% MORE gas for the same amperage. We are actually using HEAT (in addition to electricity) to make Brown's Gas.

However, when a 'C' Version HyZor is **cold** (70°F), it will consume less than 0.5 amps, most of this amperage is (at first) **'shorting'** through the gas holes, NOT making gas. The 'C' HyZor requires heat to get the electrolyte resistance down so that enough amperage can flow to generate enough gas to BLOW the excess liquid out of the top of the cells; thereby stopping the 'shorting'. This is the reason that the 'C' HyZor is so inefficient when bench tested 'cold' and with a 12 volt battery.

Once the 'C' HyZor is heated (preferably to about 170°F), provided with at least 13.5 VDC and excess liquid expelled from the cells, it becomes the world's most efficient on-board electrolyzer.

FREE HEAT (energy)

Since the ultimate gain we are after is dependent on efficiency we need to find a source of 'free' heat. Heating the HyZor with electricity from the alternator costs you the gasoline to make the additional wattage (about 7 watts of gasoline for every watt of electricity produced) because of the inefficiencies of the engine, belt drive and alternator. Exhaust heat won't work, too hot and inconsistent (remember the HyZor is made of PVC plastic).

Engine coolant is perfect. It is easily tapped into and controlled. The cooling system takes heat away from the engine via a liquid and runs this hot coolant through a radiator which transfers this heat to the air passing through the radiator. This excess engine heat is generally wasted and does nothing to help move the vehicle at all. This is an ideal heat source. Under normal conditions the coolant cannot get hot enough to cause any damage to the HyZor.

Option #1 HYZOR WITH HEAT

This section describes a simple way to access this source of heat. *See HyZor Technology book for an electronic upgrade that allows precise control of HyZor temperature using engine coolant.*

The best place to tap into the coolant system is in the hoses going to and from the heater core used for cabin heat. These hoses are smaller than the radiator so the proper size fittings are easy to find at a local hardware store. These hoses also have direct, consistent access to engine heat (not surges of heat like would go to the radiator through the thermostat).

The heater core has two hoses. One goes from the engine to the heater core and the other returns back to the engine. The hose to the heater core has higher pressure than the return hose. We will use this pressure difference to our advantage.

The idea is to place a tee into both of these hoses with a smaller - 1/4" hose between the two. This coolant circuit is in parallel to the heater core with the fuel tubing wrapping around the base of the HyZor several times, heating it.

A valve (needle or ball) is placed in this hose to restrict the flow of coolant. If we leave the needle valve out more coolant will flow than needed and reduce heat to the heater core to heat the cabin. This may not be a problem in warmer climates and the needle valve could be left out.

Find out the inside diameter (ID) of these two heater hoses. The size may be printed on the outside of the hose. It is usually about ½" ID. If it is ½" ID then go to Section A. If your heater hose is a different size refer to Section B. The section B method can also be applied to ½" I'D heater hose. Find the radiator hose inside and outside diameter before heading to the hardware store.

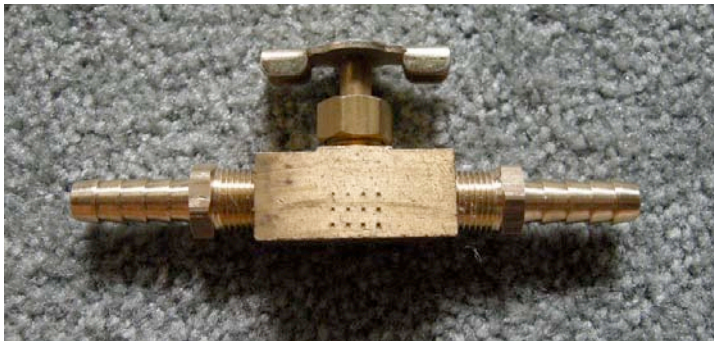
SECTION A (HEATER HOSES WITH A ½" ID)

You'll need the following items from a local hardware store and perhaps a plumbing store for the valve. An alternate source would be McMaster-Carr (their online catalog is easy to use and you can order in small quantities). The outside diameter of the ¼" pipe is actually very close to ½", the hose will fit well over the steel pipe. (If you have 5/8" ID hose, then 3/8" pipe has 5/8" OD) Buy only black rubber fuel tubing as other tubing will not hold up to coolant temperatures. If you can't find the fuel tubing, the local auto store should have it.

- 1/8" tap and an 11/32" proper drill bit
- 2 x ¼" steel (or brass) pipe about 3 ½" long (threaded is ok)
- 2x 1/8" NPT thread to ¼" hose barb
- 2x 1/8" or ¼" NPT thread to 1/4 hose barb - depending on the pipe thread size of your needle valve
- ¼" high pressure fuel tubing, enough to go from one heater hose fitting to HyZor and return.
- 1x needle valve
- 4x hose clamps to fit over heater hose
- 2x hose clamps to fit over the ¼" fuel tubing
- Tie wraps - longer the better
- 'paste' type thread sealant, for the 1/8" threads.

Steel Pipe with 1/8" brass fitting to ¼" hose barb.

To begin your work, drill and tap halfway in the middle of the ¼" piece of pipe. Clamp your work well and file off a small flat spot on the pipe and center punch where the drill will begin so the bit doesn't 'walk' away. Best to drill 3 holes total, starting with a small hole and each bigger than the last with the 11/32" being your last. This will help make a more even hole and keeps the last size from grabbing. Last is to tap the hole, working slowly and reversing the tap a few times to clear out the chips. Don't tap too deep, try your brass fittings to make sure they fit, but don't go in too far. If the brass fitting is in too far it will restrict the flow of coolant to the heater core. Be sure to use pipe sealant on the fitting before screwing it in for the last time. You will need to do this to both pieces of pipe.



Needle valve with two ¼" hose barbs.

Now take the other two brass fittings and again, with pipe sealant, screw them into each end of the needle valve. Now proceed to the installation section.

SECTION B (HEATER HOSES OTHER THAN ½" ID)

You'll need the following items from a local hardware store and perhaps a plumbing store for the valve. An alternate source would be McMaster-Carr (their online catalog is easy to use and you can order in small quantities).

Possible parts to make a T, these are for a 5/8" heater hose. Pipe thread is 3/8".

- Four hose barbs to pipe fitting - hose barb to fit your heater hose and pipe fitting to fit the pipe T
- Two pipe T's to fit the above pipe fittings - use a size that works and the available hose barb fittings will fit.
- Four ¼" hose barbs to pipe fitting - again the pipe size to fit the T, an adapter may be required.
- One needle valve
- Two ¼" hose barbs to pipe size to fit needle valve.

The materials list may seem vague, as I can't say the exact fittings your hardware store will have in stock. It's best to spend some time in the plumbing section and find all the parts that will fit work.

You can make adapters out of hose barbs to fit any size of heater hose. Have these screw into a steel or brass tee and have the ¼' hose barb fitting on the 'T'. A bushing on this side may be needed to make the hose barb fit the tee. Many options are possible. You may even want to do this if you have ½" hose but don't wish to do any tapping. The cost of this is a bit higher than the other version, but assembles quicker.

Completed adapter made out of pipe fittings with attached needle valve.

Completed adapter made out of pipe fittings.

INSTALLATION

Always take precautions when cutting into coolant hoses. It's best to either have a tray of some sort to catch the fluid or drain your coolant system down so the liquid level is below the hoses you are working on. Now may be a good time to change your coolant. Be sure to take the used coolant to a collection place of some sort, don't dump it down the drain or outside, it is poisonous and bad for the environment.

Find a good spot to cut into the heater hoses. Cut the hose in half with a sharp knife. You may need to cut a ½" section of hose to make up for the size of the adapter you are installing. Place a hose clamp onto each side of the hose and install the adapter you just made. If the hose goes on hard, try smearing a small amount of Vaseline (or spit) onto the fitting. It helps to warm the hose too. Tighten the hose clamps to hold the heater hose onto your new adapter.

Often, if you prefer not to cut your coolant hoses, it is possible to add a small length of hose onto your Tee and place the Tee onto the coolant connections at your firewall or on the engine. Just be sure to place the Tee connections on the ENGINE side of the coolant control valve for your cab heater, so you have hot water all the time.

Wrap the fuel hose around the base (the horizontal part of the HyZor) and hold it in place with tie wraps. If the tie wraps aren't long enough you can put 2 or 3 together to get the length required.

ER HyZor with heat option.

Take one end of the hose and place a hose clamp on the end and slide it onto the hose barb on the low pressure return side of the adapter you just built. If you aren't sure which heater hose is which just pick one, it isn't that important. Tighten the hose clamp. The other side of the hose should be attached to the needle valve and a length of hose from the other side of the needle valve to the other (high pressure) adapter.

Double-check all hose clamps and fittings. Add more coolant if needed and follow the manufacturers directions to bleed any air out of the coolant system.

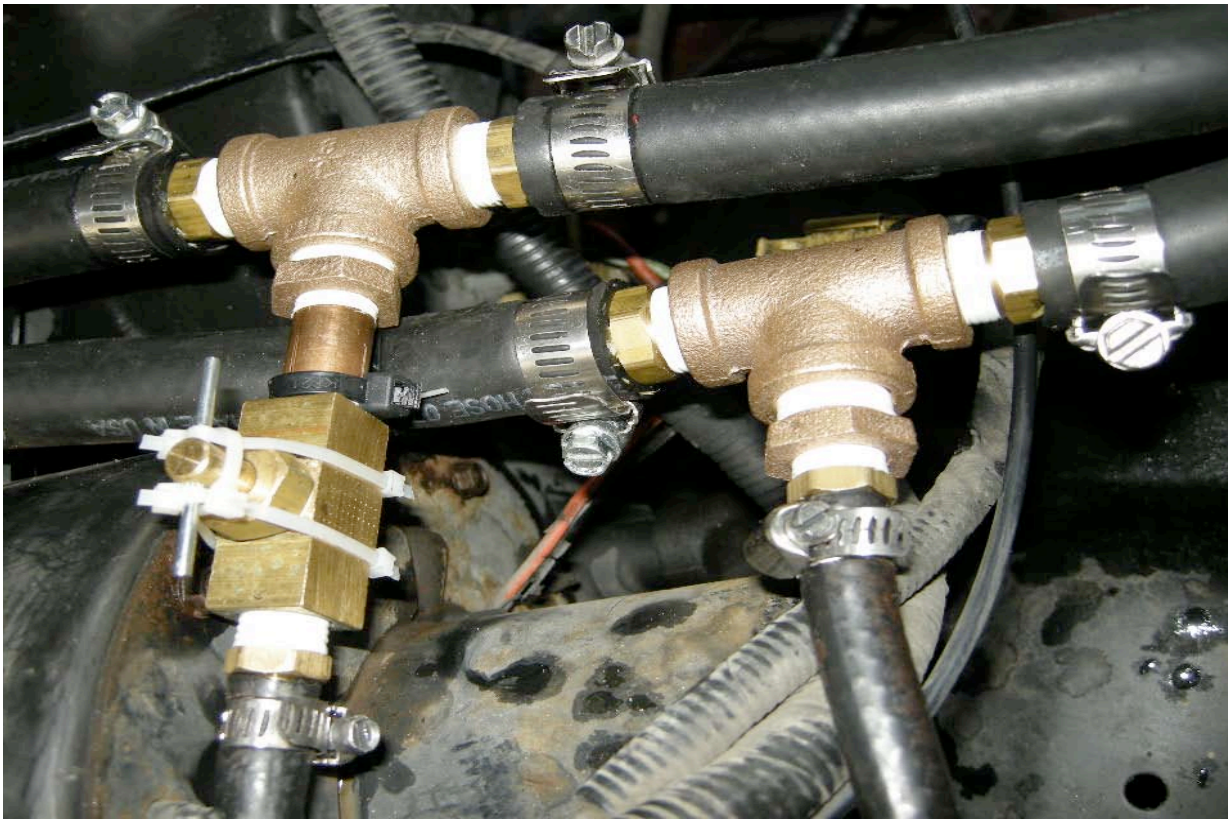
Note: ¼" copper pipe can be used to wrap around the HyZor. About 12' will wrap 5 times around each side.

Insulate/protect with rubber cut from old inner tubes.

Adjust the needle valve to have enough flow to keep the HyZor warm. The amount of heat added to the HyZor will directly regulate the amount of gas the HyZor makes. More heat equals more gas and less heat equals less gas.

An engine smaller than 1.5 liter only needs a little heat. A 5.0 liter engine would need the most heat. Try to regulate the heat so that, when warm, the HyZor is using about 1 amp per liter of engine displacement, then adjust the heat a bit at a time to maximize your mileage gains. The 'C' HyZor shouldn't be heated to more than 170°F or the plastic will get too soft.

The last important point is to wrap wire around the adjustment handle to keep it from moving. This will ensure that the adjustment valve will not back out due to any engine vibration. Not to say every needle valve is loose, it is just insurance that it won't unscrew itself and fall out. If you lose this screw you will lose your coolant.



Both 'T''s installed, T on left is high pressure hose with attached needle valve. T on right is low pressure return.

Option #2 HYZOR WITHOUT HEAT

The other option is to build a HyZor which does not require additional heat. This is ideal for an air-cooled engine, an application where the HyZor does not fit under the hood, or if you simply don't want to splice into your heater hoses. Please do read through both sets of instructions again and make your decision carefully because once built, changing versions is not practical. It is best to find a place to install your HyZor first as the location may make the decision for you.

This version is not quite as efficient as the heated version, but still plenty efficient for a good mileage gain. We will call this the unheated version. If you so choose in the future, heat can be applied to this version and it will help with the efficiency, but it will never be as efficient as the version built for heat.

Construction of the unheated version is much the same as the heated version. The difference being each cell pack is assembled with one less plate and spacer. The length of each cell pack remains the same at 2 3/4". To make up for the missing plate and spacer we make each remaining spacer wider. Each spacer is now 7/16" wide. The wider spacers are otherwise identical in construction.

****Updates will be released as we develop more pictures and receive feedback.****