



Installation Instructions

Hybrid Hydrotech, LLC is proud to offer the HydroTube, the most efficient and reliable Hydrogen gas generator available in its price range.

The HydroTube comes with a 90 day warranty against issues due to workmanship and material defects.

As with any device, proper setup, adjustment, and maintenance of the HydroTube is critical to achieve the best possible gas separation (Hydrogen from Oxygen) and the highest purity Hydrogen gas possible.

Please read the following instructions before installation of the HydroTube.

Improper setup, adjustment, and maintenance of the HydroTube per Hybrid Hydrotech, LLC's requirements will void the warranty.

WARNING: The following actions will void the HydroTube warranty:

1. **Never operate your HydroTube at electrolyte temperatures above 130° F / 54.5° C.** Electrolyte temperatures above 130° F / 54.5° C will damage the internal gas separation membranes. To manage the HydroTube's electrolyte operating temperature, always use a good quality constant current Pulse Width Modulator (PWM).
2. **Never operate your HydroTube at a voltage that it is not rated for.** HydroTube model #'s beginning with HT5-xxx **require** a DC voltage between 12v-14v. HydroTube model #'s beginning with HT10-xxx **require** a DC voltage between 24v-28v. HydroTube model #'s beginning with HT50-xxx **require** a DC voltage of 120v-122v`
3. **Never tamper with, loosen any nuts, or try to remove the outer tube to open your HydroTube:**
This will cause leaks. If a problem should arise, call your Hybrid Hydrotech Authorized Dealer immediately
4. **Never operate your HydroTube above the operating wattage** calculated for the HydroTube model you have purchased.
See "Step 3: Setting the correct amperage:" later in this manual.
5. **Never use a higher concentration of electrolyte than called for in the Installation manual, and only use Potassium Hydroxide (KOH) flakes or powder as the electrolyte.**
6. **Never make your electrolyte solution in the electrolyte tanks! Solutions of water and KOH can cause severe burns.** Mixing KOH with water creates a heat producing reaction that can raise the solution temperature approaching 200°F / 93°C, and can melt containers not designed to withstand these temperatures. Always premix the electrolyte solution in an open, thick plastic container and let it cool down to room temperature before pouring it carefully into the electrolyte tanks.

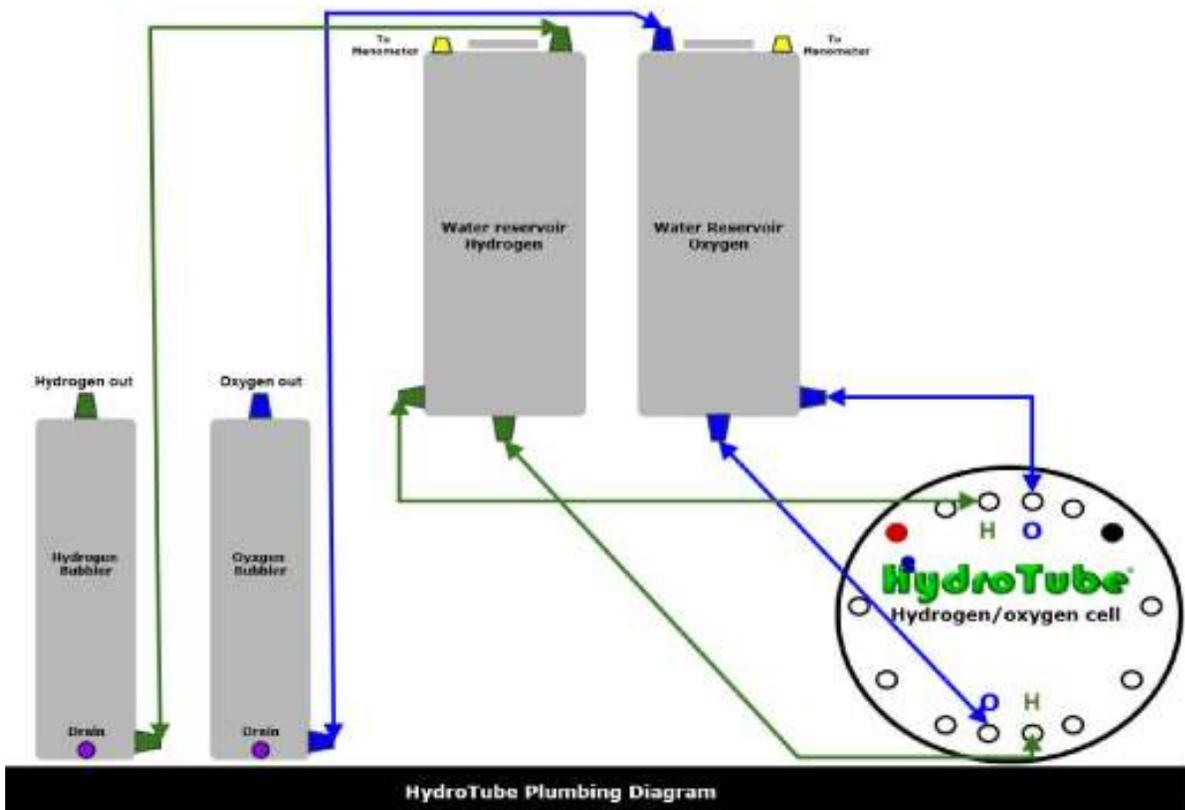
Step 1a: Physically Install and configure the system:

The HydroTube must be installed horizontally, and has been designed to support mounting clamps located within 3/4" of each end of the Tube. **DO NOT place mounting clamps more than 3/4" inside the ends of the tube as this may cause leaking.**

The HydroTube may be installed by supporting it from the top, bottom or side. **DO NOT use the bolts at the ends of the HydroTube as mounting attachment points.**

Insure that your HydroTube's physical installation is done per the diagram on the next page. These instructions assume that the HydroTube has already been electrically connected properly. The following color conventions are followed:

- Red** = Positive power connection
- Black** = Negative power connection
- Green** = Hydrogen
- Blue** = Oxygen
- Be sure to label the Hydrogen tank and bubbler with an "H", or "Hydrogen", and the Oxygen tank and bubbler with an "O" or "Oxygen"



Step 1b: Electrically Install the system:

EXTEMELY MPORTANT:

Make sure that you HydroTube is electrically connected based on the labeling on the HydroTube and the legend above (**Red** = Positive and **Black** = Negative), and that the DC power source voltage is appropriate for the HydroTube you have purchased.

Installation Instructions for the GreenFuelH2O 50-90 AMP Constant Current PWM Hydrogen Power Controller

The GreenFuelH2O PWM FEATURES:

Works with 12 or 24 volt charging systems.

Handles High loads up to 90 amps continuous (model dependent)

Efficient design needs no cooling fan

Constant current function keeps current steady.

Wire gauge size and length of wire are VERY important. The longer distance the electricity has to travel, the lower the wire Gauge should be for the same amount of current. Using the wrong Gauge wire can over heat and melt the wire's protective insulation, burn out the PWM, and possibly catch fire.

8 Gauge: up to 55 amps

6 Gauge: up to 75 amps

4 Gauge: up to 95 amps

Wire connections are very important. Crimped ring wire connection should be secure. The best connection is a soldered connection. Consider soldering the ring ends to your wires. A bad connection will build heat and can burn out the PWM.

Instructional video: <http://youtu.be/ZcmSeLIwgtU> (link is case sensitive)

Internal Connections:

12/24 volt power is connected to the 3 pin external terminal marked **P**.

A 16 to 20 Gauge wire should be used. This wire must be connect to a switch or a relay for emergency shutoff. See diagram

Ground bolt:

Connects directly to the battery negative. Do not ground to the frame if you will be pulling more than 25 amps.

Load Bolt:

Connects directly to the HydroTube's Negative connection.

Remote Console:

Connect a RJ-45 (CAT 5) data cable between the console and the PWM. It will snap into the data ports. A cable up to 8 foot may be used. Over 8 feet and the consoles LED meter will not read properly.

This unit is designed for HIGH power applications over 20 amps. The unit will work under 15 amps but won't regulate as well.

Step 2: Filling the electrolyte tanks and bubblers:

1. Once you have double checked to insure that the physical and electrical installation has been done correctly and power is available when turned on, mix up enough electrolyte, (distilled water and KOH), to fill each electrolyte tank $2/3^{\text{rds}}$ full. The amount of electrolyte will depend on the size of the electrolyte tanks and the model of your HydroTube. We recommend that you initially mix 1 liter of electrolyte at a time. Use a mix of 1 liter of distilled water and 150 grams of KOH flakes. This will yield Hybrid Hydrotech's recommended KOH concentration of 15%. **NOTE: KOH based electrolyte is highly alkaline and can cause sever burns. The mixing of distilled water and KOH flakes causes an endothermic (heat producing) reaction. Always wear plastic gloves and protective eye wear while working with KOH electrolyte.**
2. Make sure that the power to the HydroTube is turned **off** and all drain plugs are closed to insure that the electrolyte doesn't pour out.
3. Pour the electrolyte into each electrolyte tank equally and wait 10 to 15 seconds while it fills the HydroTube. Once you can no longer see any bubbles rising in the tanks, mix and pour in additional electrolyte until the electrolyte tanks are $2/3^{\text{rds}}$ full. Once the tank electrolyte levels have equalized, use a black, permanent ink, felt tip marker to draw a line on the outside of each tank at the water line. (This will be the level that you will fill to each time you add water or when you totally replace the electrolyte. **Be sure to wait until the amounts of electrolyte in each tank have leveled.**
4. Fill each bubbler $3/4$ full with water. In extremely cold environments, use a 50%/50%, or less, mix of water with an environmentally safe, non-polluting, non-foaming, anti-freeze.

Step 3: Setting the correct amperage:

Hybrid Hydrotech recommends that the HydroTube be **operated** at 294 watts/liter/minute of H^2 gas.

The HydroTube's recommended wattage can be achieved in any combination of voltage, within the voltage range of model series being operated, (12-14 volts, 24-28 volts, or 120 volts), and an Amperage that equals 294 watts/liter/minute of H^2 gas, or 325 (S Series) watts/liter/minute of H^2 gas.

For Example: Model# HT5-804 is designed to operate between 12v -14v DC. It is designed to generate 1.7 lpm of H^2 gas at Hybrid Hydrotech's recommended power consumption of 294 watts/liter/minute of H^2 . The general formula to determine the recommended operating amperage at any voltage within 12v - 14v is: Model # lpm of H^2 * 294 / voltage = Operating Amps

At 12 volts the Amperage would be: 1.7 lpm * 294 watts / 12 volts = 43.65 amps

At 14 volts the Amperage would be: 1.7 lpm * 294 watts / 14 volts = 35.7 amps

At 13.5 volts the Amperage would be: 1.7 lpm * 294 watts / 13.5 volts = 37.02 amps

To determine the kWh that a specific Model HydroTube will **consume** over an hour, multiply the Model # H^2 lpm as listed in the Price and Performance section of our web, * 0.294 kWh.

The general formula is: Model # lpm of H² * 0.294 = Energy consumption per hour in kWh

For Example: The HT5-804 produces 1.7 lpm of H² gas when operated at Hybrid Hydrotech's recommended wattage of 294 watts/liter/minute .Therefore the total kWh consumed over 60 minutes will be: 1.7 * 0.294 = 0.5 kWh of electricity.

A kWh calculator is available at: <http://www.rapidtables.com/calc/electric/watt-to-kwh-calculator.htm>

Step 4: Leveling the Electrolyte in the Electrolyte Tanks:

The HydroTube has been designed with inlet and outlet ports at each end of the tube to maximize electrolyte and gas flow. Although the HydroTube will operate using the inlets and outlets on just one side, Hybrid Hydrotech recommends that the ports on both ends of the HydroTube be used. Using all the inlet and outlet ports will smooth out fluctuations in the gas flow and gas pressure variations.

Note: The HydroTube's internal pressures are designed to self balance and will automatically produce +99% pure Hydrogen. However, to ensure that an even amount of electrolyte remains in each tank during operation, make sure that an equal amount of resistance is applied to the gas flow from both the H² and O² tanks.

The following leveling methods have been designed to level the amount of electrolyte in each tank.

Hybrid Hydrotech recommends that Step 4(a) of the tank leveling process be accomplished using a, +/- 10 psi, differential manometer. Use of a manometer for the initial tank leveling reduces this step to a matter of minutes and will insure maximum usable electrolyte in each tank. This type of manometer is inexpensive, and available on the web. Our Authorized Dealers can also sell you this item.

Whether you use a manometer to level the electrolyte in the tanks, or you do a visual leveling, the objective is the same: While the HydroTube is operating you want the level of electrolyte in the H² electrolyte tank to remain equal to, or very slightly below, the level of the electrolyte in the O² tank. Once either of these two leveling methods has been completed, you will produce the maximum H² and O² available from the water in your tanks before needing to refill with water.

Once this pressure balancing process is complete and you've marked the water level lines on the bubblers and tanks, you'll never have to repeat this process again as long as you refill the bubblers and tanks to these water line marks.

During operation, water in the electrolyte tanks is depleted, and water in the bubblers becomes contaminated as it cleans KOH from the gases. Make sure that you periodically check the level of water in the tanks and bubblers and refill both to the water level lines established during the initial tank leveling operation.

Equalizing the Electrolyte tank levels is very easy to do when looking at the screen on a differential manometer, however it is more difficult when visually balancing the HydroTube.

One additional point, if you intend to use the HydroTube to generate Hydrogen gas for storage and compression, you must purchase a Hydrogen purifier and gas dryer to ensure that stray Oxygen atoms and moisture are removed before the Hydrogen gas is compressed. Users of the HydroTube for Hydrogen storage and compression do so at their own risk. Hybrid Hydrotech, LLC does not recommend the use of the HydroTube for storage and compression of Hydrogen gas. Hybrid Hydrotech, LLC will not accept liability for damages, injuries, or death caused from accidents due to the compressing and storage of Hydrogen gas.

Note: If you are using a differential manometer to level the electrolyte tanks, do the following before you begin:

1. Drill and thread a hole in the top portion of each electrolyte tank. The hole will need to be large enough to screw in a 1/8" O.D. barbed, threaded fitting.
2. Connect the manometer pressure tubes to each barbed end.
3. Once the system is balanced, you will remove the barbed fittings and manometer tubes, and either screw a nylon plug in to the holes, or screw in nylon, .5 or less PSI cracking pressure, one way air check valves. We recommend that the check valves be installed to prevent water being sucked into the tanks from the bubblers when the HydroTube is not in operation, and a vacuum in the tanks is created due to electrolyte cooling. If water is sucked up from the bubblers into one of the tanks, it can unlevel the tanks which we just leveled.
4. Make sure that the H² and O² lines from the bubblers are vented to the open air, turn the HydroTube on and allow the HydroTube to run until the electrolyte is at least 100° F / 37.8°C. Turn the HydroTube off at least 30 minutes to let the electrolyte cool. Turn the HydroTube back on until the electrolyte has once again reached at least 100° F / 37.8°C. **Note:** You may see some foaming in the tanks. Do not be concerned. This occurs during the break in of the HydroTube as the plates and gaskets initially release surface oils and other impurities into the electrolyte. It will not affect the quality of the gas. This foaming will go away after the first mixture of electrolyte has been replaced.

Step 4(a): Pressure balancing using a manometer:

This process normally take less than 5 minutes. It doesn't matter what measurement scale your manometer measures in, psi, Mbar, kPa, inHg, mmHg, etc. For these instructions we will use **psi**. (Read your manometer user manual to learn how to use your manometer. It's actually a very easy device to use)

1. Unscrew the electrolyte tank caps 1/2 way to avoid any pressure buildup in the tanks.
2. Connect the manometer and manometer tubes to the 1/8" barbed fittings on the tanks. (As a habit, I prefer connecting the left manometer tube to the Hydrogen tank, but it doesn't matter.)
3. Turn the HydroTube on and let the electrolyte reach an operating temperature of 100°F - 110°F. (37.8°C - 43.3°C)
4. Turn on the manometer and zero out the pressure differential by resetting it. (Please read your manometers user manual to learn how to do this.)
5. Close the electrolyte tank caps. Your manometer will now show a number higher or lower than 0.000. This pressure on the screen will fluctuate slightly. The fluctuation is usually a few 10ths of a PSI. (If you decide stop and restart the balancing process before its complete, repeat steps 1, 4 & 5.)
6. Starting with the Hydrogen bubbler, open the bubbler drain to allow only 1 or 2 drips of water per second.
7. Look at the manometer screen. **If the number on the screen starts to approach zero**, (0.000) then let the bubbler drip until the number fluctuates equally above and

- below zero (for example: (- 0.050 to 0.050). At this point the electrolyte tanks will be level.
8. **If the number on the screen moves + or - .100 psi higher or lower away from zero**, turn off the Hydrogen bubbler drain and open the Oxygen bubbler drain to allow only 1 or 2 drips of water per second. (1 drip per second takes longer to balance, but gives you more time to react and is more forgiving, especially your first time through this process)
 9. Look again at the manometer screen and you should see the number on the screen start to approach zero, (0.000). Let the bubbler drip until the number fluctuates equally above and below zero (for example: (- 0.050 to +0.050) and then close the bubbler drain. At this point the electrolyte tanks will be level.
 10. Turn off the power to the HydroTube, disconnect and turn off the manometer and replace the manometer fittings with a plug or a one way check valve that only lets air in to the tank.
 11. **Note:** If, during your first time leveling, you drain the Hydrogen bubbler to less than 1/2 way full, it's best to refill both bubblers to 3/4 full and start again from step 1. This is because the water in the Hydrogen bubbler acts as a cleanser to strip off any KOH molecules that get attached to the Hydrogen gas. The less water there is in the bubbler, the less effective that cleaning action is.
 12. Now that the electrolyte tanks are level, you should let the HydroTube run for 10-15 minutes and watch the electrolyte levels in the tanks. They will lower as water is used, but the electrolyte should remain level during operation.
 13. **DO NOT FORGET TO DO THIS STEP!**
 - a. Turn the HydroTube **off**.
 - b. When the water in both bubblers are clear of any bubbles, use a black, permanent ink, felt tip marker to draw a line on the outside of each tank and bubbler at the water line. This will be the level that you will fill each tank and bubbler to each time you add water or when you totally replace the water in your tanks and bubblers. **Refilling to these lines ensures that you will get the most gas out of your electrolyte, your gas will be as clean as possible, and you will not have to level your tanks and bubblers again.**

Step 4(b): Electrolyte tank leveling using the visual method:

(A YouTube video is available at <http://youtu.be/TMOEx0Vp088>)

This method requires a little more time, is less accurate than using a manometer.

NOTE: Whether you use a manometer to level the electrolyte in the tanks, or you do a visual leveling, the objective is the same: While the HydroTube is operating you want the level of electrolyte in the H² electrolyte tank to remain equal to, or very slightly below, the level of the electrolyte in the O² tank. Once either of these two leveling methods has been completed, you will produce the maximum H² and O² available from the water in your tanks before needing to refill with water.

1. Make sure the electrolyte tank caps are tightly closed.
2. Turn the HydroTube on and let the electrolyte reach an operating temperature of 100°F - 110°F. (37.8°C - 43.3°C)
3. Look to see which electrolyte tank (H² or O²) has a higher electrolyte level.
4. If the H² tank has a higher electrolyte level, then add a small amount of water (1/4") to the H² bubbler. The level of the H² tank should begin to lower. Wait 15 seconds to

- see if the water in the H² tank is slightly lower (no more than 1/8") than the O² tank level. If it is then the tanks are leveled. If the H² tank level is still higher, add another 1/4" of water to the H² bubbler and wait 15 seconds. Repeat this process until the H² tank level is slightly lower, but not more than 1/8" lower, than the O² tank level.
5. If the O² electrolyte tank has a higher electrolyte level than the H² tank level, then add a small amount of water (1/4") to the O² bubbler. The level of the O² tank should begin to lower. Wait 15 seconds to see if the water in the H² tank is slightly lower (no more than 1/8") than the O² tank level. If it is then the tanks are leveled. If the O² tank level is still higher than 1/8", add another 1/4" of water to the O² bubbler and wait 15 seconds. Repeat this process until the H² tank level is slightly lower, but not more than 1/8" lower, than the O² tank level.
 6. Let the HydroTube run for 10 to 15 minutes to insure that the electrolyte levels have stabilized and that the H² tank electrolyte level stays no more than 1/8 inch below the electrolyte level in the O² tank.
 7. Turn off the HydroTube.
 8. **Note: Please insure that your bubblers are at least 1/2 way filled.** The water in the Hydrogen bubbler acts as a cleanser to strip off any KOH molecules that get attached to the Hydrogen gas. The less water there is in the bubbler, the less effective that cleaning action is.
 9. **DO NOT FORGET TO DO THIS STEP!**
 - a. Turn the HydroTube **off**.
 - b. When the water in both bubblers are clear of any bubbles, use a black, permanent ink, felt tip marker to draw a line on the outside of each tank and bubbler at the water line. This will be the level that you will fill each tank and bubbler to each time you add water or when you totally replace the water in your tanks and bubblers. **Refilling to these lines ensures that you will get the most gas out of your electrolyte, your gas will be as clean as possible, and you will not have to level your tanks and bubblers again.**

Enjoy Your
HydroTube®