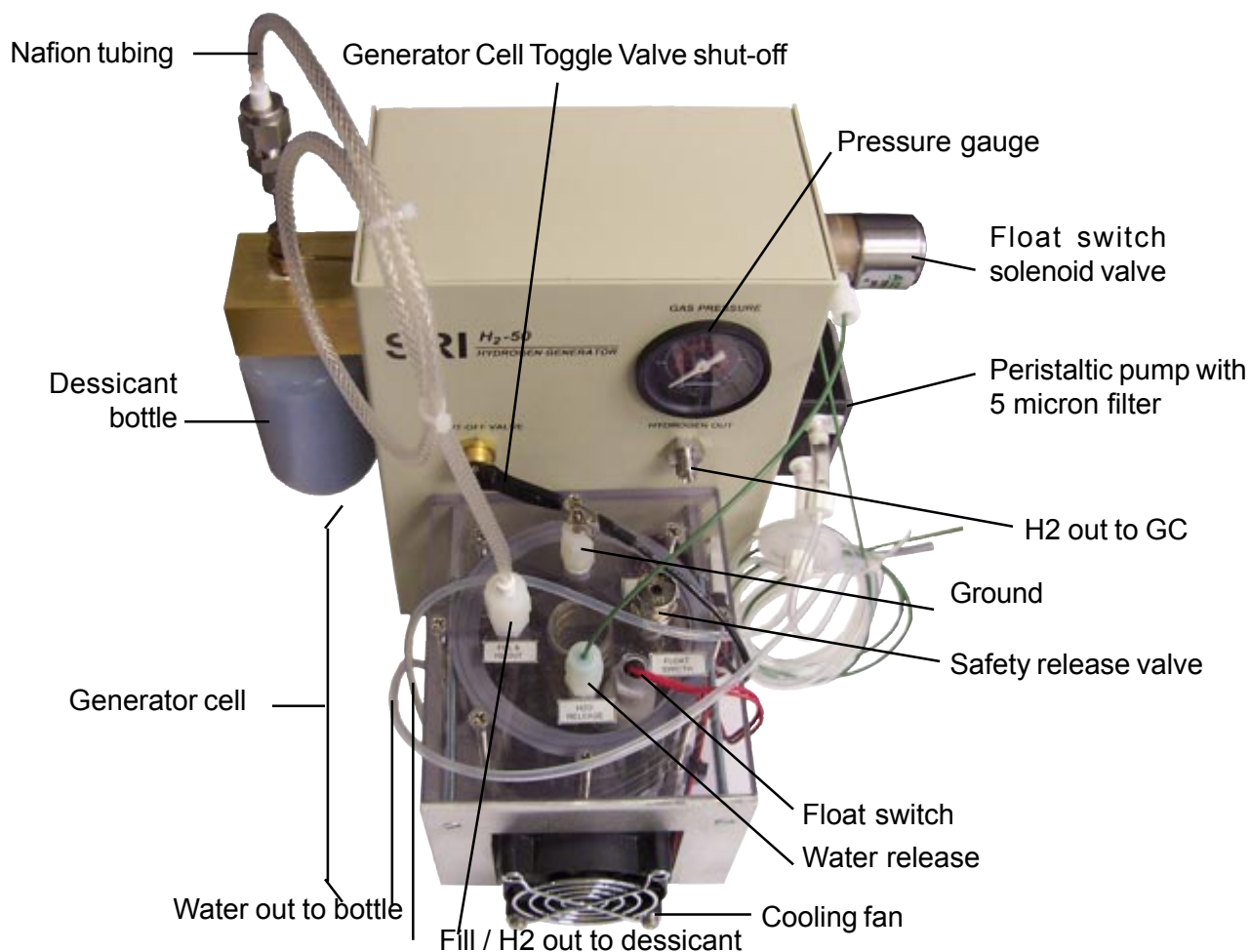


GC ACCESSORIES

H₂-50XR Hydrogen Generator

Overview

The SRI H₂-50XR Hydrogen Generator consists of a generator cell mounted on a metal chassis. The generator cell is attached to the chassis with two screws for easy disassembly. On the metal chassis is a solenoid valve, a pressure gauge, an interior pressure switch, a dessicant bottle, and a toggle valve shut-off for isolating the generator cell. The Nafion tube that connects the cell with the dessicant bottle removes most of the water vapor from the H₂ gas; the rest is removed by the dessicant before reaching the GC column. The dessicant bottle contains Indicating Molesieve dessicant beads which turn from blue to gray when they absorb water. Water is supplied to the generator cell by the peristaltic pump from the provided reservoir bottle. If the water level in the cell gets too high, the float switch opens up the solenoid to drain the excess water back into the reservoir bottle. The H₂-50XR can supply enough gas for a detector or two, plus the GC carrier gas. During operation, there is about 40mL of hydrogen gas stored in the dessicant, which is enough to operate a split injector for short periods, in addition to the detector(s) and carrier. The toggle valve shut-off facilitates checking for leaks and allows the H₂-50XR to reach operating pressure more quickly, while the interior pressure switch maintains the operating pressure. As a safety measure, a pressure release valve protects the generator cell from pressure overload. The external power supply with its own transformer enables the H₂-50XR to operate on various voltages around the world. The H₂-50XR produces 50mL/min at 30psi using distilled water from the grocery store, and can run unattended for up to 30 days.



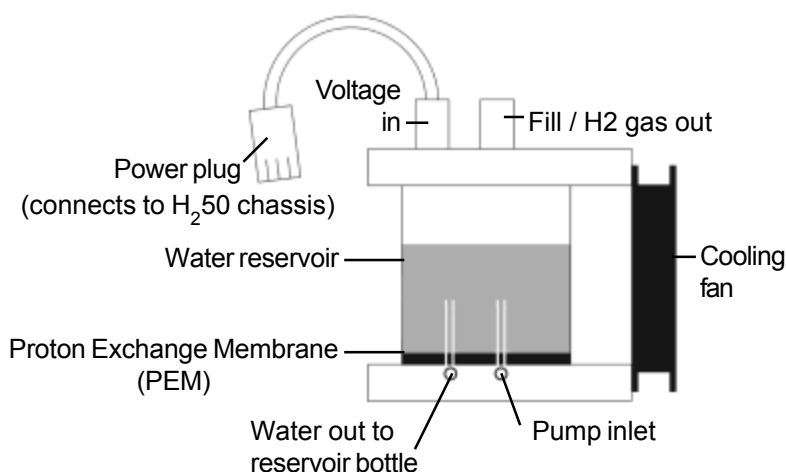
GC ACCESSORIES

H₂-50XR Hydrogen Generator

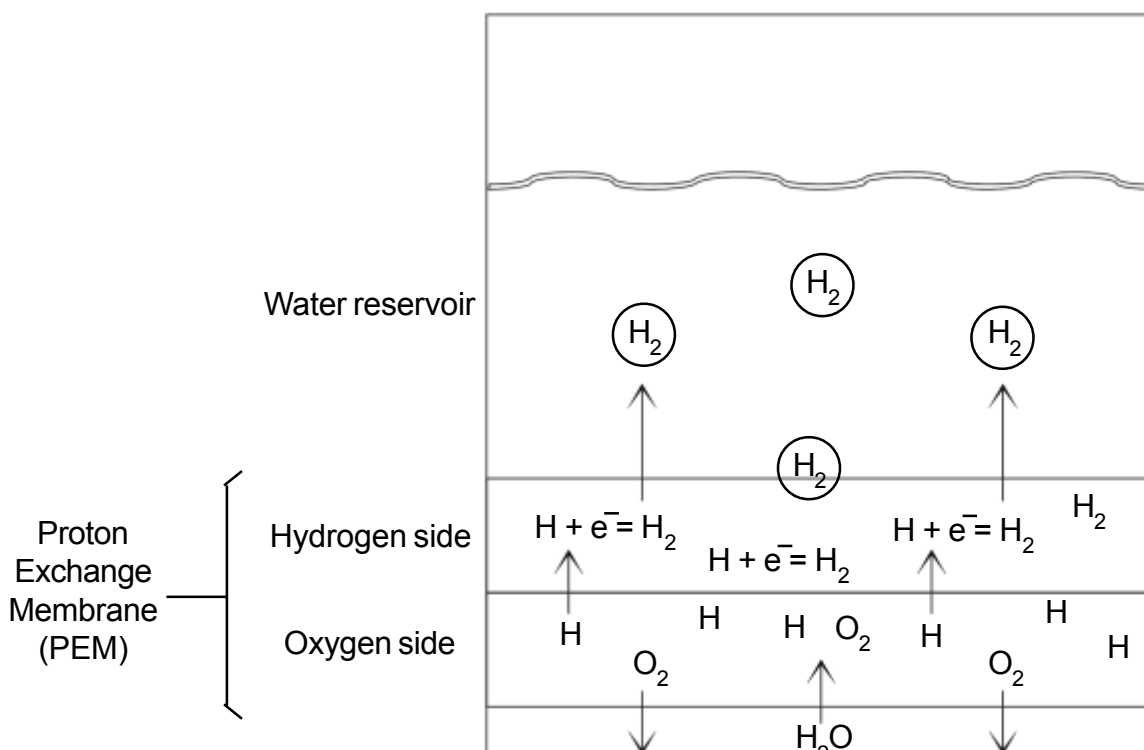
Theory of Operation

The SRI H₂-50XR Hydrogen Generator separates water into hydrogen and oxygen using a Proton Exchange Membrane (PEM). The water on the oxygen side of the PEM is disassociated into O₂ and hydrogen protons. The hydrogen proton is transported through the PEM to the hydrogen side, where it recombines with an electron to make H₂, then bubbles up through the water reservoir.

The H₂50 Generator Cell



Operational Diagram of the H₂50 Generator Cell



GC ACCESSORIES

H₂-50XR Hydrogen Generator

General Operating Procedure

NOTE: Use the H₂-50XR on a flat, level surface, away from open flame and any other ignition or spark sources.

1. Remove the nut and septum with the Nafion tubing from the “Fill/H₂ OUT” port on the top of the generator cell. Use the provided 20mL plastic syringe to inject clean water into the cell through this port. Fill only to cover the plastic disk in the bottom of the cell. The cell will automatically fill the rest of the way when you power up the H₂-50XR. Replace the nut and septum on the “Fill/H₂ OUT” port and 1/4 turn past finger tight. Fill the plastic bottle provided by SRI with the same distilled water used in the cell.
2. There are three tubing lines attached to the H₂-50XR: two clear, one green. Place the ends of all three tubes into the water bottle, through the holes drilled in the lid. The ends of the two clear tubes should be submerged in the water, and the green one should hang just above the water level.
3. Make sure the black ground wire is clipped onto the electrode protruding through the top of the generator cell, and that the red and black power cord is plugged into the H₂-50XR chassis. Then, connect the external power supply cord to the generator and a wall outlet. Make sure you have the correct input cord for the voltage you are using; SRI provides a 110VAC cord. The power supply can run on 100-240VAC. Properly used, the transformer is not a spark source and poses no ignition threats.
4. Make sure the H₂ shut-off valve is closed; the back toggle should be switched back toward the chassis. Always build up pressure initially with the toggle valve shut; it should take 5-15 minutes. The hydrogen gas pressure is preset to 30psi. Once this pressure is attained, the interior pressure switch will shut off the current to the generator. The peristaltic pump will shut off, and water in the generator cell should then stop bubbling.
5. Wait about 10 minutes to ensure that the 30psi pressure is maintained. If pressure is not being maintained, there is probably a leak. Check the dessicant bottle: it should be snug against the o-ring. Make sure the “Fill/H₂ OUT” port nut and septum are snug and intact. Check the bottom of the water reservoir around the PEM for moisture to ensure cell integrity. If you find any seepage, carefully tighten each of the eight screws that hold the cell layers together; don't force them. If you find no indication of a leak after 10 minutes of stabilization at 30psi, open the H₂ shut-off valve by pulling the black toggle switch out away from the chassis. Pressurize and release 2-3 times to get rid of oxygen and nitrogen left in the cell after filling.
6. Connect the “H₂ OUT” fitting on the H₂-50XR to the GC's hydrogen gas inlet with 1/8” or 1/16” O.D. tubing. Now the hydrogen gas will flow into the connected GC.

GC ACCESSORIES

H₂-50XR Hydrogen Generator

General Operating Procedure continued

Recharging and Replacing the Dessicant Beads

Periodic recharging of the dessicant beads will be necessary as they absorb water during operation and turn grey.

1. Before you loosen the dessicant bottle on the H₂-50XR chassis, vent the hydrogen pressure in the generator cell by unscrewing the nut capping the "H₂O RELEASE" port on the top of the cell. It will hiss audibly until the pressure is released.
2. Dry the dessicant beads by pouring them onto a paper plate and cooking them in a microwave oven for 2-3 minutes. Or, pour them onto a glass or metal pan and bake them in the GC oven at 250°C. Do not microwave or bake the plastic dessicant bottle. The dessicant beads can be recharged over and over again; they last indefinitely. Should you need them, dry dessicant beads are available in kilogram quantities from Alltech (1-800-ALLTECH; part # 05553).
3. Let the beads cool, especially after microwaving them. Refill the dessicant bottle with the dry, blue beads.
4. Replace the bottle on the H₂-50XR chassis and hand tighten it. There is an o-ring that engages with the bottle top; tighten the bottle until it is snug against the o-ring.
5. The dry dessicant contains some air which will purge out during the first few minutes of operation. You may notice your retention times change temporarily since the carrier gas may initially be a mixture of hydrogen and air for a few minutes after dessicant replacement. The FID flame may also be hard to light until pure hydrogen comes through. You can speed up this equilibration process by building up pressure in the generator cell then venting with the toggle valve 2-3 times before reconnecting the H₂-50XR to the GC. Keep in mind that the internal pressure switch will cut the current when the cell reaches 30psi, so you don't need to build up too much pressure before venting it. Experiment to learn what works best for your particular GC system.

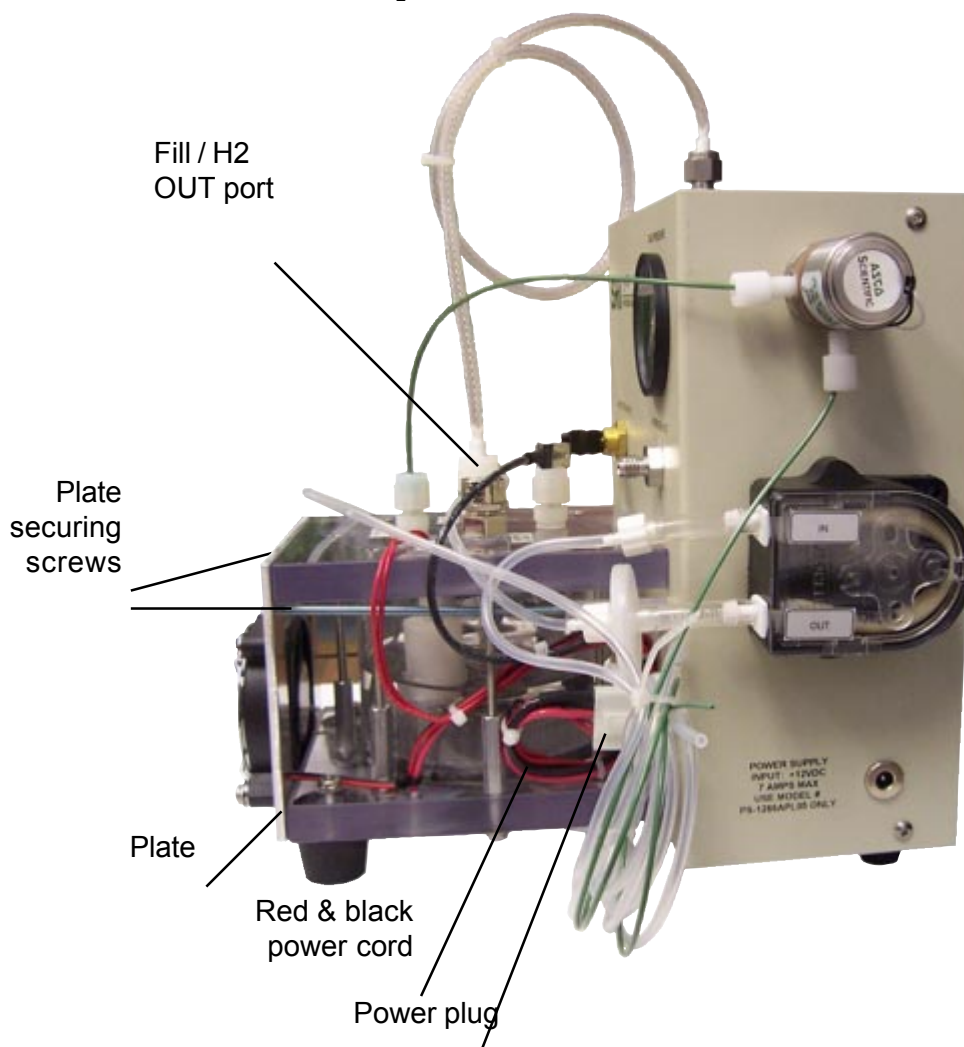
GC ACCESSORIES

H₂-50XR Hydrogen Generator

Maintenance and Troubleshooting

If the water in the H₂-50XR water reservoir looks cloudy, it needs to be replaced:

1. Remove the nut with the septum from the “Fill / H₂ OUT” port on the top of the generator cell.
3. Turn the generator over and pour the water out. When the water is almost all out, shake the generator to help it drain.
4. Use the syringe to refill the water reservoir with clean, distilled water through the “Fill / H₂ OUT”.
5. Replace the nut and septum on the “Fill / H₂ OUT”.



See the following page for PEM replacement

GC ACCESSORIES

H₂-50XR Hydrogen Generator

Maintenance and Troubleshooting continued

If the Proton Exchange Membrane (PEM) changes color, it most likely needs to be replaced. New H₂-50XR PEMs are available from SRI under part # 8690-0151.

1. Put the replacement PEM in clean distilled water to soak while you take apart the generator cell.
2. Remove the generator cell from the H₂-50XR chassis: unplug the red and black power cord from the chassis, un-clip the black wire from the ground, and unscrew the two screws that hold the clamping plate against the cell.

3. Loosen the eight screws that hold the water reservoir with a philips head screwdriver. Loosen each screw in increments; first one, then the one opposite, and so on in a star-like pattern. As you progress, be mindful of the spring in the water reservoir; don't loosen the screws too suddenly, or it may pop open the reservoir, presenting safety and damage risks. You can feel the pressure of the spring relax as you loosen the screws sufficiently; hold the top of the generator cell firmly with one hand while loosening the screws with the other.

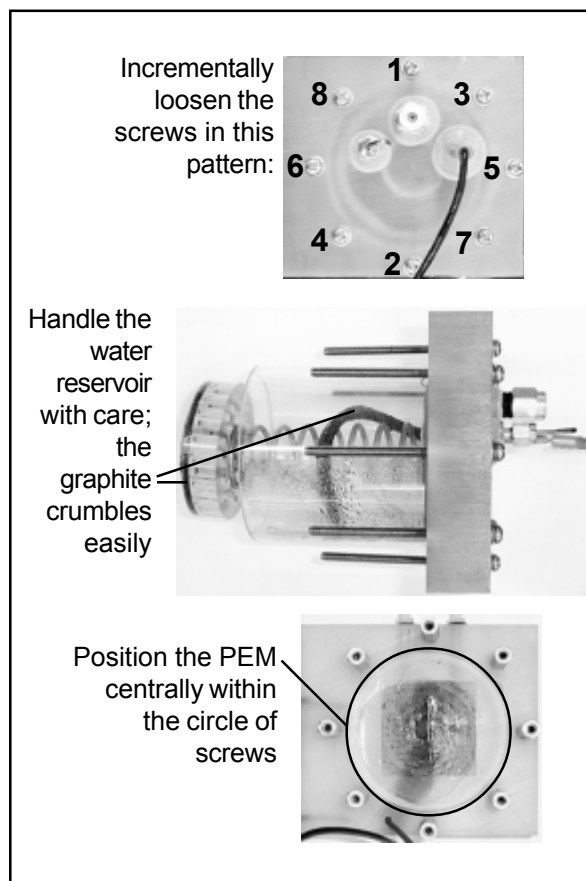
4. Once the screws are removed, carefully take the water reservoir off the bottom of the cell and remove the old PEM. Be very careful handling and moving the graphite coil, as it can easily come apart.

5. Take the new PEM out of its bath and position it centrally within the ring of screws. Place the water reservoir back on the bottom, over the PEM; the PEM should protrude slightly on all sides of the water reservoir.

6. Once the PEM is properly positioned, tighten the screws in increments until the water reservoir is snug against the bottom of the generator cell.

7. Put the generator cell back on the chassis and secure it with the plate and two screws. Plug the red and black power cord into the chassis. Clip the black wire onto the ground.

8. Plug the H₂-50XR into a wall outlet and pressurize the generator cell to 30psi. Check the bottom of the water reservoir around the PEM for moisture; if you see any seepage, tighten each of the eight screws a little more.



WARNING!



Warnings and Safety Precautions:

The H₂-50XR generates hydrogen, which is an extremely flammable gas. Under normal operation, the safety features of the H₂-50XR protect the operator. However, operators must use common sense and take basic precautions. Hydrogen burns with a flame that is invisible to the naked eye. Do not use the H₂-50XR near any flames, sparks, or sources thereof, including lab ovens, heater elements, bunsen burners, torches, etc. Hydrogen is non-toxic, but it can cause asphyxiation in confined spaces by displacing oxygen. Use the H₂-50XR in a ventilated room with an ambient temperature of 40-100°F. If the GC power is interrupted or cut off during hydrogen generation, flip the toggle valve to isolate the generator cell, then disconnect the external power source from the H₂-50XR and the wall outlet. This is a good general response in any situation of uncertain risk; if you're not sure what's happening, isolate the cell and pull the power plug. That way, you can take the time to diagnose any problems without H₂ accumulation. Familiarize yourself with the safe operation of the GC (or other equipment) to which you intend to connect the H₂-50XR.

WARNING!