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The ER50 is a uniquely efficient electrolyzer that splits water into a high-energy hydrogen and oxygen mixture called 'Brown's Gas' (BG).

ER50 (Basic) Kit ~ mini BG Electrolyzer
Version 170124 ~ Assembly • Operation

For Project SUCCESS

Read this instruction booklet carefully and completely, comparing parts to tasks. Gather the supplies and tools needed. *(see sidebars pgs. 1 & 4)*

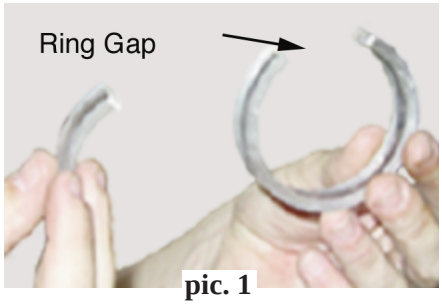
More tips and the most up-to-date construction information about the ER50 is in the ER50 Resources; which can be accessed through your Eagle-Research user account. We recommend that you fully check out the ER50 Resources **BEFORE** starting assembly.

Clean plastic residue off all kit parts.

Step 1, Cut Rings

Following the ER50 Cut Chart, *(see fig.3, pg. 4)* cut 42 spacer rings 9/32" (7mm) wide from the white pipe.

It's OK for the edges of the rings to have 'saw marks'.

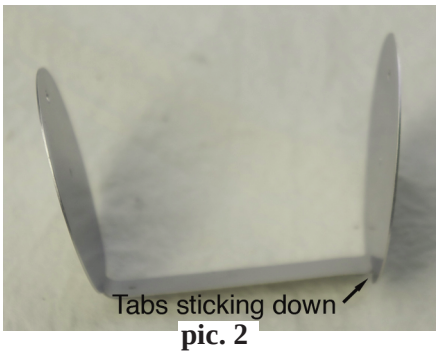


pic. 1

Cut a 2" (50mm) 'gap' out of each ring, *(pic. 1)*, so they can be compressed to slide into the cell tubes. *You can cut out blemishes as you make the ring-gaps.*

Step 2, Neutral-Zone

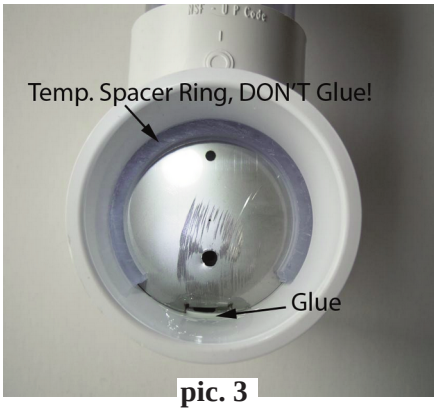
Bend neutral-zone plate as per (pic. 2). *Make sure the tabs are fully exposed.*



pic. 2

See (pic. 3) and PVC glue the larger side of the neutral-zone into the Tee. *This assures that the neutral-zone does NOT turn when the cell-pack is turned and pressed into place.*

Put glue *only* around the area where the tabs *will be*, then slide the neutral-zone into place (adjust so bar is on bottom of the Tee) and then *add more glue* on the outside of the tab-gap.



pic. 3

SKILLS NEEDED
- ☐ Use Band or Miter Saw
- ☐ Prime & Glue PVC Pipe
- ☐ Wrap threads with Teflon tape
- ☐ Wire a timing switch.

TOOLS NEEDED
- ☐ Miter, band and/or hacksaw
- ☐ 12' of 2x2 block (shave edges)
- ☐ 1 foot long 1/8" metal rod
- ☐ 1 quart (liter) glass jar
- ☐ Table knife ☐ Sharp knife
- ☐ Mini snap blade utility knife
- ☐ Roll of electrician's tape
- ☐ 3/8" box end wrench
- ☐ Wooden chop stick
- ☐ Terminal crimpers
- ☐ Vice ☐ Wire cutters

SUPPLIES ~ not included
- ☐ PVC Primer and Glue
- ☐ Teflon thread sealant tape
- ☐ Sodium Hydroxide (pure lye)

PARTS ~ not included
- ☐ Assorted plastic wire ties
- ☐ 18 gauge stranded wire, red, white & black
- ☐ Appropriate VAC power plug
- ☐ 1 x timing switch / cover
- ☐ 2 x #10 ring terminal ends
- ☐ 10 x 1/4" female terminal ends
- ☐ 1 x electrical box/ cord/ clamps
- ☐ 3 feet of ¼" ID clear vinyl hose
- ☐ 1 x check valve (for water in)

tools & parts ~ cont'd on pg 4

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ASSEMBLY TIPS

- *Taking the time* to measure, cut, glue and assemble with precision is essential to achieving the best performance from your ER50.
- When wrapping Teflon tape, make sure that the trailing end is tight as you turn. Wrap in the direction as if screwing in fitting.
- Use ONLY Teflon tape for thread sealant. No other sealant is compatible with the lye solution. *PVC compatible plastic epoxy is OK to use as a thread sealant.*
- PVC glue hardens in seconds. Take small steps & work quickly. Push fittings together firmly with a fast, smooth 180° twisting motion (*to eliminate bubbles that would cause leaks*). Make sure the fittings are oriented correctly as they come to their final position, and hold for 10 seconds after FULLY seated to prevent bounce-back.

LYE HANDLING SAFETY TIPS

- Use extreme caution when handling the lye solution. *Clean any spills immediately with lots of water & wash until the slippery feeling is completely gone.*
- In a well ventilated area, mix 30 grams of sodium hydroxide (lye) into 750 gms of pure water. Pour the lye into the water slowly. Stir constantly.

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ER50 (Basic) Kit ~
mini BG electrolyzer Version 160227
Assembly, • Operation

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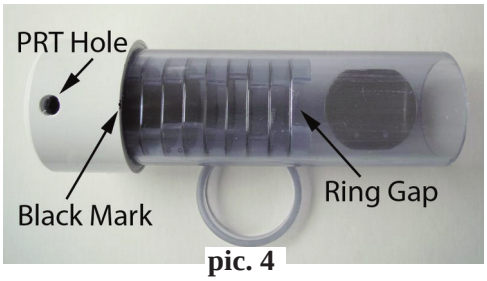
Quickly wipe off any glue that gets on area that would prevent the cell-pack from sliding smoothly into place.

Then to hold the neutral-zone in place until the epoxy cures, I use a cut ring **and** a whole ring; *taking care NOT to glue the 'holding' rings in place*! Remove these rings after glue drys.

Step 3, Make Cell-Packs

The holes in the top of the cell-pack-caps **are to be UP**, *for the PRT tubes*.

Make a mark on the 'top' (outside) of the end-cap, *that you can see as you look down the tube*, in line with the hole on top, so you can use it as a reference to line up the plates.



pic. 4

Tip: *To avoid putting pressure on the terminal bolts, stand the cell-pack assembly on a roll of electricians tape.*

Start with a ring and end with a ring, alternatively insert plates and rings into the 2 cell-tubes.
Large flat side of plate to top.


pic. 5

Put the ring gaps to the top of the cells.

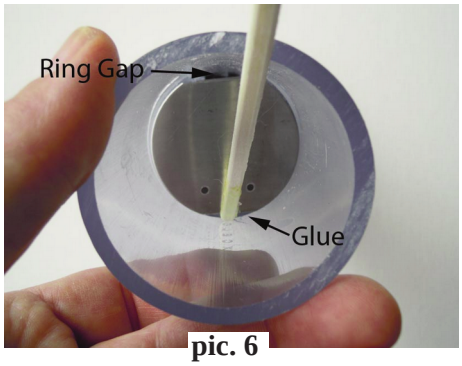
Push and compress each ring into place with your ring-pushing 2x2 plunger.

As plates are inserted, put a small dab of PVC glue at the bottom of each plate, to fill the lower 'flat' area. *This stops plates from rotating in tubes.*

I use a small wooden rod (like a Chinese chop stick) to dab the glue.

Don't let any glue touch where it's not supposed to be (pipe/plates/rings).

TIP: *Put a bit of glue in a plastic cup, to dab with, so the can doesn't dry out too fast*.
TIP: *I put the glue on the pipe just in front of the plate so that the next ring sliding down will push the glue into the gap*.



pic. 6

End the cell-pack with a ring and cut off any excess plastic even with the outer edge of the last ring. Make the end-cut square even if the ring doesn't come out to the end all the way around.

Step 4, Chamber Assembly

Glue the cell-packs into the Tee. *Start with the side of the Tee that has the larger barbell plate*.

Start with the cell-pack 180° off and rotate into place as you push in the cell-pack.
I advise to do most of the 180 turn during the first 2/3 of the insert. *You might not be able to continue to turn the pipe if you push it all the way in*.

The reason for the turning the pipe as it is inserted, is to eliminate possible air

bubbles that would then cause leaks. Make sure the top of the plates are up when the cell-pack is 'seated'.
Your 'end-cap mark' will help get the orientation correct.

See PVC gluing tips in sidebar.

TIP: *It helps to leave the PRT vinyl hoses off until the PVC glue dries.*

Step 5, Tower Cap Assembly

The 2 threaded holes, 90° apart, in the Cap Assembly are for the BG gas-out and water fill.

Use 3 wraps of Teflon tape around the threads of the 'water in' and 'gas out' fittings. Screw in the fittings so they orient conveniently.
NO need to tighten excessively, the teflon tape seals really well.

Let the chamber sit for at least a week so the PVC glue will completely cure.

Do not pour the lye solution into the ER50 until you **do NOT** smell glue.
*Uncured glue causes the gas from the ER50 chamber to smell and taste **bad**.*

Step 6, Electrolyzer Stand

See right sidebar.

Step 7, Power Supply Assembly

120 VAC on North American power grid has a power (P) and neutral (N).
P is the small slot and N the larger.

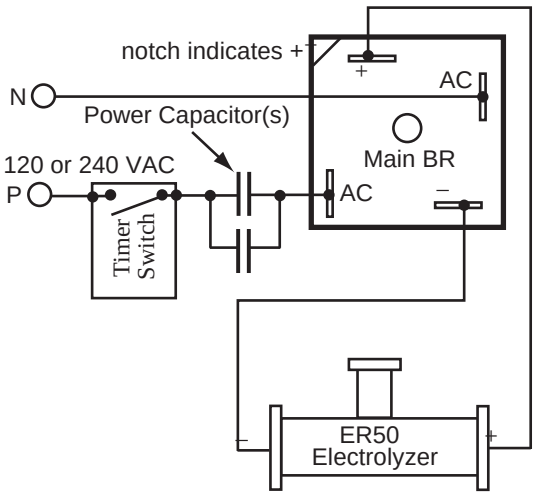


fig. 1

Be sure to observe proper wiring as per the schematic. *(see fig. 1)*
For 220 VAC wiring, just put P to both the AC legs in the fig. 1 schematic.

This ER50 uses a 'double-nut' system to securely hold the wire terminals onto the chamber end cap terminal bolts.
DO NOT allow the inner nut to turn as you tighten the outer nut into place.

Hold the wire's terminal end securely while you tighten the outer nut against the terminal end.
This is to prevent the terminal-plate bolt from turning, which would break the liquid-tight end-cap seal and cause lye leakage.

Step 8, Pressure Relief Tubes (PRT)

Once PVC glue is completely cured (**no glue smell**), you can screw the PRT fittings into place.
Teflon tape, glue or epoxy the fittings.
One at each end of the cell tubes and one on each side of the tower.
Then put the PRT tubes on, cutting them to length to make a smooth upward curve and clamping them with the plastic clamps.

Step 9, Add Electrolyte and Seal

Carefully pour the lye (*see sidebar pg. 2*) into the chamber through the open GS tower. *A funnel can be made by cutting the top off a plastic pop bottle.*

Wrap 7 times of Teflon tape around the top 3-5 threads of the GS tower.

Screw the cap-assembly onto the tower, hand tighten (no wrench needed).

Put the 1/4" rubber cap on the water-fill fitting and put a check valve and vinyl tubing on the gas-out fitting.
Make sure the check valve is oriented to allow gas to flow OUT of the electrolyzer.

WIRE COLOR CODES
black = AC power
white = AC neutral
red = DC positive
black = DC negative
The electrical components with the ER50 Kit are compatible with 110 ~ 220 VAC - 50 ~ 60 Hz power anywhere in the world.

Step 6, Electrolyzer Stand

Fasten the electrolyzer chamber, timer switch, full wave (main) bridge rectifier and the power capacitor(s) on an appropriate stand; so that the switch is easily reached without shock hazard from high voltage terminals.

A mounting stand can be as simple as a couple of pieces of ½" plywood Tee'd with a 2 x 2.

A full enclosure can help reduce electrical shock hazard and make it easier to transport.

The enclosure can be made of wood, plastic or metal.
Here are some considerations:

The terminal bolts must not touch any electrically conductive surfaces.

You need to be able to see the water level.
If you can't see the water level you need to add a float switch.

You need ready access to add water to the chamber.

The chamber needs to be mounted in an upright position.

The chamber needs to be easily removed so that it can be drained and cleaned.
I recommend a cleaning about once a year.

Plan how the electrical wires will be routed. *If you route the wires through metal, be sure to use a grommet (or equivalent) to protect wires from sharp edges of metal.*

continued from page 1

PARTS ~ included

- ☐ 2 x 11" long Trans. PVC pipe
- ☐ 2 x cell-pack tubes / Caps, 3/16" O-rings, terminal plates and #10 nuts pre-installed
- ☐ 1 x 2" Cap Assembly
- ☐ 1 x 2" PVC Tee Assembly ~ with GS Tower glued on,
- ☐ 40 x internal plates
- ☐ 1 x neutral-zone plate
- ☐ 2 x ⅛" MPT 90° to ¼" barbed
- ☐ 4 x ⅛" MPT to 3/8" barbed
- ☐ 4 x 1/2" plastic clamps
- ☐ 20" 3/8" ID vinyl hose
- ☐ 2 x 40 uF Capacitors
- ☐ 1 x 1¼" rubber cap
- ☐ 1 x bridge rectifier
- ☐ 1 x 10 ml syringe (for water fill)
- ☐ 2 x 10x24 stainless steel nuts
- ☐ 1 x check valve (for 'water in")

- **WARNINGS:** The ER50 must NEVER run out of water or it will melt down, spilling lye. Check the liquid level each time you start the timer. Do not allow the liquid level to drop more than 1/8" below the gas hole in the plates.

Over filling, so the plates are covered, is not preferred, but OK.

- **NEVER** block the basic ER50 gas output because the gas pressure will rise until the chamber bursts. *Unless you have a pressure control*.

- The ER50 gas output is a combustible, explosive mixture if ignited. **Do NOT ignite** the gas coming out of the hose or your chamber will burst. *Unless you have backfire protection*.

There are upgrades to allow the ER50 to be pressurized and the gas ignited, for use as a mini-torch.
See ER50 Resources for info.

Step 10, Operating the ER50

The ER50 will get warm during operation, which causes gas to expand. As the gas cools it reduces in volume, creating a slight vacuum.
If you have the 'gas out' hose in water (like in a bubbler), this vacuum may cause some of the water to get sucked back into the ER50 chamber. This is why we add a check valve to the gas output hose, *to stop backfilling*.

ER50 WATER LEVEL
The one thing that KILLS ER50s faster than anything else is LOW WATER LEVEL.
If the water gets too low, the electricity starts to jump from plate to plate (because it doesn't have water to go through). These arcs can cause both internal explosions AND excessive heat that melts the plastic.

While the liquid level only needs to be even with the top of the plates, in this version of the ER50 I recommend a higher liquid level.
I recommend that the water level, *when the ER50 is NOT producing gas*, is to be at the **bottom** of the clear tower tube.

When I was first developing the ER50, I melted two of my own units because I'd walk away and leave them running.
That's why I now use a timer switch, so that they will automatically shut off.

CHECK the water level every time BEFORE you turn on the ER50.
The ER50 will use about 10 mL of water for every hour of use.

PURE WATER ONLY
Use ONLY distilled water to re-fill the ER50. All other water contains impurities that will cause foam and build up sludge in your cells.

Filling the electrolyzer with water is easily done by filling the syringe with PURE water and squirting it into the 'water fill' fitting. Keep the rubber cap on whenever not actually filling the ER50.

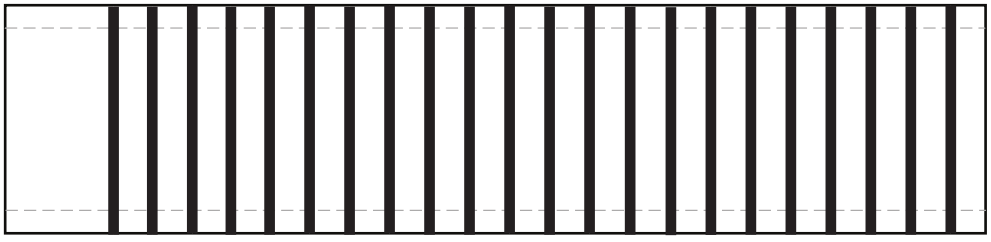
An option is to use another check-valve on the 'water-fill' fitting, so that you do not lose gas pressure as you fill the ER50. *This prevents contamination of the BG with air*.

Cutting Rings tip:
I've found that, when using a power saw to cut plastic, that a 'plywood' cutting blade works best.

These instructions were state of art when this kit was developed but kit changes are always happening.

Go online to your Eagle-Research ER50 Resources to find the latest instructions, tips, corrections, upgrades and options.

Fig. 3 Cut 42 of 9/32" rings from the 2 white schedule 40 PVC pipes



If using a rotary miter saw, use 'plywood' cutting blade. Fix a block in front of the pipe to hold rings from flinging.