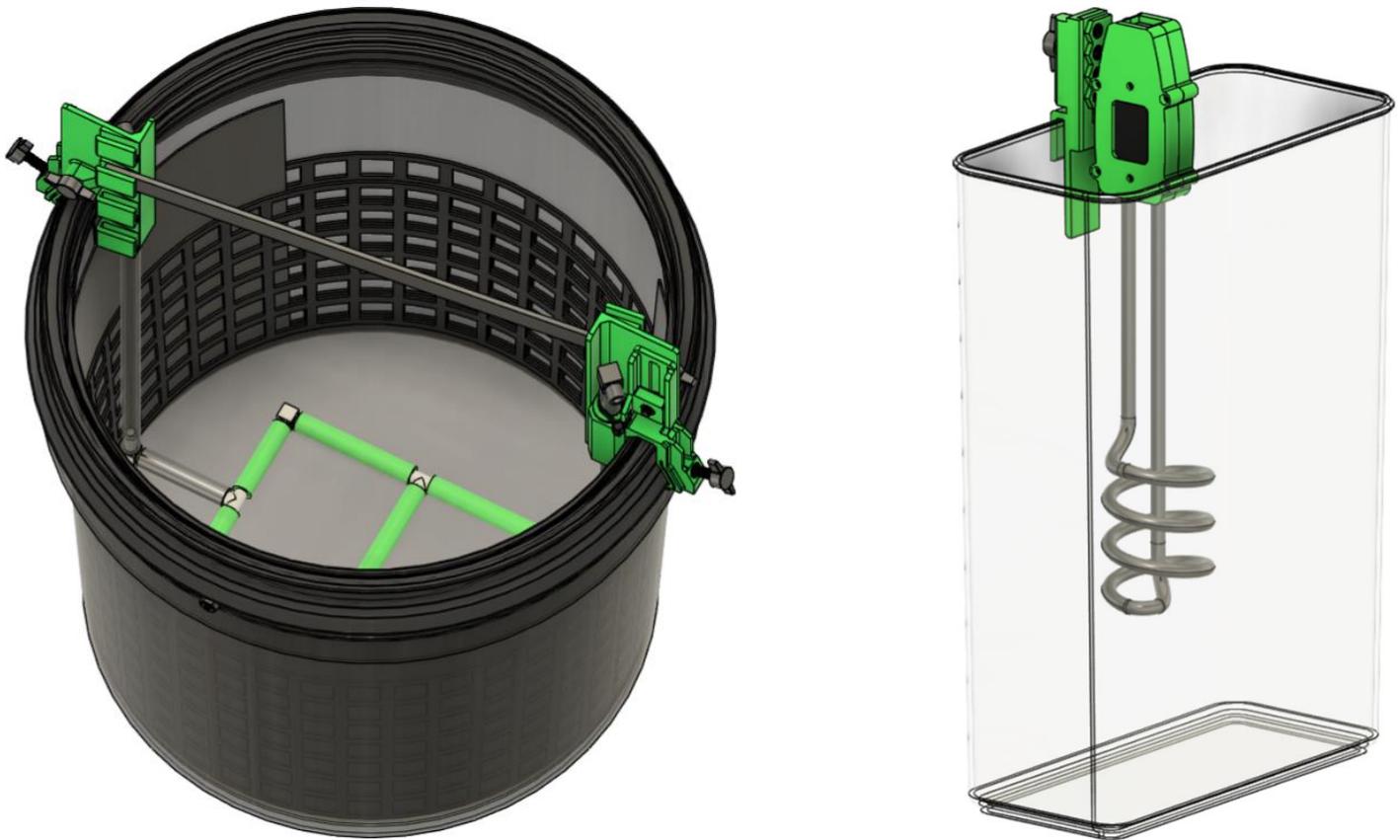
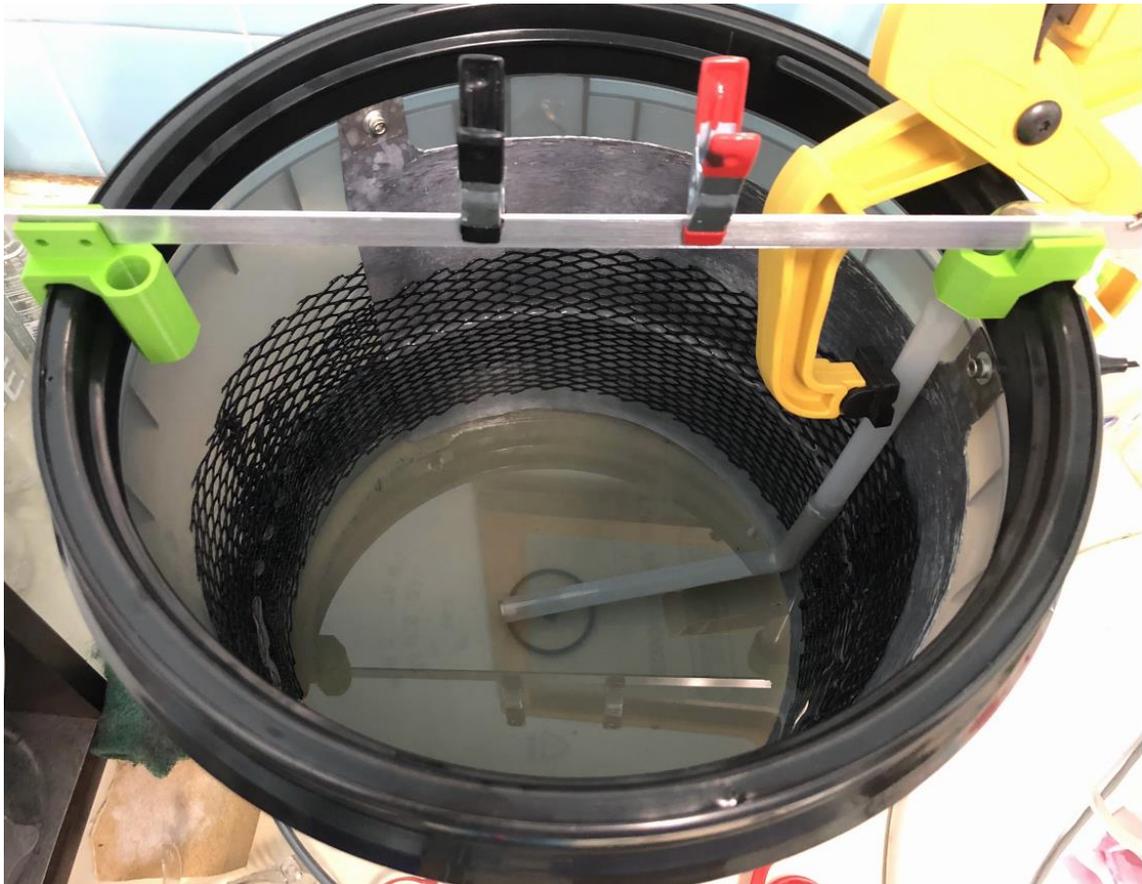


## Anodizing and Dye Tanks



Partially filled tank. Note that bar support and bubbler tube is from an earlier design.



# Contents

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Bubbler assembly at bottom of bucket .....	5
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# The anodizing process

Aluminum does not corrode as steel does due to a natural aluminum oxide layer that forms on the aluminum surface. The anodizing process increases the thickness of the aluminum oxide layer to enhance corrosion resistance and harden the surface. If there is no interest in adding a color to the aluminum, this can be considered **clear anodizing**.

For many products, the anodizing process is performed primarily for aesthetics to color the aluminum surface. Coloring aluminum using anodizing is more rugged compared to painting. Note that only aluminum and, less commonly, titanium can be anodized. Other metals cannot be anodized and can only be painted or plated.

For a colored surface, the process includes the anodizing step, where parts are suspended in a solution of sulfuric acid and a current is run through the parts and the bath. The current and time (often an hour or more) is carefully controlled to increase the aluminum oxide layer. This control also produces a surface with microscopic pores. When the part is soaked in a dye after the anodizing process, the dye is absorbed into the pores. It is this mechanism that results in the rugged colored surface.

The process is not easy and many companies and people will send parts to a company that specializes in anodizing. There are many such companies and it is tough to match the quality and consistency of their finishes. There are many people who still anodize as a hobby and there is a lot of good information on-line and there are companies that sell anodizing equipment and chemicals for the DIY market.

Caswell is likely the best known company in this space and is located in upstate New York.

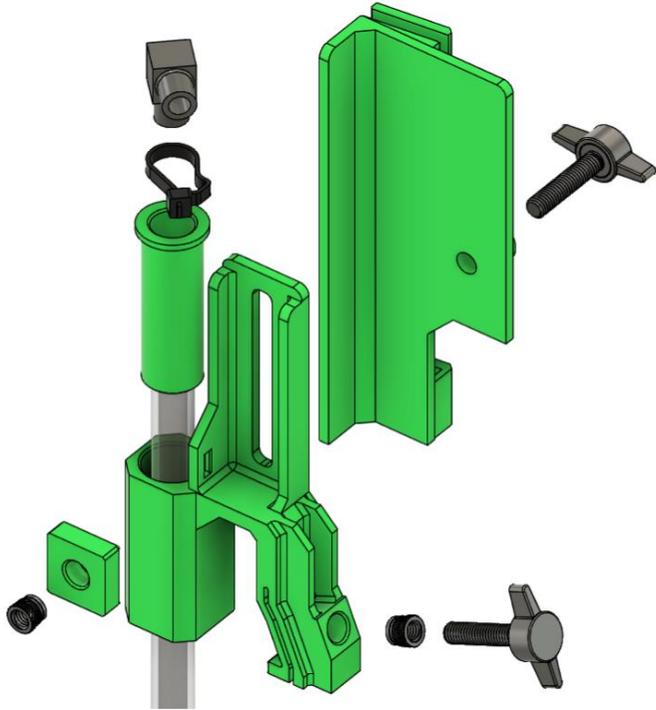
Note that the process presented in this document was done with custom equipment and a bottle of red dye first purchased on Amazon.

The screenshot shows the Caswell website's product page for Anodizing Kits. At the top, the Caswell logo is on the left, and a search bar is on the right. Below the logo is a navigation bar with links for Plating Kits, Anodizing Kits, Gas Tank Sealer, Black Oxide, Polishing, Caswell™, and More. A sidebar on the left contains a 'SHOP' menu with expandable categories: Anodizing Kits (expanded), Anodizing Accessories, Anodizing Dyes - 20% OFF, Anodizing Kits, Gas Tank Sealer, Plating Kits, Polishing, and Black Oxide Kits. The main content area features the heading 'ANODIZING KITS' and three product tiles: 'Anodizing Accessories' (a color wheel), 'Anodizing Dyes - 20% OFF' (blue plastic parts), and 'Anodizing Kits' (a complete anodizing setup). At the bottom, there are grid and list view icons, a 'Sort By: BEST SELLING' dropdown menu, and a red social media icon.

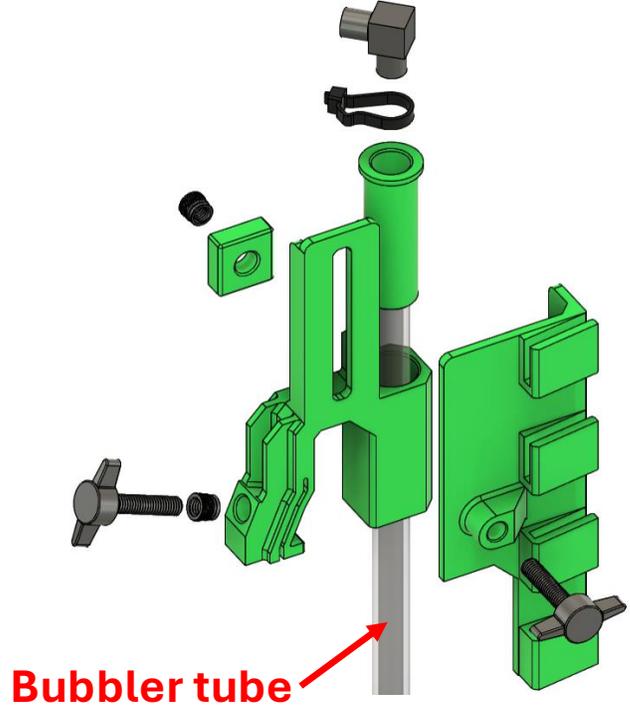
# Bar supports

A bar needs to be supported over the anodizing acid bath. 3D printed parts were designed that attach to the bucket edges. They allow multiple height positions for the bar and a further slide adjustment. Parts are hung from the bar, which may need adjustment to account for changes in the liquid level in the bath.

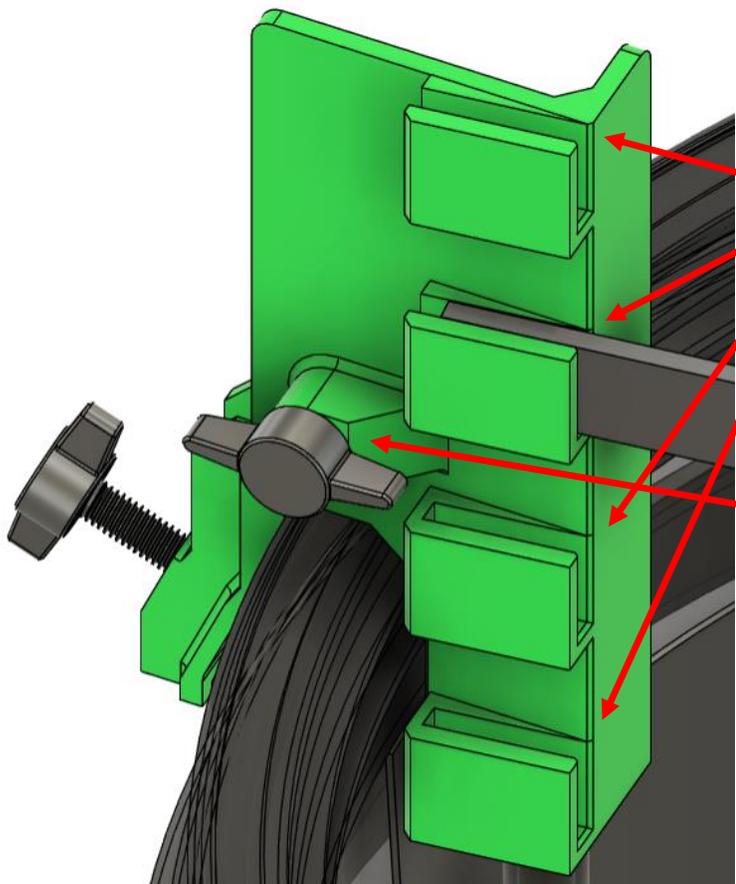
**Left side view**



**Right side view**



**Bubbler tube**

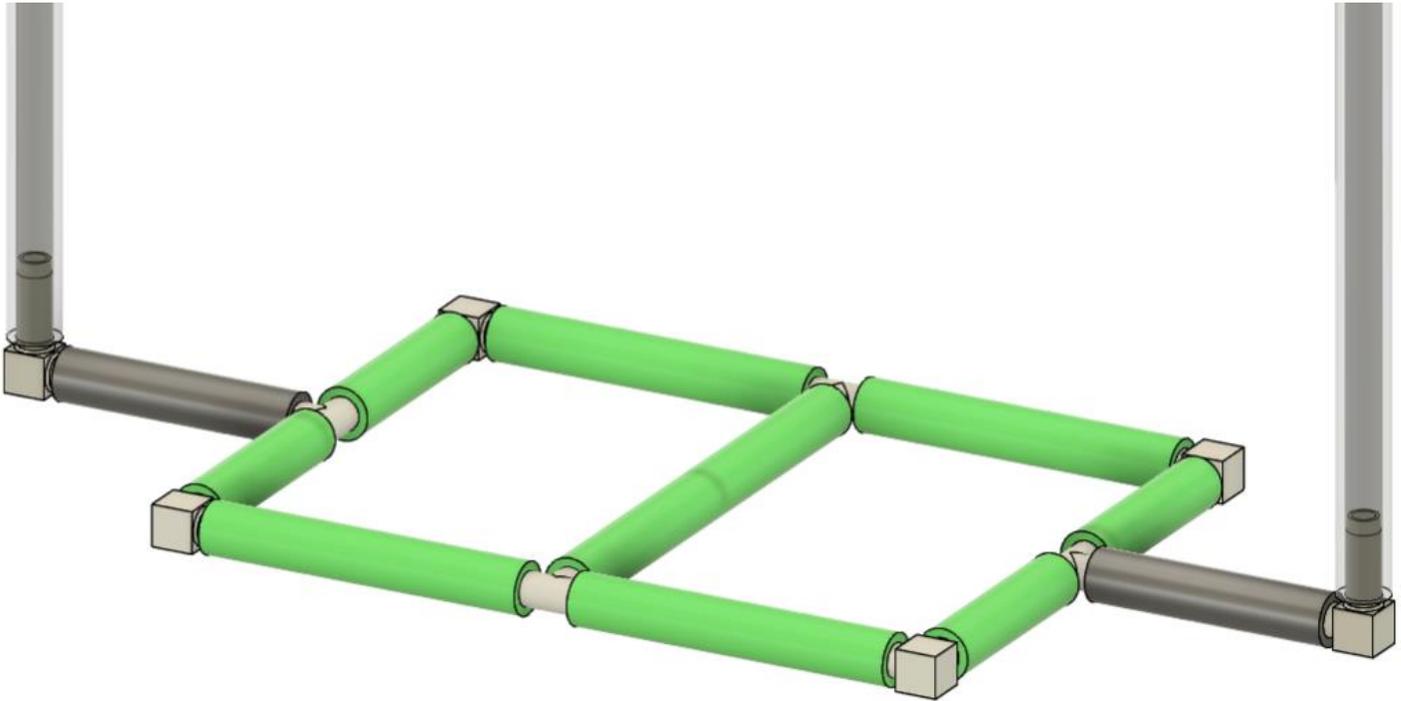


**Four possible bar positions**

**Allows vertical positioning of bar holder**

## Bubbler assembly at bottom of bucket

During the anodizing process, hydrogen bubbles will form on the part surfaces. Introducing air bubbles under the parts is needed to remove the hydrogen bubbles on the part and agitate the mixture.



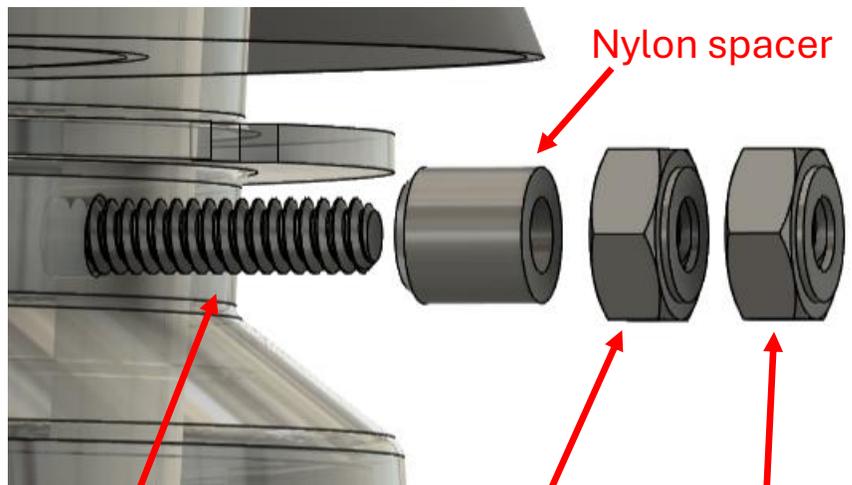
## Lead cathode mounting

Because the bucket will be filled with sulphuric acid (15% by weight) steel screws will corrode. A titanium screw and nut will be used to secure one tab of the lead sheet, which will also serve as the electrical connection.

The other two tabs of the lead sheet is secured with a nylon screw and nut. The use of titanium screws and nuts is limited due to their cost.



Lead sheet tab with screw (Titanium or Nylon)



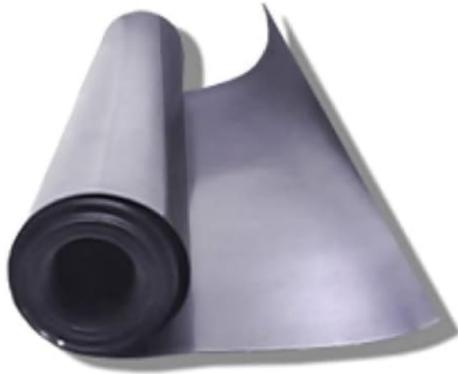
Screw threads (Titanium or Nylon)

Nut (Titanium or Nylon)

Nylon nut

# Lead cathode cutting

Lead is a common cathode material. It offers a long lifetime when continuously exposed to the sulfuric acid bath and is easy to cut and form. The aluminum alloy 6063 is often used, but the more typical 6061 alloy can be used as well. With aluminum, just make sure you don't reverse polarity from the power supply. You don't want to anodyze your cathode.



[Click to see full view](#)



## KRT Distributions Lead Sheeting, Sheet Lead Rolls (1/32" x 12" x 24")

[Visit the Phillips Safety Store](#)

4.7 ★★★★★ (595) | [Search this page](#)

Amazon's Choice

\$25<sup>95</sup>

Size: 1/32" x 12" x 24"

1/16" x 24" x 48"

\$119.00  
FREE Delivery  
Tuesday

1/32" x 12" x 12"

\$14.50  
FREE Delivery  
Thursday

1/32" x 12" x 24"

\$25.95

1/32" x 36"

\$49.95

1/32" x 12" x 36"

\$27.99  
FREE Delivery  
Tomorrow

1/32" x 12" x 48"

\$34.99

1/32" x 24" x 24"

\$37.99

1/64" x 24"

\$19.95

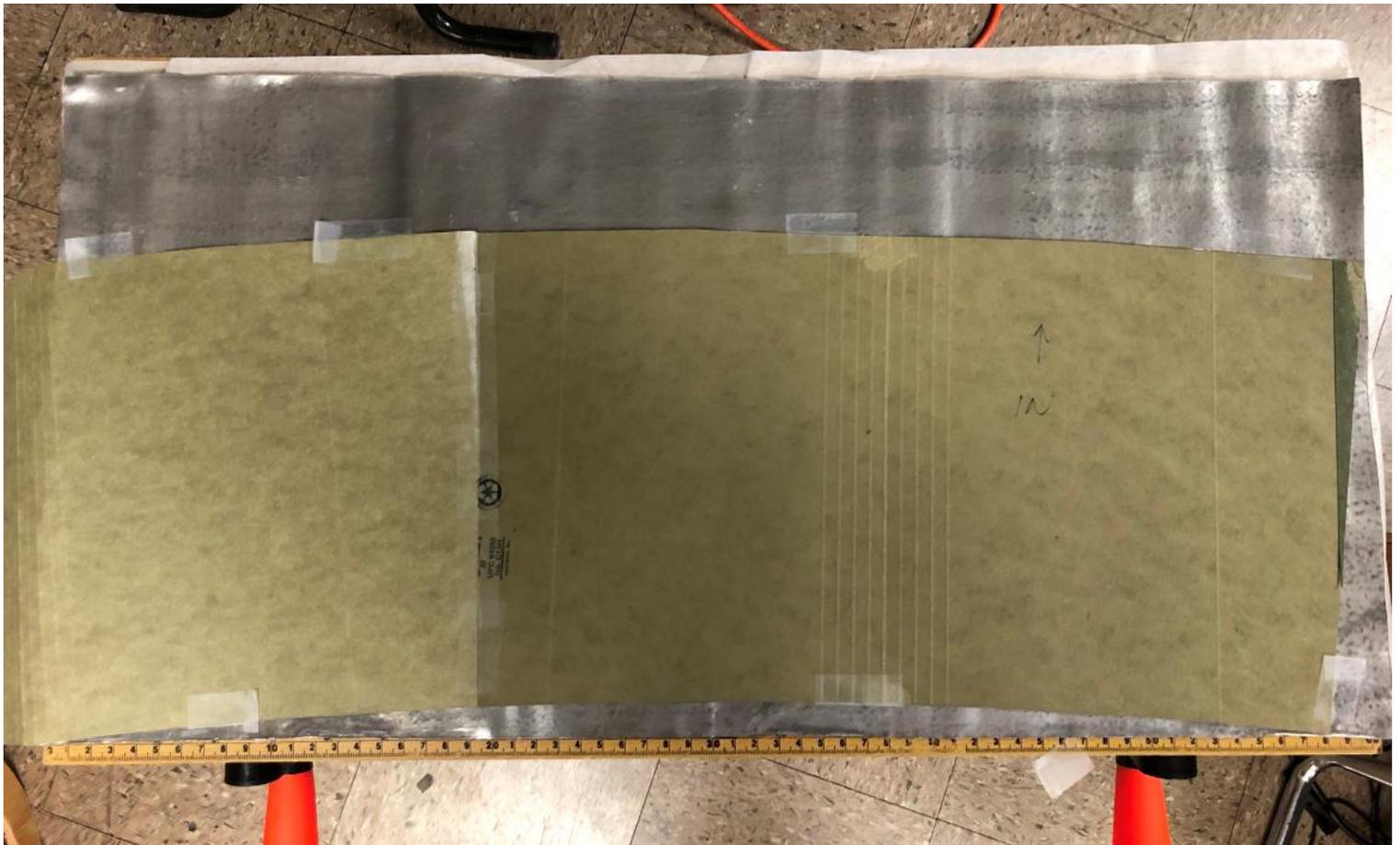
The lead sheet is unrolled and flattened. The sheet is 1/32" thick and is easy to form. It is still a little difficult to totally flatten it, as shown below.



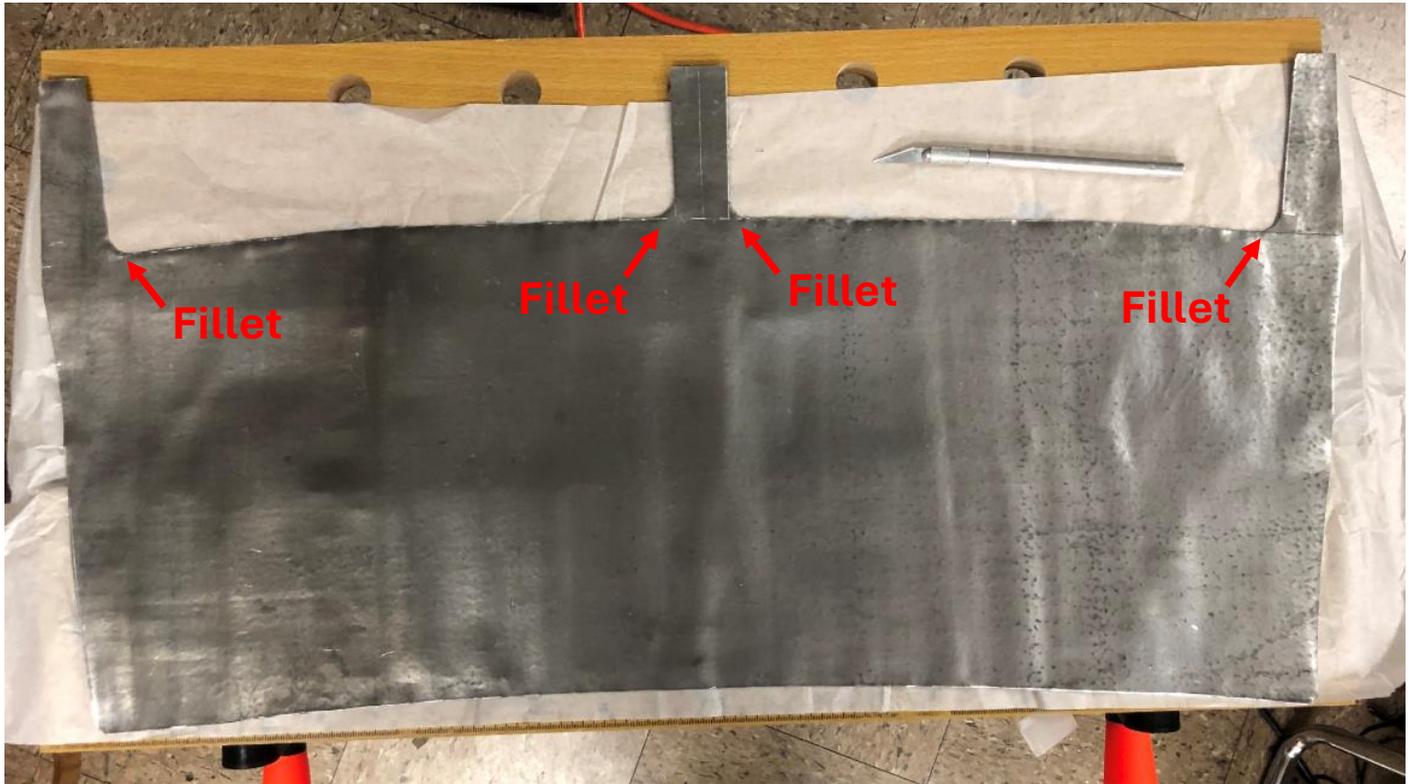
Folder material is cut to fit in the bucket and account for the tapered surface.



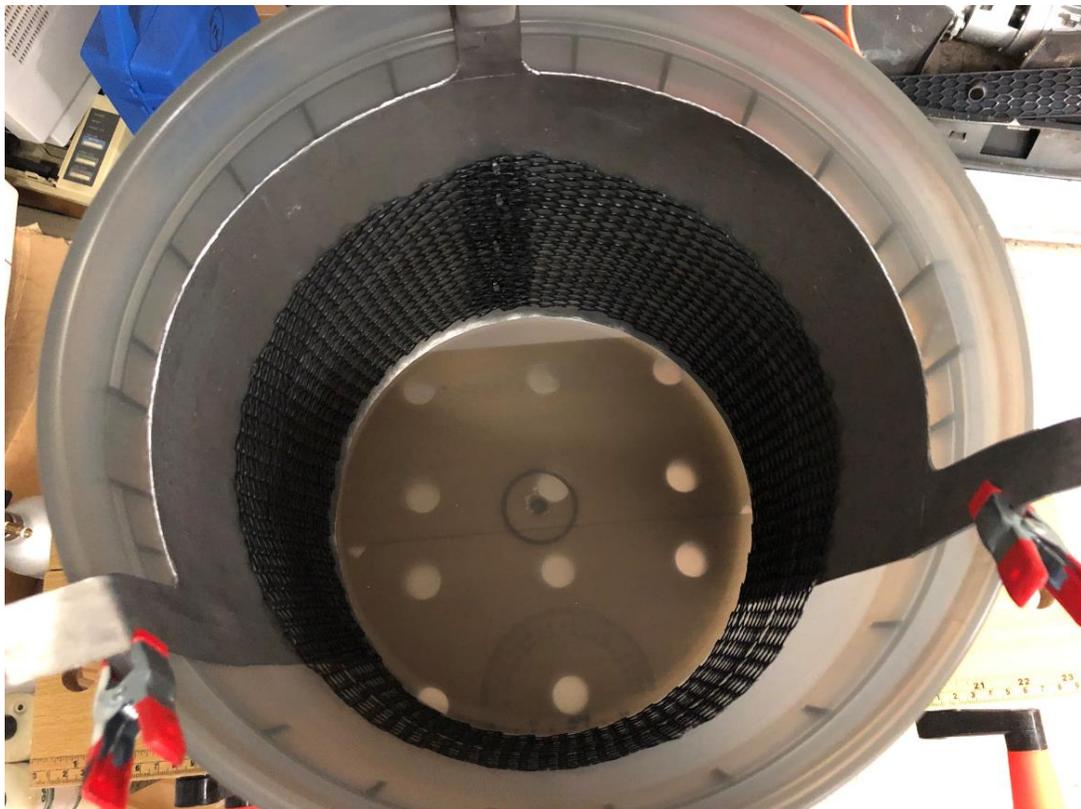
The folder material template is positioned and taped to the lead. Space is left about the template to allow tabs to extend upward.



The lead is soft and thin enough to use both a scissor and exacto knife to cut the sheet to the pattern and tabs. The lead is soft enough, where one needs to be careful not to rip it where the tabs meet the main surface. The tabs are cut with fillets to help prevent the tabs from being torn off.



The lead is positioned in the bucket and the tabs are cut near the top lip of the bucket.



A layer of plastic mesh is placed between the bucket inner surface and the cathode to allow drainage behind the cathode. A 2nd layer is placed over the inside of the cathode to help prevent objects being analyzed from shorting the circuit by touching the cathode. Plastic cable ties can be used to close up the mesh.



[Click to see full view](#)



## Plastic Chicken Wire, 15.7"×106" Plastic Wire Mesh Fence, Garden Netting Fencing Barrier for Poultry, Dogs, Rabbits, Chicken and Snake Barrier, Balcony Netting for Pets, Black

Brand: HANWRAPS

4.6 ★★★★★ (41) | [Search this page](#)

Overall Pick

400+ bought in past month

\$7<sup>09</sup>

[Price history](#)

Pay \$7.09 \$5.42 after using available Prime Visa rewards points.

**prime** Two-Day

FREE Returns

# Sulfuric acid bath

Sulfuric acid is the most produced industrial chemical worldwide. In fact its usage in a country will track the country's GDP.

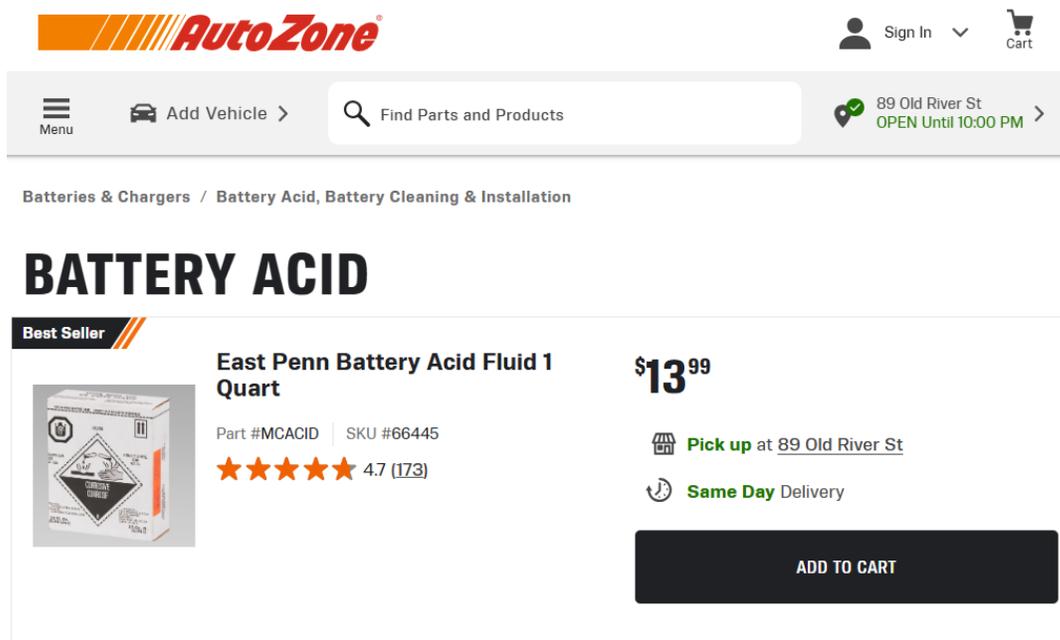
**DANGER, DANGER, DANGER !**

The danger depends on the concentration of the acid and is due to ability to burn skin as opposed to toxicity. That used in the anodizing bath will be 15% by weight. At this concentration, it can be poured on your hand and you won't feel it, however, you would not want it splashed in your eyes. Always wear true chemical safety goggles!

The greatest danger comes into play with the concentration of the acid before diluting it with water. A rule to address now. **When diluting sulfuric acid, always slowly add the acid to water, as opposed to adding water to acid or mixing the two quickly.** Mixing concentrated sulfuric acid and water liberates heat and one wants to avoid any water that can boil and splatter acid.

## Source 1: Battery acid

The safest source for sulfuric acid is battery acid. Every gasoline or diesel car or truck has a lead acid car battery, which contains sulfuric acid. The great majority of drivers never deal with the acid in the batteries, but car part companies sell sulfuric acid as "battery acid". The concentration of this acid is about 33%. If you get this acid on your hand, it may start itching a little.



The screenshot shows the AutoZone website interface. At the top, there is the AutoZone logo, a 'Sign In' button, and a shopping cart icon. Below this is a navigation bar with a 'Menu' icon, an 'Add Vehicle' button, a search bar containing 'Find Parts and Products', and a location indicator for '89 Old River St' which is 'OPEN Until 10:00 PM'. The main content area has a breadcrumb trail: 'Batteries & Chargers / Battery Acid, Battery Cleaning & Installation'. The product title is 'BATTERY ACID'. A 'Best Seller' badge is present. The product is 'East Penn Battery Acid Fluid 1 Quart' with a price of '\$13.99'. It includes part and SKU numbers, a 4.7 star rating from 173 reviews, and options for 'Pick up at 89 Old River St' and 'Same Day Delivery'. An 'ADD TO CART' button is at the bottom.

**AutoZone** Sign In Cart

Menu Add Vehicle > Find Parts and Products 89 Old River St OPEN Until 10:00 PM >

Batteries & Chargers / Battery Acid, Battery Cleaning & Installation

## BATTERY ACID

**Best Seller**

**East Penn Battery Acid Fluid 1 Quart** \$13.99

Part #MCACID SKU #66445

★★★★★ 4.7 (173)

**Pick up** at 89 Old River St

**Same Day** Delivery

**ADD TO CART**



**\$11.99**

**DieHard Powersports Battery Acid, 1 Liter - Used to fill serviceable batteries**

Part # CYCLE ACID Excluded from discounts

★★★★★ (3 reviews)

30 Day Replacement If Defective



**\$35.99**

**EP CQ DieHard Battery Acid**

Part # CYCLE ACID Excluded from discounts

★★★★★ (32 reviews)

30 Day Replacement If Defective

Up To 20% Off! Code **POURIN20** Online Only. Exclusions apply. Ends 3/30.

MENU **NAPA** Add New Vehicle + Search product, brand, or part 411 Madison (Open now)

Battery Acid (3)

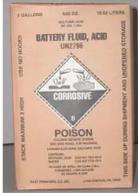
Brand  NAPA (3)

Container Size

Engine VIN Codes

Categories

Price Range



**NAPA Batteries Battery Acid 5 gal**

★★★★★ 5.0 (2)

Part #: BAT 9000

**\$45.99** / each

Out of Stock

Qty:  Out of Stock



**NAPA Batteries Battery Acid 6 Quart (US)**

★★★★★ 4.6 (5)

Part #: BAT 9002

**\$23.99** / each

Out of Stock

Qty:  Out of Stock

Feedback

## Source 2: Drain opener

Lowes and True Value sell sulfuric acid based drain opener, which is a common industrial grade with a concentration of 93%. Note that most drain cleaners are based on sodium or potassium hydroxide. Home Depot does not sell a sulfuric based drain cleaner.

**This concentration is nasty!** If you get a small drop on your hand it will start burning in a few seconds. I am surprised that a retailer would sell acid at this concentration. The mechanism of burning is the acid ripping the water out of your cells.



1k+ bought last week

**Zep Sulfuric Acid Drain Opener 32 Ounce(s) Drain Cleaner Pour bottle**

Item #1554633 | Model #ZUSADO32

[Shop Zep](#)

★★★★☆ 4.2 473

**\$11<sup>.18</sup>**

<b>Pickup</b> within 3 hrs 12 available	<b>Shipping</b> Wed, Apr 1 40 available	<b>Fast Delivery</b> Tomorrow 56
---	---	--

Home / Plumbing Supplies / Drain Openers & Septic Tank Treatments / Chemical Drain Openers & Cleaners / Drain Op / Rooto 32 Oz. Professional Drain Opener

**Rooto 32 Oz. Professional Drain Opener**

Model #1071 | Item #405175 | UPC 00037904107122 ★★★★☆ [Write the first review](#)

[Shop Rooto](#)



**\$9.79**

In-store price may vary. stores .

**Same-day Pickup**

Call for availability  
(201) 768-7759

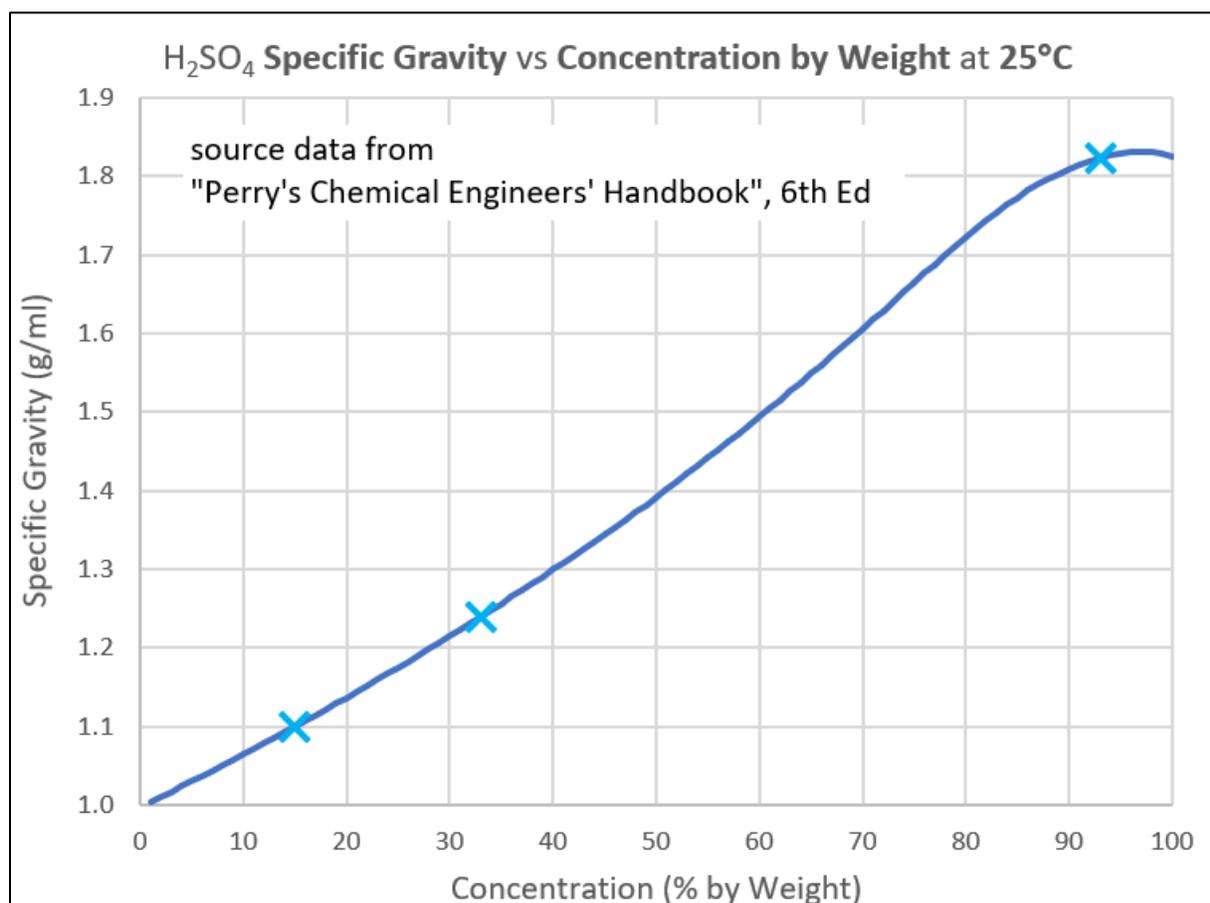


## Sulfuric acid bath mixing

The recommended concentration of sulfuric acid in water is **15% by weight**. Pure sulfuric acid is almost twice as heavy as water and thus important to note if a concentration is by weight or by volume. For anodizing only distilled water should be used. Home Depot sells 1 gallon jugs of distilled water for \$1.25.

Don't mix the acid right before anodizing. The anodizing mix should be between 68°F and 72°F. When the acid is mixed, the liberated heat will increase the temperature and then one must wait until the temperature drops. One trick to help with this is to keep some frozen bottles in the freezer, which can be added as needed. First partially fill (about 15%) them with screws or nuts so they don't float in the acid solution. Sparkling Ice seltzer bottles work well.

Note that over time water will evaporate from the bath leaving a higher concentration of acid. One may need to add water later on.



Note that over time water will evaporate from the bath leaving a higher concentration of acid. One may need to add water later on.

It's best to measure concentration using density. As seen in the **Specific Gravity vs Concentration by Weight** chart, the relationship is fairly linear up to about 90%. Using pH is

not recommended because after use dissolved aluminum can affect the pH reading. One would also have to keep a pH probe properly maintained and calibrated.

One can weigh a volume, eg 10ml, of water in a small graduated cylinder and then weigh the same volume of acid solution.

Another option is to float a *hydrometer* in the solution. Many are available on-line, but one needs to purchase one that measures the proper range. Many sold are for measuring alcohol concentration, which measure densities less than that of water. To measure any concentration of sulfuric acid, one would need a range of 1 to 2. Concentrated sulfuric acid has an S.G. of 1.84. There are others, such as the 2nd one listed here that are better for measuring the concentration used for anodizing of S.G. = 1.1.

Note that hydrometers are sometimes specified and marked for Degree Baume, which is a traditional density scale for industrial processes. For example, industrial grade sulfuric acid may be specified as 66° Baume, which equates to S.G.=1.84 or 93 % w/w (by weight).

$$\text{Baume} = 145 * (1 - 1 / \text{S.G.})$$

$$\text{S.G.} = 145 / (145 - \text{Baume})$$

**S.G. = Specific Gravity**

Specific Gravity is the density ratio to water.

The S.G. of water is 1.000

### Sulfuric Acid @25C

% w/w	S.G	Baume	Molarity	Comment
98	1.84	66.0	18.4	Concentrated
93	1.84	66.0	17.4	Industry Grade
33	1.24	28.1	4.25	Battery Acid
15	1.10	13.2	1.68	Anodizing
0	1.00	0.0	0	Pure Water

Following are 2 hydrometers. The 1st has a S.G. range of 1 to 2, which would be able to measure the full range of sulfuric acid concentrations. The 2nd has a range of 9 to 21°Baume, which corresponds to a S.G. range of 1.066 to 1.250. This would allow a more accurate measurement of the desired concentration of the bath. S.G. = 1.10 (13.2 °Baume).

Note that the bath concentration does not have to be exactly 15%. This is just a commonly recommended concentration. If the bucket is not closed after use, water will evaporate over time and the acid concentration will actually increase. One would find they have to add water at times to maintain the desired concentration.



## EISCO Laboratory Hydrometer - Specific Gravity, Heavy Liquids, Range 1.000 to 2.000 x 0.010 - Includes Protective Case - Eisco Labs

Visit the EISCO Store

4.4 ★★★★★ (119) | Search this page

50+ bought in past month



\$15<sup>79</sup>

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Save up to 21% with business pricing. Sign up for a free Amazon Business account

- Dual scale hydrometer for measuring the relative density in heavy liquids. Loaded with iron shot
- Range: 1.000 to 2.000 x 0.010
- 11" long. 0.6" diameter.
- Includes sturdy, plastic protective case
- Designed for laboratory use, but can be used in homes and shops

[Click to see full view](#)

Ask Rufus

What liquids can this hydrometer measure?



## SP Bel-Art, H-B DURAC 9/21 Degree Baume Hydrometer (B61804-0100)

Visit the SP Scienceware Store

3.5 ★★★★★ (6) | Search this page

-23% \$31<sup>06</sup>

List Price: \$40.15

✓prime Tomorrow

FREE Returns ▼

- DURAC Baume plain form hydrometer is for use with liquids heavier than water
- Range: 9 to 21; divisions: 0.1; accuracy: 0.1 Baume
- 300mm (11.8) in length
- Individually serialized; features a metal ballast
- Tested and calibrated in our exclusive triple accredited/registered ISO/IEC 17025:2005, A2LA accredited laboratory against equipment whose calibration is traceable to NIST and DKD/PTB



[Click to see full view](#)

Ask Rufus

What liquids is this hydrometer made for?

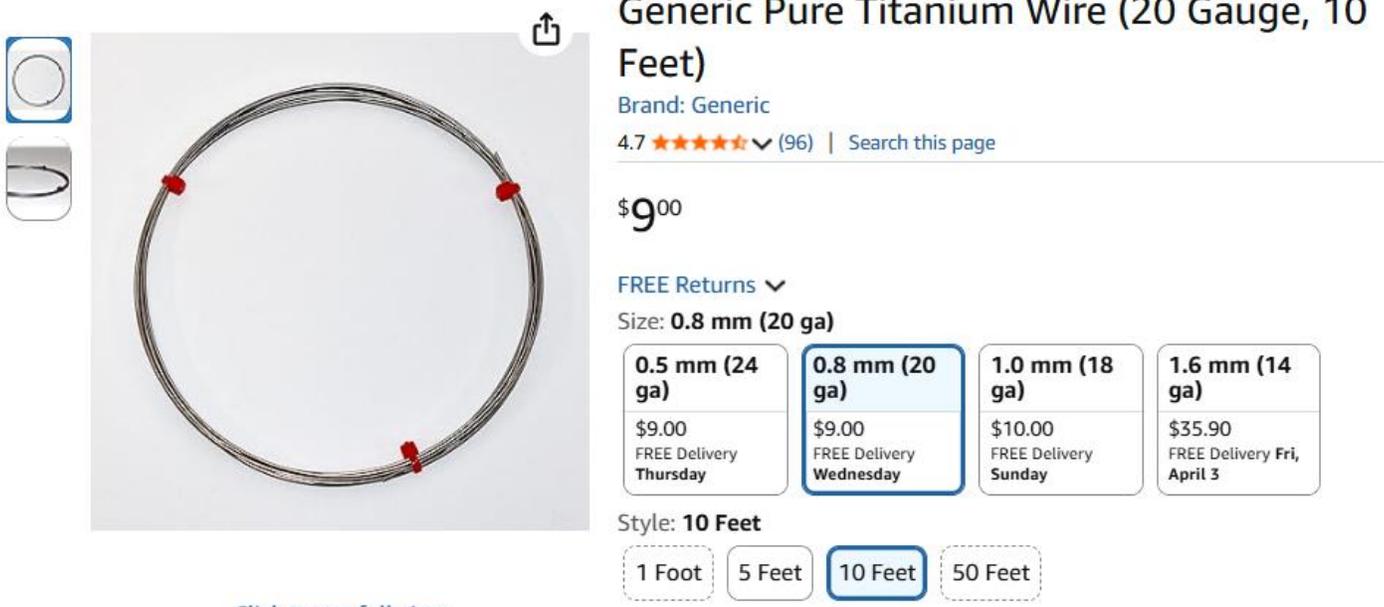
## Attaching parts to the anode bar

Parts being anodized must be electrically connected to the anode bar with wire so they hang down in the acid bath. This can be done using titanium or aluminum wire. Titanium wire has the advantage of being reusable and has a springiness so that a folder section can be placed in a hole. If a part has a hole, either threaded or not, this is an advantage because it can be used as the connection point.

In the anodizing industry there are companies that make all sorts of racks and accessories to hold parts in anodizing tanks.

The connection between the wire and the part to be anodized is critical. A connection may seem fine at first, but during the anodizing process the connection can degrade. One will see the voltage increase and the bubbling of the part surface stop. Then the part has to be removed from the bath and a proper connection reestablished.

Titanium wire is available on Amazon in various diameters. One annoyance of titanium is its brittleness. When using pliers to make sharp bends, the wire can crack. Lower down is an Amazon listing for silicone tapered plugs. They can be inserted into a hole with the wire to help secure them. They can also be used to plug blind holes, which is a hole (with or without a thread). This helps prevent discoloration around a hole due to liquid from a previous step becoming trapped in the hole.



**Generic Pure Titanium Wire (20 Gauge, 10 Feet)**  
Brand: Generic  
4.7 ★★★★★ (96) | [Search this page](#)

\$9<sup>00</sup>

FREE Returns ▾

Size: **0.8 mm (20 ga)**

0.5 mm (24 ga)	0.8 mm (20 ga)	1.0 mm (18 ga)	1.6 mm (14 ga)
\$9.00 FREE Delivery Thursday	\$9.00 FREE Delivery Wednesday	\$10.00 FREE Delivery Sunday	\$35.90 FREE Delivery Fri, April 3

Style: **10 Feet**

1 Foot 5 Feet **10 Feet** 50 Feet

Material: Titanium  
Color: Silver  
Brand: Generic  
Finish Type: Polished

[Click to see full view](#)

**Ask Rufus**  
What are common uses for titanium wire?



## MECCANIXITY Silicone Rubber Tapered Plug 1.5mm to 4.5mm Solid Purple for Powder Coating, Painting, Anodizing, Plating, Sandblasting, Laboratory Use 50 Pieces

[Visit the MECCANIXITY Store](#)

4.8 ★★★★★ (5) | [Search this page](#)

\$9<sup>99</sup> (\$624.38 /100 cm)

Size: **1.5mm to 4.5mm**

1.5mm to 4.5mm

1.6mm to 3.2mm

1.6mm to 4.8mm

3mm to 7mm

3.2mm to 6.4mm

5mm to 9mm

It is a good idea to buy a pair of long stainless steel tweezers for fishing parts out of the bath that have detached from their wires.



## JETKONG 12-Inch Fine Tweezer Tongs Long Cooking Tweezer Stainless Steel Kitchen Tweezers

[Visit the JETKONG Store](#)

4.8 ★★★★★ (832) | [Search this page](#)

Amazon's Choice

100+ bought in past month

\$8<sup>99</sup>

✓prime Tomorrow

FREE Returns

Save up to 19% with business pricing. Sign up for a free Amazon Business account

Item Package Quantity: 1

1

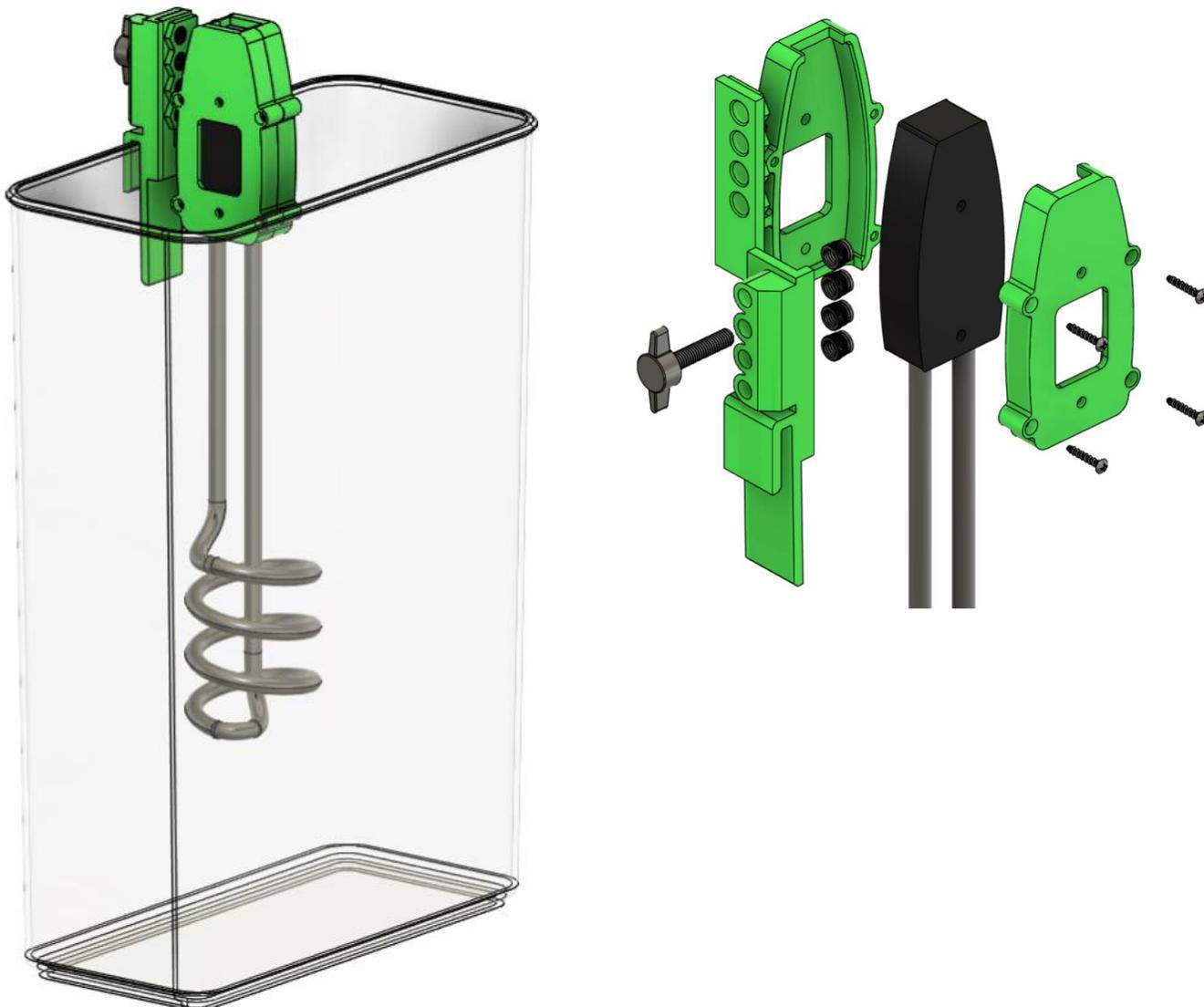
2

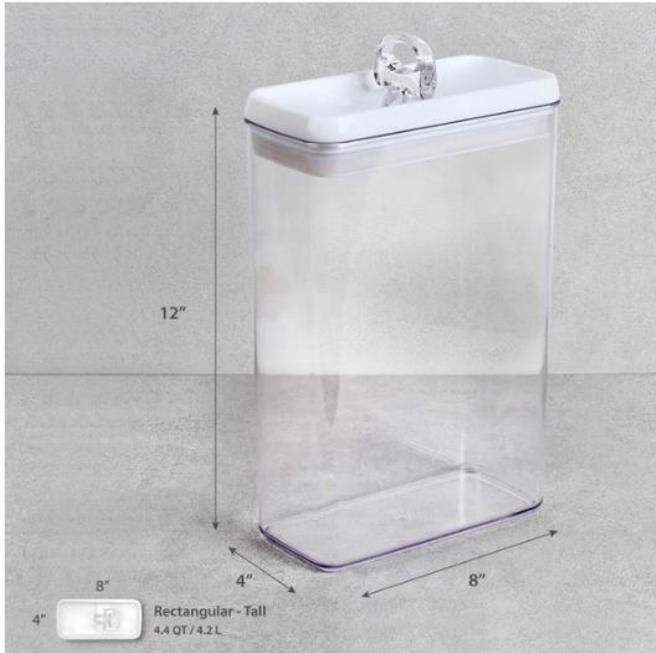
## The dye bath

The anodizing dye used should specify a temperature in the range of 115 to 140F so it must be heated. A container that seems to be a good choice is the Felli Flip-Tite 4.4qt, which can be found at Home Goods. It is meant for food storage and has a top that can be sealed. The rectangular shape can accommodate a range of parts. A good strategy is to have a few, which stay filled with certain color dyes.

A 3D printed heater mount was designed to hold a 1000W bucket heater. This will also help ensure that the heater does not touch the plastic container walls.

**Be careful with the heating!** 1000W of heating is a lot for a small container. Hitting the exact specified temperature is not critical. The dyeing time may only be a few minutes and a good strategy is to power the heater only until a temperature a few degrees over the target temperature is hit. Don't leave the heater on unattended. Other heaters were considered, but a low power cup heater was taking too long. One could consider a controller.

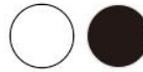




# Flip-Tite 4" Rectangular-TALL 4.4QT / 4.2L

\$15.99

Color: White



Quantity

- 1 +

**ADD TO CART**

✓ Pickup available at 11256 Jersey Boulevard  
Usually ready in 2-4 days



# 1000W-110V Immersion Water Heater-10in Electric Water Heater, Portable Submersible Immersion Element, Calentador de Agua Electrico Boiler Element Heating Coil for Heating Waters in Jug,Flask or Bucket

[Visit the Rugam Store](#)

4.3 ★★★★★ (280) | [Search this page](#)

**Overall Pick**

100+ bought in past month

-6% \$9<sup>39</sup>

Typical price: \$9.99 | [Price history](#)

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Exclusive Prime price

Coupon price \$8<sup>45</sup> [Terms](#)

[Click to see full view](#)

VIDEO



# TempPro TP01A Digital Meat Thermometer for Cooking Candle Liquid Deep Frying Oil Candy, Kitchen Food Instant Read Thermometer with Super Long Probe, Backlit, Lock Function (Previously ThermoPro)

[Visit the TempPro Store](#)

4.4 ★★★★★ (23,533) | [Search this page](#)

600+ bought in past month

[Click to see full view](#)



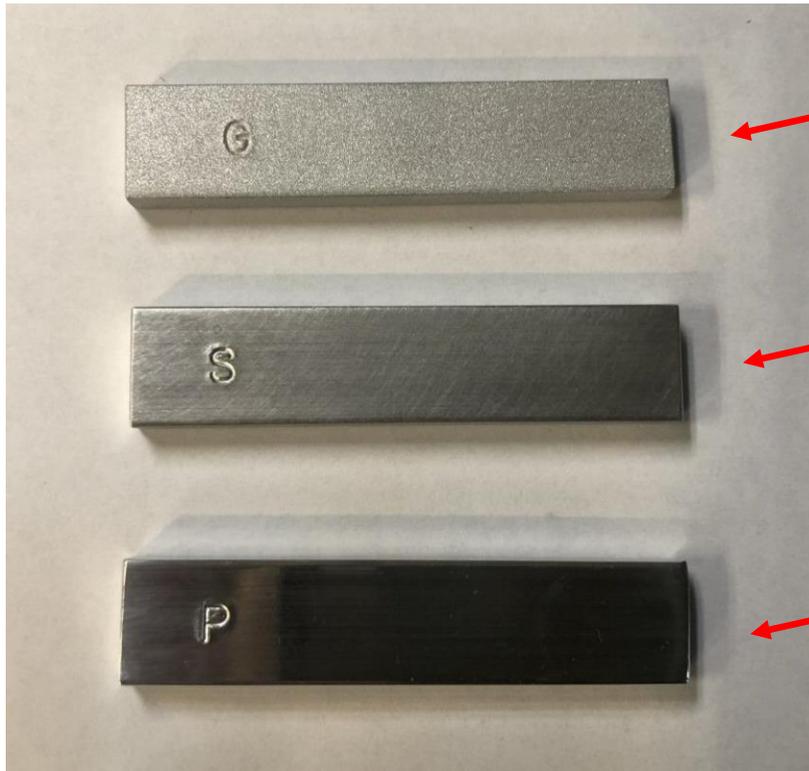
8 VIDEOS

**-40%** \$8<sup>99</sup>

List Price: \$14.99 ⓘ

## Part surface preparation

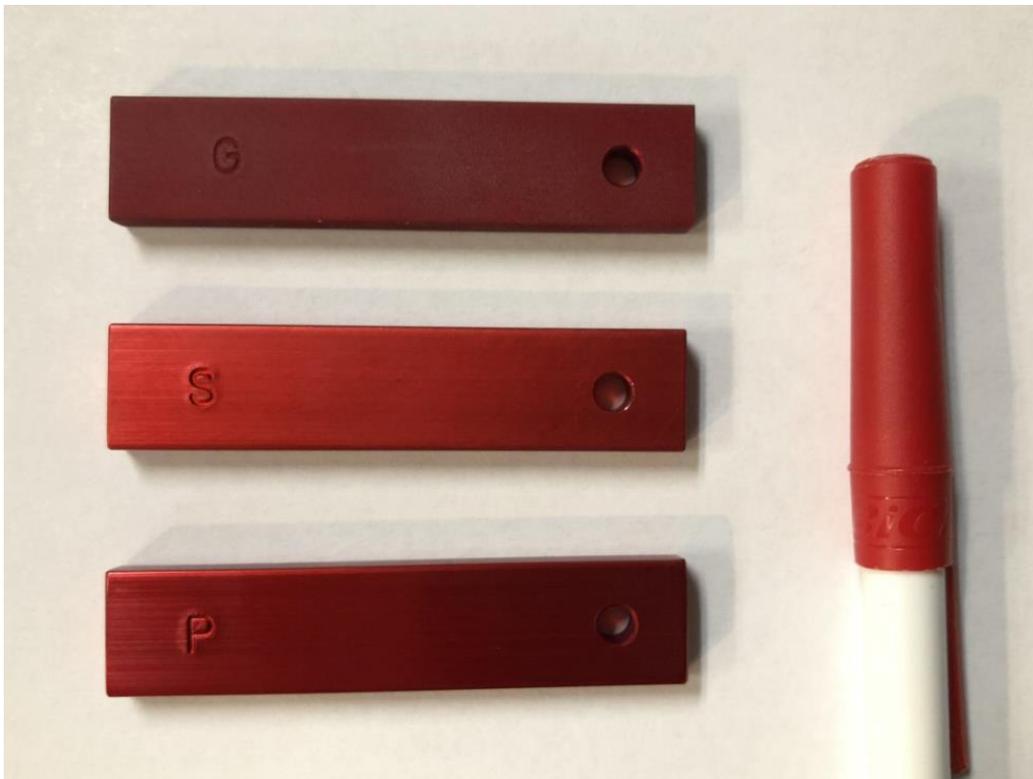
Various surface finishes were tried. It was found that polished aluminum resulted in the best look after anodizing. When starting an anodizing line, run some test pieces for various finishes. A good recommendation is to use sandpaper or a buffing wheel that has not been used for steel. One wants to ensure that steel particles don't become embedded in the aluminum surface to avoid any spots in the anodizing finish.



Glass bead sandblasting

Sanded with 220 grit aluminum oxide sandpaper

Polished with green rouge



# Aluminum Alloys

The best alloy to use for anodizing is 6063, however, the more common 6061 alloy works well.

The higher strength aluminum alloys, such as 2024, are a greater challenge to anodize. Due to the higher copper concentration, an additional nitric acid bath is needed before anodizing, to prevent spots on the final product.

## BOM (Bill Of Materials) – Anodizing Tank

Line	Qty	Type	Description	Part Num	Price
1	4	screw	Thumb 10-32 7/8"L PlasticHead TwoArm	91185A909	\$8.03(10)
2	1	screw	6-32 3/4"L PanHead Phillips Titanium	90234A215	\$5.32(1)
3	2	screw	6-32 3/4"L PanHead Slotted Nylon	92942A732	\$6.42(100)
4	1	nut	6-32 5/16"W 0.109"H Grade2 Titanium	90545A007	\$7.42(1)
5	5	nut	6-32 5/16"W 1/8"H Polypropylene	96169A452	\$6.75(10)
6	3	spacer	1/4"OD 0.14"ID 1/4"L Unthreaded Nylon Black	90176A133	\$4.78(25)
7	4	insert	10-32 0.225"L HeatSet 18-8SS	94459A757	\$8.09(5)
8	1	bar	1/8"T 1/2"W Grade2 Titanium 1ft	9139K11	\$21.50(1)
9	2	tube	1/4"ID 3/8"OD Clear PVC Hard 1ft	53945K13	\$2.72(1)
10	4	tube	BubblerTube2.36in		
11	4	tube	BubblerTube2.05in		
12	1	tube	BubblerTube4.58in		
13	2	tube	1.75in		
14	2	fitting	Elbow		
15	1	undef	3.5gal 70mil HDPE TranslucentGray HomeDepot	1005623606	\$6.98(1)
30	1	undef	BucketCompanion HDPE Black HomeDepot	266050	\$5.98(1)
16	2	printPLA	MountBase		
17	2	printPLA	MountSlider		
18	2	printPLA	SliderNut		
19	2	printPLA	MountBaseSpacer		
20	2	printPLA	CableTieUpper		
21	1	undef	OuterPlasticMesh		
24	1	undef	InnerPlasticMesh		

Anodizing Worksheet (Rev1).xlsx

Item description	
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NaOH soak time		Ex: 2 mins ( <b>optional</b> , skip if using de-oxidizer)
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De-ox soak time		Ex: 1-3 mins ( <b>optional</b> , use for Al 2024)
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SurfaceArea (in^2)	
Current (A)	
based on 6 ASF (42mA/in^2)	

Start bath temp (F)		Ex: 60-75F
Start time		
Ramp finish time		
Voltage at ramp finish		
Stop time		
Voltage at stop time		
Stop bath temp (F)		

Dye color		
Dye temp (F)		Ex: 115-140F
Dye pH		
Dye time		Ex: 10 min

Seal time		Ex: 30 min
Nickel acetate used		y or n

- clean/degrease
- ensure Ti/Al attached wires are proper length for hanging
- attach Ti/Al wires (bend out bottom hook if needed, if using Al sand connecting area)
- spray (distilled H2O)
- soak in NaOH (ex: 2 mins, **optional**, skip if using de-oxidizer) (33g NaOH to 1L H2O)
- soak in de-oxidizer (ex: 1-3 mins, **optional**, for Al 2024)
- spray down (distilled H2O)
- soak (distilled H2O)
- ensure power supply set for 20V and 0.050A
- clean top hang bar if needed
- hang in bath and ensure parts are not touching
- set start of current ramp (ex: 100mA)
- start heating dye (~15 min before needed)
- remove parts and spray down (distilled H2O)
- soak in NaHCO3 solution (ex: 5 min) (40g NaHCO3 (baking soda) to 1L H2O)
- remove parts and spray down (distilled H2O)
- soak parts in dye (ex: 10 min)
- remove parts and spray down (distilled H2O)
- boil parts (ex: 30 min, optional use of nickel acetate)
- let parts dry