Anodising Aluminium at home

Many aluminium products, such as heatsinks, are available pre-anodised, with a hard coating of aluminium oxide (often dyed black) that makes the surface considerably tougher. But sometimes parts are supplied in 'raw' aluminium. What if you'd like *them* anodised? As it turns out, as long as you take due care (especially with the chemicals used), it isn't that hard to do it yourself.

by Phil Prosser

We are all familiar with aluminium. It is a very common metal that is seen in all aspects of our lives, from structures through to household goods like drink cans and of course in electronic systems.

After all, aluminium is the most abundant metallic element in the Earth's crust.

Aluminium was not isolated as a metal by itself until 1824, and not industrially produced until the mid-1800s. The primary difficulty was that efficient refinement of aluminium ore to metal requires electrolys at very high temperatures and uses a great deal of electrical energy, which was not available back then.

So common industrial use of aluminium did not commence until well into the 1900s. Read up on the Hall–Héroult process if you are interested.

Why anodise?

As hobbyists, aluminium is a 'go-to' material due to its easy workability, ductility, low weight and low cost.

But it is often not clear how to finish the aluminium that you use. Many commercial products have an anodised finish, which is easily recognised by the very thin, very hard and often coloured finish.

The principal benefit of anodising aluminium is that it significantly increases the corrosion resistance of the underlying metal.

When you cut or otherwise expose raw aluminium, it very quickly oxidises and forms a layer of aluminium oxide (Al_2O_3) on the surface. This actually forms part of the surface and is effective protection for the underlying reactive material.

Still, it is very thin, easily damaged and is not sufficient to protect the metal in corrosive environments or over long periods.

For industrial applications, aluminium surface protection cannot be left to chance. The anodising process is often used to artificially grow a thick layer of aluminium oxide on the metal surface.

This provides excellent corrosion resistance and provides an extremely hard protective layer to the metal.

The structure of aluminium oxide in the anodised layer also provides the ability to bind dyes, which is how many anodised surfaces are coloured

Doing it yourself

In this article, I will describe how you can anodise and dye your own parts at home, resulting in much more durable and attractive products.

For feature parts and modestly-sized items, anodising at home is a practical option. Very attractive results can be achieved without undue effort.

Some specialised applications require "hard anodisation" which creates a thick, hard oxide layer aimed at providing wear resistance.

Standard anodisation creates an oxide layer up to 30 microns thick, while hard anodisation can create a layer up to 100 microns.

But this involves refrigeration and much higher voltages; while you probably could do it at home, it isn't as easy. So I won't describe that here.

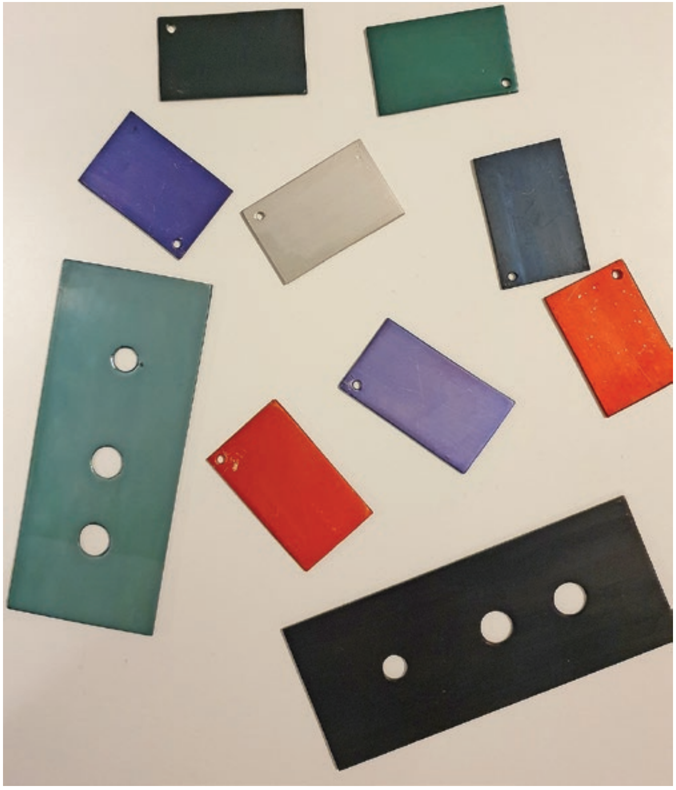
So the goal of this article is to describe the regular anodisation process, which provides corrosion resistance and the ability to apply decorative finishes.

What can I anodise?

It isn't just aluminium that can be anodised. Other suitable metals include magnesium, titanium, tantalum and zinc.

But we'll focus here on aluminium as it is commonly available, easy to work and the process for anodising it is not complicated.

As you will see in this article, anodising falls somewhere between DIY electronics and chemistry. I will walk you through the following five steps:



- **Cleaning**
- **Pre-anodisation etching**
- **Anodising**
- **Dyeing**
- **Sealing**

We will also walk through the set-up of the etching bath, anodising bath and provide some guidance on how much

Here's what you will need:

Item	Source	Comment
Safety glasses	Any hardware store	*Buy a pair that wraps around your face.*
Nitrile gloves	Hardware store, supermarket	*Buy a large box of disposable gloves.*
Power Supply	Your workshop	*Ideally 3-30V at 1-6A (depending on job size).*
Clip leads	Your workshop	*Acid will corrode your clips! Wash them or use old leads.*
Anodising tank	Hardware store, supermarket	*A plastic tank just large enough to hold your workpieces – food containers or plastic pails are suitable.*
Lead Sheet	Hardware store	*This is sold as lead flashing. It is expensive.*
Sulfuric acid (H_2SO_4)	Battery or car accessory shops	*Acid is not on the shelf; you need to talk to staff. Expect to pay about $10/L.*
Sodium bisulphate ($NaHSO_4$)	Hardware store or pool shop	*Alternative to sulfuric acid; commonly sold as pool pH dropper.*
Safety container		*Slightly larger than your acid bottle, to contain any leaks.*
Rinsing container		*Larger than your parts, kept full of clean water for rinsing off after etching, anodising and staining.*
Dyes	Lincraft, eBay	*Clothes dyes or anodising dyes.*
Sodium bicarbonate	Supermarket	*1kg containers are cheap; buy several and keep at hand in case you need it to neutralise spilled acid. Also called "bicarb soda".*
Acetone	Hardware store	*Used for cleaning oil off parts before etching.*
Deionised/distilled water	Supermarket, car accessory shops	*Tap water can be used, but this is better.*
TIG aluminium wire	Hardware store	*Or strip out of cabling.*

We cannot emphasise enough the need for safety equipment and all care. Some of the chemicals used for anodising are pretty nasty and can cause damage or injury if you're not careful. You should also store chemicals with a second container which will catch any spills before they have a chance to do damage (known as "bunding", as seen at right).

current you should be using to anodise your parts and for how long.

Safety

Before we start, let's discuss safety. Anodising requires the use of both a strong acid and a strong base. It is essential to understand the hazards of working with these chemicals, and to know how to manage the risks involved.

Anodising aluminium uses two common but nevertheless nasty chemicals, sulfuric acid and sodium hydroxide.

Sulfuric acid is a hazardous chemical. In the concentrations we need, it is corrosive to eyes, respiratory system and skin. It will quickly eat through clothing and unprotected surfaces. You can download a PDF material safety data sheet (MSDS) from **siliconchip.com.au/link/ab0h**

The etching process uses a 2% mixture of sodium hydroxide, which is a caustic base, and quite harmful to skin and eyes. Download a PDF of its MSDS from **siliconchip.com.au/link/ab0i**

I recommend that you use the "take 5" approach before any operation using the chemicals in this article:

1) STOP before starting each activity. Consider all aspects of this, including your preparedness.

2) THINK through what you need to achieve and consider what might go wrong or cause a problem.

3) IDENTIFY potential hazards to yourself, others and the environment around you. What is the potential risk?

4) PLAN how to undertake the activity while minimising hazards. Have contingencies for spills etc.

5) PROCEED

So why do we need acid?

It turns out that sulfuric acid is an extremely useful reagent and a chemical that is found in many industrial processes and parts of everyday life. It is produced and used in large quantities all around the world. While sulfuric acid

has primarily industrial uses, it's also found in everyday household products such as drain cleaner and fertiliser.

You should obtain and read the safety data sheets (linked above) for sulfuric acid, sodium hydroxide and, if you use it, sodium bisulphate (**siliconchip.com.au/link/ab0j**) before starting. Without seeking to replicate the safety data sheets, key messages are:

- **skin contact –** if sulfuric acid comes into contact with your skin, immediately flush the affected area gently with lukewarm water for at least 30 uninterrupted minutes. **Seek medical attention immediately**.
- **eye contact –** if sulfuric acid gets into your eyes, immediately flush the eye(s) with water for at least 30 minutes. **Seek medical attention immediately.**
- **ingestion –** if you ingest sulfuric acid, rinse your mouth immediately with water. Do not induce

Bicarbonate of Soda (often abbreviated to simply Bicarb Soda) is readily available in supermarkets as it is used extensively in cooking.

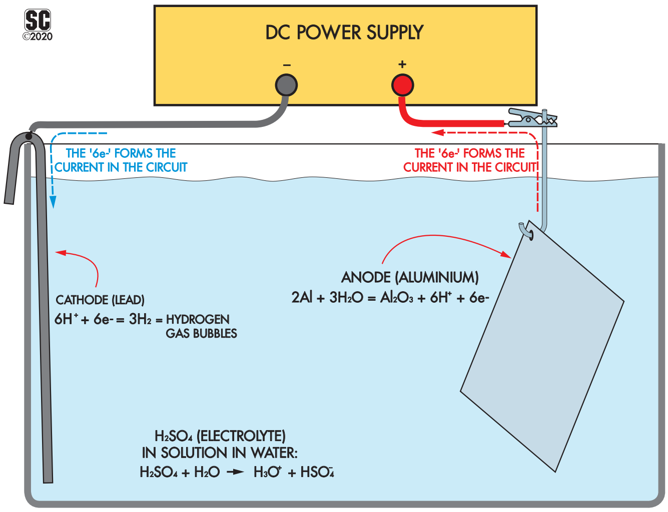


Fig.1: the basic arrangement for anodising aluminium. The part to be anodised connects to the power supply +, while the lead cathode connects to the power supply –.

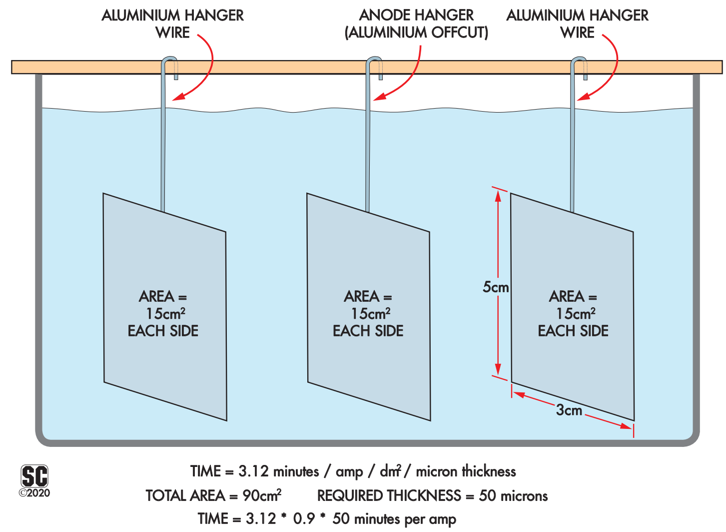


Fig.2: you can anodise several pieces at once like this. Add up the total surface area (include both sides!) to calculate the required time and current.

vomiting. Continually rinse your mouth with water and **seek medical attention as soon as possible.**

- **inhalation** – if you inhale sulfuric acid aerosols, **seek fresh air and medical attention immediately.**
- **spills** – if you spill acid, first check that none got onto yourself or others. If so, deal with that first. Small quantities of sulfuric acid can be neutralised using sodium bicarbonate, which once neutralised, can be cleaned up and disposed of.

Personal protective equipment (PPE) is required. The recommendation for working with these chemicals includes:

- **wrap-around eyeglasses**
- **nitrile gloves**, which you change every time you touch acid or base containing vessels
- **overalls**, or clothing you don't mind getting a few holes in, and
- always wash your hands after moving from the work area

Pro safety tip: always store acid in a 'bunded' area, so if there is a failure of your acid container, the spill is caught in the bunding. We do this by merely placing the acid container inside a slightly larger container.

We trust that at this point, you have informed yourself of the materials with which we are working and established a safe work area. Let's get into the process.

Just what is happening?

Fear not; this is as much chemistry as I will go into. Because anodising aluminium is an electro-chemical process, we need to consider what happens at the anode (which is the workpiece) and the cathode in the reaction. Fig.1 shows the general arrangement.

At the anode: $2Al + 3H_2O \Rightarrow Al_2O_3 + 6H^+ + 6e^-$
At the cathode: $6H^+ + 6e^- \Rightarrow 3H_2$

The resulting anodising reaction is:

$$2Al + 3H_2O \Rightarrow Al_2O_3 + 3H_2$$

The Al_2O_3 is a conversion of the aluminium on the surface of the workpiece. Hydrogen gas (H_2) is generated at the cathode, and can be seen as bubbles – so definitely no smoking anywhere in the area and care must be taken to eliminate electrical sparks.

The electrolyte, generally sulfuric acid, is not consumed in the anodising reaction. So the acid bath can be reused many times.

Anodisation actually converts a very thin part of the surface of your workpiece into aluminium oxide. The process described in this article produces a 25-50 micron layer, which usually leads to an insignificant change in thickness.

The way that aluminium oxide grows on the surface of the part creates a hexagonal, honeycomb-like structure. The structure is tiny, but large enough for dyes to be captured within.

So once we have anodised a part, we can take advantage of this structure and use it to hold coloured dyes.

Anodising time

We have just seen that anodising is a chemical conversion of the part, driven by an external power source. So how much current is required and for how long?

The current at which you anodise has several impacts on the type of finish you get. This is a variable that you will need to experiment with. I'll provide some rules of thumb, and the results of my experience as a starting point:

- lower temperatures and higher voltages (to achieve the required current) can lead to very thick finishes
- the type of aluminium alloy present, and any impurities, has an impact on the result
- the thickness of anodisation layer is largely a function of how long you anodise
- if you use a voltage source rather than current source, the current will vary throughout the process

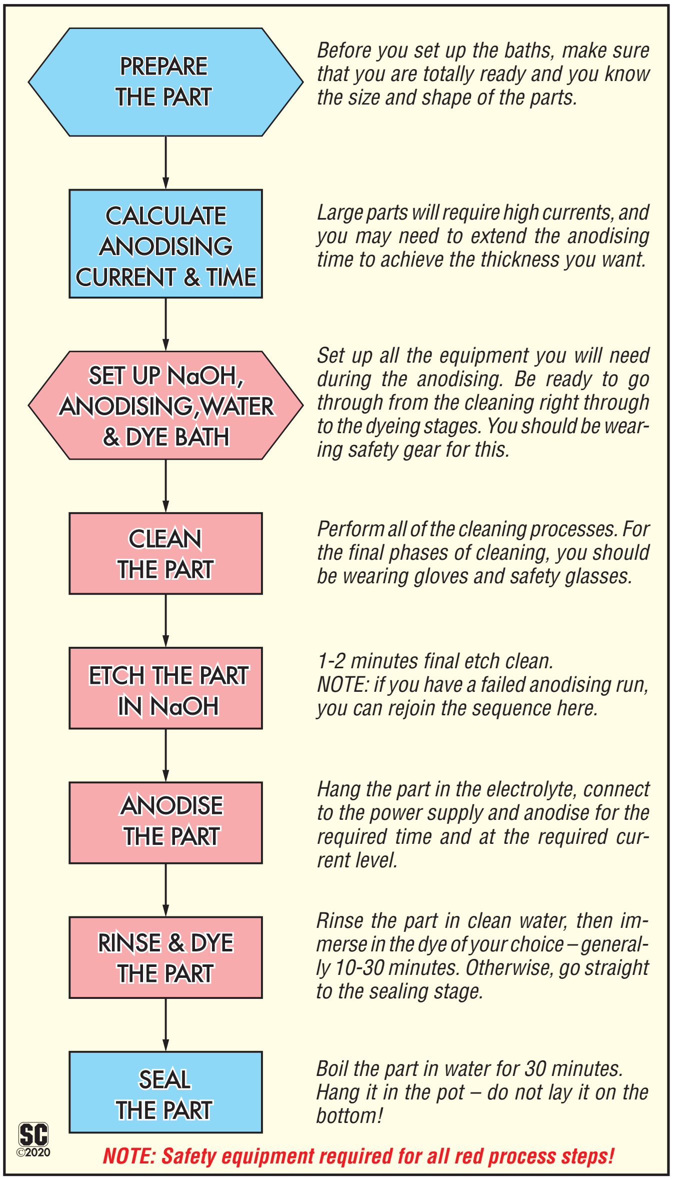


Fig.3: a flow chart which explains all the steps required in anodising. It is not absolutely essential to dye the part, nor even to seal it – but it will be much tougher if you do! Note the comment regarding safety equipment: it's for YOUR protection!

Remember that anodising is all about a chemical reaction, and the current the process draws is a result of the chemical reaction moving ions around. So controlling the current is much preferable to the voltage, as this gives you some control of the chemical process.

One common rule often used to determine the current required is "the rule of 720", where:

$$\text{minutes to anodise} = \frac{\text{thickness of the desired layer in mils} \times 720}{\text{amps/ft}^2}$$

Converting this to metric units gives us the rule of 3.12 (almost pi, but not quite!):

$$\text{minutes to anodise} = \frac{\text{thickness of the desired layer in microns} \times 3.12}{\text{amps/dm}^2}$$

Yes, we are using the decimetre (dm) as a unit. One square decimetre is 100cm^2, eg, 10x10cm.

Acetone is used to clean the parts to be anodised of any oily residue. It is readily available at hardware stores.

Sodium Bisulfate, an alternative to Sulfuric Acid, is also readily available – a good source is your local pool shop, where it is sold as pH Decreaser.

One of my tests used three pieces of aluminium of 30cm^2 each (see Fig.2).

So we had a total of 90cm^2 or 0.9dm.

I wanted a 50 micron thick coating, so the calculation was:

$$\text{minutes to anodise} = \frac{50 \times 3.12}{(\text{amps} \div 0.9)}$$

This works out to 140 minutes (50 x 3.12 ÷ 0.9) ÷ amps.

Try to keep the anodising current in the region of 1-3A per 100cm^2, if for no other reason than this will give you a reasonable time to anodise the part to a 20-50 micron thickness.

You will note that for large parts, this might require a very high current source.

I have not tried anodising whole rack cases, but if your power supply cannot deliver the required current, you just need to anodise at the highest available current setting and let it run for as long as required.

The process – a workflow

Fig.3 shows a basic workflow for anodising, with the steps you will need. They are described in more detail below. There are many variables, especially in the parts you wish to anodise and the equipment you have available.

The steps include preparation, setting up the anodising, staining and sealing. I suggest that you start at a small scale and run some test pieces before ramping up to large parts.

Remember that large parts will require large baths and power supplies.

Anodising bath electrolyte

While it is not commonly used, it is possible to anodise using sodium bisulphate as the electrolyte instead of sulfuric acid. I ran several tests using sodium bisulphate and got identical results.

There is not a lot of discussion on the internet about this alternative. Some commenters suggested that the chemical bath may need to be replaced regularly, as opposed to sulfuric acid, where the same bath can be kept and used many times.

I suspect that they may have a point, but for the few tests I ran, it gave perfect results.

If you are having trouble finding sulfuric acid and only wish to run a few experiments, then this is a real option as the materials are available at your local pool or hardware store.

You won't need a whole roll of lead – it's quite expensive so if you can beg or borrow a smaller quantity (maybe a local builder or plumber?) you will be better off!

Aluminium wire is commonly available at better hardware stores – it is sold as "Tig" welding wire.

Sodium bisulphate is inexpensive, and if you are not planning to set up a factory, the possible short lifespan of the electrolyte bath is not a big deal.

Electrolyte preparation steps – sulfuric acid

1) Purchase standard battery acid. I bought some with an SG of 1.28, or about 36% concentration, and diluted it to between 10-15% concentration. Add acid to water!

2) Select your anodising bath container. Make sure it is much deeper than your part, can be carried easily and emptied easily.

3) Fill to 2/3 of the final bath depth with deionised/distilled water.

4) Then (and this is the last time I will mention this) wearing your personal protective equipment, add acid to the water, filling the bath to the final depth. NEVER add water to acid, as this can lead to the water boiling and splashing!

Electrolyte preparation – sodium bisulphate

The steps are the same as above, but you need to add 20% by weight of sodium bisulphate crystals to the water for the final solution. So if you want 5L of electrolyte, add 1kg of sodium bisulphate crystals to 4L of water. Note though that this will give you a little less than 5L – to be honest, I cut a corner and just used a little extra water to make it up.

We found the crystals took ages to dissolve. They eventually did, though.

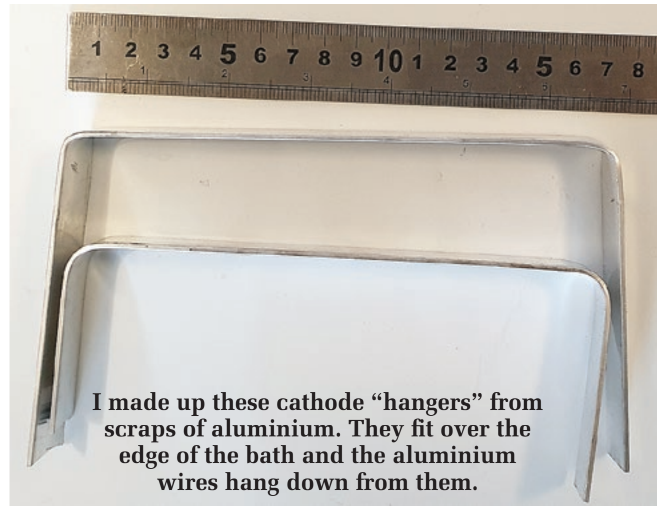
We noticed that the sodium bisulphate bath was less clear than the sulfuric acid bath. I suspect that this is because the purity of pool chemicals is not great, while battery acid usually is very well controlled.

The bath was somewhat cloudy, though over several batches of anodising, it did clear up a bit. Your experience may be different.

Note that when using sodium bisulphate, you're likely to get sodium sulphate generated and deposited at the cathode. So you may need to clean the cathode after a few runs or else you might find that you have to apply a higher and higher voltage to get sufficient current flow.

Cathode preparation

The cathodes can be either aluminium or lead. Aluminium will not last, but lead can be tricky to find in small pieces. Digging around in the back of an old shed usually unearths a few sheets of lead, which is commonly used for flashing on roofs. You may also be able to get your hands on lead curtain weights without spending much.



I made up these cathode "hangers" from scraps of aluminium. They fit over the edge of the bath and the aluminium wires hang down from them.

You will know when you find it, as it is heavy, very ductile and often crusty looking if it is old. That is OK, a good scrub with a scourer will make it ready to use. The cathode surface area should be approximately the same as the area of your workpiece, although that is not critical.

If you want to buy some lead, it is available from hardware stores, but you may be forced to buy more than you want, and it is not cheap.

A friendly chat with your local plumber might be a cost-effective alternative, especially if facilitated with a six-pack of your plumber's favourite beverage.

I simply cut and bent the lead sheet to fit my container. Make sure your connection to the cathode is outside the electrolyte, or your leads will very quickly become corroded, and may contaminate your acid bath.

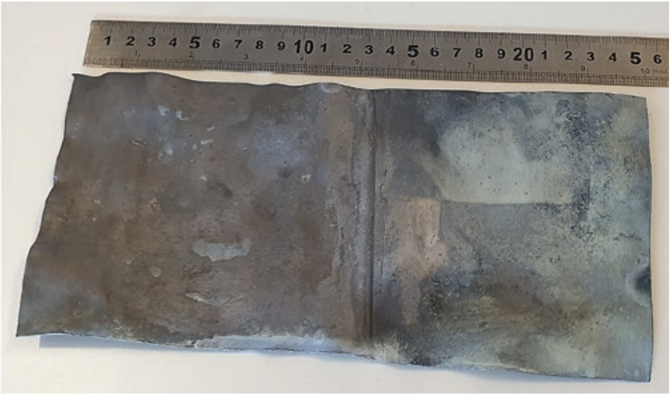
Even though it gets "dirty", the cathode is not used up in this reaction, so it can be reused many times.

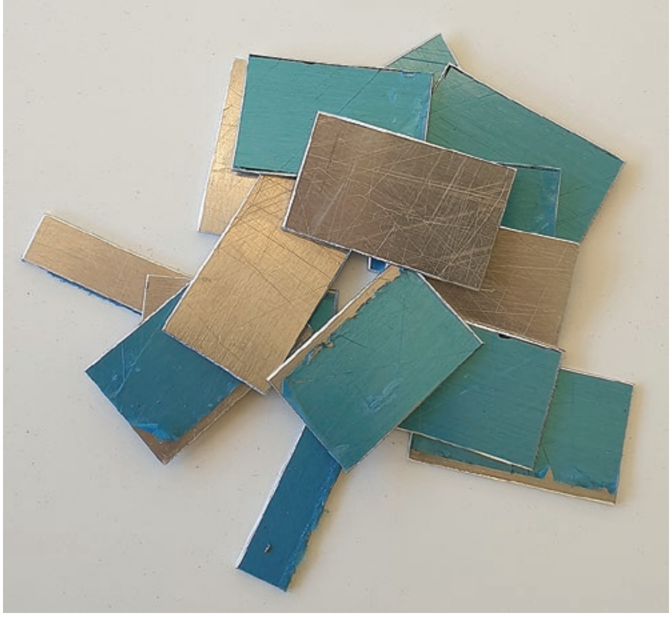
As noted above, if lead is too much of a hassle, heavy aluminium foil such as you find on takeaway containers also works.

I used this in my first tests without a problem. Should you happen to have a stash of titanium sheet, this would be ideal.

Unfortunately, my personal jet fighter needs all of its titanium bits!

The surface finish on your parts before anodising will determine how they come out. Once anodised the surface finish is protected by the hard anodised layer. Spend that extra five minutes before anodising to get them perfect.





Lead makes a great cathode. Lead sheet is not pretty, especially after use, but that is fine – you can use it over and over again.
(Right): these are some scrap pieces I used for trialling my anodising processes and chemistry. It's always wise to do many trials on offcuts and scraps to get timing and chemicals correct before the "real thing".

As you may have guessed, the cathode will eventually connect to the negative end of your DC power supply.

Part preparation

Preparation is absolutely everything in terms of the finish you achieve on your parts. Anodising produces a micron-scale later of aluminium oxide, which will do nothing to hide a scratch or dent. Dyeing the part simply changes the colour, and does nothing to fill defects or blemishes. If you spend five minutes preparing the part, you will be able to tell at the end!

That said, if you are restoring an old vehicle and want to anodise old aluminium parts that you have cleaned up, plain anodising will certainly protect that part from the elements and ensure that all your hard work lasts.

There are a few steps to prepare your parts for anodising:
1) make the parts (if not already made)
2) prepare the surface
3) scrub clean
4) clean of oil and finger grease
5) etch the surface to remove any residual anodising
We'll go through these briefly.

Manufacturing the parts

If you are making the parts yourself, it is a good idea to make sure there is a conveniently located hole that can be used to hang the part during the anodising process.

For the demonstration parts, I simply drilled a small hole in the corner. But you might not have that luxury with your part!

It is imperative that there is good electrical contact between the hanging wire and your part.

One option that we've taken in the past is to drill a hanger hole in a spot that will be hidden from sight in the final application, and make "paper clip" type hooks from aluminium wire to feed through that hole and hang the part in the bath.

Surface preparation

The first level of preparation is to ensure the surface is free of scratches and dents. This starts when manufacturing your part. Just as if you were planning on painting the surface, use material that is free of scratches and dents, be careful how you mark it up and do not leave tool marks on the part.

Finishing your edges requires either clean cuts (for example, using a guillotine), or you need to file and sand the edges smooth.

When filing, remember that you need to work from a coarse to a fine file, and probably will want to end with sandpaper to get a clean edge.

Scrub clean

Once your parts are made and finished to your satisfaction, they need to be cleaned of any surface contamination. Unless the surfaces are freshly machined (ie, you have just taken the part off a lathe or milling machine), you will need to clean the surface very thoroughly, including scrubbing off any existing anodisation layer on the surface.

This is generally done by taking a green scouring pad or fine sandpaper to the surface and scrubbing away any sign of anodisation, oil or other surface contamination. This needs to be a very vigorous process and should leave you with an immaculate and shiny part.

Work from say 400 grit wet and dry sandpaper through to 800 or even 1200 grit. The surfaces I finished with 1200 grit came out very smooth and clean looking. You need to be careful to sand in straight lines and not leave scuffs on the surface.

Using wet and dry paper under running water assists with keeping the paper clean.

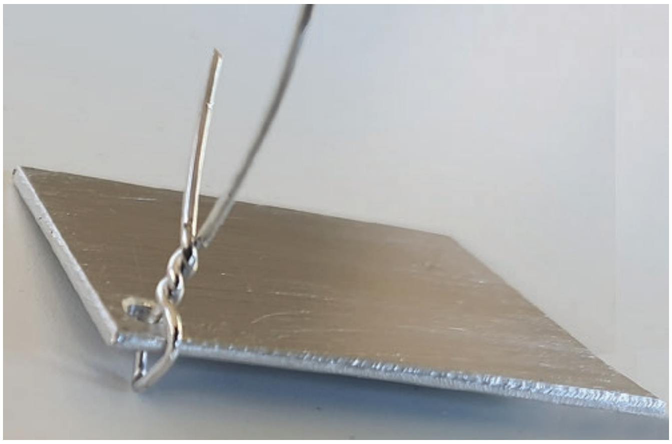
Clean away oil and finger grease

At this point, you need to glove up. This time, it is to keep you from contaminating the part with oil from your fingers.

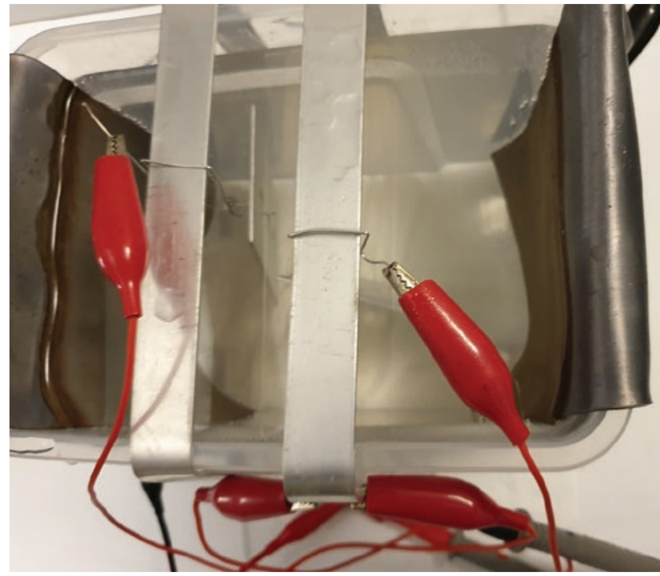
Any oil deposited from here on will interfere with the anodising process. In one of my tests, I touched a part and once it was stained, it was obvious where it had been touched.

Clean the part(s) first with soapy water, then with acetone, by wetting a tissue with acetone and wiping the part down.

Use acetone in a reasonably ventilated area, and dispose of the tissues with care, as it is flammable. Once cleaned,



Achieving good electrical connection to your parts is essential. It is also not as easy as it might seem. Our main cause of problems was poor connection at the anode.



At right: we made up these "hangers" to support small pieces of work – the idea is to keep these out of the solution so they don't get anodised!

attach your connection wire.

As discussed above, having a cleverly placed hole that you can squish the wire into helps. Do this with your gloves on, and make sure the connection is solid.

Making the anode connection

To make your part an anode, you need to attach a piece of aluminium wire. Why use aluminium wire? If you put steel or copper into the bath, the electrolytic process will eat these away very quickly, and in the process likely cause the anodisation to fail.

By using aluminium wire, this is avoided, and the only effect is that **the hanger wire is anodised in the process.**

Aluminium wire is available as TIG welding wire from a hardware store (I patronised my local Bunnings). It will probably be hidden away in the tools section. Alternatively, if you have some heavy-duty power line cables laying around, they might use aluminium wire internally, so this could be a cheap source.

Ideally, the hole in your part should be just the right size to poke the TIG wire into, with a tight fit. I used a 0.8mm PCB drill for this, and squished the TIG wire so that it was tight in this hole. Alternatively, you could fold the wire over and push it into a screw hole.

Professional anodising systems use aluminium or titanium hangers which incorporate clips that firmly grip the part.

Etching the part surface

Place the part in the sodium hydroxide bath for 1-2 minutes to remove any remaining oxide layer. To prepare this bath, make a solution of 2% sodium hydroxide with clean water. That is about two spoons of pure NaOH per 500mL of water.

Keep your gloves and glasses on during this process.

Hold your part by the attached anode wire; do not put your fingers in the solution even with gloves on. By one minute, your parts should be fizzing away happily, and by two minutes, you can pull them out and move them to a clean water bath.

This water bath removes any residual sodium hydroxide before the part goes into the anodising bath.

Anodising

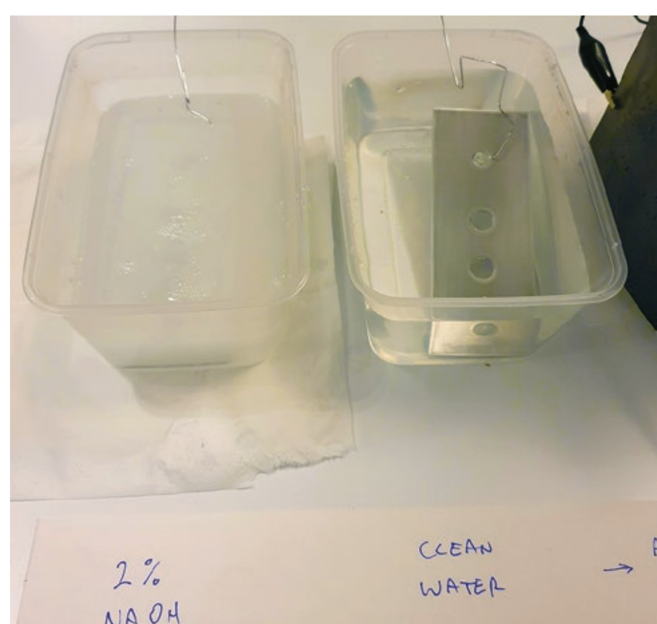
You are now ready to anodise your parts. You should have your anodising bath ready, with the cathode plate in and connected to your power supply, and a hanger of some sort that allows you to hang your parts in the bath. The bath should already contain the electrolyte.

Take your parts from the clean water bath and bend the hanger wire to allow them to hang in the anodising bath without touching the cathode or each other.

When hanging the parts, wear all your protective equipment. Do not put your hands in the electrolyte, even though you have gloves on.

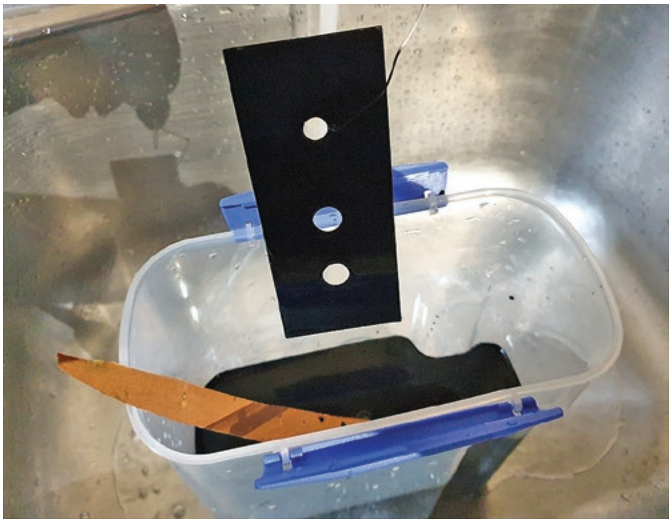
If you drop a part, use timber tweezers or similar to fish it out and then clean it off in water and start again.

Use clip leads to make sure that there is an electrical connection from the positive supply to the anode



Arranging your workspace is important. This shows how we lined out etch and rinse baths up to support a simple workflow.

This tub of green dye works particularly well. This is after a very brief dip – and shows that we had not properly mixed the powder in. Preparation is important.



This black dyed part used a specialist anodising dye, and worked extremely well – much better than some of the RIT fabric dyes (see the table below).

connection on your part. This might save you from using bad language later on!

Apply power and set the current to your desired level.

To check that there is a good connection to all your parts, take a clip lead off each one and ensure that the supply voltage changes (or current, if you are using a constant voltage power supply).

The anodising process will take quite a while. My test case took two hours. Most practical runs should be in the 1-2 hour range, possibly more if your parts are substantial.

Check from time to time that everything looks OK. Remember to put your glasses and gloves on every time you go near to the bath. Be prepared to dispose of a fair few pairs of gloves.

When the time is up, fish your parts out using tweezers and put them in a clean water bath. There will be a subtly grey finish to the parts. This is the raw anodised layer. They are then ready for staining and sealing.

Staining

To stain the parts, hang them in a stain bath. The time required depends on how dark you want the colour to come out and on the dye itself. In preparing this article, I tried out quite a few different dyes with mixed success. The most consistent outcomes were found with dyes sold especially for staining anodised surfaces.

I also had success with some (but not all) of the RIT dyes which are sold for colouring fabric.

Take a look at the photos to see a few of my test pieces.

Generally, 5-20 minutes is enough to stain parts. Note that the sealing process takes away a little of the colour depth.

If something went wrong in the anodising process (most likely due to a power supply connection problem), that part will not take any colour in the dyeing process. This is because the aluminium oxide microstructure is not there to hold the dye.

Sealing the parts

This simply involves immersing them in boiling water for 30 minutes. This seals off the top of the cells in the aluminium oxide and holds the dye in place. If you aren't dying the parts, you still need to seal off the top of the cells.

Use an old pot with a lid. I bought mine at a local op shop for a couple of dollars. Some dye is released during this process, and it's best not stain the expensive kitchenware.

Results and conclusions

I ran several test runs on some small pieces of aluminium to test out the process and a range of dyes. I found that the process worked well with both sulfuric acid and sodium bisulfate as the electrolyte.

Of the dyes I tested, many of them gave excellent colours. It is clear that anodising and staining can deliver both protective and decorative results.

With appropriate care and preparation, the process is safe and straightforward.

At left is my evaluation of the range of dyes tested, which are available from eBay and in your local store.

I have included some photos of the results of our tests, to show you the sort of colours you can achieve. You will see some scratches on these – that's because I was still learning some of the tricks that I have now passed on to you! SC

Dye	Result
Classic Plating Green (eBay)	*Very effective (specialised anodising dye)*
Classic Plating Black (eBay)	*Very effective (specialised anodising dye)*
RIT Tangerine powder	*Worked a treat*
RIT Denim Blue powder	*Very inconsistent and patchy result, though this was a powder dye; it might work better as a liquid.*
RIT Royal Blue liquid	*Worked OK*
RIT Scarlet Red liquid	*Worked well*
DYLON Velvet Black (Coles)	*Total failure*

Some dyes give a better result than others – and some are pretty hopeless! It really is a matter of trial and error (more errors than trials?).