Understanding DC Power

Electroplating and anodizing require a DC power source, at varying amperages, in order to work. You can't simply plug in your kit into a wall outlet, which is AC power. You need a converter to convert the AC current, into DC. These converters are called Rectifiers.

But wait a minute, don't most batteries output DC power? Why can't I use a car or motorcycle battery, or a battery charger? Well, actually, you can use any of these as a power source for your plating or anodizing. However, you must then rig up a way to control how many amps are coming from your battery into your plating kit. The amperage used varies based on the surface area of the part being plated or anodized.

If you're an electronics whiz, this is easy to do. In fact, we have several tutorials on our web site about controlling the power using resistors, automotive light bulbs and banks of Nichrome wire. If however, you don't know the difference between a volt and an amp, or simply don't want to waste time changing out light bulbs every time you want to plate something, a rectifier makes a lot of sense. Simply figure out the required current, turn on the rectifier and dial it in.

From this point on, we're going to assume that you're using a rectifier as your power source. If you want to use batteries, light bulbs etc, please refer to the tutorials on our web site.

Power Supplies or Rectifiers

The term rectifier was used to describe power supplies in the 19th.Century. 'Electronics' had not been invented so power supplies as we know them didn't exist. In spite of not being used for 100 years the name 'rectifier' stuck, and power supplies used for plating and anodizing purposes are called this in the Industry.

Regulated and Non-Regulated Power Supplies

A regulated power supply has a circuit to hold its output to a particular value when the load on the power supply changes. A non-regulated power supply does not have this circuit, so its output will change as the load changes. A common example of regulated would be the power supply in your personal computer. An automotive battery charger would be an example of a power supply with no regulation.

Adjustable and Non-Adjustable Power Supplies

An adjustable power supply has a control to allow the user to adjust its output, and a non-adjustable power supply does not. Your computer power supply is non-adjustable and so is your battery charger. All plating and anodizing rectifiers are adjustable, as are laboratory type electronics power supplies. For all plating and anodizing purposes, an adjustable power supply is required.

Power Supply Regulation, CV and CC Methods

There are two regulation methods in common use, Constant Voltage (CV) and Constant Current (CC). Constant Voltage (CV) regulation has the means to measure its own output voltage, and a circuit that compares this to a reference voltage set by the user (the Volts knob). Regulation is achieved by the power supply constantly adjusting its output voltage so that it matches the user set reference. Hence the name, Constant Voltage. This will operate up to the maximum current capability of the power supply, called its current limit.

Constant Current (CC) regulation has the means to measure its output current, and a circuit to compare this current to a reference current set by the user (the Amps knob). Regulation is also achieved by the power supply constantly adjusting its output voltage, but this time so that the output current matches the user set reference current. Hence the name Constant Current. This regulation is maintained up to the maximum voltage the power supply is capable of, this limit is called the power supply's maximum voltage compliance.

Laboratory type power supplies often have both types of regulation and can operate in either CV or

CC modes. The Caswell 3 Amp, 5 Amp, 25 Amp and 30 Amp CV/CC rectifiers are examples of these.

Power Supplies for Plating

A CC power supply is clearly the easiest and best type to use for any plating application. Many of the electrical problems encountered by new platers can be avoided entirely by using CC. Not the least of these problems is plating at a consistent current; as the plating process continues, small changes in electrical characteristics of the plating setup occur which cause significant changes in the plating current. This in turn can cause uneven plating thickness and poor plating adhesion. These changes are unavoidable, and with CC operation the power supply compensates for them automatically, requiring no action or adjustments by the plater. For this reason Caswell Inc. recommends the use of CC for any and all electroplating applications.

Sizing a Power Supply for Plating

We have established previously that a CC power supply will provide the easiest and best results. The next question would be how large the power supply should be. This must be carefully considered as the power supply is often the most costly component in a plating setup.

Power Supply Voltage and Current

Current (amps) does the plating when tank plating, not voltage.
There needs to be sufficient voltage to support the required current, or that required current cannot be obtained. All common forms of plating involve plating metals onto the work; and most metals are good conductors of electricity, so the voltage requirements are low at about 3 volts or so. Better conductors (copper, gold and silver) require less voltage and poorer conductors (like chrome) requiring more. In all cases, the bulk of the 3 volts is dropped by the electrolyte itself. This is because the electrolyte is a solution made with water, which conducts electricity much less than the metals. The required current for a given plating job depends on the current density specified for each type of plating, and the surface area of the work to be plated.

Our plating kits can be put into to two categories; 'Chrome' and 'Everything Else'. The Everything Else category requires current densities of 9 amps per square foot or less, and Chrome requires about 200 amps per square foot.

Surface Area

Surface area is a measure of the entire surface of the work to be plated, or in other words, all of the work in contact with the electrolyte. Since it is an area, it is given in square feet (or square inches). It is essential for a good plating job for it to be within 10-20% accuracy.

Some Power Supply Sizing Examples

Example 1
Most platers want the capability to plate more than one metal. Flash plating and undercoat plating are often required on materials such as steel and aluminum. According to the Plating Manual, flash

copper requires 9 ASF. If you selected a 3 amp CC/CV power supply, you could plate 3÷9 = 0.33 square feet with Flash Copper. If instead you selected a 20 amp CC/CV unit, you could plate 20÷9 = 2.22 square feet with Flash Copper.

Example 2

According to the Plating Manual, zinc requires the highest current density (20 ASF) of all others in the Everything Else category. If one chose to forgo chrome plating, a 3 amp CC/CV supply would allow 3÷20 = 0.15 square feet to be plated with any metal except chrome. 0.15 square feet is 0.15×144 = 21.6 square inches, which would be suitable for plating many small objects. If a 20 amp CC/CV unit was used, you could plate 20÷20 = 1 square foot. That's 1 × 144 = 144 square inches.

In both examples, the voltage required was still about 3 volts. In practice some spare voltage will be needed for the inevitable voltage drop of the wiring. Allowing an additional 3 volts for the wiring is safe in most plating setups. This means that a 6 volt adjustable CC/CV would be all that is required. Unfortunately, low voltage adjustable CC/CV power supplies are not very common. This is because the majority of applications for power supplies of this type are for powering electronics, where higher voltage lower current units are the norm.

Power Supply Power Ratings

Power supplies are commonly rated in Watts (W = volts times amps). The 20 amp CC/CV supply discussed here is capable of 30 volts, so its power rating is 30V×20A = 600W. Since only 3V is used for the actual plating, only 3V×20A = 60W is actually used, that only 10% of what the power supply is capable of. When the voltage is increased to allow for the wiring, the power goes to 120W. This is still only 20% of the power supply's capability.

Power Supplies for Anodizing

A CC power supply also greatly benefits anodizing. Since the anodize film is an insulator, the changes in electrical characteristics during the process are much larger than in plating. CC operation provides a uniform anodize pore structure all the way down to the base metal. This promotes even and deep dye penetration, and the consistent pore structure provides a better looking and stronger anodize coating than if the pores are distorted by changes in the current. For this reason Caswell Inc. recommends the use of CC for any and all anodizing applications.

Power Made Easy

So now that you understand the power requirements of your plating kit, you know that you'll need to calculate the surface area of the parts you are plating, and then multiply that by the current requirement of your plating type. We've made both jobs a bit easier for you with some online tools.

First, working out the surface area for most objects can be done at http://www.caswellplating.com/surface.html

Next, finding the amperage required can be done at http://www.caswellplating.com/cdcalc.html