CASWELL

Caswell One-Plate® 1 – Electroless Nickel Made Easy

These Instructions Replace The Electroless Nickel Instructions in The Manual For Products Purchased After November 2022

Caswell One-Plate® 1 Electroless Nickel is truly a revolution for small scale Electroless Nickel plating. No more mixing of multiple chemicals, simpler one solution additions, lower consumption rate of chemicals, cheaper and easier overall operation.

Caswell One-Plate 1® uses ONE simple chemical for solution makeup and replenishment. Simply mix the required amount of concentrate and add distilled water. Heat to 185 deg F and start plating.

Commercial electroless nickel platers usually employ full time chemists to make additions to the solution. This is a time consuming activity for a small operation and is not cost effective. Our system is designed around the KISS -'Keep It Safely Simple' principal, so you will not have to 'titrate' and mess around with this technicality. We have developed a straightforward way of estimating the nickel depletion of the bath, and fresh additions can easily be made to prolong the life of the solution. The procedure is much like balancing your checkbook.

The brightness of the plate will, to some extent, depend on the degree of polish existing on the part. The higher the shine initially; the brighter the plate. Surfaces requiring shiny finishes should be done in fresh batches of solution; otherwise they may have to be buffed to obtain a high gloss. The duller finishes resemble cadmium or Butler nickel, so are of great value to most vehicle restorers. Numerous variations can be achieved by changing the surface finish prior to plating.

Electroless nickel plating is not new; it has many applications in industry. Because the system plates evenly over all areas of the part, even down tubes and holes, it is frequently used for firearms and small hand tools. It is ideally suited for coating extrusion dies to assist in mold release and protection of the surface. For the motorcycle restoration enthusiast, electroless nickel has a great application for evenly plating the air-cooling fins on many engine blocks, particularly older Indians and Harleys.

MAKING UP THE ELECTROLESS NICKEL SOLUTION

Kit Size	Caswell One-Plate® 1 Solution	Distilled Water
Mini (0.83 Gal)	1 Pint (473ml)	90 fl oz (2.66 L)
Standard (1.6 Gal)	1 Quart (946 ml)	1.35 Gal (5.11 L)
Deluxe (3.4 Gal)	2 Quarts (1.89 L)	2.8 Gal (10.6 L)
Jumbo (6.7 Gal)	1 Gallon (3.78 L)	5.7 Gal (21.5 L)

- Add the bag of plastic balls into the tank (these help keep heat in the tank)
- Mark the liquid level on the outside of the tank. This will show you your original tank level and help with replenishment.
- Heat to 185 deg F
- Monitor temperature with the glass thermometer

ALTERNATIVE METHOD

Some customers prefer to plate in a plastic bag. They will fill a metal tank with water (material not important) and then place the plating solution in a heavy plastic bag, like a good quality Ziploc bag. Heat the water to 185 deg F and submerge the sealed bag in the water.

Depending on the size of the bag, Caswell One-Plate® 1 solution can be made using 15% Caswell One-Plate® 1 solution, balance water (eg 0.15 gal Caswell One-Plate® 1 to 0.85 gal DI Water)

MAKING UP THE DEGREASER TANK

- Add 1 oz by weight of SP Degreaser powder per pint of water.
- Heat to 185 deg F

USING THE SYSTEM

While Caswell One-Plate® 1 simplifies many aspects of Electroless Nickel Plating, there are still some considerations that must be planned.

PLATING COPPER AND COPPER ALLOYS

Parts made from copper and copper alloys need to be in contact with a piece of steel, in the solution, for approximately 5 minutes so that the auto-catalytic reaction will start. Once the reaction starts (part will start to gas), you can remove the steel. Some customers prefer to hang these parts into the solution from a piece of steel wire.

MAX LOAD

Electroless Nickel plating uses a chemical reaction rather than electricity to plate nickel onto parts. This reaction will not occur if there are too many, or too large a part in the bath.

Kit Size	Maximum Surface Area Plated At Once
Mini	70 sq in
Standard	140 sq in
Deluxe	2 Sq Ft (288 sq in)
Jumbo	4 Sq Ft (576 sq in)

REPLENISHMENT

Electroless Nickel baths must not be allowed to have their nickel content drop below 80% of its nickel level. Nickel is removed from the bath during plating, so it is important to replenish the nickel content either during or after plating, depending on the size of the part and the plating time.

Kit Size	Starting Credits	Replenish Before Using (80% Credits)	Replenish Amount
Mini (0.83 Gal)	1800	360	2 fl oz
Standard (1.6 Gal)	3600	720	4 fl oz
Deluxe (3.4 Gal)	7200	1440	8 fl oz
Jumbo (6.7 Gal)	14400	2880	16 fl oz

What is a 'Nickel Credit'?

The level of nickel metal in the solution must never be let to drop below 80% of its initial level. If it does, the bath will crash and will be rendered useless. Therefore, we must monitor and replenish the amount of nickel in the tank as you plate your parts.
Nickel credits are a term we use to keep track of the nickel level in the tank.
Depending on the volume of plating solution, you start out with a number of credits. In our mini kit (5 pint), you have 1800 credits to start.)
Credits are used when you plate a part. To calculate credits used, you multiply the surface area in inches by the time you are plating.
The time you are plating, determines the plating thickness. 30 minutes of plating time give a coating that is 1/2 mil thick (0.0005")

Let's practice a few calculations:

Example 1

You have a part that is 5"x5" square, and flat, that you need to plate. That's 25 square inches per side, or 50 square inches total.
You want 0.0005" of nickel plating on the part, requiring a 30 minute plating time.
You will use 50 x 30 = 1500 nickel credits

Example 2

You have a cube shaped part that is 3"x3"x3". That's 54 square inches in area.
You want 1 mil of thickness, requiring 60 minutes plating time.
You will use 54 x 60 = 3240 nickel credits
Ok, so we understand how credits are used, but how are they replenished in the plating system?

Replenishment

In our Standard Electroless Nickel Kit (10 pint bath), we start out with 3600 nickel credits. This is based on the volume of chemicals in the tank. A kit twice the size would have twice the credits to start.
Using Example 1 above, we would use 1500 nickel credits during plating, so 3600-1500 = 2100 nickel credits left after plating. Easy, right?
BUT - we MUST remember that at no time can the amount of nickel credits in the bath get below 80% of their initial level, or the bath will crash. 80% of the original 3600 = 2880 credits.
So, if we plated this part for the entire 30 minutes, the bath would have crashed and would be useless.
So, how can we plate this part? Simple.....we must add replenisher during the plating.
Using Example 1 above, we know that we will use 2100 nickel credits during the 30 minute plating time.
We know that we must replenish after we use up 80% of the original credits (80% of 3600 = 720)
We know that credits are calculated as time x area.
We can work out that if the part is 50 square inches, we will lose 720 credits after 14 minutes. (720/50=14.4)
Therefore, we must add replenisher every 14 minutes to bring the bath back up to it's original level. (To replenish 720 credits, we add 4 fl oz of One-Plate solution)
We will need to do this every 14 minutes, so during a 30 minute plating cycle, you will replenish twice.

Ok, let's try with Example 2:
In a Standard Electroless Nickel Kit we start with 3600 credits.
Your part is 54 square inches in area.
How many credits will you use during the entire plating time of 60 minutes?
At what credit level do you need to replenish?
After how many minutes should you replenish?
How many times?

Answers:
60 mins x 54 sq in = 3240 credits
80% of the beginning 3600 = 720 credits
720 credits, divided by 54 sq inches = 13.3 minutes (13 is ok)
3240 credits used / 720 credits each time = 4.5. If you replenish 4 times, once every 13 minutes, you'll have added 2880 credits out of the 3240 used, so at the end, add half a replenisher to give you back the balance of 360 credits.

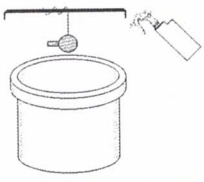
Advanced Users /Titration Procedures
For Reference Only
For the advanced user who wishes to measure and replenish the bath more exactly, we have included instructions. Caswell Inc does not offer technical support on this procedure.

Bath Replenishment:
To ensure proper operation of the Electroless Nickel system, the solution chemistry must be maintained between 85% and 105% of initial activity. This is accomplished by measuring and monitoring the nickel metal concentration via a standard EDTA titration.

Titration Procedure
- The plating bath is maintained by simple analytical procedures and subsequent replenishment
- The following reagents are required: Concentrated ammonium hydroxide, Murexide indicator mix (2 grams murexide powder in 100 grams sodium chloride), and 0.0575M E.D.T.A. solution.
- Analysis procedure:
- Pipette 10 ml of plating solution into a 250 ml Erlenmeyer flask.
- Add 100 ml of deionized water, 10 ml of concentrated ammonium hydroxide, and about 0.2 grams murexide indicator mixture and mix well.
- Titrate immediately with standard 0.0575M E.D.T.A. solution to purple endpoint, and record the number of ml of the E.D.T.A. solution used.
- The grams/liter of nickel metal in the bath = ml of 0.0575M EDTA used x 0.336.
- Replenish according to the chart below, based upon the ml of E.D.T.A. consumed in the titration procedure above.
- If the nickel metal concentration in the bath falls below 80%, it is best to replenish in two steps to avoid over-stabilization.
- Each replenishment component should be added separately to the bath.
- All replenishments should be made slowly with good mixing, and not directly over the workload.

For 100 Gallon Bath

% nickel metal present	100	95	90	85	80
ml 0.0575M EDTA consumed per 10mL aliquot	14.8	14.1	13.3	12.6	11.8
g/l nickel metal present	5	4.75	4.5	4.25	4
Add Gallons of One-Plate® 1	0	0.75	1.5	2.25	3

PROCEDURE	SETUP	OPERATING PARAMETERS	EQUIPMENT	SAFETY
1. SURFACE PREPARATION	Buff & Polish for a mirror finish. Bead Blast for a 'flat' finish. Nylon Abrasive wheel buff for a 'scratched brush' look.			
2. DEGREASING		140- 200F No agitation 5 mins immersion 1 oz SP Degreaser per 1 Pint of distilled water per	1 x Enamel Lined tank 1 x tank lid 1 x 2lb SP Degreaser	
3. RINSE IN DISTILLED WATER SPRAY				
4. WATER BREAK TEST	 Oil/dirt film makes water bead up		 No oil/dirt film allows water to cover part	
5. CALCULATE TOTAL SURFACE AREA AND PLATING TIME REQUIRED 6. CALCULATE CREDITS THAT WILL BE USED 7. CHECK MAXIMUM LOAD NOT EXCEEDED 8. CHECK FOR COPPER ALLOY (PART MUST BE CONTACTED WITH A PIECE OF STEEL FOR 2-5 MINS)				
9. TANK MAKEUP		• 185°F (Heat on hotplate or range) • Add bag of mist balls Add 15% EZ-PLATE to 85% DI Water MARK LIQUID LEVEL	• 1 x Enamel Tank • 1 x Tank lid • Mist Balls • Caswell EZ-PLATE • Distilled water	Wear rubber gloves and goggles. Do not ingest. 

10. PLATING TIMES	Time	Application	Plate Thickness
	15 mins	Indoor items, decorative etc	0.00025"
	30 mins	Hand tools, guns, nuts, bolts, brackets	0.0005"
	60 mins	Marine, motorcycle, car or outdoor fitting	0.001"

11. REPLENISH

Tank Size	Max Load (Sq In)	Starting Credits	Replenish Before Using (Credits)	Replenisher Addition
Mini	70 sq in	1800	360	2 fl oz
Standard	140 sq in	3600	720	4 fl oz
Deluxe	2 Sq Ft (288 sq in)	7200	1440	8 fl oz
Jumbo	4 Sq Ft (576 sq in)	14400	2880	16 fl oz

12. TOP UP	After adding replenisher, top up with distilled water to original level. Avoid adding large amounts of water that will decrease temperature of bath.
13. BUFF & POLISH	Buff and polish to enhance the finish, using white buffing compound or Blue Begone Polish

Dispersions - Boron Nitride, Silicone Carbide or PTFE Nickel

One of the most exciting elements about our new Electroless Nickel System is that you can convert our regular nickel system into either a Boron Nitride, Silicone Carbide or PTFE composite plating system.

Note, once you add a dispersion material, you cannot go back to regular Electroless Nickel Plating, so if you want to plate multiple finishes, you will need multiple kits.

All dispersion Electroless Nickel systems will plate a matte grey finish. They could be polished slightly after plating, but will never be as bright as regular electroless nickel.

The amount of dispersion per kit size required is shown in the table below. You will probably want to purchase slightly more for replenishment.

Kit Size	Boron Nitride	Silicone Carbide	PTFE
Mini	5.3 fl oz	2 fl oz	19 grams (0.67 oz by weight)
Standard	10.6 fl oz	4 fl oz	38 grams (1.4 oz by weight)
Deluxe	21.2 fl oz	8 fl oz	76 grams (2.7 oz by weight)
Jumbo	42.4 fl oz	16 fl oz	152 grams (5.4 oz by weight)

Boron Nitride

BN EN is an extremely slick, abrasion resistant, low-friction, high lubricity coating.

Ideal for all types of guns, engine pistons, fry pans, in fact anywhere where dry lubrication and non-stick is an issue. We see interesting potential in lining parts of Paintball Guns to prevent wear of the soft aluminum.

The coating can be applied in 20 minutes, to zincated aluminum, steel, nickel, copper, brass and bronze. Other metals can be treated as long as a nickel plate is previously applied.

Where corrosion may present a problem (such as on steel) the part should be previously plated with at least 0.0002" of Electroless Nickel plate. Generally gun components can be plated directly without a base primer of nickel.

The coating is applied at 0.0002" in 20 minutes.

The system requires constant agitation, so a pumping system is required. The pump must be able to withstand 185 deg F. If you do not have such a pump, we sell an optional unit. You will also need fittings and tubing to connect the pump to the plating tank - available in any hardware store. We sell such a suitable pump here.

PTFE

PTFE is an excellent coating to provide low friction values on parts, especially where two parts are sliding together. It is especially useful on tools, molds, dies, cylinders, gun parts, bearings etc. and provides self lubricating properties to the parts it is applied to.

Our PTFE Electroless Nickel system plates a mid-phosphorous nickel plating, with 20-25% PTFE deposits, and plates, in many cases, twice as fast as conventional EN/PTFE processes.

The coating is not effective for corrosion resistance, so where corrosion resistance and lubricity are desired, plate the part first with our regular EN system, then plate with the PTFE system.

The system is easy to operate, requiring no complex chemistry knowledge, expensive pumps, or filtration.

Mild solution agitation is recommended during the plating cycle to keep the PTFE particles mixed. Manual movement of the part in the bath would be sufficient, or the more enterprising user could construct a simple mechanical mixer.

Silicone Carbide

Silicone Carbide Electroless Nickel Plating creates an extremely hard and wear resistant surface (almost matching the hardness of diamonds) and is used on parts that bear endure heavy loads with little to no lubrication.

Commonly found on pump shafts, machinery parts and even scissors, this coating will outperform almost all others in durability.

Parts being plated should be non-magnetic, to avoid excess particles being attracted to the part. Mild agitation of the solution is required to ensure the Silicone Carbide particles remain suspended. Manual stirring or part movement in the solution will usually suffice. A small aquarium air pump could also blow air into the solution through some airline.

TROUBLE SHOOTING

The following are problems that may occur in plating, plus a listing of possible causes and suggested remedies.

Skip plating, pitting, edge pull-back, step plating, dark or laminar deposit - See: 1, 2, 3, 7

Roughness in deposit - See: 4, 5, 6

Streaks in deposit - See: 1, 3, 7, 8

Dull or Matte Deposit - See: 1, 3, 9, 11

Poor adhesion - See: 1, 11, 12

Poor corrosion and/or chemical resistance - See: 1, 3, 4, 10, 11

Slow Plating Rate - See: 2, 3, 5, 7, 8, 9, 11

Fast Plating Rate - See: 4, 11

Short Bath Life - See: 2, 3, 9, 11, 12

Possible Causes/Remedies:
1. Improper Pretreatment - Temperature should be checked as well as purity and concentration of cleaner, activator, and other pretreatment solutions. Some metals and alloys, such as leaded steels, brasses, copper and aluminum, require special preparation. Rinsing, temperature and rinsing time should be checked. Consider using an electro-cleaning, ultrasonic cleaning, and/or other methods of cleaning. Minimize transfer times between pretreatment steps. Consider a double zincate process for aluminum work pieces.
2. Over stabilization of bath - Bath should be dummied or discarded and replaced. Review replenishment history. Insure adequate work load in the bath, and add additional surface area if needed.
3. Chemical contamination - Bath should be dummied or discarded and replaced. Insure no sources of nitric acid, heavy metal or other contamination. Use only proper quality deionized water. Avoid drag-in.
4. Particulate contamination from solid particles; i.e. dust, loose nickel or metal chips - Avoid contamination and/or improve workload cleaning and rinsing, and bath filtration. Use only proper quality DI water.
5. Excessive solution replenishment while work is being plated – Replenishments should be added slowly and mixed thoroughly, as far away from work piece(s) as possible.
6. Only one side of work affected - Agitation around work pieces should be increased and/or work pieces should be rotated while plating.
7. Improper agitation - Agitation around work pieces should be improved and/or work pieces should be rotated while plating.
8. Low surface area - Surface area should be increased to recommended range.
9. Bath very old - Bath should be discarded, and new bath prepared.
10. Pitting in base metal and/or deposit – Inspect base metal and remedy plating bath as needed.
11. Poor bath control - Uniform temperature should be maintained, pH and replenishment controlled.
12. Zincate build up in plating bath - Bath should be used for non-aluminum parts or discarded. Double zincate processing will reduce the rate of zinc contamination.