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A2LA Accredited ISO/IEC 17025:2005 Certificate # 2558.01

377 Electroless Nickel-Boron Process

Accu-Labs 377 is a semi-bright electroless nickel-boron alloy process designed to produce uniform nickel alloy deposits containing a maximum of 0.5% boron. These deposits can be applied to a wide variety of properly prepared metallic and non-metallic substrates. **Accu-Labs 377** can be used for rack and barrel plating.

Accu-Labs 377 deposits have low internal stress and are characterized by resistance to high temperatures; good welding and brazing characteristics, solderability; and high hardness, which improves their resistance to wear.

The **377** bath operates at low temperatures and is easy to maintain. The bath is tolerant to metallic impurities, a feature that serves to extend the life of the bath.

FEATURES

- High-purity deposits
- No toxic heavy metals, lead free RoHS compliant
- Easily welded, soldered and brazed
- Easy to activate for further deposits
- High-temperature resistance
- For resilient contact surfaces
- High hardness, durable finish for excellent wear resistance
- Can use for high diffusion temps

PROCESS COMPONENTS

Accu-Labs 377-A	Nickel Metal, Make Up
Accu-Labs 377-M	Nickel Metal, Maintenance
Accu-Labs 377-B	Reducer
Accu-Labs 377-ZX	Stress and Rate Agent

SOLUTION MAKE-UP

<u>Component</u>	<u>100 gallons</u>	<u>100 Liters</u>
Accu-Labs 377-A	15 gallons	15 liters
Accu-Labs 377-B	5 gallons	5 liters
Water (distilled or deionized)	Balance	Balance

- Fill tank $\frac{3}{4}$ full with distilled or deionized water.
- Add 15% by volume **377-A**, stir well.
- Add 5% by volume **377-B**, stir well.
- Adjust pH to 6.5 (high quality dilute ammonium hydroxide to raise pH) or (50% acetic acid to lower pH if above 7.0).
- Adjust solution level to final volume with distilled or DI water and mix well.
- Heat solution operating temperature. Solution is now ready for operation.

OPERATING GUIDELINES:

Characteristic	Range	Typical
Temperature	140 - 170°F (60 - 77°C)	150°F (65°C)
pH	6.0 – 7.0	6.5
Plating Rate	0.15 - 0.3 mils/hour (3.8 - 7.5 $\mu\text{m/hr}$)	See range
Bath Loading	0.1 – 1.0 Ft ² /gallon	0.5 Ft ² /gallon

SOLUTION MAINTENANCE AND CONTROL

Additives used for solution maintenance are:

Accu-Labs 377-M Nickel Metal Replenisher used at 1:2
Accu-Labs 377-B Reducer/Stabilizer used at 2:1 replenishment

Replenishment additions of **Accu-Labs 377-M** are based on the percent nickel metal activity of the plating solution (see titration analysis procedure or percent nickel metal activity). After determining the percent nickel metal activity, use the addition schedule to obtain the amount of **Accu-Labs 377-M** required to maintain the percent nickel metal activity near 100%.

Avoid making infrequent, large additions of **377-M** as this practice will cause bath over stabilization. If nickel metal activity drops more than 20% between additions, increase the frequency of routine analysis and additions of **377-M**.

Nickel Metal Activity Analysis

- Pipette 10mL cooled sample of plating solution into 250mL e-flask
- Add about 100mL of distilled or deionized water.
- Add 10mL of concentrated ammonium hydroxide.
- Add about 0.2 gram murexide indicator.
- Titrate immediately with 0.0575M EDTA solution to an endpoint color change of light brown to violet.
- **Calculation:** % nickel metal activity = mL EDTA X 5.62

% Ni Metal	377-M mL/gallon	377-M mL/liter	377-M gallons/100 gallons
100	None	None	None
90	20	5	0.5
80	40	10	1.0
70	60	15	1.5
60	80	20	2.0
50	100	25	2.5

Replenishment additions of **377-B** are based on the reducer concentration of the plating solution (see titration analysis procedure for determining the **377-B** reducer concentration). After determining the reducer concentration, use the addition schedule for **377-B** to obtain amount of **377-B** required to maintain reducer concentration at 5% by volume. In general the **377-B** should be added at a ratio of 2:1 **377-B** to **377-M**.

Maintain reducer concentration by routine small additions of **377-B**. Do not make infrequent, large additions as this practice will reduce the efficiency of the bath. If the reducer concentration drops more than 20% between additions, increase the frequency of routine analysis and additions. **NOTE:** If the bath is to be idle for a time, DO NOT MAKE **377-B** additions until bath is ready to be worked.

Procedure for 377-B Analysis

- Pipette 10mL cooled sample of plating solution into 250mL e-flask
- Add 50mL of distilled water.
- Add 1 to 2 mL of starch indicator.
- Titrate with 0.1N iodine solution to starch endpoint.
- **Calculation:** % by vol. **377-B** = (mL iodine solution) X N* X 1.97
*N is exact normality of iodine solution

% BV 377-B	377-B mL/gallon	377-B mL/liter	377-B gallons/100 gallons
5.0	None	None	None
4.5	20	5	0.5
4.0	40	10	1.0
3.5	60	15	1.5
3.0	80	20	2.0
2.5	100	25	2.5

When plating continuously, a ratio of 2:1 **377-B** to **377-M** will maintain the **377-B** at approximately the correct level. (Optimum conditions would require additions of 2.15 parts of **377-B** to one part **377-M**.) **DO NOT MIX 377-B WITH 377-M PRIOR TO ADDING TO THE WORKING BATH!**

377-ZX: Under normal bath operation, additions of **377-ZX** are not required. **Accu-Labs 377-ZX** additions may required to reduce the internal stress of the deposit or if the plating rate is excessively high (>0.35 mil/hr) with all bath parameters within range. Use increments of 2 mL/gallon (0.5 mL/liter) or less of bath until excessive deposit stress or excess plating rate is corrected

EQUIPMENT

Tank and heating: A variety of tank and heating systems can be used. Electroless Nickel-Boron chemistries are more sensitive to localized over-heating compared to Nickel-Phosphorus chemistries and the heating selection becomes more critical.

One system in common use is a double tank. The outer tank is filled with water or other suitable heat transfer fluid, and is heated with a steam coil or a derated electric heating unit. Circulation of this fluid may be accomplished by a stirrer or a pump. The inner tank, which contains the **Accu-Labs 377** plating solution, can be constructed of 316 stainless steel (or mild steel) lined with a suitable non-metallic, high-temperature material.

A non-metallic inner tank, such as polypropylene or high-density polyethylene, may be used; however, heat transfer time should be carefully considered before attempting to use these materials in the double-tank system. For ease of operation and maintenance a disposable 20 mil or thicker liner insert can be utilized. PVC liners should not be used.

An alternate tank and heating system for the **Accu-Labs 377** process can consist of a single, reinforced, high-temperature polypropylene tank and Teflon Super coil (using hot water) directly in contact with the plating solution. An external heat exchanger system utilizing hot water is also acceptable.

Ventilation: The area immediately around the plating tank should be ventilated. An air removal system located at the side of the tank or adjacent to the plating bath to remove the plating vapors is suggested. Avoid overhead ventilators-because condensate can contaminate the bath. Make-up air should be filtered to avoid dust or particulate contamination of the tank.

Filtration: Continuous filtration or daily filtration of the plating solution is suggested. This is done most effectively after the solution has cooled. Avoid contact of solution with metal. Use non-metallic elements. Use filter cartridges with a polypropylene fiber and polypropylene core (recommended retention size – 0.45 micron). Cartridges must be leached in hot (170°F) water prior to use.

Agitation: Mild agitation is suggested. Avoid strong agitation. Agitators should be non-metallic or coated with PTFE. Do not use air agitation.

ADDITIONAL OPERATING GUIDELINES:

Do not allow nickel metal activity to drop below 80% during bath operation.

Do not allow the concentration of **Accu-Labs 377-B** to drop below 4% by volume.

A complete solution replenishment of metal content (metal turnover) occurs when 6.4 fl oz/gal (50mL/L) **Accu-Labs 377-M** have been added.

Under optimum conditions a complete solution replenishment of metal content (metal turnover) requires 500mL/gal (132mL/L) **Accu-Labs 377-B**.

Proper chemical cleaning and pretreatment of parts to be plated with **Accu-Labs 377** is most important to insure maximum performance.

Although the **Accu-Labs 377** system is tolerant to nominal amounts of impurities, the system can be affected by the drag-in of specific impurities such as palladium, cadmium, copper, and sulfur-containing compounds. Good rinsing is most important prior to the **Accu-Labs 377** bath. Filter out particles as they appear.

Cool the **Accu-Labs 377** plating bath to room temperature when not in use.

Safety

Wear protective gear and follow safe handling procedures for all chemicals used. Read and follow the safety information in the Material Safety Data Sheets before use and handling.

DISCLAIMER

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