

## SELECTIVE BRUSH PLATING FOR DECORATIVE APPLICATIONS

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### Abstract

The selective brush plating process is generally known as a selective metal deposition process for industrial or aerospace applications. However, the brush plating process has been successful in producing decorative finishes for a vast array of decorative finishing applications. Special techniques have been used to produce attractive, high quality decorative finishes in many instances where conventional bath plating would be impossible or too costly. Also, additional finishes have been developed for use with brush plating, such as a patented, corrosion resistant, brass colored finish.

### Introduction

For many years, conventional tank plating has been invaluable for the decorative finishing of metal and plastic parts. Through the extensive use of decorative plating, applications for brush plating have become significant in the decorative finishing industry. The versatility of brush plating has played an important role in the growth of decorative brush plating.

This paper will explore brush plating as a processing technique for decorative finishing. Areas of discussion will include an explanation of brush plating, various applications, finishes available, processing techniques including the limitations of the process, and future developments in brush plating for decorative finishing.

### The Brush Plating Process

The brush plating process is an electrodeposition process by which metal, pure or alloy, is selectively deposited on only the specific area which requires electroplating. The brush plating process can be used as a portable system or a fixed installation (see Figure 1). The equipment and solutions for brush plating are capable of producing high quality deposits, although brush plating systems are relatively inexpensive.

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The brush plating system operates on the same theory as conventional tank plating, except the process does not require any tanks. The cathodic (negative) charge from the power supply is connected directly to the part being plated and the anodic (positive) charge from the power supply is connected to a stylus holder. The anode on the stylus holder is typically fabricated to match the contour of the area to be plated. The anode is wrapped with absorbent cotton or polyester which is then saturated with the brush plating solution. The electroplating then occurs as the anode is brushed across the part being plated (see Figure 2).

The usefulness of brush plating is defined by the specific advantages the process holds over conventional processes of metal deposition (see Table 1). The brush plating process yields excellent adhesion, especially of difficult to plate metals. Brush plating chemicals are relatively mild and safe to use. Brush plating operators can become proficient with little or no background in electrochemistry or other technical fields.

#### Applications of Brush Plating for Decorative Finishing

The applications for decorative brush plating are extensive (see Table 2). Brush plating is adaptable for plating on any size of part. For example, brush gold plating has been applied to the copula on top of the California State Capitol Building (see Figure 3). An estimated 36,000 square inches were 24 karat gold plated to a thickness of 50 millionths of an inch with a nickel underlay of 250 micro-inches minimum. The portability of the brush plating process allowed the plating to be performed from scaffolding 300 feet above ground level. This is an obvious need for brush plating.

Other types of parts which would require brush plating are plumbing fixtures which cannot be easily removed. Faucets, sink drains, spa fixtures, and bar sinks are examples of brush plating jobs completed in the past, either to repair old plating or to change the finish on the fixture. Many of these fixtures can be plated in place with little or no difficulty.

Another application of decorative brush plating which is currently popular is the gold plating of automotive emblems on the car. The chrome plated plastic emblems can be striped to expose a bright nickel surface. The nickel is electrochemically activated and plated with a 23-karat gold finish. The 23-karat gold finish is substantially harder than the 24-karat gold, yet has the same rich gold appearance. The chemicals used in brush plating are relatively safe and therefore, will not damage the automotive paint finish.

## Available Finishes

A large number of finishes are available for decorative brush plating (see Table 3). Once the initial investment has been made in the brush plating system, applying the various finishes requires merely purchasing the plating solution for that particular finish.

Due to the problems associated with brass plating, Electrum\* was developed in 1980 as a brass substitute. Electrum provides a simulated brass finish, yet does not oxidize or discolor as brass does. The Electrum finish when exposed to a 5% Salt Spray Test in accordance with ASTM B117 did not show any visible signs of corrosion after 1000 hours (see Figure 4). The Electrum in combination with a nickel underplate provides an effective corrosion barrier on brass.

The Electrum finish has been used as a brass substitute for water fountains at Disneyland, telegraphs on board the Queen Mary in Long Beach (see Figure 5), and bathroom fixtures in many homes throughout Beverly Hills and Bel Air in California (see Figure 6 & 7). The finish applied over solid brass with a nickel underplate has provided years of service without fail.

Other finishes can be brush plated to provide similar cosmetic and protective characteristics as their tank plated equivalents. Some of these finishes require a light polish after plating, while many will plate out as bright as the underlying surface.

## Process Techniques

Many of the electrochemical or mechanical preparation procedures used in brush plating are designed to provide high levels of adhesion when heavy deposits (.010 inches or greater) are applied. Decorative plating deposits rarely reach this thickness and therefore, do not require extensive preparation. Excellent adhesion for thinner deposits is obtainable in brush plating without necessarily etching or dulling the surface prior to plating.

Brush plating solutions are typically designed to conform to military standards and therefore, do not contain organic brighteners to produce bright deposits. Decorative brush plated deposits will typically duplicate the brightness of the substrate. Therefore, to avoid polishing after brush plating, metal preparation procedures which do not etch the substrate are essential. Also, relatively low current densities should be used to produce more lustrous deposits.

\*Electrum is a patented product of Brooktronics Engineering Corporation.

The procedures used for electrochemical preparation of the substrate are usually forward polarity operations (see Table 4). There are a few exceptions, such as in the case of chrome stripping or the preparation of aluminum. Although the chrome stripping is a reverse polarity operation, the underlying nickel surface will retain its original bright surface once the chrome has been removed. The bright nickel surface provides an excellent base for gold or Electrum plating among other finishes. Aluminum requires etch operation even with thin deposits for adequate adhesion.

Some limitations do exist when using the brush plating process for decorative finishing. The unavailability of brush plating solutions with brighteners can result in labor intensive polishing operations after brush plating over dull substrates. Substrates would require a hand or machine polish prior to brush plating. With the exception of aluminum, bright surfaces can easily be obtained over polished substrates. Aluminum would require a tank plated bright nickel deposit prior to brush plating with gold or the desired finish. The size limitations of gold plating tanks would make this a viable option when gold plating larger parts.

Decorative finishes requiring a satin or matte appearance can easily be obtained through mechanical or electrochemical preparation procedures on all substrates.

#### Future of Brush Plating within the Decorative Finishing Industry

With the environmental costs of cyanide based gold solutions and the material costs of filling and maintaining a gold plating tank, the application of brush gold plating will be a popular alternative in many instances. Larger parts can be brush gold plated with only a minimal investment in gold plating solution required.

The development of brush plating solutions with brightening agents and levelers will open new doors for brush plating in the decorative industry. The surface condition of the substrate will not be as important to obtain brighter finishes.

#### Conclusion

Decorative brush plating has established a position in the decorative finishing industry. Brush plating is not intended to replace tank plating, but more importantly, complement tank plating as an additional method of processing.

Many finishes can be brush plated to meet a multitude of decorative applications. With the specialized procedures developed for decorative brush plating, lustrous and eye pleasing finishes can be easily obtained.

	Brush Plating	Tank Plating
Portable	Yes	No
Adhesion of Deposit	Excellent	Good
Deposition Rate	Very Fast	Slow
Hydrogen Embrittlement	Little to None	Significant
Masking Requirements	Minimal	Poss. Extensive
Equipment Cost	Economical	Expensive
Environmental Waste	Minimal	Poss. Extensive
Adaptable to Large Volume	Not Usually	Frequently
Labor Intensive	Usually	Not Usually

Table 1: Comparison of Brush Plating versus Conventional Tank Plating.

### Decorative Applications of Brush Plating

Item	Typical finish
Elevator Doors	Gold, Nickel
Plumbing Fixtures	Gold, Electrum, Chrome
Auto Emblems & Trim	Gold, Chrome
Marine Hardware	Gold, Electrum, Chrome
Ornamental Fixtures	Gold, Electrum
Church Building Domes	Gold, Copper
Statues	Gold, Copper, Nickel
Artwork	Gold, Electrum, Nickel
Aircraft Interiors	Gold, Electrum
Slot Machines	Gold, Chrome
Architectural Trim	Gold, Chrome, Nickel, Electrum
Building Lobbies	Gold, Electrum, Nickel
Musical Instruments	Gold, Electrum, Silver
Brass Household Fixtures	Electrum

Table 2: Partial list of applications for decorative brush plating.

### Decorative Brush Plated Finishes

Gold  
Electrum  
Silver  
Copper  
Nickel  
Chrome  
Palladium  
Antique Colorings

Table 3: Selected list of decorative brush plated finishes available.

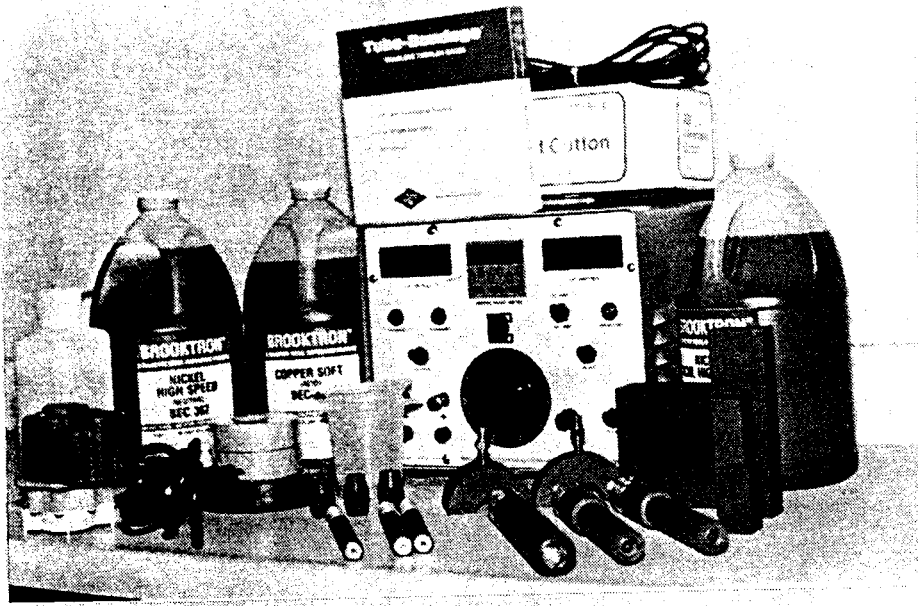


Figure 1: Example of a basic brush plating system, including power supply, stylus and solutions.

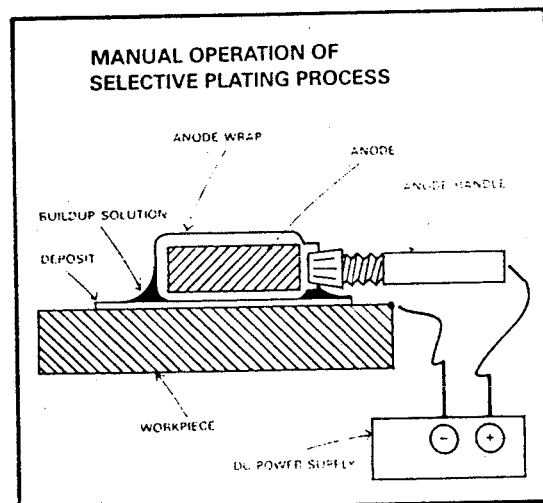


Figure 2: Brush plating diagram illustrating process.

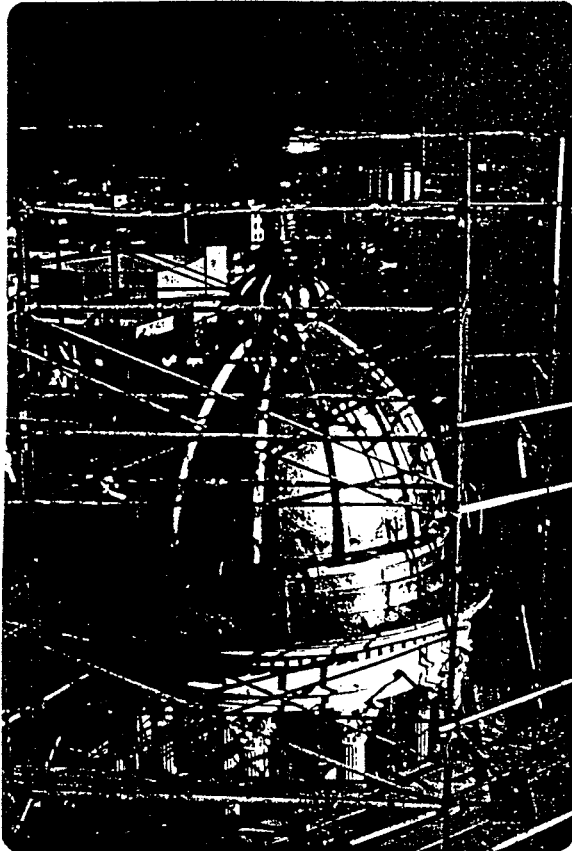


Figure 3: Brush gold plating on copula at the top of the California State Capitol Building.

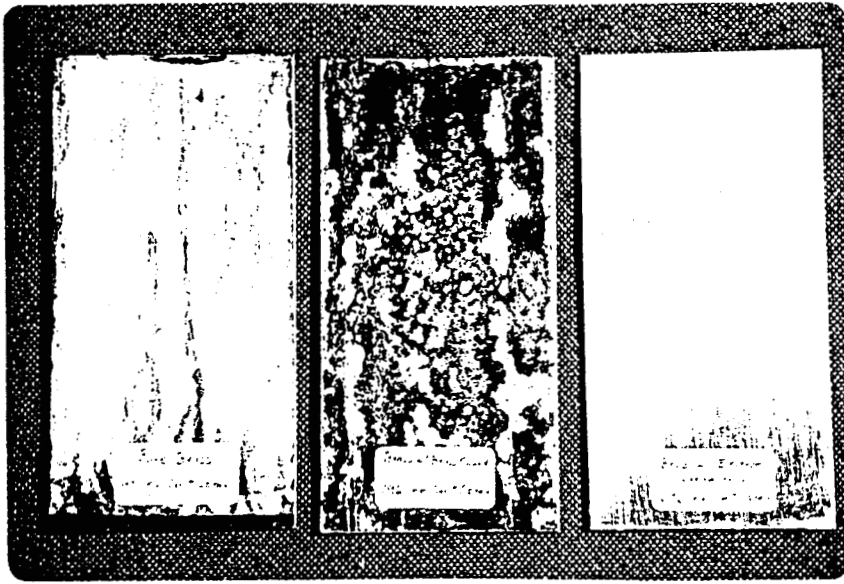


Figure 4: Salt spray results of brush Electrum coating.

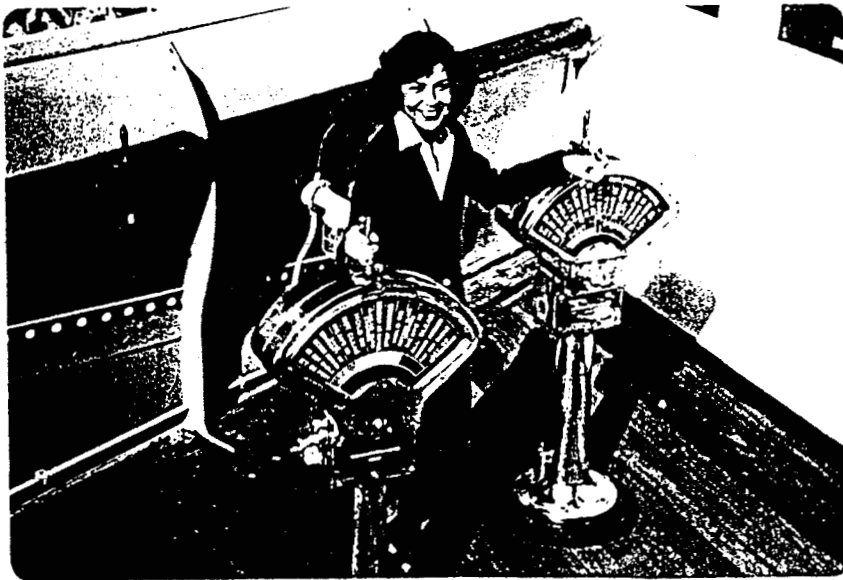


Figure 5: Telegraphs on board the Queen Mary brush plated with Electrum.

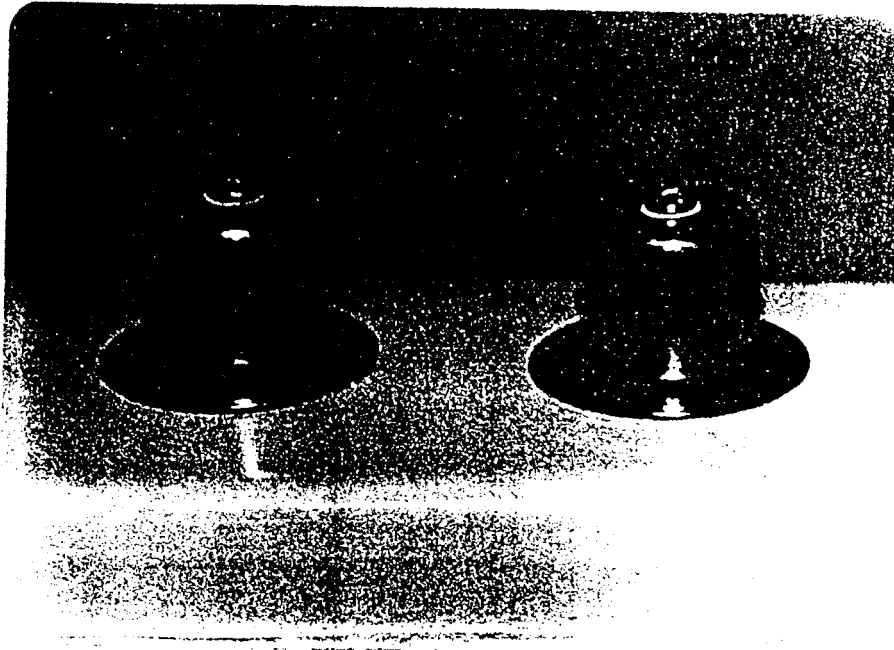


Figure 6: Spa air intake valves prior to brush plating.

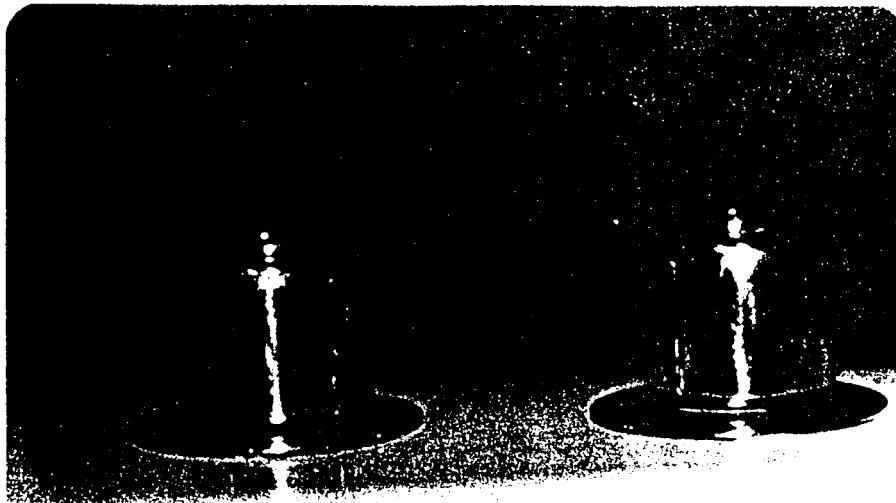


Figure 7: Spa air intake valves brush plated with Electrum.