# The Most Significant Troubles Caused by Disregarding Design Considerations in Plating Products Electrically

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## Abstract
The main objective of the electroplating process is coverage with uniform thickness distribution without any problem on the entire surface of the product, and it is difficult to obtain uniform thickness distribution with the appearance of some defects resulting from errors in the design process. To avoid these defects, design considerations shoud be observed regarding the shape of the product, racking, The shape of the anodes and heaters, the causes of the plating problems resulting from failure to observe the design considerations should be known as well, in addition to knowing how to solve them. Furthermore, obligatory design principles and critera should be determined.
The process of electroplating is not a cheap process, especially in the case of plating with precious metals such as gold, which requires particular specifications.Good design allows the application of good coverage, and often small changes in design can be made to help greatly in simplifying the treatment process, avoid plating problems resulting from lack of observed design considerations and reduce costs.
The designer must know the principles and design considerations that affect the quality of the coating process, as well as the causes of the problems of the electroplating process in order to avoid them since the beginning of the design.

## Keywords
Design considerations - electroplating troubleshooting- poor throwing power- anode’s shape

### Statement of Problem
The research problem lies in the necessity for the designer to know the design considerations affecting the electroplating process, which results from not taking into account several problems, as well as to know how to treat them in order to reach a quality surface for the product at the lowest costs.

### Purpose
The purpose is to conduct an analytical study to find out the causes of some of the problems of electroplating resulting from failure to observe the design considerations regarding the shape of the product, racking, the shape of the anode and heaters and how to treat them.

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**Research Hypotheses**

Taking into account design considerations regarding the product shape, racking, and the shape of anode and heaters leads to:

- Avoiding many electroplating problems of different solutions.
- Achieving better results at the lowest costs.

**Research Introduction:**

Electrochemical processes are among the high-quality processes in achieving the best results for treating the surface of the metal product. These processes require a high level of diligence, experience and accuracy to do them correctly. This not only depends on the exact specifications of the electrochemical process, but also depends on the processes previously performed on the metal before starting. In these processes, as a result, many defects appear due to the complexity of the process.

This research deals with some defects of electroplating for the surface of a metal product resulting from errors in the design process and the relationship between the design process and the quality of the electroplating for the surface of the metal product, and determines the design principles and standards that must be taken into account when starting the design process to improve the quality of the surface of the metal product, and the defects that appear in the product after the electroplating procedure requires re-operations again. These processes are expensive as they often exceed the cost of doing them correctly the first time. So, the best treatment is prevention. Hence, it is important to know the problems of disregarding design considerations during the electroplating process, as well as their causes, and to know how to solve these problems.

**Troubles related to disregarding design considerations in electroplating:**

**General troubleshooting electroplating**

| Problem | Cause | Remedy |
|---|---|---|
| No deposit (No gassing) | No current (or gassing from part) | Check all electrics |
| Pitted Plate and Orange Peel effect. | 1. Impurities in solution<br>2. Hydrogen bubbles formed on part. | 1- Plate adummy for 30 mins. If no improvement, filter solution through activated charcoal placed into a coffee filter, then replace the Brighteners.<br>2- Add 5-15 ml. of HYDROGEN PEROXIDE per 2 gals of solution to reduce pitting, alter air agitation. Make air flow(bubbles) larger, or use manual agitation of the part. |
| Rough Plate | 1- Current density too high.<br>2- suspended particles in solution.<br>3- (PH) too high or low. | 1- Lower current density.<br>2- Filter solution.<br>3- Adjust (PH).<br>4- Adjust to 2:1 ratio. |

| | | |
|---|---|---|
| | 4- Anode to cathode ration wrong.<br>5- Rectifier ripple.<br>6- Anodes are not suitable. | 5- Add filter to rectifier, equalize tap switches.<br>6- Use of suitable anodes. |
| Dark deposits (esp. on low spots) | There is zinc, lead, copper, etc. in the solution (especially zinc plating( | Plate a dummy for 30 minutes over a polygon cathode. Zinc contamination can appear as alternating dark and light regions, and air excitation should be turned on, and the pH should be adjusted in the range of 3.5 - 4.5 |
| Burnt Plate | 1- Current density is too high.<br>2- Low temperature<br>3- poor agitation.<br>4- Anodes too long.<br>5- Brightener is low. | 1- Lower current density.<br>2- Adjust solution temperature.<br>3- Increase agitation.<br>4- The length of the anode must be proportional to the length of the cathode (work piece).<br>5- Add brightener. |
| Cloudy deposits on the plate | 1- Poor cleaning and rinsing.<br>2- Organic contamination.<br>3- High temperature.<br>4- Low agitation. | 1- Improve cleaning and rinsing<br>2- Filter solution through activated charcoal placed into a coffee filter, then replace the Brighteners.<br>3- Adjust temperature.<br>4- Improve air agitation. |
| Dull plate | 1- Current density too high.<br>2- Part not buffed enough.<br>3- Insufficient Brightener. | 1- Lower current density.<br>2- Strip the plate off and re-polish, or plate with copper, polish the copper and then re-plate.<br>3- Add brightener |
| Plate Peels or Blisters off | 1- Current density too high.<br>2- Surface too hot when buffed.<br>3- Poor surface. preparation.<br>4- Plated onto steel. | 1- Lower current density.<br>2- Reduce pressure on Buffing wheel.<br>3- Improve technique.<br>4- Prime steel with nickel before copper plating. |
| Plate peels or blisters off when applied to nickel base | 1- Nickel has ozidized<br>2- Insufficient cleaning and Poor preparation.<br>3- Current density is too high. | 1- Prior to plating swab nickel base with battery acid, then rinse.<br>2- Check part with 'waterbreak' test.<br>3- Lower current density. |

**Solving the problem of poor electrical conductivity resulting from poor design of plating racks:**

**1-** Using well designed fixtures and ensuring their cleanliness before each use.

**2-** Checking that parts are firmly secured in the fixtures before plating.

**3-** Cleaning the contact area (contact points) in the plated busses and trying to connect the electricity source to the distribution conductors on which the plating racks are suspended directly.

**Advantages of high operating temperatures:**

1- Higher solubility of basic electroplating bath ingredients (with some exceptions).

2- Higher ionic motion and consequently increased conductivity in the bath which allows higher current density to be used.

3- Reducing the anode and cathode polarization in most electroplating baths, such as nickel baths.

4- Increased cathode current efficiency; the notable exception is chromium baths.

5- Anode corrosion improvement.

6- The ability to operate dilute electroplating baths without loss of performance.

7- Low energy consumption due to lower required voltage.

**Potential disadvantages of higher solution temperatures:**

1- Increasing tendency for hydrolysis and deposition, for example, metal impurities in nickel, iron, or zinc baths, leading to pitting.

2- Dissolution of brightening and leveling agents.

3- Production of weak deposits that need additional activation.

4- Reduction of throwing power.

5- Excessive evaporation, which leads to noticeable changes in the solution composition and difficulty rinsing.

6- Cloudy deposits over the plating layer.

7- Very dark or brown golden color during gold plating (burnt gold).

8- Reddish to reddish brown golden color during gold plating.

9- Shortening the life of electroplating equipment.

**To avoid problems related to anode design considerations, the following should be observed:**

1. The size of the anode must be proportional to the fact that thin anodes will have a temperature increase and become subjected to corrosion.

2. The total area of the anode must be large in relation to the area of the cathode (twice the area), so that the problem of overheating of the coating solution would not occur.

3. The anode is shorter than the cathode or the anode terminals are isolated to avoid overcurrent at the cathode terminals (work piece).

4. The convergence and regularity of the distance between the anode and the cathode improve the uniformity of the thickness of the plating layer, while maintaining a safe distance and non-contact so as not to damage the cathode (work piece).

5. The use of anodes must be compatible in shape with the cathode to improve the plating layer and uniformity of thickness.
6. Auxiliary anodes are used when the inner diameters of the long cylinders are plating and the anode current density is always greater than the cathode current density. Therefore, the permissible anode current density must be determined before determining the cathode current density.

## Results &Discussion:

1. Many of the problems of electroplating are due to disregarding design considerations.
2. The problem of ion throwing power is affected by the following factors:

- The shape of the product, in which throwing power increases at protrusions and sharp edges and decreases at the sockets.
- Throwing power decreases with increasing temperature.
- The distance between the anode and the cathode (mismatch of the anode shape with the work piece), Throwing power increases by nearing the distance.

3. The problem of gas escalation is affected by the following factors:

- Suspension that is not suitable for the parts to be plated.
- The shape of the product, as the presence of the holes that are not closed leads to the continuous rise of gases, which leads to the absence of the plating layer being deposited over these holes.
- Small distance between anode and cathode.

4. Adherence to design considerations can avoid many electroplating problems, improve product surface quality, and save economic costs.

## Recommendations:

1. More research that deals with the problems resulting from disregarding design considerations in electroplating solutions should be made.
2. Attention should be paid to advanced research in the field of electroplating.
3. More research dealing with the problems caused by electroplating with chromium solutions should be made.

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