

## Zinc Plating Overview

### Offered at MPP Illinois Acid Chloride and Alkaline Non-Cyanide Processes

Zinc plating is a widely used surface finishing process that provides corrosion protection, wear resistance, and a uniform metallic finish for steel components. By depositing a thin layer of metallic zinc, zinc plating acts as a sacrificial barrier, preventing rust and extending part life.

Two common chemistries are employed: acid chloride zinc plating, which produces bright, thin deposits, and alkaline non-cyanide zinc plating, which produces thicker, more ductile coatings while avoiding toxic cyanide compounds.

### How Zinc Plating Works

Zinc plating is an electrolytic process. The steel part is immersed in a solution containing zinc ions and acts as the cathode in the electrical circuit. When current is applied, zinc is reduced from solution and deposited onto the steel surface.

Prior to plating, parts are thoroughly cleaned to remove oils, oxides, and surface contamination. This ensures good adhesion and prevents defects such as pitting or uneven deposits. After plating, parts are often treated with a chromate conversion coating to enhance corrosion resistance and, in some cases, add color.

### Acid Chloride Zinc Plating

Acid chloride plating uses a highly acidic zinc chloride bath. It produces bright, fine-grained deposits that are smooth and uniform. Coatings are typically thin (2–10  $\mu\text{m}$ ) and are excellent for decorative finishes or small parts with intricate geometries.

Acid chloride zinc plating offers:

- Fast deposition and high throwing power
- Excellent adhesion to well-prepared steel surfaces
- Compatibility with clear or colored chromate passivation

Applications: fasteners, small hardware, decorative components, and functional parts requiring light corrosion protection.

## **Alkaline Non-Cyanide Zinc Plating**

Alkaline non-cyanide plating uses an alkaline solution with zinc salts and complexing agents. It produces dense, ductile, and corrosion-resistant coatings, typically thicker than acid chloride deposits (5–25  $\mu\text{m}$ ).

Benefits include:

- Environmentally friendly and safer than cyanide baths
- Excellent corrosion protection, particularly when combined with chromate passivation
- Good ductility for parts subject to handling or assembly stress

Applications: industrial machinery parts, automotive components, larger fasteners, and assemblies where functional corrosion resistance is critical.

## **Alloy and Material Considerations**

Zinc plating is most effective on low carbon steel (typically <0.25% C). Using high carbon steel or hardenable alloys increases the risk of hydrogen embrittlement, which can lead to cracks, fractures, or premature failure under stress. The hardness of a substrate to be plated can be important. For example, steel having a hardness greater than Rockwell “C” 35 is sensitive to hydrogen embrittlement and is more difficult to prepare for plating.

## **Recommendations:**

- Use low carbon steel or mild steel for parts that will be zinc plated.
- Avoid high-strength, high-carbon, or quenched and tempered steels
- For critical fasteners, threaded parts, or load-bearing components, post-plate baking is often required to drive out hydrogen absorbed during plating.

## Dimensional and Coating Considerations

Zinc plating deposits are thin, so dimensional impact is minimal. Typical thickness ranges are:

- Acid chloride: 2–10  $\mu\text{m}$
- Alkaline non-cyanide: 5–25  $\mu\text{m}$

For tight tolerances, consider accounting for the zinc layer and any chromate or sealant coatings in assembly dimensions.

## Corrosion Protection

Zinc plating protects steel primarily through sacrificial protection. If the zinc coating is scratched, the exposed steel remains protected as the zinc preferentially corrodes. This is explained by the EMF and galvanic series of metals. If two different metals are immersed into a conductive solution, a galvanic cell will be produced. The less noble metal (Zinc) will corrode and become the positive terminal in a “galvanic cell” (battery) and the more noble metal (Iron) will be protected from corrosion and become the negative terminal of the galvanic cell.

## Choosing the Right Zinc Plating Process

- Acid chloride plating is ideal for small parts, bright or decorative finishes, and applications where thin coatings suffice.
- Alkaline non-cyanide plating is ideal for functional components or larger parts

Always consider substrate material to prevent hydrogen embrittlement, especially for load-bearing or critical parts.