

Factors Affecting Variations in the Appearance, Color, and/or Texture  
of  
Zinc Nickel Alloy Electrodeposits

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The electro-deposition of Zinc-Nickel alloys was developed as an alternative (and wherever possible, replacement) for cadmium electrodeposits. The unique property of the zinc-nickel electrodeposit is, when the alloy is deposited within a certain composition range, its corrosion potential differs compared to the alloying elements. That is, the zinc-nickel alloy corrodes at a much slower rate than either of the elements alone, even at relatively low thicknesses.

The corrosion resistance of zinc-nickel alloys can be further enhanced by applying different post treatments that serve as a final finish or as a base for paint or dry film. However, zinc-nickel alloy deposits from an aesthetic prospective are subjective to variations in appearance, color, and texture which **do not diminish** the unique properties of the deposit.

Har-Conn, *the specialists in metal finishing*, believe it is important for our customers to understand the reasons for these variations in the zinc-nickel alloy deposits and why they occur. Hence, for the benefit of our customers who may not be familiar with the intricacies of the process, we prepared this synopsis.

Factors Affecting Variations in the Appearance, Color, and/or Texture

- 1) Surface condition of the base material as received, to which the zinc-nickel deposit is to be applied.
- 2) Preparation of the base material prior to the zinc-nickel plating process.
- 3) Operating parameters of the zinc-nickel plating process.
- 4) Operating conditions during the zinc-nickel plating process.
- 5) Post treatments applied to the zinc-nickel deposits, (i.e., chromate conversion coatings, non-chromate sealers, phosphate coatings, post plating Hydrogen Relief Bakes, paint and dry film).

Base Material

Manufacturing operations performed on the parts such as brazing, forming, grinding, heat treating, joining, machining, and media finishing can affect the surface condition of the base material prior to the zinc-nickel plating process.

Preparation of the Base Material Prior to Plating Process

Abrasive blasting, chemical cleaning, acid activation, and application of a copper and/or nickel strike deposit prior to the zinc-nickel plating process can further affect the surface condition of the base material.

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Operating Parameters of the Zinc-Nickel Plating Process

Zinc-nickel plating processes are designed to operate within specified parameter ranges (e.g., anode to cathode ratios, concentration of constituents, current densities, pH, temperature, process time, etc.). Although these parameters can be controlled and maintained, slight variations within the acceptable ranges can influence the alloy composition of the deposit and consequently affect the appearance, color, and texture of the deposit.

Zinc-Nickel Process Operating Conditions

Parts for zinc-nickel plating must be fixtured or racked for the pre-treatment process (i.e., cleaning, activation, strike) and for the plating process. The geometry of the parts and the orientation of the parts on the fixture or rack can contribute to variations in the appearance, color, and/or texture of the deposit during the plating process. This is most noticeable in the areas on the part where the fixture or rack makes the point of contact. The current density in the area of the point(s) of contact can affect the alloy composition, thereby resulting in the variations.

Re-orientation of the parts on the rack or fixture during processing minimizes this occurrence. However, special attention must be given to this procedure to prevent deficiencies in the uniform distribution of the zinc-nickel deposit over the entire part.

Slight changes in movement of the plating solution caused by agitation and/or filtration while the parts are plating can also affect the alloy composition and hence, variations in appearance, color, and/or texture in the zinc-nickel deposit.

Post Treatments Applied to Zinc-Nickel Deposits

Any slight changes in the alloy composition of the zinc-nickel deposit is further exacerbated by post treatment processes with respect to appearance, color, and/or texture. Post treatments applied such as:

- ✚ chromate conversion coatings
- ✚ non-chromate sealers
- ✚ phosphate coatings
- ✚ post plating hydrogen relief bakes
- ✚ paint and dry film coatings

significantly contribute to these variations.

For example, parts requiring a post plating hydrogen relief bake may require a re-activation process prior to the application of these pretreatments. This re-activation can alter the appearance and texture of the zinc-nickel deposit.

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Post Treatments Applied to Zinc-Nickel Deposits (continued)

Another example is when a phosphate coating is applied to the zinc-nickel deposit. The phosphate crystal structure changes the surface texture of the deposit, producing an appearance of non-uniformity and roughness.

Furthermore, proprietary chromate conversion and non-chromate sealer formulations differ slightly from one manufacturer to another. Hence, they react differently to the alloy composition of the zinc-nickel deposits with respect to appearance and color.

Finally, paint and dry film coatings applied to zinc-nickel deposits will differ depending upon thickness of the coatings. Thin coats of paint and dry film will be more likely to reflect surface condition subtleties from the combination of the: a) base material after the parts are manufactured; b) the zinc-nickel plating process; and, c) the subsequent post plating treatments. Thicker applications of these coatings tend to eliminate these subtleties.