MECHANICAL ZINC PLATING

A Non-Embritting Alternate to Cadmium Plating. Electroplated Zinc & Hot-Dip Galvanize

Mechanical zinc plating has been applied to many high-strength steels in the past to provide a protective finish with minimum hydrogen embrittlement. Other platable basis metals are zinc die cast, copper and copper alloys, aluminum, lead, powdered metal, nitrided steel, loaded steel, cast iron, and low and high carbon steel. New developments have eliminated the need for a copper flash, and provide a mild preparation environment with little hydrogen adsorption and increased corrosion resistance without the use of post-plating coatings. The improved process provides the means to plate a wider variety of shapes than previous processes.

This article provides a description of the process capabilities, the techniques, and deposit characteristics. Newer mechanical zinc plating processes provide improved corrosion resistance, smoothness of deposit, and more uniform plate distribution. The use of a copper flash is no longer a necessary part of the process. The result is better adhesion, less tendency for hydrogen embrittlement, and elimination of a second dissimilar metal (copper). Thus waste treatment and disposal of copper is no longer necessary. These characteristics, along with the ability to match cadmium deposits for lubricity, result in favorable and controllable torque/tension values.

Chromate conversion coatings can be produced on these deposits easily, providing uniform protection and color including clear blue-bright, trivalent chrome blue-bright, yellows, olive drab, and uniform black. In addition, lubricants including waxes, PTFE, oil, and synthetics can be easily applied, as well as a number of corrosion-resistant coatings which add to the long life of plated products.

These new processes adapt well to producing alloys such as aluminum-zinc, zinc-nickel, alloys of most of the metals which can be deposited, and a number of other single metals. Metals that can be mechanically plated are zinc, tin, lead, copper, cadmium, aluminum, silver, gold, and indium. Layered deposits are easily achievable as well. In addition, plating onto non-ferrous basis metals is possible.

Deposit Characteristics

The deposit’s structure is different from hot-dip galvanize or electrodeposited zinc: it is a dense, continuous coating consisting of cold-welded, flattened particles and electrochemically-deposited zinc. The electrochemical deposition is catalyzed by small amounts of more noble metals. The deposit is usually semi-bright, although bright deposits are achievable. Unlike electroplated zinc, deposits of mechanically plated zinc are somewhat thinner on sharp edges, and they produce thicker (uniform) coatings onto what would be considered the low-current-density areas of electroplating.

Using the new process, this more uniform deposit thickness provides better overall corrosion protection on complex-shaped parts. For example, blind holes and threaded parts can be plated more uniformly. Corrosion resistance is enhanced, not only by more uniform deposit distribution, but also because thicker coatings can easily be applied in very short time cycles. Corrosion resistant alloys can easily be produced, such as nickel-zinc, zinc-tin, zinc-aluminum, etc. Ternary and quaternary alloys, as well as layered deposits of different metals, can produce customized corrosion protection for the expected environment to which the device may be exposed.

Applications include mainframe and transformer fasteners, circular connectors, EMI and RF shielding, various types of fasteners such as phosphate- head bolts and screws, machine screws, metal tacks, and nails of all types. The plated fasteners will withstand impact, allowing the use of automatic tools.

Clamps, washers, nuts, springs and small hardware parts which would have to be rack electroplated can be plated in bulk by the mechanical plating process. Cup-shaped parts which could not be electroplated without the use of internal anodes and special racking are plated uniformly in bulk by the mechanical plating process.

Equipment

A lined, open, inclined or horizontal barrel, usually multi-sided and often with small internal baffles is used. The barrel rotates at a nominal speed. Glass beads in various sizes, from .006” to .25”, are combined in specific ratios and added to the barrel tumbler.

The Process
Parts to be plated must first be cleaned. Heavily soiled parts may require pre-cleaning off line or in the processing tumbling barrel. After rinsing the pre-cleaned parts, they are placed in a barrel, glass beads are added, water and the conditioning/cleaning or pickling chemicals are added. Tumbling for 1-3 minutes in the mildly acid medium, followed by the addition of what is called a plating promoter, is added. After approximately 2 minutes, a very small amount of zinc powder is added and mixed in for 1-2 minutes. Then zinc powder is added, in increments or continuously, until the desired thickness is obtained.

The parts and beads are rinsed, the glass beads are separated from the parts to be used again. Post treatments of various kinds can then be applied to the plated parts. Total process and plating time for 1 mil is usually 15-20 minutes, 30-35 minutes for 2 mils.

Environmental benefits are realized in the elimination of cadmium for certain applications. Very little zinc is left in the effluent and removal of residual ppm is simple. Small parts and some larger parts, up to about 12 inches long, can be processed in bulk, reducing dragout losses compared with electroplating. There are fewer rinse steps compared with electroplating. For heavily oiled parts or for scaled parts, a rinse after cleaning and descaling is advised. Rinsing is not required after cleaning and conditioning mildly soiled parts.

No other rinses are required until plating is completed.