

# Cyanide Copper Plating

Jack Horner

## Applications

Electroplated copper from cyanide-based plating solutions has long been used both as an engineering or decorative finish, and as an undercoat for other plated metals. These cyanide copper solutions are used to plate on a wide variety of base materials. These include steels, zinc alloys, aluminum alloys, copper alloys, magnesium alloys, nickel alloys, and lead alloys. An important property of copper from cyanide-based systems is its ability to adhere well to these alloys. Other properties of electroplated copper deposits that are of interest for various applications include: (a) soft, ductile deposits; (b) it is easily buffed; (c) good electrical conductivity; (d) good solderability; (e) stop-off properties on steel for selective case-hardening processes; (f) decorative finishes can be plated bright with proprietary additives, or given attractive antique finishes such as oxides or patinas, (g) copper plate from cyanide plating solutions protects acid-sensitive base metals from attack by subsequent acid plating solutions; and (h) it plates easily with other metals.

As an undercoat for subsequent nickel-and-chromium or nickel-and-brass electroplates, cyanide copper is applied in the decorative or functional plating of zinc alloy castings used for trim or hardware in the automotive, appliance, electrical, plumbing fixtures, household goods and other industries. Copper is also used as an undercoat over copper and nickel alloys for subsequent nickel-and-gold, silver, or nickel-and-silver electroplates in the electronic connector and electrical industries.

Since soft copper is much easier to polish by buffing than steel, cyanide copper plated deposits can be plated on rougher steels and then buffed to produce "high-luster" finishes when used as an undercoat for a minimum thickness of subsequent bright nickel plating.

As a decorative finish without subsequent electroplates of other metals, copper cyanide deposits are used on cabinet hardware, hinges, drawer pulls, knobs and brackets. These are sometimes given post-treatments to color or darken the deposits, which are then highlighted by mechanical finishing or selective buffing to produce antique finishes. Similar finishes are found on fireplace trim, lamps, lighting fixtures and other household items with or without the antique post-treatment. For these applications, clear lacquers are used over the copper plate to preserve the color and luster.

Some functional applications for cyanide copper as a finish include plating the steel clamps on battery jumper cables, as well as other electrical connectors and fittings, alligator clips, etc. Aluminum buss bars have been plated with cyanide copper to provide low contact resistance for bolted connections. Lead sporting ammunition is plated with heavy copper deposits to prevent lead fouling of gun barrels, protect the projectile shape, and produce desired expansion characteristics on impact.

A relatively new application with which most everyone has daily contact is found in coinage, where cyanide copper is used to plate zinc alloy penny blanks by the millions! The properties of the unbrightened cyanide copper deposits are such that the coining operation produces a very bright appearance. The plated penny has surprised many critics with its resistance to corrosion during the rigors of circulation.

Copper is used in many other plating applications in which cyanide solutions are used very little. Electroforming, with a few exceptions, is usually done from acid copper solutions. Printed wiring boards utilize electroless copper, acid copper and pyrophosphate copper, with the exception of one major manufacturer who used cyanide copper successfully on special boards for many years. Copper plate is also used as a dry lubricant in some wire drawing processes, but an immersion copper process from acid solutions is most often mentioned. Immersion copper deposits are also used in coating steel items such as BB shot for appearance, lubricity, and temporary rust prevention; on welding rods for low contact resistance; and on other steel parts, sometimes just for color identification purposes.

## Processes

Copper is electroplated primarily from cyanide, acid sulfate or pyrophosphate plating solutions; in the U.S., pyrophosphate is the least used. Other bath formulations have been published or advertised but have not reached sufficient commercial volume to be significant.

## Cyanide or Acid?

While it is not the intent here to go into all the factors that influence the choice of which copper plating solution to use, a list of the major factors would include:

1. Acid copper plating solutions attack most basis metals and/or produce immersion deposits with poor adhesion, especially on steel, zinc and aluminum alloy substrates. When acid copper is to be plated over these metals, cyanide copper plating is used as an undercoat to produce good adhesion.
2. Deposits from cyanide plating solutions exhibit much less deposit thickness variations (better throwing power) over the surface of a part. The more complicated the shape of a part, the more significant this property becomes.
3. Cyanide is, of course, highly poisonous and must be handled with great care. Additionally, limitations on allowable cyanide in wastewaters are very stringent and complete destruction methods are required in most areas. However, it should be recognized that cyanide destruction technology is well established and proven effective.
4. Proprietary bright acid copper solutions are capable of a high degree of "leveling" *i.e.*, the smoothing of rough surfaces with increased plating thickness). Cyanide cop