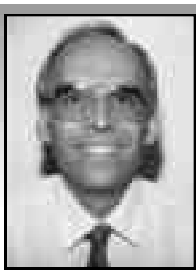

Finishers' Think Tank

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2001: A Plating & Surface Finishing Odyssey
The Journey Continues, Part 5

Having arrived at Alk Zinc Depot, we find some time to refresh and prepare for our next destination, Alloy Zinc state. Many of us write notes to our friends on picturesque postcards that only cost 25 zincmeers. Others purchase Zn-rite jeans, depicting the latest galvanize style. The most fascinating discovery was made by the "rockhounds" in our group. They found a shop laden with souvenir ores of zinc, such as: sphalerite (zincblende), smithsonite, and hemimorphite. The shopkeeper gave us this valuable bit of information, stating "Every ton of the Earth's crust contains 2.3 ounces of zinc." Quite impressive, as has been our trip to Zincmalia. While processing our tickets and baggage to Alloy Zinc, we learn there are many passengers like us traveling to Brass. In fact three express trains are being placed into service: 70/30, 75/25, and 85/15.

Boarding the train, our first encounter is with the brilliant brass handrails. A few sharp whistle blasts and we depart the Alk Zinc Depot.

Gathering speed, the express zips past the commercial zinc plating district, and meanders into a spectacular countryside. Leaving Zincmalia, we are rewarded with breathtaking scenery equal to our earlier trip in. Traveling about one hour, we approach the Brass state. Someone points out the beautiful sunset. It's the famous red brass, not seen anywhere, except here. Cameras click and video recorders save the scenery. Further down the golden tracks, we pass alongside fields richly splashed in colors of: lemon yellow, green/yellow, reds, and purples. Soon we cross majestic Lake Brasso, traveling on the historic CuZin bridge. Our guide informs us the bridge was built in 1940, commemorating the 100th anniversary of commercialized brass plating. It was a labor of "east meets west", acknowledging the work of a German chemist in Russia. Soon the express pulls into Brass Depot, on track 4. With bags claimed and the group organized, we board the charter bus to begin our tour of the Brass state.

The main thoroughfare is Alessandro Volta Parkway, a beautifully landscaped highway. We recall that Volta discovered the battery in 1800, making direct current available, paving the way to practical electroplating. To think it all began around 1841, when cyanide solutions of brass, copper, gold, and silver were found to be compatible for plating these specific metals. The overhead video screens come on, offering a concise history of brass. Because of its appealing color and workability, the ancient Romans found many uses for brass. In fact, it almost became synonymous with some of their traditions and routines. Assorted jewelry, show armour, jugs, and beverage vessels, were popular items made of brass. European craftsmen during the 12th to 17th centuries produced many decorative goblets, basins, plates, and trays, ornately designed as showpieces, before the discovery of gold in the new world. Brass also had several practical applications, such as navigation, surveying, and astronomy. The next video segment reviewed the different types of brasses.

- White. A component of certain alloys used in die casting. It's also used in soldering.
- Alpha. These alloys typically contain less than 40% zinc, which permits cold working of the material. Ammunition cartridge cases, pins, screws, and bolts, are some of the manufactured products.
- Beta. Stronger than alpha, but not as ductile. Some popular products include window & door fixtures, sprinkler heads, and faucet handles.

A separate class of brasses are alloys containing other elements along with copper and zinc. These materials have been found to improve corrosion resistance, increase mechanical & physical properties, and machining characteristics. In some instances, additional elements form a specifically pleasing alloy color for decorative and aesthetic purposes. These brasses include:

- Leaded. Softer, easier to machine and work.
- Aluminum. Provides improved corrosion resistance and strength.
- Admiralty or Naval. Exceptional resistance to seawater corrosion, by adding small amounts of tin.

The conclusion of the video coincided with our first stop, to the Industrial Brass Museum. We marveled at the many exhibits of materials and products just covered in the videos. Brass is certainly an alloy, with applications ranging from simple to complex. Without brass, our daily tasks and materials we use would certainly be very complicated and difficult.

The bus exits at the Alloy Loop, proceeding to Bright Brass Boulevard. Here we get off at Technology Center. Our tour guide informs us that plating is the next agenda. It's designed as a walk through, practical experience and review. Thin, bright, or decorative deposits are most common. Heavier deposit thickness is typically associated with additional post finishing, such as antiquing or oxidizing. These deposits are duller or somewhat flat, requiring mechanical brightening by buffing or burnishing.

The Key Ingredients

Whether the intended plating solution is for a bright, flash deposit, or a heavier functional one, cyanide is an integral part of the formulation. The formation of copper and zinc complexes with cyanide are very stable. A specific ratio of copper to zinc is balanced to provide very close potentials for the deposition of these metals. The best deposits and reproducible on an ongoing basis are still the cyanide chemistry types. Nothing, as yet, does it better than cyanide. Ammonia is a by-product of the solution's operation. It's a good brightening agent. Other brighteners include substituted glycols & acetylenics. Grain refiners produce smoother deposits. Anode corroders keep the anodes clean, corroding evenly, avoiding anode polarization. Wetting agents have these functions: emulsify oils and grease on the parts, antipitting agent, and formation of thin foam blanket to suppress fumes.

Under The Hood

- Copper. Has a critical bearing on efficiency.
- Zinc. In ratio with copper.
- Cyanide. In ratio with zinc, strongly influences deposit color.
- Sodium Cyanide. Forms separate complex with copper and zinc. Optimum concentration maintains efficiency, low current density coverage, and color when in ratio with zinc.
- Carbonate. Provides solution pH buffer. As bath ages with electrolyzing, the carbonate level rises, reducing bath efficiency.

Class Acts

General formula classes and their operating parameters are given.

General Bath Formula—Flash Brass

Bath Constituent	Conc. (oz/gal)	Conc. (g/L)
Copper Cyanide	3.2-4.3	24.0-32.2
Copper metal	2.3-3.0	17.2-22.5
Zinc Cyanide	1.1-1.4	8.2-10.5
Zinc metal	0.6-0.8	4.5-6.0
Sodium Cyanide	6.0-7.0	45.0-52.5
Sodium Bicarbonate	1.5-2.5	11.2-18.8

General Bath Formula—High-speed Brass

Bath Constituent	Conc. (oz/gal)	Conc. (g/L)
Copper Cyanide	9.5-11.5	71.2-86.2
Copper metal	6.7-8.1	50.2-60.8
Zinc Cyanide	0.6-0.8	4.5-6.0
Zinc metal	0.3-0.4	2.2-3.0
Sodium Cyanide	15.0-17.0	112.5-127.5
Sodium Hydroxide	5.0-7.0	37.5-52.5

General Bath Formula—Red Brass

Bath Constituent	Conc. (oz/gal)	Conc. (g/L)
Copper Cyanide	5.0-7.0	37.5-52.5
Copper metal	3.5-5.0	26.2-37.5
Zinc Cyanide	0.5-1.5	3.8-11.2
Zinc metal	0.3-0.8	2.2-6.0
Sodium Cyanide	8.0-11.0	60.0-82.5
Sodium Bicarbonate	1.0-2.0	7.5-15.0

Yellow Brass

20-30% zinc with balance copper. This bath is perhaps the most common, a workhorse. Barrel and rack applications. Deposit color is almost uniformly "lemon yellow" throughout the current densities. Most deposits in this bath are a thin, bright flash as plated over bright & leveled nickel. Post finishes are essential to prevent tarnishing. Spray or dip lacquers , benzotriazole type antioxidants dips, chromates (immersion or eletrolytic), and soap dips forming mechanical barrier films can be applied. Barrel-plated parts are easily burnished in special soap formulations, enhancing deposit brightness while developing an antioxidant surface film.

The preferred metal ratio of copper to zinc is 4:1. The free or titratable cyanide should be in the range of 1.4-2.7 oz/gal (10.5-20.2 g/L). Solution pH in the range of 10.0-10.8. Caution! pH determination by papers may give values up to 0.5 units higher than by preferred measurement, using a calibrated pH meter.

Operating Parameters

- Temperature, 80-110°F (27-43°C)
- Voltage, 2-3 (rack) 8.5-11.5 (barrel)
- Ratio anode to cathode, 1.75 to 2:1

Bath conductivity increases with solution temperature. Ammonium hydroxide additions will also increase as the solution temperature rises. Carbon filtration is a good option to minimize organic contaminants. More importantly, non-air solution movement helps maintain uniform bath temperature, while continually introducing fresh solution at the cathode interface.

High-speed Brass

This system is an excellent approach when plating requirements for thicker deposits are specified. Post-plate oxidizing, antiquing, and buffing, remove some of this extra deposit. Continuous strip and wire plating become critical when residence time in the plating bath is very closely monitored. Thicker deposits are obtained at the price of reduced brightness. Therefore buffing or where applicable, burnishing is required. Conventional barrel and rack applications are fine.

The preferred metal ratio of copper to zinc is 20:1. Bath constituents of the high speed bath range from 2-3 times greater in solution versus the flash brass.

Operating Parameters

- Temperature, 150-170°F (66-77°C)
- Current Density, 8-90 ASF

This bath is more efficient, permitting the use of higher current densities. Deposit color can be maintained by adding ammonia. However, the operating temperature rapidly volatalizes ammonia. Organic addition agents (substituted polyglycols and amines) adjust deposit color while maintaining active, stable levels in the operating solution.

Red Brass

This bath plates an 85/15, copper-rich alloy, hence the red deposit tone.

Operating Parameters

- Temperature, 90-115°F (32-46°C)
- pH, 10.0-10.8

Troubleshooting Guide

Deposit flakes, blisters	high/low free CN, insufficient surface prep
Red deposit (high copper)	low CD, high temp., low Zn, low ammonia, free CN
Pale, bronze red deposit	high CD, low copper, low temp., low free CN
Polarized anodes	low anode corroder, low CN, low ammonia
Black anodes	above conditions or lead contamination
Bright, crystalline anodes	high free CN
Cold solution crystallizes	excess carbonates
Cannot plate	poor surface prep, high free CN, bussing reversed
Rough deposit	suspended particles & precipitate
Inefficient	high free CN, low metals

This solution is less efficient than the yellow brass. Desired color is harder to control. Therefore, closer analytical control is recommended to maintain a preferred cyanide to zinc ratio.

Troubleshooting Tips

Brass-plated rejects can be stripped as follows:

- Flash brass over nickel, in reverse current electrocleaner.
- Brass over steel, in reverse current electrocleaner. Or, in solution consisting of special organic oxidizing salt and sodium cyanide.

Be sure to completely strip any lacquer coatings first, before removing the brass deposit. After stripping the flash brass, the nickel deposit will be passive. It should be activated in a cathodic acid, followed by a nickel flash, before brass.

Spot Checks

Analytical control, on a routine basis, is recommended. Wet analysis should consist of: titrations for copper, zinc, free cyanide, and carbonate. The pH of non-caustic baths should be determined by pH meter. A Hull cell deposit of the bath complements the wet analysis, to determine appropriate additions or treatments.

Our walking tour has been completed. Looking back, everyone is glad they saw each installation, and had the opportunity to speak with the process representatives. We agree the brass plating hasn't changed to any degree in all the years. It's a simple technology that requires some care and diligence to control and operate. Cabinet pulls, knobs, strike plates, bath & lighting fixtures, screws, and fasteners are among the many parts brass plated. It's a unique finish that retains a consistent brilliance, adding color to our surroundings. Brass will do so for many years to come.

Pity the tour guide. With so much interest during this stop, how could he outmaneuver brass, to prepare us for our next stop, the Zinc Nickel state. He finally did when the Brass Technology Center closed at dusk. All aboard as we reversed course on Alessandro Volta Parkway to the Brass Depot. Enough time for dinner at the Brass House, followed by beverages at the Brass Rail, and a show at the Brass Cinema. Brass—ya gotta love it! *P&SF*