Finishers' Think Tank

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Hang 'em Up, Hang 'em Right, Hang 'em High

This month's column concerns racking. In itself, racking can be an overlooked part of a metal finishing process, such as plating. Options to fixture parts cover a wide range, from simplicity to sophistication, from braided copper wire to specially designed racks with spring contacts and internal anodes.

I'll leave the specialized technology of rack design and engineering to the experts. Instead, this article focuses on basic designs, materials of construction, maintenance and stripping. Sooner or later, racks must be serviced, adjusted and/or replaced. Paraphrasing the message of an American Dental Association slogan, "Ignore your racks and they will go away!" Being cost-conscious finishers, we aim to obtain maximum quality performance from racks.

Build It Right

The most common and widely used material for splines is copper. It wins hands-down by virtue of its superior conductivity and ease of machining and conformation. Other materials include brass, copper/phosphorus, bronze and stainless steel. These metals have specific applications that make up for their lower conductivity compared to copper. Racks are usually designed and built with these considerations:

- Parts & geometry
- Plating bath application
- Throwing power of the intended bath
- Targeted current density
- Production requirement per rack

Once these limiting factors have been determined, the total amperage per rack is calculated (total surface area x ASF current density). This value is cross-referenced to the current-carrying capacity of the material of rack construction (example: copper). The size and dimension of the material is determined based on the current requirement. Without good stability in agitated baths, racks can creep along the cathode bar and interrupt electrical contact, get damaged, cause a short to the anode, or fall off. Perhaps you have seen that brilliant glow emanating from hooks making poor contact on racks, which is the result of poor design, dirty cathode bar or improper placement. The right rack for the job rings as true as the "right tool for the job." Rack contacts, clips and tips are designed for particular parts. Considerations include:

- Contact points for optimum current distribution
- Cradling to ensure rigidity or gravity contact
- Contact angles to minimize thieving and rack marks.
- Geometric orientation to prevent thieving and promote maximum drainage
- Type of plating bath and application
- Weight of parts
- Transfer efficiency

Contacts, clips and tips are made of any of the materials mentioned previously, based on process application considerations. Tips made of titanium, for example, are overwhelmingly used in anodizing applications. (Don't overlook the importance of stripping maintenance—another critical concern for rack tip materials. This will be discussed later.)

Nature designed trees with tough, resilient connections between branches and the trunk. Year after year, storms cause trees and branches to bend and sway, but they rarely break. Well-built racks exhibit their own quality service life. Rack tips are opened, closed and made to conform to specific holding requirements. Quality connections of tips to splines are usually accomplished with rivets, screws or welding. This is critical to maintain current-carrying capacity.

Dress in Style

The simplest rack can be a piece of wire (*e.g.*, copper thin strand, braided) or a hook. For all intents and purposes, these are easy to make, recyclable and—although somewhat labor-intensive—are maintenance-free. The downside is fixed work throughput capacity, limited reuse (buildup of plating deposits) and brittleness, usually occurring in wire that has been plated. Build a rack as previously discussed and finish it by dressing it in style. Specifically, apply quality insulation to prevent the deposition of deposits where not wanted. Polyvinyl chloride (PVC) is the most widely used insulation coating. The pros know how to mix it, apply it and cure it. Good insulation exhibits quality by how it is applied, used in the field and checked. During

a typical service life, cracked or pin-holed insulation can result in:

- Repeated buildup of metal deposits that laminate, peeling off into plating baths
- "Stealing" current from rack tips
- Capture of solutions and carry over as contaminants into down-line baths
- Accelerated corrosion of rack base metal material

Quality built racks deserve quality insulation "threads." Maintenance and service, however, are very important to achieve optimum service life of racks.

Maintenance

Once in service, racks will gradually lose their new luster, taking on a used—but hopefully not abused—appearance. Eventually, rack contact points become over-plated or break, thereby rendering a portion of the rack useless. Splines may crack or break. Each rack out of commission or any portion of the rack being unusable reduces production output. The worse the condition of racks, the lower production becomes throughout the line. Perhaps the easiest way to properly inspect racks is by rotating them, taking a specific number out of production use. The service department or rack supplier can evaluate contacts, splines, hooks and insulation. Many racks are built to allow easy replacement of certain parts, such as contact tips. Rack sections that are connected by bolts can be readily disassembled and serviced. Cracked or pin-holed insulation can be patched or stripped and replaced. Maintenance rotation of racks is a sensible game plan, to be implemented on an ongoing basis.

Chemical maintenance can be very beneficial—specifically, chemical stripping of rack tips. This service tool minimizes metal deposit buildup, a tremendous benefit in itself. It can be accomplished by immersion or electrolytically. The selection of rack material of construction is an important consideration when this form of chemical maintenance is considered. Stainless steel rack tips conform best to chemical stripping systems. Rack tips are SS 304 or 316. Immersion strippers usually fit the following profile:

- Typically strip copper, nickel
- Stripping solution is composed of nitric acid, in combination with accelerators and fume suppressants
- Rapid, efficient stripping will keep rack contacts clean and more effective
- Unless cooled, rising temperature can result in etching rack tips

Electrolytic strippers exhibit the following profile:

- Strip many metal deposits, such as copper, nickel, chrome, alloy deposits, zinc, tin and solder
- The primary source of oxidation is anodic current on the racks in a range of 250-700 ASF
- Secondary oxidizing additives complement action of reverse current
- Buffers help maintain bath operating pH mildly acidic to neutral
- Operate warm to approximately 150° F
- Some stripped coatings form insoluble metallic hydroxides, which can be removed by filtration

In either stripping application, racks can be rotated. In some automatic lines, after removing finished parts, racks progress to the electrolytic stripper for conditioning before a new set of parts are racked. Remember to withhold any racks with cracked or damaged splines. Either type of chemical stripper will aggressively attack the rack material of construction.

Most plating lines provide continuous, partial stripping by means of the operating electrocleaner. Chrome and brass are anodically stripped in the electrocleaner. Chromates strip in the soak and electrocleaner. Zinc is partially stripped in the electrocleaner and usually completely stripped in the hydrochloric acid dip.

Many shops and plating installations have shelves, pipes or bars for storing racks. The important thing is to keep racks off the plant floor. Otherwise, they will lean against one another, become entangled, drop or come in damaging physical contact with other plant equipment. Maintain an allocated storage area for racks and use it.

Racks are only as good as:

- Their intended design and application
- Materials of construction
- Chemical and mechanical maintenance

Productivity starts with good racks and racking technique. Rejects are not hard to generate, but they sure make this statement ring true: "An ounce of prevention is worth a pound of cure."

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A previous article in this column stated that the soak cleaner is the first and perhaps the most important step in most finishing process cycles. That still holds true ... but those racks become mighty important as the carriers of success. Rack and load!

Mail Bag

Question

We are looking for options to clean parts in a more environmentally friendly way. We currently use two nickel lines (Watts process). As you know, nickel builds up on the parts racks. How can we either reduce the amount of nickel on the racks or clean the racks without using acid?

Answer

I assume the rack tips are made of stainless steel and a nitric acid solution is used to strip the built-up nickel deposit. An alternative is the electrolytic stripper system, which has been described in the text of this month's article on racks. Benefits of the electrolytic rack stripper include:

- Elimination of nitric acid and accompanying nitric oxide fumes
- The working solution pH is close to neutral
- The process bath has the option of infinite service
- Heat provides evaporation to accommodate room for chemical additions
- Stripped nickel forms nickel hydroxide sludge
- This sludge can be dried and used by a smelter

There are many proprietary electrolytic rack stripper baths available. Check with your suppliers for compatibility to equipment, racks and rate of attack on the Watts nickel deposit. P&SF

Think Tank Trivia

- One of the greatest headaches for nickel platers was solved in the 1920s. Gas pitting has since been controlled and minimized by adding wetting agents to the plating bath. The surface tension of the bath is lowered to 30–40 cyne/cm^2, causing hydrogen gas bubbles to slide off the surface being plated.
- The preferred immersion coating over aluminum before painting is chromate. It's also the way to pass MIL C-5541-D, a 168-hr salt spray.
- How might one quickly distinguish a chloride zinc deposit from a cyanide or alkaline zinc deposit? Strip each deposit separately in 50-percent v/v hydrochloric acid. Wetters co-deposit in chloride zinc. The acid in this stripping solution will become foamy.

Questions?
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