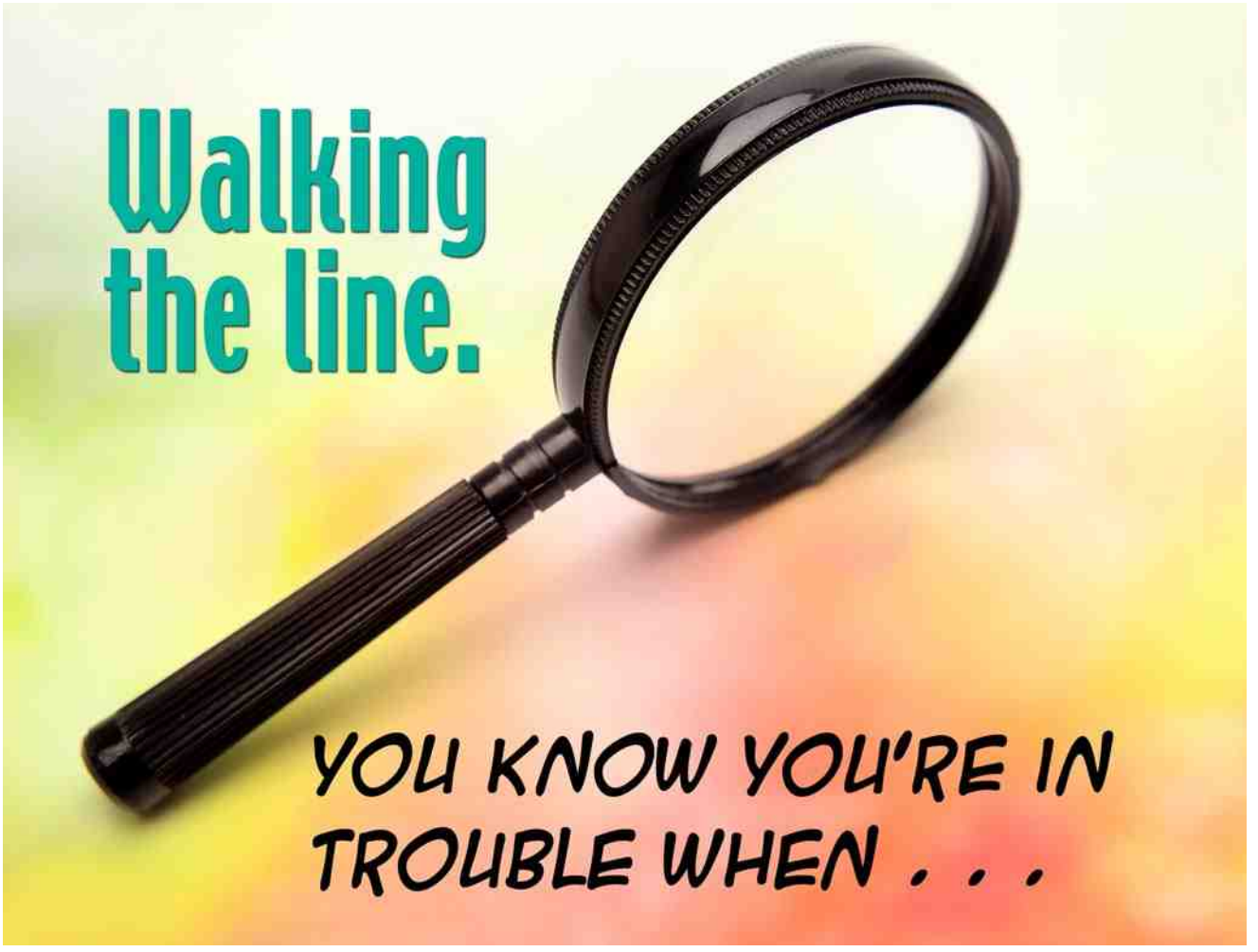

by Ralph V. Dixon
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Most of us are aware of the plight of the metal finishing industry in the U.S.A. today. It's kind of sad. There's been a continuing war with offshore competition. It seems we have chosen a rag tag army to fight our fight. One would think Yankee ingenuity would be on the forefront, using the latest technology and resources. However, our weapons of choice for most metal finishers to ward off these threats have been to cut maintenance, both preventive and normal. "The Best Practice Principle" has been thrown out the window. Most of the full existing automatic systems are in a poor state of repair, rusting away at their foundations. The one exception to the above is the automotive and motorcycle component platers. There are some great plating houses catering to these industries, but they are in the minority.

I spent my early years selling decorative processes and full automatic plating equipment. As a finishing supply salesman, you never really received your wings until you sold your first full automatic finishing system. In the 1960s and 70s, there were dozens of automatic plating machines sold every year. Now on days when you hear of a new system being installed, it's an event to be celebrated.

I chose the title of my paper after conducting many plating line audits and servicing these accounts and walking the line. "You Know You're in Trouble When … ." Platers continue to produce quality finishes, although it's becoming more difficult. I am often amazed when I see quality finishes being produced on these tumble-down machines. You know you're in trouble when examining the base structure of machines and find portions totally rusted away. There are hydraulics systems that leak and tank structures being maintained (or held together) by the tank liner. Since most of these system were manufactured in the 60s and 70s, they have reached the rare old age of 30 to 40 years. Considering the severity of the plating atmosphere, its surprising most have lasted this long.

You Know You Are in Trouble When, you walk the line and find:

- **Contaminated cleaners**

- **Anode bars encrusted with salts.**

- **Anodic cleaners with yellow foam from chromium contamination.**

- **Anode bags contaminated with iron.**

- **Acid tanks contaminated with floating oil films.**

- **Anode baskets polarized.**

Plus:
- Tank lining delaminating
- Soak cleaner re-circulating and skimmer pumps down.
- Anode bags below solution level.
- Poor air agitation patterns caused by damaged spargers.
- Filters with non-functional gauges.
- Live entry and exit current devices non-functional.
- Rectifier meters non-functional.
- Spray rinse header broken.
- Improperly designed racks.
- Rack tip nickel build-up.
- Temperature controllers non-functional

The MECH factor

For any finishing line to produce a quality finish requires what I have termed as the **MECH** factor to be at 100%.

M - Mechanical
E - Electrical
C - Chemical
H - Human

Problems in any one of the above will produce less than optimum results. My interpretation of optimum is operating with rejects in a range of 3 to 5%.

The basics of quality plating

The basics of quality plating include:
- A well designed plating line.
- Sufficient steam and AC power.
- Properly designed racking.
- Adequate DC power.
- A sufficient cleaning cycle.
- Adequate rinsing.
- Adequate air agitation.

Nickel chromium plating is a science, an art and a touch of black magic. All three are needed to produce a quality finish. Fundamentals of plating are a true science. These values must be adhered to. The art portion is gained through years of experience, plus trial and error. All good electroplaters have their little secrets, but they usually don't reveal them. Black magic seems to play a role in the process. One must always keep their fingers crossed. When the above rules are followed, your chances of producing perfect work are approximately 95%. The average reject rate is 5%, even in the top shops.

Absolute Musts!

Cleaning

Parts to be plated must be clean regardless of the type of process being used. Electroplating is the molecular bonding of dissimilar metals. Any films or oxides between layers will cause delamination of the layers, clouds and hazes. There is no universal cleaner. Different metals require different cleaners and cycles. Zinc die-castings are similar to Swiss cheese wrapped in cellophane. Once you remove the outer skin, it's a totally different part. Brass, copper, steel and aluminum all require specialized cleaning cycles. Zinc die-cast is the most difficult to strip, while aluminum is the most difficult to plate.

Rinsing

Adequate rinsing between processes with good quality clean water is required to prevent contamination of the different baths in the line. Acid films should not be dragged into alkaline solutions and vice versa. Nickel is a contaminant to chromium. Chromium is a contaminant to nickel. A minimum of two rinses are required between acid and alkaline baths, three rinses between nickel and chromium. After chromium plating, three to four rinses are required to remove all traces of chromium.

Stripping

Re-plating previously plated work is not easy. Not only is it expensive, the fall-out rate is greater than the first time through. Every effort must be made to get it right the first time.

Process layout

To prevent process contamination by solution gassing and splashing of dissimilar processes, tanks should be arranged with adequate space between dissimilar processes.

Plating process parity

Bright nickel baths must be maintained in a high state of purity, free of both organic and metallic contamination. The nickel process is maintained by filtering continuously through fresh activated carbon. The recommend filtering rate is three to four passes through the filter per hour. The recommended carbon to pre-coat the filter is two to three lb. of activated carbon per 1,000 gallons of solution per 40 hours of production.

Compliance

Prior to starting a metal finishing operation, permits are required from Federal, State and Local Authorities. These will cover effluent and atmospheric discharges. Penalties for non-compliance are quite severe. Size of operation does not matter.

Focus on quality nickel - chromium plating

In light of these *Absolute Musts*, consider a decorative nickel - chromium finishing operation. A good process will have the following cycle and chemistry (see table):

Process chemistry

Cleaner and acids

Soak cleaner	8.0 - 12 oz/gal.
Anodic clean	12.0 oz/gal.
Cathodic sulfuric acid	20% - Acid salts 16 oz/gal
Strip Process	Anodic sulfuric acid plus glycerine, using lead anodes

Process cycle	Temperature	Voltage	Low pressure air agitation	Ventilation
1. Soak clean	200°F	•••••	X	X
2. Anodic clean	180°F	6.0	•••••	X
3. Rinse	•••••	•••••	•••••	•••••
4. Rinse	•••••	•••••	•••••	•••••
5. Cathodic acid	120°F	6.0	•••••	X
6. Rinse	•••••	•••••	•••••	•••••
7. Rinse	•••••	•••••	•••••	•••••
8. Nickel plate	140°F	9.0	X	•••••
9. Rinse	•••••	•••••	•••••	•••••
10. Rinse	•••••	•••••	•••••	•••••
11. Rinse	•••••	•••••	•••••	•••••
12. Chromium	115°F	9.0	•••••	X
13. Rinse	•••••	•••••	•••••	•••••
14. Rinse	•••••	•••••	•••••	•••••
15. Rinse	•••••	•••••	•••••	•••••
16. Hot rinse	190°F	•••••	•••••	X

Bright nickel

Nickel metal	12.0 oz/gal.
Nickel sulfate	40.0 oz/gal.
Nickel chloride	12.0 oz/gal.
Boric acid	6.0 oz/gal.
Secondary brightener	0.125%
Carrier brightener	1.00%
TOC	15,000 - 20,000 ppm max.
Primary brightener	4.00%
Anodes	Nickel chips in titanium baskets with bags.

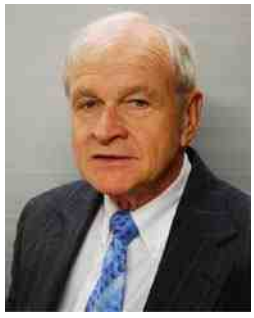
Bright nickel plating baths must be maintained free of organic and metallic impurities. Brightening additives are added on an ampere-hour basis. Failure to follow these rules will result in dull deposits with poor chromium receptivity. Amperage consumed in electroplating is based on amperes per square foot of part plated. Nickel is plated at an average of 30 to 40 amperes per square foot. "Ampere Hour" is the number of amperes consumed in one hour. All plating consumption is based on ampere hours. A nickel tank with a 1,000 ampere rectifier, operating for one hour will equal 1,000 ampere hours. The amount of nickel consumed is 2.4 lb. per 1,000 ampere hours. Deposit thickness, 0.74 oz of nickel will coat one square foot to a thickness of 0.001."

Chromium

Chromic acid	32.0 - 43.0 oz/gal.
Sulfate	0.13 - 0.16 oz/gal.
Ratio	250:1
Fluoride	500 ppm
Temperature	110 - 115°F
Anodes	Lead 296 alloy (2 per foot of anode bar)

Bright chromium baths operate at only 15% efficiency, 85% of the consumed amperage producing hydrogen gas. Chromium deposits are either good or bad, there is no in between. Work is transferred between the nickel and the chromium as fast as possible. Contact in the tank has to be direct and solid. Otherwise the part will be white-washed. Average current density for chromium is 120 amps/square foot. Normally, if a part is placed in the chromium bath and voltage adjusted to 5 to 6 volts, coverage will be adequate.

The above information may be used as a guide to fine tune you decorative plating line to meet today's high quality standards. The closer your line represents the recommended cycle the better your chances will be. I look for a return of metal finishing to the U.S.A. We should strive to produce the finest quality possible. This means that our equipment and processes must operate at optimum levels of producing quality nickel and chromium deposits.



Ralph Dixon *has been serving the metal finishing industry for the past 52 years in all phases, from technical field service to sales management with world class suppliers. He specializes in decorative nickel and chromium finishes to the appliance, automotive and motorcycle industries. He is currently involved as a consultant in the promotion of decorative plating processes in the United States, and South America with Basically Nickel Inc.*