CAL 87

CAL 87 is an immersion process to form a uniform, jet-black coating of cupric oxides that exhibit excellent chemical and heat stability, increase the corrosion protection of the substrate and are highly adherent to the surface. It can be used to blacken a wide range of copper alloys ranging in copper content from 65 to 100%. The process is useful as a cosmetic "antique" finish or as a base to increase the adhesion and protection of organic coatings.

Operating conditions:

Concentration:	1 to 1.5 lbs/gal.
Temperature:	190˚ to 210˚ F.
Immersion Time:	5 to 15 minutes

Typical Process Cycle:

A. Mechanically polish surface (for bright finishes)
B. Clean in Cal-Pac's NS200 or AP-500 Soak Cleaner
C. Cold water rinse
D. Activate in Cal-Pac's 101 or 170 Acid Salts
E. Cold water rinse
F. Chemically etch surface (for satin finishes)
G. Cold water rinse
H. Activate alloys of less than 90% copper in CAL 94
I. Cold water rinse
J. Blacken in CAL 87
K. Cold water rinse
L. Dry

Make up:

To make-up a new CAL 87 solution, fill the tank one-half full with cold water and stir in the required amount of CAL 87 salts. Use care when dissolving salts since considerable heat will be evolved. Continue agitation until all salts have dissolved, making sure there are no lumps at the bottom of the tank. Fill the tank up to within 6 to 8 inches of the top of the tank and begin heating the solution to operating level (see the Solution Control paragraph below).

Operation:

The actual blackening of the copper surface is accomplished by simply immersing the work in the hot CAL 87 solution. However, the finish that will be obtained depends heavily upon the

procedure used to prepare the surface. The oxide coating will to a great extent reflect the surface beneath it; that is to say, a smooth surface will produce a shiny, black finish while a dull surface will produce a matte, black finish.

If the desired surface is to be shiny, then the work must be polished and buffed to a shine. The compounds must then be removed and the part cleaned to allow the CAL 87 solution to evenly wet the surface. Soils which prevent this even wetting action will produce uneven, streaky blackening. Cal-Pac's NS-200 or AP-500 cleaner are recommended to clean the surface followed by the 101 or 170 Acid Salts to activate the surface. After blackening, the work should be rinsed and dried without handling the surface. It can then be oiled, waxed or lacquered if greater protection is desired.

For matte finishes, the surface must be uniformly roughened prior to blackening in the CAL 87. This can be accomplished by mechanically brushing, leeing or blasting the surface; however, it is more economically done by chemically etching the surface in one of the following solutions:

A. For an aggressive etch:

Muriatic acid:	10% b.v.
Ferric chloride:	8 oz/gal.
Temperature:	65˚ to 90˚ F.
Immersion time:	2 to 3 minutes
Equipment:	plastic or rubber lined

B. For a moderate etch:

Sulfuric acid:	33% b.v.
Nitric acid:	33% b.v.
Muriatic acid:	1/3 fl oz/gal.
Temperature:	65˚ to 90˚ F.
Immersion time:	5 to 15 seconds
Equipment:	plastic or ceramic lined
	Ventilation

When blackening copper alloys with less than 90% copper, it is first necessary to condition the surface by immersing in Cal-Pac's CAL 94. This material is operated in much the same matter as CAL 87 (for specific details refer to CAL 94 data sheet):

Concentration:	1 to 1.5 lbs/gal.
Temperature:	190˚ to 210˚ F.
Immersion time:	1 to 5 minutes
Equipment:	316 stainless

Once the work has been properly cleaned and activated it is simply immersed into the CAL 87 until the desired color is obtained. The exact color will depend upon the temperature and the concentration. A wide range of colors can be produced by varying these two parameters:

A. Lighter tones:

Concentration:	1 lb/gal. (approx)
Temperature:	100˚ to 140˚ F.

B. Brown tones:

Concentration:	1 ¼ lb/gal. (approx.)
Temperature:	150˚ to 175˚ F.

C. Black tones:

Concentration:	1 ½ lb/gal. (approx.)
Temperature:	190˚ to 210˚ F.

Some experimentation may be necessary to determine the exact parameters to obtain the color you desire. If the work is processed in a basket or barrel, it must be rotated occasionally to assure an even coating.

After blackening, the work should be adequately rinsed to remove all the salts which may become trapped in surface porosity, blind holes, recesses or creases. Usually, this is accomplished most efficiently in alternating hot and cold rinses. After rinsing, it is recommended that work which is to have a wax, oil or an organic coating applied be immersed in a dilute chromic acid solution (1/4 to ½ oz/gal.) to neutralize any alkalinity remaining on the surface. This improves corrosion resistance and helps eliminate any reaction between the alkali and the coating. After reasonable drainage, the work can be coated water-soluble waxes or oils or it can be dried in sawdust or corn-cob.

Solution control:

The water level of CAL 87 solutions must be closely observed, as evaporation is quite rapid due to high operating temperatures. Water should be added to compensate for both evaporation and drag-out, since too high of a concentration will impart a light gray, instead of jet black finish. The blackening requires more than 12 to 15 minutes, salts should be added. For more precise control, determine the specific gravity at 70˚ C. or the boiling point, and compare it to the following chart.

Specific Gravity at 70˚ F.	CAL 87 lbs/gal	Boiling point Fahrenheit
1.105	1.00	216.0
1.125	1.25	217.5
1.145	1.50	219.0
1.156	1.75	220.5
1.176	2.0	222.0
1.195	2.25	223.5
1.215	2.50	225.0

Equipment:

The CAL 87 solution should ideally be contained within a stainless steel tank. Steel may be used, however, some rusting will occur above solution level and on rare occasions, a localized

corrosion cell may form below the surface level. None of the seams or connections which come in contact with the solution can be soldered or brazed. All related equipment should be steel or stainless, other metals will be attacked by the solution. The tank should be designed to allow between 6 to 10 inches free-board to accommodate the evaporation losses. Heat should be by gas flame tubes or by high-pressure steam. Ventilation is recommended to remove the large volumes of water vapor.

Caution:

The CAL 87 salts contain both alkali and strong oxidizing agents. The solution operates at very high temperatures. Use extreme caution when working around this solution. Avoid contact with skin, eyes or clothing. Operators should wear the proper protective clothing and eye protection. If contact occurs, flush with plenty of water and call a physician. Do not allow the salts to come into contact with combustible materials.