CONCENTRATION RESEARCH PAPER

BRONZE AND ALUMINUM PATINA FORMULATIONS

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Statement of Intent

The intent of this research is to provide the Colorado State University Sculpture Department concise formulations for the patination of 95•4•1 silicon bronze and 351 secondary aluminum. The nature of the research will deal with preparations of the metals, heat sources, and application procedures. All formulations will be complied so as not to exceed any limitations set by the Sculpture Departments present facilities, equipment, or budget.

TABLE OF CONTENTS

I. Metal Preparation for Patination

Patination is the process of artificially coloring or changing the surface of a metal. The patina, or adhering coat, is almost invariably the result of chemical corrosion, although it may also be the application of laquers, colored waxes or paint to alter the surface appearance of the metal.

The appearance of cast silicon bronze, when removed from a plaster and sand investment, can vary from a charcoal black scale to a semi-gold luster. This surface is undesirable on the majority of bronze castings in addition to flashing and alterations due to chasing and/or welding. Because of this undesirability the employment of patination becomes clear.

A patina can be applied to the fire scaled surface if unevenness of coloration is desired. All of the test plates used in this research were sand-blasted prior to patination with EI-70 silica sand. The air pressure on the blasting unit gauge should never exceed 50 lbs. p.s.i. and the primary gauge, located on the east wall of the sculpture foundry should be turned wide open with an air pressure reading of approximately 80 lbs. p.s.i. When blasting either bronze or aluminum, all surface scale should be removed leaving the bronze a matt tan in coloration and the aluminum a matt gray. Coloration of both the metals should be uniform. Any discrepancies in surface coloration will result in an uneven application of

most chemical patinas. To insure proper surface preparation through sand-blasting, a six to eight inch distance should be maintained between the blasting orifice and the metal being blasted. Always be sure to wear suitable protective clothing, face shield and a dust particle respirator while sand-blasting.

Silicon bronze can also be cleaned and readied for patination through the use of a chemical bath. The bath solution consists of one part nitric acid to eight parts water. When mixing this formula, always add the nitric acid to the water. Do not reverse this procedure. As with blasting, employ proper safety precautions such as adequate ventillation, respirator and rubber gloves. After submersing the bronze in the solution for five minutes, the chemical reaction can be stopped by rinsing the piece in tap water. The bronze should be allowed to air dry completely prior to the application of the patina.

With both of the above procedures(sand-blasting and acid bath) care must be taken not to touch or handle the cleaned surfaces with bare hands. The oils and chemicals from the human hand will affect the metals and begin a chemical reaction wherever touched. Though these spots may not be noticable at first, once the patina application begins, they will be evidenced in the form of a splotchy coloration. Clean gloves, rags or paper are recommended for handling. Because of the effect of the atmosphere, patination should begin once the metal is cleaned.

II. Heat Sources

Many patina processes require heating the metal to produce the proper chemical reaction. Depending upon the desired results, the heating of the metal can be achieved with a number of techniques. Covered in this section are the uses of ovens, the oxy/acetylene torch, and the propane torch.

Ovens are perhaps the most desirable means to achieve uniform heating of the metal. Even heating of the metal produces a more uniform patina coloration. A temperature of 350°F, is required for all chemical applications when heating is neccessary. The electric ceramic kiln, located in the north-east corner of the sculpture foundry, can be suitably adapted for this purpose if the proper precautions are taken. First, place the bronze on a piece of steel or any other material that will not be affected by heat or chemicals. Elevate the steel platform with fire bricks to insure easy removale of the platform and the piece from the kiln. Close the kiln door and turn every other element to 'low'. Once 350°F has been attained, remove the piece and platform within fifteen minutes and immediately begin the application of the patina. Be sure that all element controls are in the 'off' position. DO NOT apply any chemicals while the piece is in the kiln, as this will destroy the heating elements and contaminate the kiln bricks. Be sure to wear asbestos gloves while removing the piece and platform from the kiln.

The oxy/ acetylene torch is the most common means of hot patina application employed at Colorado State University. The coloration results can be quite uniform, although due to uneven heating, variations may occur. In order to safely utilize these torches the following procedures must be observed.

(1) select the proper torch tip and hand-tighten on the torch handle; a no.2 tip is recommended for most patina applications

(2) turn the main valve on the oxygen tank all the way open and set the secondary gauge on the tank to 18 lbs. p.s.i.

(3) turn the main valve on the acetylene tank ¼ turn and set the secondary gauge on the tank to 5 lbs. p.s.i. ; DO NOT exceed 15 lbs. p.s.i. on the acetylene tank; ignition with the atmosphere will occur.

(4) open the acetylene knob on the torch handle (red hose) and slightly open the oxygen knob on the torch handle (green hose), use striker to ignite torch; DO NOT use matches.

(5) adjust the flame to the desired setting using the torch handle knobs.

When applying a patina with the torch, heat the bronze thoroughly before the application of any chemicals. Once the patina application process begins, keep the torch moving rapidly over the surface of the piece. Concentrated heating in one area will scorch the chemicals resulting in discoloration of the patina. When applying more than one chemical solution, do not let the metal cool before beginning any additional applications. Reheating of the first chemical application may again cause discoloration and scorching of the patina. Be sure to turn off both tanks when patina is completed.

A hand-held propane torch can also be employed for the heating of metal, but is recommended only for the patination of small scale pieces. The heating capabilities of the flame produced by this torch are much lower than those produced by an oxy/acetylene torch. A propane torch would not be conducive for the patination of large surfaces, if consistancy of coloration is desired. The same care must be taken to avoid discoloration and scorching as with the oxy/acetylene torch.

III. Sealing the Patina

Most chemicals will continue to react with the metal surface or with the atmosphere if the patina is not properly sealed. The two forms of patination sealing commonly used at Colorado State University are Johnsons Paste Wax and Grumbacher Mysta-fix Spray Fixative.

The spray fixative is suitable for use over any of the patina formulations covered in this research. Only when the metal is at room temperature should the fixative be used on the patina. When spraying, be sure to seal the entire surface. Areas that are not sealed by the spray will discolor. Two or three coats are recommended and allow each coat to dry before respraying.

The paste wax is also applicable to all the formulas in this research, as long as the metal is at room temperature. Applying the paste wax to hot metal will cause discoloration in patina formulas involving Bismuth or Cupric Nitrates. These chemicals form layers of crust-like

coloration. Hot wax is able to penetrate between some of these layers causing random areas of discoloration. Whenever these two chemicals are used in a patina formulation, a cold wax application is recommended. An advantage to hot waxing is the permeability of the liquid wax into tight and inaccessable areas. This technique is excellent on patinas using the chemicals Potassium Dichromate of Ferric Nitrate. Be sure to use a clean brush for the wax application. The paste wax is flamable. Be sure that all flames are extinguished. Never reheat the metal once the wax application has begun. Once the wax has dried to a hardened state, Buff lightly with a soft cloth. No buffing results in a matt finish.

IV. Highlighting and Antiquing

To achieve controlled light and dark value changes in a patina, the techniques of highlighting and antiquing may be employed. To use highlighting, the first coat of the patina formula must be Potassium Sulfide (Liver of Sulphur). Once the piece has reached a blackened stage as a result of the chemical reaction with the Potassium Sulfide, stop the reaction by rinsing the piece in cold tap water. Using steel wool, buff the Potassium Sulfide from the high points on the surface, leaving black in the recesses. Rinse all steel wool from the piece and allow it to dry prior to the application of the second chemical. The piece may be heated after the steel wool has been rinsed from the surface.

Antiquing is the process by which particles of carbon are suspended in wax on the surface of the patina. Only when a casting has been patinated, waxed and buffed will it be ready for antiquing. The process involves building a thick coat of carbon on a steel plate or smooth stone surface with only the acetylene knob (red hose) on the torch handle being used. A small stiff bristle brush should be used to mix a brushful of wax with the carbon on the plate. Once the wax is black with carbon, stipple the black paste on the surface of the piece and allow to completely dry. With a soft cloth, lightly buff the surface where it is to be lightened. Repeated buffing will remove all the carbon/wax paste. Allow the piece to set a few minutes before applying the final coat(s) of wax.

Fig. 1, Documentation of Test Plates, 1978-1979

TABLE OF CONVERSIONS FOR WEIGHTS AND MEASURES

1 1/2 teaspoons=1/2 tablespoon

3 teaspoons=1 tablespoon

2 tablespoons=1/8 cup or 1 fluid ounce

4 tablespoons=1/4 cup

8 tablespoons=1/2 cup

1 cup=8 fluid ounces

2 cups=1 pint or 16 fluid ounces

2 pints=1 quart or 32 fluid ounces

4 cups=1 quart

4 quarts=1 gallon

28 grams=1 ounce

16 ounces=1 pound

1 pound=453.59 grams

WAX WEIGHT CONVERSIONS

1 pound of wax=10 pounds of bronze

1 pound of wax=3.3 pounds aluminum

TEST PLATE

PATINA FORMULATIONS

1-24....95•4•1 SILICON BRONZE

A-E....351 SECONDARY ALUMINUM

CHARACTERISTICS: opaque surface coating
can be used on steel, aluminum, bronze

MATERIALS REQUIRED: Chromium Oxide
pint container
soft bristle brush
heat source (oxy-acetylene torch)
water
fixative or wax

MIXTURE: mix 4 tablespoons Chromium Oxide with one cup of water in the pint container

APPLICATION:

Heat the entire piece thoroughly. The metal must be hot enough to evaporate the moisture in the solution. Once the metal has attained temperature (350°F), apply the solution with the soft brush, building coats slowly. The temperature of the piece must be maintained during the application process. Keep the torch moving rapidly over the surface. Should the flame actually contact the surface with the already dried chemical coating, a carbon black coloration will result due to the oxides scorching. If heavy brush marks appear in the dried patina surface, dilute the mixture with a small amount of water. Allow the metal to cool completely before sealing with spray fixative or wax.

CHARACTERISTICS: metal/chemical reaction
bronze only
often spotted with blacks toxic

MATERIALS REQUIRED: Ammonium Chloride
Cupric Chloride
large plastic trash bag
soft brush
water
¼ gallon container
½ pint container
fixative or wax

MIXTURE: mix ½ ounce Ammonium Chloride with 3 ounces of Cupric Chloride in a small container then add to one quart of water

APPLICATION:

The metal should be as cold as possible. Refrigerate the piece if necessary. Brush the mixture rapidly over the piece, keeping the entire surface wet. Cover the piece with the plastic bag immediately, being careful not to contact the piece with the plastic bag. This may cause discoloration on the piece. (An armature to support the tent is recommend-- ed, but not necessary.) Weight the edges of the plastic tent to seal the interior environment as well as possible. Ammonium Chloride evaporates quickly and must be contained by the tent to insure results. Leave the piece covered for 15 to 20 minutes. The chemical action can be stopped by rinsing the piece in cold water. Wax or fixative may be used only after the patina is completely dry.

CHARACTERISTICS: opaque surface coating
bronze only

MATERIALS REQUIRED: Potasium Hydrosulfuret (liver of Sulphur)
Cupric Nitrate N-Hydrate
soft bristle brush
pint container
gallon container
heat source (oxy-acetylene torch)
water
fixative or wax

MIXTURE: mix $\frac{1}{4}$ cup Liver of Sulphur with 1 gallon warm water
mix 3 tablespoons of Cupric Nitrate N-Hydrate with $1\frac{1}{2}$ cups water
DO NOT mix the chemicals in the same container.

APPLICATION:

Dip the bronze in the Liver of Sulphur solution until it turns charcoal black. Stop the chemical reaction by rinsing the bronze with cold water. Next, heat the bronze and apply the Cupric Nitrate N-Hydrate solution with a soft brush. The metal should be hot enough to evaporate the moisture from the chemical solution within seconds of its application. The layers must be built up slowly to avoid a thick crust. Do not concentrate the flame on the chemical as this will result in discoloration or a carbon black coloration due to chemical scorching. The flame should be kept moving rapidly over the surface to aid in the evaporation of the water content from the chemical solution. Once the desired coloration is achieved allow the bronze to completely cool before applying wax or fixative.

CHARACTERISTICS: semi-opaque surface coating
bronze only

MATERIALS REQUIRED: Cupric Nitrate
soft bristle brush
pint container
water
heat source (oxy-acetylene torch)
wax or fixative

MIXTURE: mix 3 tablespoons Cupric Nitrate with 1¼ cups water in pint container

APPLICATION:

Heat the bronze uniformly with the torch and apply the Cupric Nitrate solution with a soft brush. The metal should be hot enough to evaporate the moisture from the chemical solution within seconds of application. The layers must be built up slowly to avoid a thick crust. Do not concentrate the flame on the chemical as this will result in discoloration or a carbon black coloration due to chemical scorching. The flame should be kept moving rapidly over the surface to aid in the evaporation of the water content from the chemical solution. Once the desired coloration is schieved, allow the bronze to completely cool before applying wax or fixative.

SKY BLUE (antiqued)

CHARACTERISTICS: semi-opaque surface crust
bronze only

MATERIALS REQUIRED:
- Cupric Nitrate
- soft bristle brush
- stiff short bristle brush
- pint container
- heat source (oxy-acetylene torch)
- wax
- clean steel plate

MIXTURE: mix 3 tablespoons Cupric Nitrate with 1½ cups water in pint container

APPLICATION:

Apply the Cupric Nitrate solution as described in number 4. After the piece has completely cooled, and after it has been waxed and buffed, apply the antiquing as described on page 7.

AVACADO GREEN (with copper spotting) 6

CHARACTERISTICS: metal/chemical reaction
bronze only

MATERIALS REQUIRED:
Ammonium Chloride
Cupric Chloride
large plastic bag
soft bristle brush
¼ gallon container
½ pint container
water
steel wool
wax or fixative

MIXTURE: mix ½ ounce Ammonium Chloride with 3 ounces Cupric Chloride in container then add to 1 quart of water

APPLICATION:

Apply the Ammonium Chloride/Cupric Chloride solution as described in number 2. Prior to stopping the chemical action with cold water, press steel wool on the surface of the piece. No change in coloration will be apparent until the piece is rinsed in extremely cold water. Wax or fixative should be used when the bronze has completely dried.

BLUE-GREEN (with rust tones)

CHARACTERISTICS: opaque surface coating
bronze only

MATERIALS REQUIRED: Cupric Nitrate
Ferric Nitrate
soft bristle brush
pint container
pint spray bottle
heat source (oxy-acetylene torch)
water
wax or fixative

MIXTURE: mix 3 tablespoons Cupric Nitrate with 1½ cups of water in pint container
mix 2 tablespoons Ferric Nitrate with 1 pint water in spray bottle

APPLICATION:

Apply the Cupric Nitrate solution as described in number 4. Once the sky blue coloration is achieved and while the bronze is still hot, begin application of the Ferric Nitrate solution with the spray bottle. The solution should steam off the bronze. If the solution remains wet on the piece, the bronze is too cool. Maintain heating the bronze, being careful not to scorch the Cupric Nitrate. (Light spraying will result in a blue/green coloration with rust tones. Repeated spraying will result in a warm brown coloration with green tones.) Allow the bronze to cool completely before applying wax or fixative.

CHARACTERISTICS: metal/chemical reaction
bronze only

MATERIALS REQUIRED: Potassium Dichromate
pint spray bottle
water
heat source (oxy-acetylene torch or kiln)
wax or fixative

MIXTURE: mix 2 tablespoons Potassium Dichromate with 1 pint of water in spray bottle

APPLICATION:

Heat the bronze thoroughly with the torch or to 350°F in the kiln. Spray the Potassium Dichromate solution in light coats, allowing the moisture to evaporate completely between coats. Light spraying will result in brassy yellow. Continued spraying will result in a golden brown. Once the desired coloration has been achieved, evaporate the remaining moisture with the torch and apply the wax while the bronze is still hot. If fixative is used, allow the bronze to completely cool before spraying.

GOLDEN BROWN (antiqued) 9

CHARACTERISTICS: metal/chemical reaction
bronze only

MATERIALS REQUIRED: Potasium Dichromate
stiff bristle brush
pint spray bottle
heat source (oxy-acetylene torch or kiln)
wax or fixative

MIXTURE: mix 2 tablespoons Potassium Dichromate with 1 pint of water in spray bottle

APPLICATION:

Apply the Potassium Dichromate solution as described in number 8. After the piece has completely cooled, and after it has been waxed and buffed, apply the antiquing as described on page 7.

COPPER (with avacado green spotting)

CHARACTERISTICS: metal/chemical reaction
bronze only

MATERIALS REQUIRED:
- Ammonium Chloride
- Cupric Chloride
- large plastic trash bag
- soft bristled brush
- ¼ gallon container
- ½ pint container
- water
- steel wool
- wax or fixative

MIXTURE: mix ½ ounce Ammonium Chloride with 3 ounces Cupric Chloride in container, then add to 1 quart of water

APPLICATION:

Apply the Ammonium Chloride/Cupric Chloride solution as described in number 2. Prior to stopping the chemical action press the steel wool on the surface of the bronze. No change in coloration will occur until the piece is rinsed in extremely hot water. Let the piece cool and dry completely before applying wax or fixative.

WHITE or LIGHT MINT

CHARACTERISTICS: opaque surface coating
bronze only

MATERIALS REQUIRED: Bismuth Nitrate
soft bristle brush
cup container
water
heat source (oxy-acetylene torch)
wax or fixative

MIXTURE: mix 2 teaspoons Bismuth Nitrate with ¼ cup water

APPLICATION:

Heat the bronze thoroughly with the torch and apply the Bismuth Nitrate solution with the soft brush, building coats slowly. The hotter the metal is, the whiter the patina. Warm metal results in a light mint coloration. Allow the bronze to cool completely before applying wax or fixative.

CHARACTERISTICS: opaque surface coating
bronze only

MATERIALS REQUIRED: Bismuth Nitrate
Ferric Nitrate
soft bristle brush
cup container
pint spray bottle
heat source (oxy-acetylene torch)
water
wax or fixative

MIXTURE: mix 2 teaspoons Bismuth Nitrate with ¼ cup of water in cup container
mix 2 tablespoons Ferric Nitrate with 1 pint of water in spray bottle

APPLICATION:

Apply the Bismuth Nitrate solution as described in number 11. Once the white coloration is achieved and while the bronze is still hot, begin application of the Ferric Nitrate solution with the spray bottle. The solution should steam off the bronze. If the solution remains wet on the piece, the bronze is too cool. Maintain heating of the bronze, being careful not to scorch the Bismuth Nitrate. Light spraying will result in a golden cream coloration. Repeated spraying will result in a dark rust coloration. Allow the bronze to cool completely before applying wax or fixative.

CHARACTERISTICS: metal/chemical reaction
bronze or aluminum

MATERIALS REQUIRED: Ferric Nitrate
pint spray bottle
heat source (oxy-acetylene torch or kiln)
water
wax or fixative

MIXTURE: mix 2 tablespoons Ferric Nitrate with 1 pint water in spray bottle

APPLICATION:

Heat the metal thoroughly with the torch or to 350°F in the kiln. Spray the Ferric Nitrate solution in light coats, allowing the moisture to evaporate completely between coats. Light spraying will result in an amber coloration. Repeated spraying will result in a burgundy red coloration. Once the desired coloration has been achieved, evaporate the remaining moisture with the torch and apply the wax while the bronze is still hot. If fixative is used, allow the bronze to completely cool before spraying.

DARK BROWN (highlighted)

CHARACTERISTICS: metal/chemical reaction
bronze only

MATERIALS REQUIRED: Potassium Hydrosulfuret (Liver of Sulphur)
Ferric Nitrate
pint spray bottle
steel wool
gallon container
heat source (oxy-acetylene torch or kiln)
water
fixative or wax

MIXTURE: mix ¼ cup Liver of Sulphur with 1 gallon warm water
mix 2 tablepsoons Ferric Nitrate with 1 pint water in spray bottle

APPLICATION:

Dip the bronze in the Liver of Sulphur solution until it turns charcoal black. Stop the chemical reaction by rinsing the bronze with cold water. Steel wool the surface as described under highlighting on page 6. Once the piece has been highlighted, rinse off all steel wool particles and heat with the torch or in the kiln. Apply the Ferric Nitrate solution in light coats to the heated surface. Once desired coloration is achieved, brush the wax over the still hot bronze. If fixative is being used, allow the piece to completely cool before spraying.

CHARACTERISTICS: opaque surface coating
bronze, aluminum, steel

MATERIALS REQUIRED: Ferric Oxide
pint container
soft bristle brush
heat source (oxy-acetylene torch
water
fixative or wax

MIXTURE: mix 4 tablepsoons Ferric Oxide with one cup of water in pint container

APPLICATION:

Heat the entire piece thoroughly. The metal must be hot enough to evaporate the moisture in the solution. Apply the solution with the soft brush, building coats slowly. The temperature of the metal must be maintained during the application process. Keep the torch moving rapidly over the surface. Should the flame actually contact the already dried chemical coating, a carbon black coloration will result due to the oxide scorching. If heavy brush marks appear in the dried patina surface, dilute the mixture with a small amount of water. Allow the metal to cool completely before sealing with spray fixative or wax.

CHARACTERISTICS: opaque surface coating
bronze, aluminum, steel

MATERIALS REQUIRED: Ferric Oxide
pint container
soft bristle brush
stiff short bristle brush
heat source (oxy-acetylene torch)
water
wax
clean steel plate

MIXTURE: mix 4 tablespoons Ferric Oxide with one cup of water in pint container

APPLICATION:

Apply the Ferric Oxide solution as described in number 15. After the piece has completely cooled, and after it has been waxed and buffed, apply the antiquing as described on page 7.

CHARACTERISTICS: metal/chemical reaction
bronze only

MATERIALS REQUIRED: Potassium Hydrosulphuret (Liver of Sulphur)
gallon container
water
wax or fixative

MIXTURE: mix $\frac{1}{4}$ cup Liver of Sulphur with one gallon of warm water

APPLICATION:

Dip the bronze in the Liver of Sulphur solution until it turns charcoal black. This solution can also be used to achieve colorations ranging from a light brown, through a range of gray and ultimately an intense black. The coloration is dependent upon the length of time the bronze is left in the solution and the strength of the solution. Stop the chemical reaction by rinsing the bronze in cold water. Allow the piece to dry completely before applying spray fixative or wax.

CHARACTERISTICS: opaque surface coating
bronze only

MATERIALS REQUIRED: one six pack favorite beer
2 or 3 packages of potting soil
large bucket
large plastic trash bag

MIXTURE: consume the entire six pack of beer and fill the large bucket with potting soil

APPLICATION:

Dig a hole in the center of the soil and place the bronze in the cavity. After consuming the beer, urinate on the bronze and cover completely with remaining potting soil. Place the bucket in the plastic trash bag and store in a well ventilated area for 3 to 4 days. Rinse the bronze thoroughly and allow to dry before applying wax or fixative.

CHARACTERISTICS: transparent surface coating

MATERIALS REQUIRED: wax
brush

MIXTURE: not applicable

APPLICATION:

Brush the wax on the freshly sand-blasted metal surface and allow to dry before buffing. DO NOT HOT WAX. Heating of the sand-blasted bronze may cause surface discoloration.

CHARACTERISTICS: transluscent surface coating

MATERIALS REQUIRED: wax
stiff bristle brush
oxy-acetylene torch
clean steel plate

MIXTURE: not applicable

APPLICATION:

Brush the wax to the freshly sand-blasted metal surface and allow to dry before buffing. Apply the antiquing according to the process described on page 7.

CHARACTERISTICS: surface transformation

MATERIALS REQUIRED: white diamond buffing compound
80 through 400 grit sandpaper
toothbrush
ammonia
power buffing wheel

MIXTURE: not applicable

APPLICATION:

Begin with 80 grit sandpaper and sand the surface completely before moving to the next gradation of sandpaper. Once the piece has been sanded with the 400 grit paper, apply the buffing compound to the buffing wheel and buff the surface of the piece. Use the toothbrush dipped in ammonia to remove excess buffing compound from the bronze. Polished bronze will tarnish if it is not sealed. Paste wax is recommended for sealing the surface.

CHARACTERISTICS: metal/chemical reaction
bronze only

MATERIALS REQUIRED: Potassium Dichromate
Ferric Nitrate
2 pint spray bottles
water
heat source (oxy-acetylene torch or kiln)
wax or fixative

MIXTURE: mix 1 tablespoon of Ferric Nitrate with ½ pint of water in a spray bottle
mix 2 tablespoons of Potassium Dichromate with 1 pint of water in remaining spray bottle

APPLICATION:

Heat the piece thoroughly and apply an extremely light coat of Ferric Nitrate. While the piece is still hot, apply the Potassium Dichromate solution as described in number 8 until desired coloration is achieved. The metal may be hot waxed immediately or allow to cool completely before applying the spray fixative.

CHARACTERISTICS: opaque surface coating
bronze only

MATERIALS REQUIRED: Bismuth Nitrate
Ferric Nitrate
soft bristle brush
stiff short bristled brush
cup container
pint spray bottle
heat source (oxy-acetylene torch)
water
wax
clean steel plate

MIXTURE: mix 2 teaspoons Bismuth Nitrate with ¼ cup of water in cup container
mix 2 tablespoons Ferric Nitrate with 1 pint of water in spray bottle

APPLICATION:

Apply the Bismuth Nitrate and the Ferric Nitrate solutions as described in number 12. Apply antiquing as described on page 7.

CHARACTERISTICS: transparent surface coating

MATERIALS REQUIRED: spray fixative

MIXTURE: not applicable

APPLICATION:

Spray the fixative on the freshly sand-blasted metal surface. Apply several light coats.

CHARACTERISTICS: metal/chemical reaction
aluminum, bronze

MATERIALS REQUIRED: Ferric Nitrate
pint spray bottle
heat source (oxy-acetylene torch or kiln)
water
wax or fixative

MIXTURE: mix 2 tablespoons Ferric Nitrate with 1 pint of water in spray bottle

APPLICATION:

Apply the Ferric Nitrate solution as described in number 13.

POLISHED ALUMINUM

B

CHARACTERISTICS: surface transformation

MATERIALS REQUIRED: white diamond buffing compound
power buffing wheel
80 through 400 grit sandpaper
toothbrush
ammonia

MIXTURE: not applicable

APPLICATION:

Follow procedures described in number 21.

CHARACTERISTICS: transparent surface coating

MATERIALS REQUIRED: spray fixative

MIXTURE: not applicable

APPLICATION:

Spray the fixative on the freshly sand-blasted metal surface. Apply several light coats.

MATT GRAY (antiqued)

CHARACTERISTICS: semi-opaque surface coating

MATERIALS REQUIRED: wax
stiff bristled brush
oxy-acetylene torch
clean steel plate

MIXTURE: not applicable

APPLICATION:

Brush the wax on the freshly sand-blasted surface and allow it to dry before buffing. Apply the antiquing according to the process described on page 7.

CHARCOAL BLACK or GRAY

CHARACTERISTICS: metal/chemical reaction
aluminum only toxic

MATERIALS REQUIRED: Caustic Soda
Calcium Chloride
water
large container
rubber gloves
fixative

MIXTURE: mix 4 ounces of Caustic Soda with 1 ounce of Calcium Chloride in 1 quart hot water

APPLICATION:

Dip the aluminum in the Caustic Soda/Calcium Chloride solution until desired coloration is achieved. Apply in a well ventilated area. Be sure to wear rubber gloves to protect your skin. Stop the chemical reaction by rinsing in cold water. Allow the aluminum to dry completely before applying spray fixative.

CHARCOAL F

CHARACTERISTICS: semi-opaque surface coating
bronze or aluminum

MATERIALS REQUIRED: 320 grit carborendum
Tru-Oil (mineral oil)
soft cloth

MIXTURE: mix the carborendum with a small amount of mineral oil until it developes into a thick paste

APPLICATION:

Apply the paste with the soft cloth to the surface of the piece generously. Let the paste set for 2 to 3 minutes, then burnish with a soft cloth. Allow the piece to set overnight before handling.

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