



Small Scale or Test Decal Manufacture

The manufacture of quality decals requires that the decal maker pay strict attention to every detail. The essence of this instructional sheet is to explain all the procedures that we feel will lead to trouble free decals.

There are three major areas of concern to be addressed when attempting to decorate glass or ceramics with decals. These are:

1. Color preparation
2. Decal manufacture
3. Transfer and firing

Each of these areas will be presented under its own heading, and then all three will be incorporated into a flow chart that will follow at the end.

1. Color Preparation

A. Recommended equipment: Palette knife

Glass slab

Glass muller

Analytical Balance (weight scale)

Dust mask

Kitchen Aid mixer

- when preparing ceramic color for decal production, one should be careful not to create any unnecessary dust, as the material is toxic in high concentrations. For this reason, we recommend the use of a dust mask.

B. Procedure:

A ratio of 2 to 1 (66:34) or follow the recommended mixing ratio specified by the decal medium manufacturer, by weight, of powder to decal medium, is a recommended starting point. This should be mixed with the palette knife until a decent paste is achieved. At this point the color should be put on the glass slab and the muller used to insure that all the particles are thoroughly wet by the decal medium. After using the muller, you should check the paste for flow. If the paste is too thick or viscous, extra decal medium should be added to thin the material to the desired consistency. If additional powder is added to thicken the mixture, we recommend that you use the glass slab and muller again to insure that the added powder is mixed properly.

Caution should be taken to make sure that the powder is free of moisture before mixing with the decal medium. If you suspect the powder has picked up some moisture, it should be dried at 250° F. for approximately one hour in a shallow pan.

(If you are able to meet the minimum order requirements, your color supplier can mill the color in decal medium for you. Slight thinning may still be necessary to attain the proper screening consistency.)

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When quantities from 1 to 3 pounds of past are made, it is far easier to purchase a small mixer. The preferred mixer is a Kitchen Aid made by Hobart Manufacturing, and is available in most department, discount and small appliance stores. The Kitchen Aid has a single mixing paddle which spins within the mixing bowl, and in addition to this spinning, revolves within the bowl, like a bakery dough-mixer. Make sure that the powder color has been dried as outlined above, and then weight the entire amount of decal medium into the bowl. Add the weighed amount of color powder directly to the oil, mixing between each addition of powder. When all the powder has been added, turn the mixer on HIGH and whip the paste for 15 minutes. It is then ready for use.

C. Problems associated with improper color preparation:

- I. **Gritty surface** due to improper mixing.
- II. **Blistering** during firing due to included moisture.
- III. **Washed out appearance/Translucent** if too much oil is used.
- IV. **Inability to print through screen** if too thick.

2. Decal Manufacture:

- A. Recommended equipment: Squeegee (80 durometer, square edge)
Screen (180-325 mesh for color)
Screen (72 mesh for covercoat)
Decal paper
Decal covercoat (lacquer)
Racks (*optional*)

Discussion of the silk screening process is not the focus of this section. However, you should realize that the basic silk screening process should be followed.

Registration of the decal paper under the screen should be done in such a fashion that it could be repeated. This is very important for multiple print decals. The screen mesh for printing the color can range from 180 to 325 meshes; the higher number screen for printing fine detail. The squeegee blade should be kept sharp, as a dull blade will cause problems such as smeared edges.

B. Procedure:

The actual screening process is quite simple. However, extra care must be taken to insure that each coat is completely dry before any subsequent applications. The drying rate is affected by various factors such as: room temperature, humidity and airflow. Ideally, the drying time should be overnight, in a humidity controlled room at approximately 80° F. The decal paper cannot be subjected to heat or low humidity, as this will cause it to dry out, curl and change its dimensions.

For this reason, we recommend that you adhere as closely as possible to the prescribed drying cycle. It is important that each print be dried in this fashion, as it only takes one mistake to ruin a decal of several prints.

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The decal covercoat acts like a shield to protect and hold the decal together during the transfer. The covercoat should be printed so as to allow up to a 3/8" or less overlap all around each design is often used. The decoration and the covercoat slide off the decal paper during transfer.

After the covercoat has been applied, the same drying time is recommended. At this point the decal is complete.

C. Problems associated with improper decal manufacture:

- I. The decals are curling up because the paper has become too moist or too dry; curling up, too humid, curling down, too dry.
- II. Blistering or pin holing caused by improper drying between print or too thick of paste.
- III. Pin holing caused by dust or dirt on the paper.

3. Transfer and firing:

- A. Recommended equipment: Squeegee
Water
Kiln or Lehr
Pyrometric cones
Pyrometer

B. Procedure:

Just as important as the decal manufacture is the transfer and firing of the decal. The decal paper has been treated with a soluble coating that dissolves in water, thus releasing the decal. Once the decal is free of the paper, it can be applied to the surface that is to be decorated. It is very important that you do not get any air bubbles trapped under the decal, as this can cause problems during firing. Once the decal is in place, the excess water should be removed by using the squeegee blade. Although the decal exhibits good wet strength, care should be taken not to tear the decal during the squeegee process. When all the water has been removed, it is recommended that the decal be allowed to dry overnight. At this point, you are ready for firing.

Firing a ceramic decal is, for the most part, more demanding than firing a direct screen-print. You have to remember that you are burning out multiple layers of organic materials. Each layer is capable of causing blistering and ruining the piece. Although each firing cycle is a time temperature curve, the following guidelines should be followed. The ware should enter a furnace at a temperature not higher than 150° F., although we recommend starting at room temperature. The ware should be loaded to allow good air circulation throughout the furnace. During the pre-heat and burnout phase of firing, it is very important that the furnace be vented. We recommend that the furnace door be left slightly open until the furnace has reached a temperature of 800° F. This will allow the decal medium and covercoat to burn away and all the gases to escape. Failure to vent the furnace will result in a reducing atmosphere, which in turn will cause bleaching in all colors, specifically in the red and yellow range. Once the furnace has reached 800° F. and there is no visible smoke, you can proceed by closing the furnace completely and continue to heat to the maturation temperature.

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Once you have reached the maturation temperature, the furnace can then be shut off and allowed to cool. The overall cycle should be slow and steady with no sudden fluctuations in temperature, specifically in the burnout zone.

Also of prime importance is a method of temperature control. Most all furnaces have a means of temperature control, however, each type of control should be checked periodically to insure that it is functioning properly. In a like manner you may also want to include a pyrometric cone from time to time in your firings to guarantee that the proper temperature was reached.

- C. Problems associated with improper firing:
- I. Blistering due to improper burnout.
 - II. Large voids in the fired decal due to trapped air during the transfer process.
 - III. Crazeing due to improper thermal expansion or thick application.
 - IV. Darkening of cadmium colors (reds, oranges, yellows) due to improper venting.