Principles to Understand

1. Metal Preparation
Dome to prevent warpage

2. Counter Enamel
Balance th stress created with enamel layer on metal
Equal (or close) amount of enamel on back
Will back of piece be seen? Use trivet

3. Enamel Layer Thickness
1st layer direct on metal: cannot be too thick
2nd layer on top of enamel can be thicker
transparent layer must be thin

4. Fine Silver and Reflectivity
Compression vs Porosity
Flashing to seal the porosity

5. Copper and Reflectivity
"Clear" transparents with high heat first firing

6. Chemical Reactions
Silver: enamels with gold (reds, oranges, pinks, opal white)
Copper: Colors with manganese have reaction
Colors with gold fire dark

7. Transparency
Air bubbles appear as cloudy areas
Larger grain size, less air bubbles
Thinner layer, less air bubbles

8. Unleaded with leaded enamels
Use unleaded UNDER leaded enamels

9 Firing Time & Temperature Relationship
Hotter the kiln, shorter the firing time.

10. Firing Stages
Enamel surface changes from sugar to orange peel to gloss
Orange peel ranges from grains just beginning to join together to almost perfectly smooth
Overfiring is relative to what you want

11. Warpage
Hot metal becomes softs and moves under weight of enamel
Longer, asymmerical shapes warp more, use thicker metal
You have approximately 8 seconds to press on enamel after it comes out of the kiln to repair warpage

12. Fix dome with one layer of enamel fired
Enamel will still be somewhat flexible if no counter enamel has been fired

13. Color Layers
You can use transparent, opaque, and opalescent colors in any order
Opaques will cover up layer below
Transparents can be darkened with a second layer but not lightened.

13. Each Enamel Grain has Depth (size of grain)
Depth of transparent enamel creates Value

14 Each Enamel Grain has an Edge
This is where the color ends

15. Water Quality may effect enamel
Fire transparent enamel to check for cloudiness
Use distilled water for last rinses to remove salts

16. Enamel does not have to be dried before firing
Use toilet paper to blot out excess water

17. Kylr fyre should be dried before firing
Prevents gas bubbles from lifting enamels or foil

18. Blu-Stik does not have to be dry before firing.

19. Kylr fyre and 3 Dimensional Forms
3 parts water to 1 part Kylr fyre

20. Degrease Metal before wet application
Use spit or penny brite (cleans copper)

21. Fire Opalescent enamel at lower temperatures.
Between 1300 and 1400. This applies to all firings if there is opal enamel on the piece.

Reflectivity and Fine Silver

The heating process anneals your metal base

When you heat your enamel piece, the metal becomes annealed in the process.
Fine silver which might look shiny prior to firing can become dull (looking matte white) under your enamel. This is because the heat has caused the metal to anneal, which decompresses the silver crystals, allowing them to "relax". This creates a slight porosity in the metal surface, and the metal loses its "mirror -like" finish. You can see this by taking piece of fine silver, polishing it, and then heating it with a torch. As the silver gets hotter it will lose it's shine and become matte white in color. The same thing happens in the kiln.

How can you keep the Mirror Finish on your fine silver through the firing process?

I've found that compression will help keep the silver shiny throughout the firing process.
This can be done several ways.
-roller-printing will compress the silver and make it shiny
-engraving will compress the metal and keep it shiny
Tumbling/burnishing will compress the metal and keep it shiny.

Each one of these methods works with more or less success. If you anneal your purchased metal it will make it more difficult to use the roller-printing or burnishing method. Engraving works well even on annealed silver.

Flashing will keep your Mirror Finish regardless of having annealed your silver.

I've found that "flashing" or heating the silver hot enough that it begins to flow/liquefy, will create a mirror finish which will remain throughout later heating steps. This process is similar to Silver Granulation, in which you heat the metal just until the surface begins to "flash" a bright silver color. This occurs just after the piece has turned orange. This can be done on a hot plate kiln, charcoal block, fire brick, or any surface which will reflect the heat back onto the metal.

Some tips for Flashing your Fine Silver

- I use a hot plate kiln when working on larger pieces.
- factors to consider are size of the piece, thickness, how hot the flame is, how close the flame is to the metal, speed of moving the flame over the metal, texture on the metal. Try to play around with each of these to find what works best for the piece you are trying to "flash".
-Be prepared to blow on the piece immediately after it flashes so that it doesn't overheat. Overheating may cause the silver to become to liquid and begin to flow or pool , and sometimes change color to a brown color. I believe this is impurities in the metal pooling together.
-Don't touch the piece with your fingers prior to applying wet enamel. The grease keeps the enamel from flowing evenly.

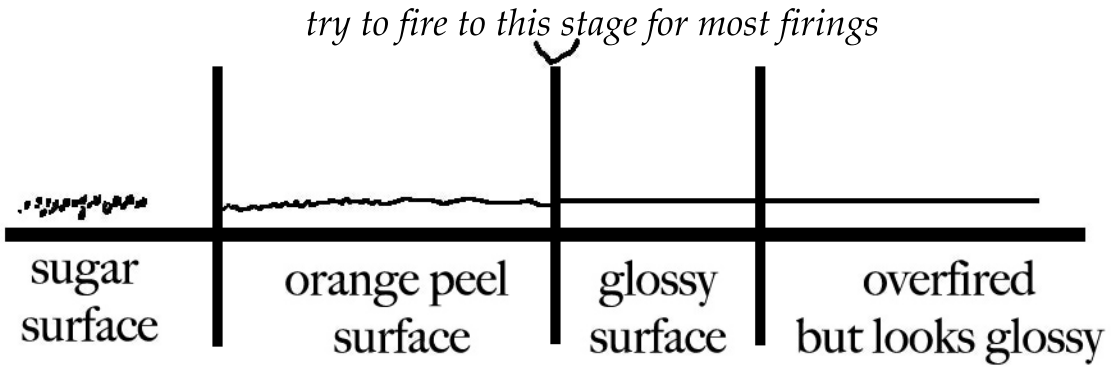
Firing Stages and Temperature

General Firing Information

I fire my enamels at approximately 1400 to 1450 degrees farenheit.
If I'm using opalescent enamels I will fire at a lower temperature and not let the kiln temperature reach 1400.
I keep my firing glasses on my head and the glove on my hand while I'm firing to remind me that I'm in the kiln.
I don't let myself pay attention to or focus on anything; i will lose track of time and overfire the piece.
Make sure your firing area is clean of any black flaking off from the firing screens. Clean it up as needed.
I generally try to fire to just past orange peel, so that the surface is just slightly gossy.
Generally, sugar fired surface needs to be fired longer if you are going to either glue foil to the surface or paint another layer of enamel over it. It is so porous that the glue or water will soak down like a sponge below the surface.
Train yourself to see when the enamel changes from Orange Peel to Glossy.
If you can catch it at this stage you will not over fire it.

Temperature/Firing Time Relationship

The hotter the temperature, the shorter the firing time
The cooler the temperature, the longer the firing time



Sugar Surface

resembles sugar cookie surface; each individual grainof enamel melts and pulls into itself, making a tiny ball of glass

Orange Peel Surface

resembles the skin of an orange; individual grains have begun to fuse together but the surface still has a texture. Orange peel surface has many different looks, from very textural to almost smooth.

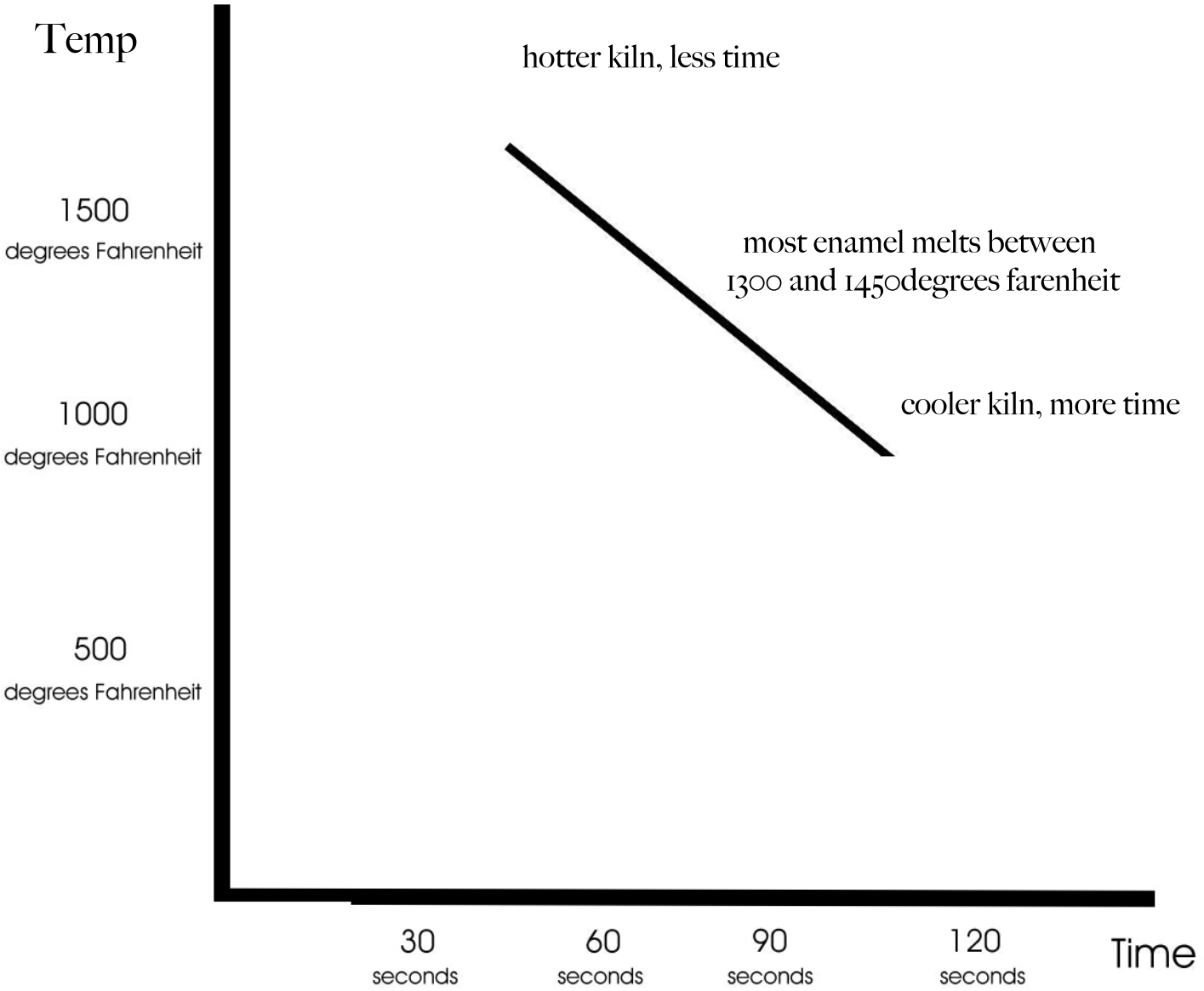
Glossy Surface

surface texture has leveled out and is completely smooth

Over fired Surface

There is not a "specific" over fired look. It may look the same as glossy.
The enamel is over fired when the firing has gone past the desired effect and the enamel begins to do things you don't want it to do: crawl up the side of a cloisonne wire, turn an undesirable color, bubble through a top layer, etc.

Time /Temperature Relationship



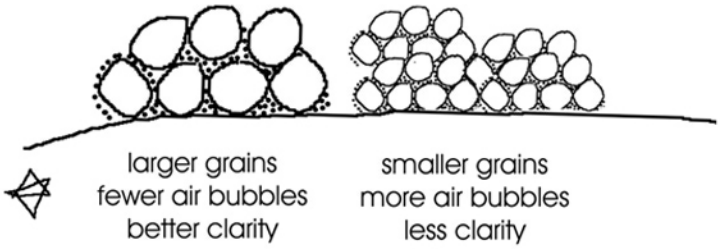
Graph not specific for exact firing time and temperature. It is to suggest a relationship necessaryfor enamel to melt.

There is a relationship between time and temperature which determines when the enamel will begin to melt.
The hotter the temperature, the less time it will take to melt.
The cooler the temperture, the more time it will take to melt.
The temperature of the kiln at any one moment does not determine when the enamel will melt;
it is how hot the enamel piece has gotten and for how long.
Firing times will vary. Factors include:
Initial temperature of kiln?
How long door is opened putting the piece in the kiln?
How long the kiln has been on? How long since someone last fired a piece?
How big is the piece? How thick is the metal? How big is the trivet or screen?
What is the firing temperature of the enamel used?
What do you want the result to look like?

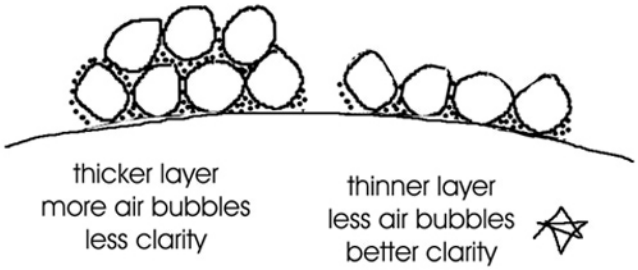
Air Bubbles and Clarity

The key to having clear transparent colors is to consider the two factors:
1). Particle/grain size
2). Thickness of the layer

To prepare your transparent enamels for a wet application, you'll need to remove the finest particles.
Air bubbles cause cloudiness in glass. The more fine particles, the more air bubbles will be present in the layer, as air bubbles surround each grain of enamel.



(black specks are air bubbles)



Rinsing out the Fine particles

If I am using 80 mesh enamel straight out of the jar/bag, I always grind it up slightly with a mortar and pestle, using water. Most often I use ordinary tap water (I've had to use distilled water once when enameling in the desert city of Tucson, AZ).This breaks down the grains slightly removing any older surface enamel which may not be as clear as the inner part of each particle. I then pour this into a 1 oz medicine cup and swirl it around to get the finest particles to float in the water, while the heavier grains fall to the bottom of the cup. I pour out the water, being careful not to pour out the larger particles. I pour the water into a plastic shoebox or bucket so that the fine enamel grains don't go down the drain to contaminate the drain and clog it up. Repeat this process until the water is crystal clear, with no fine grains floating around in the water.

Grinding enamel from lump.

I prefer to use lump form enamel for several reasons:
* It has an unlimited shelf life
* It is always crystal clear
* the particle sizes can be bigger, giving me less air bubbles
* it last longer after I have ground it up while sitting on my desk
* use a solid mortar, not a hollow one
* the best I have found is made of aluminum oxide from CoorsTek