Firing decals (Ceramicdecals.org)

• Put ware to be fired into kiln

- “Stilting” is not necessary but recommended for large, heavy, or asymmetrical pieces

- Always be sure that the kiln shelves have a sufficient coating of kiln wash

- Decals should have been allowed to dry 24 hours

COMPUTERIZED KILNS

• Set Cone for 017 or 018

• Set Firing Speed for MEDIUM

• Leave kiln lid cracked about 1” and

Leave all “peep holes” open (except if you are using a Down-Draft Kiln Vent)

> Start kiln

• When kiln stops smoking, close lid

This will usually be about 2 hours into the firing

“Peep holes” may remain open the entire time

• When kiln shuts off, leave lid closed for 2 hours

• After 2 hours, crack lid 1”

You may also just leave lid closed for the entire cool down

• Let kiln cool down naturally

• Remove ware when kiln has cooled

Approximate firing time is about 3 - 3½ hours

MANUAL KILNS

- Put 017 or 018 cone into “Kiln Sitter”
- Leave kiln lid cracked about 1” and

  Leave all “peep holes” open (except if you are using a Down-Draft Kiln Vent)

- Turn ALL switches on LOW
- After 1 hour turn all switches on Medium
- After 1 hour turn all switches on High
- When kiln stops smoking, close lid

  This will usually be about 2 hours into the firing

  “Peep holes” may remain open the entire time
- When kiln shuts off, leave lid closed for 2 hours
- After 2 hours, crack lid 1”

  You may also just leave lid closed for the entire cool down
- Let kiln cool down naturally
- Remove ware when kiln has cooled

Approximate firing time is about 3 - 3½ hours

More Simply Put

- Use the recommended “cone” for your ware
- Stilt your ware if necessary

• Leave the lid cracked and peepholes open (unless you're using a power vent)

• DON'T FIRE FAST!

• Close the lid when the kiln has stopped smoking

• Don't cool down fast, especially for the first 2 hours after the kiln has shut off

Re: Down Draft Kiln Vents (Power Vents)

- It is not necessary to crack lid at the beginning
- Leave "peep holes" closed (except for the one in the kiln lid)
- Turn OFF the Power Vent for 2 hours when the kiln has shut off
- After 2 hours you may turn on the Power Vent

Or, just leave the Power Vent off for entire cool down

This is the Overglaze/Decorative Firing for Hobby Ceramic and Terra Cotta (Cone 017/018)

Chinaware and Stoneware Overglaze Firing should be a little hotter (Cone 015/016)

All Ceramic Decals, Gold, and China Paints* may be fired as described.

* China Paints are also know as Overglaze Colors, and are, in fact, the same colors that are used to print Ceramic Decals

For More Expansively Put see the link for "Firing Fundamentals".

I am using the firing instructions from the “Firing” link as a framework for an expanded explanation of Firing Principles. Note: There will be many things mentioned that apply to ALL types of firing, not just overglaze firing.

• **Put ware to be fired into kiln**

One should approach loading a kiln much like designing a work of art. There should be balance, not too much and not too little, colors kept together, do as if you were God planting a village.

Having said that, I will proceed to give you the less romantic version.

- Keep pieces at least 1” from the sides of the kiln wall (meaning, the heating elements). Placing pieces too close to a heating element can distort or burn a color from too much localized heat.

- Make sure that there is a direct “line of sight” for every piece so that they can “see” a heating element. It is interesting to know that heat is transmitted in 3 ways in a kiln: Convection, Conduction, and Radiation. Convection means heated air. Just like your house can be heated by forcing heated air through it, so a kiln creates air currents as the air inside becomes heated. Conduction means when heat is passed from one hot surface to another by touching it or when heat travels through a solid. So then, the kiln shelves that your pieces are sitting on will pass on heat to the pieces themselves and vice versa. In fact, they try to balance out their heat distribution. This is why you need to “stilt” larger pieces, which we will discuss later. And lastly, Radiation, which means reflected heat, like your radiator reflects heat at home. Radiation transmits heat from the heating coils directly to you ware and is in fact the primary way the ware is heated when your kiln reaches higher temperatures. That is why it is important that your pieces be able to “see” the heating coils, for then they will receive heat from the coils. But if blocked off, they will under-fire. And So…

- Do not over pack a kiln because the pieces in the center will receive less heat.

- Do not under pack a kiln because you will use electricity less efficiently. Which brings us to Firing Principle #1 – A small kiln is just as efficient as a large kiln as long as it is fully loaded. [A Story: A friend of mine, Mary Jetner of 3 Cones Ceramics, had a husband who worked as a government engineer by day and as her kiln repairman by night. His name was Ed. Well, you now how engineers are. They want to know every little thing about everything, especially whatever they are personally involved in. So Ed decided to make a study about power consumption for electric kilns. He hooked up meters and timers, and did charts and graphs, as engineers are wont to do. So what do you think he discovered? “It takes X amount of BTU’s to raise the Specific Heat of a given Mass.” Said another way, the more weight you put in a kiln, the more electricity it will use. Well, Duh, Ed. Actually, this WAS a revelation because it revealed that 1) A kiln is at it’s maximum efficiency when it is fully loaded; 2) A small kiln is just as efficient as a big kiln as long as it is fully loaded; 3) If greenware is too thickly poured or bulky (like ceramic Christmas Trees) you can actually lose money when firing them according to traditional pricing methods. The Jetner’s responded to this new information by “charging by weight” for their firing, which was and is a radical way of pricing firing (but nevertheless highly accurate). Ed sent all his research to Paragon Kilns where it was filed in oblivion cabinet. But I remember and I pass this on to you, my posterity.][PS – This is why I always encourage people who are contemplating buying a second kiln to buy a small one. It can be used for specialty firings, like gold or decals, or overflow firings, when the big kiln is too full.]

- Put pieces that have the same color decal on them on the same shelf. Most decals fire pretty consistently. But pinks, yellows, and oranges are temperature sensitive. They will alter slightly depending on what temperature they are fired at. The temperature distribution in a firing chamber is fairly simple. It’s cooler in the bottom and warmer at the top. Heat rises, you know. So by putting like colored pieces on the same shelf, you are reasonably insuring that they are going to be heated

together at the same temperature. You need to know that in a large kiln the temperature differences between the top and the bottom can be as much as 2 Cones in overglaze firings. Interestingly, Down-Draft Kiln Vents cut this differential in half. I'll have more to say about them later too. (I like 'em!)

- **"Stilting" is not necessary but recommended for large, heavy, or asymmetrical pieces**

Typically, you do not need to stilt your ware in an overglaze firing. The Kiln Wash you use to coat your shelves and posts should be enough to keep them from sticking. The reason for this is because in the overglaze firing you have not passed the Transition Zone Temperature and so your glaze has not become liquid yet. What is the Transition Zone Temperature you ask? It's way more information than you need to know. But because some people like trivia, I'll go over it here. Actually, I find it fascinating.

- The Transition Zone Temperature (TZT) refers to the temperature range where the glaze is neither solid nor liquid. Glaze has a lot changes of it goes through when it is firing. But simply put, it goes from being a solid to a liquid. The TZT might be described as it being in a molten state (I call it the Twilight Zone). The glaze gets soft and tacky, but it's not quite liquid yet. Well, guess what? All overglaze firing is done in the TZT range: gold, decals, china paints, and lusters. For Hobby Ceramics and Terra Cotta (both are softer, less dense ware) the TZT is between Cones 019 and 016. If you go colder than 019, the glaze is still hard and the decoration scratches off. If you go hotter than 016, the glaze becomes liquid and your gold cracks (because it has lost its surface tension) or your decal sinks a little bit under the glaze (which some people like). Note: For harder, more dense ware, like Porcelain and Stoneware, the TZT is 018 to 015. This is why commercially made ceramic tile should be fired hotter (016), like chinaware, because they are made from industrial grade ceramics which is similar in hardness to Japanese porcelain.

Now having said all that, it IS necessary to stilt large, heavy, or asymmetrical pieces. This is so they won't crack in the firing. When you set a large, heavy, or asymmetrical piece flat on a kiln shelf, when the kiln is heating up, the shelf, because it is thicker and heavier than the ware, heats up at a slower rate. So because heat wants to equalize, some of the heat from the ware will be pulled out of the ware (by Conduction)(see above) and into the shelf, and the bottom of the ware will heat up at a slower rate than the top. And this will produce uneven "rates of expansion" (all heated ware expands), and your ware will crack. So… stilt those large, heavy, or asymmetrical pieces. Note: Always stilt in 3's. 3 point suspension means stability. 4 point suspension means "rocking" and sometimes cracking.

Now for an insider tip: In the case of commercially bought tile (like at Home Depot) and china plates, you can, and should, fire these on edge. This is why they make tile holders and plate racks (be sure to coat these with kiln wash). I don't know why it is, but tiles and plates never crack when they are fired on edge. In fact, what I do is break my own rule. I lean tiles and plates up against the kiln wall (decal away from the heating elements, of course). I've done it for years and have never had a firing failure. Ain't I sumthin'. But I say you should try it too. You may have noticed that I said you "should" fire these this way. This is because the air can get to the design better with a standing tile or plate than it can with them laying flat. And air makes the colors bright, as I will explain below.

- **Always be sure that the kiln shelves have a sufficient coating of** Kiln**Wash**.

We've mentioned this already but I'd like to add a little extra information. "KilnWash" is basically composed of Alumina Hydrate (an inorganic material resulting during the process of refining aluminum) / Kaolin (clay) / Silica (sand) whereas "Glass Separator" (used in glass sagging and fusing) lacks the Silica. Either one is satisfactory for overglaze firings or glass decorating (at Cone 022). But for glass fusing and sagging, use Glass Separator. It doesn't leave a residue on the glass like regular KilnWash does. Do-It-Yourselfers can mix their own, however there is a lot to be said for the quality control measures used by manufacturers and purveyors of the stuff. Said another way: Buy it already mixed. It's not worth the effort.

- **Decals should have been allowed to dry 24 hours before firing**.

This is a biggie! 90% of all the problems I have ever been asked to troubleshoot were traceable back to not letting the decal dry long enough. No matter how well you think you applied your decal, there is still a little water underneath that must be given time to evaporate. Even a little bit of water can have an effect on a decal that is being fired because of the violent transformation of water into steam at 212°F (100°C). So guess what happens when a film of water, even a very thin film, is left behind? Snap, crackle, pop... all over the areas where the water film is. That's why we let the decal dry for a while, even when firmly mounted; so as to get as much water out as possible.

The Firing Cycle

• **Use Cone for 017 or 018**

I've got a lot to say about firing temperatures, so you should go get a cup or coffee or something and return.

The best general Cone for Hobby Ceramics or Terra Cotta is 017. It is right in the middle of the Transition Zone Temperature described above. It gives you a nice balance of good pinks without fading yellows and oranges. It will work with any manufacturer's ceramic decal since all ceramic decals are made from pretty much the same china paints (overglaze colors). The only thing to be aware of is to allow the kiln to "soak" for a couple hours after it has shut down (leave the lid closed for 2 hours), so that the colors will set nicely (be smooth to the touch).

BUT this is NOT the only Cone that you can use!! Below are the various Cones that are used to produce a variety of effects.

Cone 015 – Probably the second most popular Cone after 017. It produces a shinny finish because the glaze has gone past the TZT and become liquid, allowing the decal pigments to sink a little underneath the glaze. A lot of people like this. To it's credit, it will give you wonderful pinks (the hotter you fire a pink, the brighter it becomes), and, you don't have to worry about "soaking" as much. To it's demerit, it will fade your yellows and oranges a little (no, they won't bleach out. They just will become a little lighter.), and, you WILL need to stilt allyour pieces.

Cone 016 – The compromise Cone, combining the best and worst of 015 and 017. Not many people use it.

Cone 018 – The all-purpose Cone. With this Cone you can fire your decals and gold together in the same load. Pretty convenient. The problem: Pinks won't turn pink. They usually turn mauve at best or stay brown at worst. Furthermore, you MUST fire slowly and BE SURE to "soak" at the end of the firing or your decal may feel rough to the touch (like fine sandpaper). Because it is such a strong temptation to eliminate having to fire 2 separate loads, may I recommend putting your decals near the top of the kiln (where it is hotter) and your gold near the bottom. Beyond that, slow firing and long cool-down soaks are just good firing practices anyway, which I will elaborate more on below.

Cone 019 – The china painter's Cone. China Painter's have always historically fired their colors a Cone or two cooler because they intend to go back and add more china paint. Well what's a ceramic decal made from? China Paint! If you would like to add china paint to your decal, fire it at Cone 019 and add to your heart's delight. Fire again at 019 and add some more. Finished? Do the final firing at 017 or 018. It's fun. My mother used to teach this technique.

Cone 020 – Nope too cool. Your decal will scratch off.

Cone 06 – Cone 06? Isn't that what you fire glazes at? Yup. You can't fire off a decal. It just sinks further into the glaze. Some colors fade away, but the earthtones usually stick around. Moreover, the

pattern “mutes” as the pigments start migrating out into the glaze. But you know what? It usually looks pretty cool. Like a whole ‘nother decal. Antique looking. Try it sometime.

Note: For harder ware such as Porcelain and Stoneware, the best general Cone is 016. Again, this is right in the middle of the TZT for harder ware. It is an almost universal rule that the harder your ware, the hotter you fire it (on everything you do: bisque, glaze, and overglaze). Note: Because of this principle, I fire gold on chinaware at 016. It doesn’t work just fine. It works better. The gold shines brighter and lasts longer.

• **Set Firing Speed for MEDIUM (computerized kiln)**
• **Turn ALL switches on LOW (manual kiln)**

Computerized kilns are great. I would recommend one to anybody. Eventho I told you to always fire slowly, if you set the firing speed to MEDIUM, you will fire slowly anyway. You can thank the glaze companies for this. Ever since they came out with Lead Free glazes, the tech sheets say to take at least 2 hours to get to 1000°F (537°C). The kiln companies in turn have made the MEDIUM speed slow enough to fire the Lead Free glazes. Truth be known, Firing Principle #2: “Slow” is our friend!”. A slow firing gives you more forgiving results. It equalizes the temperature differentials in the firing chamber. It gives you a more thorough burn off of the organics. (And I don’t mean just decal organics. I mean glaze and greenware organics too. This is especially important with thickly cast ware.) And it is just good firing practice. A seminar speaker once wisely said that when you think about firing ceramics, “Think Potatoes”. Just like it takes a long time for the heat to work through a potato, it takes a comparablely long time for heat to work through ceramics. And, yes, I can read some of your minds, “What about microwave ovens?” We’re not even going to go there.

• **Leave kiln lid cracked about 1”**
• **Leave all “peep holes” open**

This applies only if you do not have a Down-Draft Kiln Vent (which I am also a big fan of).

There are 2 very good reasons why we “crack the lid” and open the peep holes of a kiln before we turn it on. The first is so that the fumes from the organics being burned off will have someplace to go. Decals Stink! So does gold and luster. Well, get that stink out of there by cracking that lid. After about 800°F or so, all the organics have burned away. You can close the lid (usually about after 2 hours), but you still want to leave those peep holes open because of, reason #2, color maturity. All fired color needs air to be pretty and bright. A firing chamber that is starved for air is called a “reduction firing”. Potters sometimes like to do this because they are looking for different effects. But most people want pretty, bright colors. By leaving your peep holes open, you insure that the firing chamber always has access to fresh air. Some colors need lots of air. Red is the most notorious. Want to know how to have a beautiful bright red? It’s not how you apply the heat, but how you supply fresh air to it. Want to have a dark, dingy red? Starve it for air. Note: This applies to glazes as well as decals. That’s why Down-Draft Kiln Vents are so neat. They constantly supply a flow of fresh air to the firing chamber. Oh, you don’t have a Down-Draft Kiln Vent? Well, just set you red decal about 2” from the peep hole and it will be a lovely red. Firing Principle #3 – Get air into you kiln.

> **Start kiln**
• **After 1 hour turn all switches on Medium (manual kiln)**
• **After 1 hour turn all switches on High (manual kiln)**

• **When kiln stops smoking, close lid**
- This will usually be about 2 hours into the firing
- “Peep holes” may remain open the entire time (as said above)

This instruction “to close the lid after 2 hours” is a general instruction. You really don’t close the lid until you can’t see any smoke (from the burning organics) or smell that awful smell (from same). The amount of time it takes can vary. A small kiln with a small decal load takes less time. A big kiln with a big decal load will take more time. 2 hours is about the average. Don’t stress it if you don’t get around to closing the lid EXACTLY when the kiln has stopped smoking. It’s not a big deal. Some people leave their kiln cracked for the entire firing cycle. They probably are using too much electricity, but they aren’t hurting how their ware will fire.

• **When kiln shuts off, leave lid closed for 2 hours**
• **Turn off Down-Draft Kiln Vents**

• **After 2 hours, crack the lid 1” or turn on the Down-Draft Kiln Vent**
- **You may also just leave lid closed for the entire cool down**.

When you leave the lid closed for 2 hours, you are doing what is called a “cool down soak”. “Soaking” refers to allowing the heat to saturate the chamber and the ware. You can also do a “heat up soak” by programming you computer controlled kiln to HOLD at the high temperature for 2 hours, but why use the extra electricity? Soaking makes a decal “set” better. It gives it a smoother finish. It also allows other pieces in the kiln to get all the heat they needed (if they are in the bottom or poorly positioned. If you are like me, you fire in the evening. When the kiln shuts off, I just go to bed and wake up in the morning to a cooled down kiln.

• **Let kiln cool down naturally**

I have instructed those with Down-Draft Kiln Vents that it is OK to turn them back on 2 hours after the kiln has shut off. It really shouldn’t be a problem. But the truth is, unless you are in a dreadful hurry, just leave it off and let the kiln cool down naturally. Remember “Slow is our friend”? This applies to the cool down period as well. Unbeknownst to you, there is a special temperature of 1063°F (573°C) called the Quartz Inversion Temperature. Basically, at this temperature anything with quartz in it (which is pretty much all ceramics) does a little dance. And even more interestingly, it will do this dance on both the heat up AND the cool down. On the heat up, computerized kilns will slow down at about 1040°F and speed back up after 1080°F. Manual kilns are advised to just fire slowly. But what about the cool down? Want to hear the “ping of death” from inside your kiln? Then hustle through the cool down. Want to never worry about it? Just let it cool down naturally with the lid closed.

• **Remove ware when kiln has cooled**

Ah, yes, I have been in a hurry. So I grabbed those oven mitts and lifted that “too hot to hold” ware out of the kiln, and set it on what I though would be a safe surface (newspapers), and… crack, there went my piece. Patience, my dear, Patience.

Approximate firing time is about 3 - 3½ hours

This is a good approximate time for a complete firing cycle. If it takes 4 hours, not a problem. If it’s 5 hours, don’t worry. If it’s 6 hours, get your kiln fixed, but your firing should still be OK. “Slow is our friend”. But don’t go less than 3 hours. Maybe you think your load turned out OK, but you are playing against the odds. Eventually you will have a problem. But cheer up. Just re-fire it again!

A Word about Down-Draft Kiln Vents

If you are only firing about once a week or several times a month, you don’t need a Kiln Vent. If you are firing every day or several times a week, they are a good investment.

A Down-Draft Kiln Vent will considerably equalize the temperatures in your firing chamber because it pulls the hot air towards the bottom of the kiln. It will also give you brighter colors, especially reds, because ALL fired color needs air to mature properly, and that's exactly what a Kiln Vent does best, namely, pull fresh air into the kiln. It will double the life of your heating elements (because airborne corrosion that can come from firing is actively removed from the chamber), which in effect, doubles the life of your kiln. (Note: It is usually less expensive to replace all the elements than to buy a new kiln.) It evacuates the fumes from your kiln to an outside source. (I know an exhaust fan does the same, but it isn't always easy to install an exhaust fan. You have to have an outside wall, you know. Whereas you can snake the exhaust hose from the Down-Draft Kiln Vent over ceilings and around corners to get to an outside wall.) I am a convinced advocate of Down-Draft Kiln Vents.