

Ten Basics of Electric Firing

by Bill Jones

Firing is the most critical part of the ceramics process because it is the one thing that makes clay durable, hence ceramic. Here are some of the principles of firing and getting the best results with electric kilns.

FROM MUD TO CERAMIC

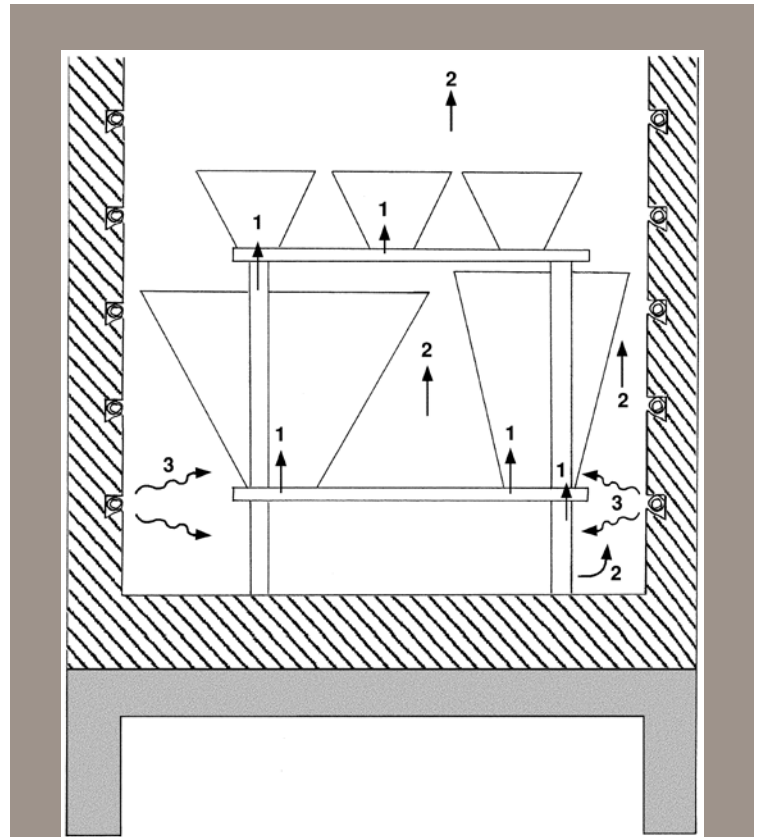
Firing converts ceramic work from weak clay into a strong, durable, crystalline glass-like form. Ceramic work is typically fired twice: it is bisque fired and then glaze fired. The goal of bisque firing is to convert greenware to a durable, semi-vitrified porous stage where it can be safely handled during the glazing and decorating process. It also burns out carbonaceous materials (organic materials in the clay, paper, etc.). As the temperature in a kiln rises, many changes take place in the clay. The Firing Chart (available at www.ceramicartsdaily.org/education/resources/) explains what happens to clay as it heats up.

HOW HOT

All clays and glazes are formulated to mature at certain temperatures. Firing clay too high can cause it to deform or even melt, too low and it will not be durable. Firing glazes too high can cause run-off on the pot, too low and they will be dry and rough. To fire to the right temperature, pyrometric cones are used. Cones are made from various oxide mixtures and bend at known temperatures (figure 1).

In general, the following cones are used in the pottery studio:

- bisque fire (cone 08–05)
- low fire (cone 06–04)
- mid-range (cone 4–7) and high fire (cone 8–10).



HEAT TRANSFER IN A FIRING

Heat in an electric kiln is transferred to the ware being fired in three ways:

- Conduction—heat transferred through physical contact (1)
- Convection—heat rising through the air (2)
- Radiation—heat emanating from all of the kiln elements (3)

How it works:

Electricity passing through coiled heating elements (made especially for high temperatures) generates radiant heat, which rises and is absorbed by everything in the kiln.

USING CONES

Cones are used in every firing. Typically, a three-cone system (either large or self-supporting), consisting of a guide cone that is one cone below the target temperature, the firing cone and a guard cone (figure 2) provides the best information about the firing. Bar cones and small cones are used in a properly adjusted Kiln-Sitter®, an automatic shut-off device (figure 3). While the three large cones are not required for kilns equipped with a KilnSitter or an automatic controller, they do provide a second point of reference for how a kiln is operating.

GET READY

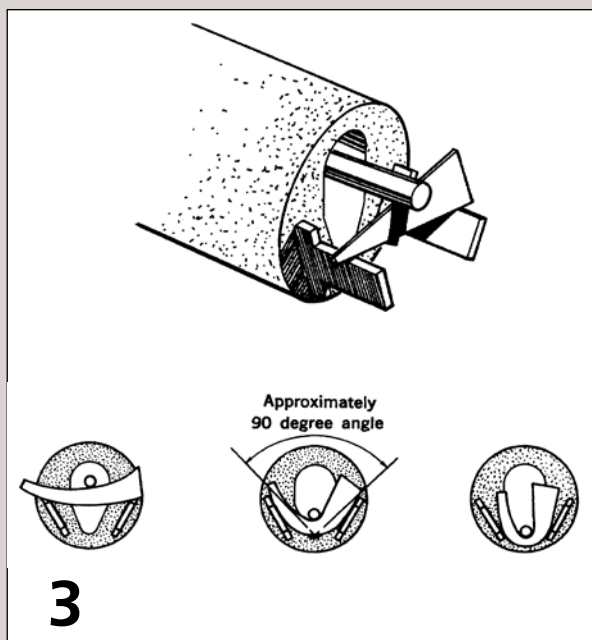
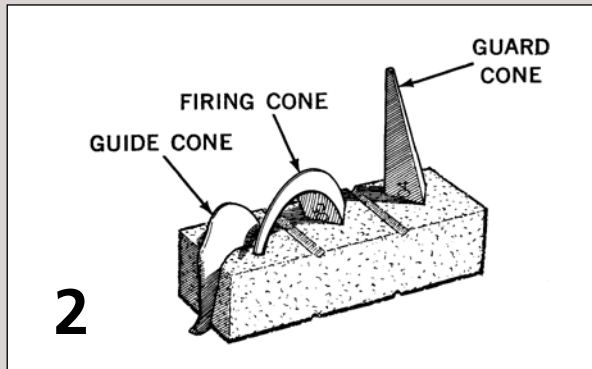
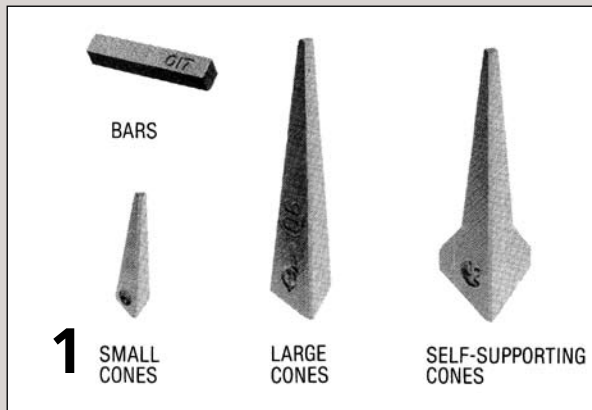
Before firing any kiln, vacuum it out if necessary—bottom, sides, element channels and lid. Check the elements for breaks, and chisel off any glaze drips on the shelves. Visually check the electrical cords and connections. Make any repairs required (see owners manual or call your local supplier for service).

KILN FURNITURE

An assortment of kiln furniture (figure 5) is needed to hold and support ware during a firing. Furniture consists of shelves, posts, stilts and tile setters, all of which are made from refractory materials. Kiln furniture is designed to withstand the repeated heating and cooling to high temperatures without deforming.

THE BISQUE LOAD

Loading a bisque kiln is a fairly simple task, but there are some basic rules. Fire full loads to take advantage of conduction heating and also save electricity. All work should be bone dry. If the work is cool or cold to the touch, it is not bone dry. Handle all work very carefully because it is extremely fragile at this stage. Place the bottom shelf on 1-inch stilts to aid circulation, and



Kiln Controllers

Many electric kilns are now equipped with kiln controllers. Kiln controllers use a signal from a thermocouple (a sensing device that detects temperature) that's located in the kiln. When the controller senses the temperature, it compares this information with a computer program that tells the relays to turn on or off. The relays control current going to the elements. Controllers take the guesswork out of when and how high to turn up the heat on the kiln. Because they are accurate at sensing temperature, they are more efficient than manually-fired kilns. They come with preset programs, or you can even easily input programs to adjust to special firing requirements.

keep ware 1 inch away from elements, walls, thermocouple and KilnSitter (figure 6). Unglazed pieces may touch each other. Place a small cone in the KilnSitter and/or a cone pad on the middle shelf. Fire to cone 08–05, depending on the type of clay and amount of porosity you want for glazing.

THE BISQUE FIRE

During the bisque firing a lot of damage can take place. Thicker pieces with moisture or air bubbles create the biggest problem. Clay needs to dry evenly through its entire thickness. If the outside dries faster, it seals off the escape route for the interior moisture. The interior moisture turns to steam and forces its way out (explodes) during the bisque. To avoid this, start off slowly when firing a bisque kiln. Turn on one element to low. If you do not have a downdraft exhaust system, prop the lid open, take the peephole plugs out and keep the temperature below 212°F until all the moisture is gone. Close the lid and check for moisture (hold a mirror or piece of glass up to the top peephole to see if it fogs up). Turn on all elements to low for at least an hour then to medium for an hour before turning all elements on to high. The firing is done when the firing cone falls.

THE GLAZE FIRE

Vacuum the kiln, especially if any pieces exploded during the bisque. When firing glazed pieces, make sure there is a thin coating of kiln wash (available from suppliers) on the shelves (figure 7). You do not need a fresh coat for each firing, but any bare spots should be coated. Built-up kiln wash becomes bumpy and should be cleaned off with a chisel. All glazed pieces must be checked to make sure there is no glaze touching the shelf. Coat with wax at least ½ inch from the bottom of the piece. Sort work by height and place on shelves with a minimum of ½ inch between pieces and 1 inch from the walls, elements and KilnSitter. Turn the kiln on low for about an hour and then medium for about an hour before turning on to high. The higher the cone you are going to, the longer it will take to fire.



WHAT'S THAT SMELL?

Clay and ceramic materials change their chemistry when fired. Carbonaceous materials burn out between 500°F–1450°F. Firing clay materials in electric and gas kilns produces carbon monoxide, formaldehyde, sulfur dioxide gases and more. Some of the byproducts are harmful so vent kilns to the outside. A downdraft vent system works best, but an updraft or crossdraft system is better than nothing. All kilns must be vented to the outdoors.

KILN FIRING SAFETY

Firing is a potentially hazardous activity and all students must obey safety rules to avoid injury. Instructors must read and understand all the safety information that came with the kiln, and assure that the kiln is properly installed and maintained. If a manual is not available, many companies post them online or you can request a replacement copy from the manufacturer. For operating the kiln, students must:

- Turn off kiln prior to loading or unloading. Disconnect the kiln for any servicing or when kiln is not in use.
- Do not touch heating elements with anything since they carry high voltage.
- Do not place any combustibles within 12 inches of any surface of the kiln.
- Do not leave kiln unattended while firing.
- Never look into a hot kiln without properly tinted safety glasses (e.g., welder's glasses). Sunglasses only block ultraviolet light.
- Make sure the ventilation system is working properly.
- Never add extra insulation around a kiln to conserve energy. Extra insulation can cause the wiring and the steel case to overheat.
- Remove all tripping hazards. Keep the power cord out of the way.
- Do not fire with cracked shelves. They can break during firing, which could damage the ware inside the kiln. Store kiln shelves in a dry area.
- If you smell burning plastic, turn the kiln off. Examine the wall outlet and power cord for signs of burning.
- Never wear loose-fitting clothing around a hot kiln.
- Do not open a kiln until it has cooled to room temperature. Pots may break from thermal shock.
- Keep the kiln closed when not in use, and never place anything on the kiln lid, even when the kiln is idle—you may forget.
- Always keep unsupervised children away from the kiln.
- Do not place any objects under or around the kiln stand. Blocking airflow changes the kiln's heating characteristics.
- Remove all flammable materials from the kiln room.