LOADING THE HIGH FIRE

Stilt bricks are positioned on the floor of the kiln to support shelves; no pots are loaded on the kiln floor. Our kiln is loaded with two stacks: one two shelves deep in the back of the kiln and one two shelves deep in the front. The entire back stack is loaded before the front stack. One or two inches are left between the two stacks. Shelves are placed on the stilts and 1/4, 1/2, 3/4, or whole brick stilts are positioned on top of the shelves for that level. All glazed ware should be "dry footed" -- that is, all glaze cleaned off the base and about 1/4" up the foot rim. Glazed pieces should be loaded at least 1/4" apart because heat radiation can cause shininess. Remember that turbulent currents occur during firing. Pieces that are unstable should be positioned to avoid hitting other pieces if they lean or fall, or they should be rejected. Handles or other extremities should be turned to the inside of the kiln, not to the edge of the shelf. Pieces should not overhang the edges of shelves where they can be exposed to intense flame. A uniform load without tight spots will help produce an even firing. Staggering the shelf stacks in a large kiln will create a better heat flow (e.g. don't match the brick heights in the back stack with those in the front stack). Each stack should be built up until less than five inches of empty space is remaining at the arch. Firing a half of a load should not be done since it will result in uneven temperatures, ruined ware, and wasted fuel.

GLAZE FIRING -- CONE 10 REDUCTION

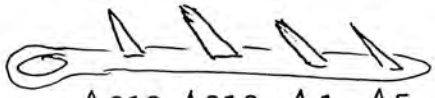
Reduction high firing in a downdraft kiln fueled by natural gas is the primary glaze firing method used in the William and Mary Ceramics Studio. Although it is possible to finish ware in electric kilns, high firing with gas results in a wider variety of surface, warmth of color and texture. A "reduction" method of firing further enhances these qualities. When the firing has reached 010 (1634 F), we "stall" the kiln by pushing in the chimney damper to create a heavy reduction atmosphere. This deprives the kiln atmosphere of oxygen, starves the flame of its natural fuel, and results in the flame utilizing the particles of minerals and chemicals within the clay and glazes. It also creates free floating excess carbon in the kiln atmosphere which is absorbed by the exposed clay body and some glazes. As examples: iron impurities in the clay body come to the surface and "blend" on the surface of the glaze (the speckles in our White Satin Matt glaze), unglazed clay turns from gray to a warm tan or brown (body reduction), iron glazes turn green (Celadon), shino glazes capture excess carbon turning grey/black (Dan's Carbontrap and Creamy Shino), and copper-based glazes turn red (MacNelli's Red). After the heavy reduction period, the kiln is maintained in a slight reduction atmosphere to prevent the effects from reversing during the latter part of the firing. Often, a short heavy reduction is done at the very end of the firing to boost reduction effects in glazes. As an aside, gas kilns are more economical to fire at high temperatures than electrics.

A downdraft kiln directs the flame downward inside the kiln. This is accomplished by the three components of the kiln: the firebox (combustion area), the stack area (where pots are placed), and the kiln stack (chimney, which includes the flue damper system). The firebox is composed of the burner ports, bag walls, and target bricks. The gas/air mixture enters the burner port where it combusts into flame. The bag wall protects the ware from direct flame and helps funnel the flame toward the target brick. On hitting the target brick, the flame is deflected upward and begins its path through the stack area. Target bricks are often offset which affects the path each flame takes through the kiln and promotes even firing throughout the stack area. The function of the stack is to create a draft for the flame, drawing it through the ware and downward to the flue. This draft commences either under the kiln floor or on the same level as the floor. In our kiln, it is achieved at floor level at the burner port. The flame passes through the flue (which is at floor level) and up the kiln stack (chimney). The chimney includes a damper opening about three or four feet above the floor. A kiln shelf inserted into this opening serves as the damper which can be moved to vary the size of the chimney available for the flame to pass through.

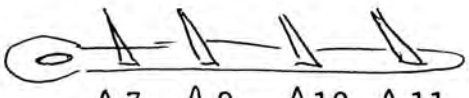
Three factors are manipulated to control the speed, atmosphere, and evenness of the firing: the gas pressure, available air, and damper placement.

GLAZE FIRING PREPARATION -- CONE 10 REDUCTION

CONE PACKS must be made for all of the spyholes of the kiln. Our high fire kiln has four: one far side, one near side, and two door. We use eight senior pyrometric cones for each spy divided between two cone packs as follows:



Δ012 Δ010 Δ1 Δ5



Δ7 Δ9 Δ10 Δ11

Δ012 serves as a warning cone that the kiln is nearing Δ010 which is the target cone for putting the kiln into reduction. Δ1, Δ5, and Δ7 serve primarily as information cones during a period when adjustments of gas, air, and damper can be made to affect evenness and speed of firing, and kiln atmosphere. Δ9 serves as a warning cone that the kiln is nearing Δ10 which is the target cone for the end of the firing. Δ11 serves as a safety cone to ensure that an area is not extremely overfired if other areas have not yet reached Δ10.

Clay (in the correct temperature range!) should be used to make the base of each cone pack in the form of a spoon. The bowl of the spoon should be about the size of a teaspoon and will serve to catch melted cones as they fall. Cones should be positioned in a straight row (like marching soldiers) so that they will fall into the spoon. Cones are manufactured to fall (bend) in a specific direction; although they are triangular, one side is slightly broader than the other two and the cone will fall in that direction. It is important that cones be positioned correctly in packs; giving them a slight angle toward the bowl of the spoon will <u>not</u> cause them to bend in that direction. It's a case where gravity cannot conquer design. Cone packs must be dry when the kiln is loaded, so they should be made several days in advance. As little clay as possible should be used without making the pack susceptible to breakage. Finally, the cones should be positioned fairly close together, without touching, to make the pack as short as possible so it can fit into small spaces in the kiln.

Kiln Wash and Shelves Kiln wash is composed of 50% kaolin and 50% silica (aka flint). It should be mixed with enough water to achieve the consistency of heavy cream, whitewash, or thin paint and should be stirred smooth (not lumpy). The kiln wash is applied with a brush to silicon carbide shelves to achieve an even coating about 1/8" thick. The kiln wash protects the shelves from glaze and cone pack runs and drips. A runny glaze which would fuse to a bare kiln shelf can be popped off of the kiln wash, usually taking some along with it. This also protects the piece because running glaze can often be ground off. In cases where the piece has fused to the shelf, the piece must be broken for removal. During the firing, the kiln wash remains porous but becomes brittle and often flakes up from the shelf. Before each firing, all loose kiln wash must be scraped from the shelves and glaze/cone drips scraped, ground, or chiseled off. All debris must also be removed from the

sides and back of the shelf. Then thin or bare areas of the shelf are touched up with new kiln wash. The entire shelf should not be re-washed as this causes an unnecessary build-up of wash which leads to flaking. The sides and bottom of the shelf are not washed.

Kiln Pack is also composed of 50/50 kaolin/silica, but it is mixed with water to achieve the consistency of workable clay. Kiln pack is used during kiln loading to level shelves as the layers are stacked.

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FIRING SCHEDULE - CONE 10 REDUCTION

-- Preheat for two hours with low gas and minimal air; spyholes and damper open; arch cracked open. This slowly brings ware up to colored heat and drives off trapped moisture.

-- At end of preheat, close spies and arch. Push damper in about half way. At half hour intervals, increase gas pressure and available air. At each interval, slightly push in damper to encourage even heat throughout the kiln. Maximum gas pressure (kiln on high) reached in five intervals.

-- Within one hour after kiln is on high, Δ012 and Δ010 should fall. When all Δ010's are down, push damper all the way in to begin reduction. If you have a cold spot, at least the Δ012 should be down there or the clay body will not reduce.

-- Keep kiln in heavy reduction for one hour.

-- At end of heavy reduction, pull damper out about 1/3 of way. Adjust gas/air mixture as necessary to achieve a slightly reducing atmosphere which will still allow the temperature to climb. Δ1

should fall about two hours out of heavy reduction. Δ5 about two hours after. Δ7 falls shortly thereafter. Use damper, gas, and air to achieve an even temperature.

-- Occasionally, a kiln will "race" or increase in temperature too rapidly which does not allow glazes time to mature. More often kilns will stall at a temperature and require adjustments to continue to climb. About an hour each should pass between Δ7,Δ9, and Δ10. If a cold spot lags behind, it is advantageous to allow more time between Δ9 and Δ10 to allow glazes a "soak" in which to work at the higher temperature. At the very least, Δ10 should have begun to move in a cold spot before the kiln is shut off. Underfired glazes will be dry and sometimes bubbly. Obversely, overfired glazes are often runny and may crawl, bubble or crystalize. Our class glazes have a fairly broad firing range and generally do well from Δ9 through Δ11; nonetheless, the margin for error is still narrow in our 55 cubic foot kiln.

-- At Δ10, push damper almost all the way in for fifteen minutes to enhance glaze reduction results.

-- At end of glaze reduction, pull damper all the way out for a two minute cleanup. This removes excess gas and carbon from the atmosphere which can cause glaze defects during cooling.

-- At end of cleanup, turn off main gas valve, secondary valves, close damper, close burner air openings, cover burner ports, be sure all spies and arch are closed.

-- No earlier than ten hours after the end of firing, cautiously remove spies, damper, and door bricks during a two day staggered cooling period. Rushing the cooling will result in stress cracks in the fired ware.

TEMPERATURES

Δ 012	1544	F
Δ 010	1634	F
Δ 1	2057	F
Δ 5	2156	F
Δ 7	2210	F
Δ 9	2282	F
Δ 10	2300	F
Δ 11	2345	F