

Vince Pitelka, 2016

Firing the ACC Downdraft Kiln

As you are getting to know any kiln always keep accurate kiln-logs in order to learn the kiln and its firing characteristics from one firing to the next so that you can build on your successes.

General Information

Type/Size: 40 cubic feet (stacking space), downdraft, forced-air (power burners)

Fuel Type and Line Pressure: Propane, 9" (WCI - water column inches)

Burner Type: two power burners, Ward Burner Systems model MB400, 440,000 BTU each

Construction: Sprung arch front-loader, 9" IFB walls, high-duty hardbrick in high-stress areas (floor, fireboxes, bag walls, flues, door jambs).

Gas Pressure at the Power Burners

This kiln is equipped with power burners capable of firing a kiln twice this size. The supply-line gas pressure on our indoor gas kilns is regulated down to 9", but that is more than is ever needed to fire this kiln. It is never necessary and potentially destructive to turn the gas pressure on this kiln above 6" on the WCI gauges on each burner.

After an appropriate overnight preheat with the main burners on, you can do a cone 10 high-firing in six or seven hours without turning the gas above 6" and it will give far better glaze results than could be achieved with a faster firing. There's no gain in attempting to fire this kiln faster.

Power burners of this type are equipped with inexpensive rheostat-type blower speed-controls that are inaccurate and unreliable, especially as they age. The solution is to simply set the rheostat on high and perform all adjustments of the primary air with the pivoting primary-air-shutters on the blower intake. Note that as soon as you turn the rheostat knob and it clicks on, it's set on high. Leave both rheostats on high for the duration of the firing, and do all primary air adjustments with the air shutters.

NOTE: Power burners are never perfectly matched, especially in terms of blower performance and WCI gauge readings. Your objective is to get the same sound and appearance of flame from both burners, rather than to mechanically duplicate the same settings. Each time you adjust a burner, observe the appearance and sound of the flame, and try to duplicate that on the second burner.

When working with low pressure gas burners, excessive noise generally indicates a cool, inefficient flame, where too much air is being introduced into the flame. A healthy gas flame should be fairly quiet. Except during overnight preheat (when we specifically want a cooler flame), if the burners sound especially noisy the shutters are probably open too far.

In initiating body reduction and partial reduction you will adjust the gas pressure, primary-air-shutter, and damper setting to alter the kiln atmosphere. The weather conditions and the configuration and tightness of stacking will affect each firing differently. After adjusting the burners and damper as indicated later in this handout, you may have to further adjust the damper

or the primary air shutters in order to get the atmosphere and back-pressure (desired flame at the spy-holes) that you want. It is important to realize that the instructions in this handout are generalized, and you may have to tweak the adjustments to achieve desired performance.

NOTE: in order for this kiln to fire evenly, the flue-opening in the bottom back of the kiln interior must draw primarily from beneath the bottom shelf. The bottom layer of shelves normally stays in place from firing-to-firing (unless they need cleaning and re-washing), and should be spaced one brick (4 1/2") off the kiln floor. Always leave the softbrick pieces in place beneath and behind the rear bottom shelf so that the flue draws mostly from under the bottom shelf. This helps to give more even draw from front to back.

For even firing, make sure that the first posts (between the bottom and second layer of shelves) are at least 4" tall, even if you are firing plates. Above that, the posts should be as short as possible to accommodate the wares with a minimum of 1/8" clearance above.

Burner Valves

The main burner valves (yellow handles) are a standard ball-type gas valves with 90 degrees of handle movement between full off and full on. Such gas valves are off when the handle is 90 degrees to the gas pipe, and full-on when parallel to the pipe. As mentioned earlier, you will only need to use a portion of the available gas pressure, so the handle will never approach full-on position. When adjusting the valve, move the handle carefully, because even a slight turn can mean a significant adjustment in gas delivery pressure and volume.

The Chimney and Damper

This kiln has a very tall chimney that produces powerful flue-draft and thus it is rarely necessary to open the damper more than 1 1/2" overall (3/4" on each side) at any point during the firing except during overnight preheat or oxidation cleanup (for the same reasons – to maintain a cooler flame). The damper on this kiln features horizontal sliding slabs on both sides of the chimney, and both slabs should be moved an equal amount whenever adjusting the damper. Note the vertical black line on the rear edge of each damper slab. When this line is flush with the surface of the chimney on both sides, the damper is completely closed. To open the damper 1", pull each slab out 1/2". Grasp the damper slab with both hands to adjust it, and ignore the cracks. They've been there for over twenty years.

Sometimes when the kiln has been sitting idle there can be a strong reverse draft of cool air coming down the chimney. As long as the blowers are set on high with the primary air shutters open during preheat, things will quickly start flowing properly in the chimney. During this period, make sure the spyhole plugs are in place so that the heat will fill the kiln and enter the chimney.

Controlling Kiln Atmosphere Before Body reduction

It is critically important to maintain a clean oxidizing or neutral atmosphere up until body reduction temperature to avoid trapping carbon and sulfur in the claybody and possibly causing carbon-coring and subsequent bloating. At the same time, after an overnight preheat we need to maintain some back pressure to ensure efficient heatwork and fuel economy. Before the kiln is well into red heat, the only indication of excessive reduction is the unpleasantly sweet, acrid smell of hot, unburnt hydrocarbon gases, primarily carbon monoxide. ***Do not ever bring your face close to the***

spyhole on a kiln that is firing or cooling. To check for reduction smell, remove the top spyhole plug, stand off to one side, wave a gloved hand in front of the spyhole towards your face, and sniff the gases. If the kiln is oxidizing, you will smell nothing, because no gases will be exiting the spyholes. If the atmosphere is neutral, there will be slight back pressure and the fumes at the spyhole will smell like a clean-burning gas stove. An oxidizing atmosphere is inefficient in this case because excessive cold air is being drawn into the kiln and useable heat is escaping up the chimney. If you smell nothing at the spyholes, close the damper a little at a time until you detect the smell of a healthy gas flame, like a gas stove, indicating a neutral atmosphere. If you smell reduction, open the damper by 1/8" increments until you get the clean neutral smell, and re-check to make sure that the gas pressure and primary-air-shutters are properly adjusted. ***NOTE: As you approach red heat, the fumes coming out of the spyholes are hot enough to burn you badly even if no visible flame is present. Please observe the precautions mentioned above, and keep your unprotected hands or face away from spyholes.***

Once you are well into red heat you'll be able to gauge kiln atmosphere by the flames at the spyholes. A very small blue flame at the top spyhole indicates a neutral atmosphere, which gives the most efficient heatwork and fuel economy. ***Make sure that there is no trace of reduction at any point before you initiate body reduction at the proper temperature.***

Reduction Glaze-Firing in the Downdraft

The downdraft kiln is specifically designed for reduction high-firing, and it is the best kiln we have for this purpose. It is easy to high-fire in this kiln, and far easier to achieve an even reduction atmosphere than in an updraft kiln. Reduction requires back-pressure within the kiln achieved by restricting the exhaust at the damper. An updraft kiln oxidizes easily, and it takes specific and precise adjustments of the burners and damper to make it reduce efficiently. A downdraft kiln reduces easily, and it takes specific and precise adjustments of the burners and damper to make it oxidize efficiently.

Cone Packs for a Cone 10 Firing

Cone packs for a cone-10 reduction firing normally include 012, 010, or 08 body reduction cones with melt-basin to catch the melting cone, a cone-9 warning cone, a cone-10 firing cone, and a cone-11 guard cone. If you include any additional low-temperature cones then the entire cone pack must be surrounded by a molded trough or placed in a shallow tray to catch the melting cones.

We generally use the term body reduction, but the objective of this early period of reduction may be glaze development rather than just creating speckles in the claybody. Carbon-trap shino glazes and copper reds benefit from starting reduction fairly early, and for those you should commence body reduction at cone 012. If your only objective is to develop iron blooms (speckles) in the claybody, start body reduction at cone-010 or 08. Be sure to consult the handout or text on making proper cone packs. Poorly-made cone packs can blow up and ruin your ware, while properly-made cone packs will never blow up, even if placed in the kiln freshly-made and heated quickly.

Place conepacks carefully on very stable arrangements of brick and/or kiln furniture, and ***make sure that you can see the entire conepack and the full height of every cone clearly through the spyhole with the door closed.*** You will need a flashlight to properly check conepack position. The

outcome of your firing depends on being able to clearly see the entire cone pack. Once your cone packs are in place, close and latch the door gently, making sure to place the shims behind the latch cams so that the door is pulled up against the face of the kiln. **DO NOT OVER-TIGHTEN THE LATCHES!** Just tighten until the door is snug.

Firing Schedule for Cone 10 Reduction Firing

Overnight Preheat

It is always best to do an overnight preheat with the main burners on very low, It heats the kiln, furniture, and ware gently at first, and ensures a reasonably short firing the following day. Be sure that no more than ten hours elapse between starting the overnight preheat and turning up the kiln the next morning, and be sure to set the burners exactly as described. Otherwise you risk heating the kiln excessively overnight.

- Put in the spy-hole plugs in order to trap the heat in the kiln so it will exit through the flue and warm up the chimney.
- Open the damper to 3" (1 ½" on each side)
- Open the primary air shutters ¼" and tighten the wing-nuts securely.
- Turn on the main power switch on the backside of the chimney. This turns on the draft-inducer fan above the kiln hood and opens the electromagnetic valves on the gas line.
- Make sure the burner valves are closed (handle 90 degrees to pipe).
- If the pilot valves are closed, turn the handle on each valve three full rotations counter-clockwise. No gas will come through until you energize the Baso valve as described below.
- Turn both blower rheostats to high. As mentioned earlier, note that as soon as you turn the knob and click the rheostat on, it is on high.
- On one burner, press down and hold the red button on the Baso valve and light the pilot with a torch. Hold the button down one minute and release. If the pilot goes out repeat this step.
- Repeat with the other burner to light the pilot.
- On each burner, open the main burner valve until the WCI gauge shows 2" of pressure, lightly tapping the gauge to make sure the needle is moving properly. The flame should make a muted roaring sound, indicating a cool (in relative terms) oxidizing flame. If the flame is set too low, it will repeatedly disappear and reappear, as it extinguishes and is re-lit by the pilot. If this is happening, turn the gas pressure up very slightly.
- After two hours, come back and check the burner flames and the settings, just to make sure that both burners are properly set. Make sure that the damper is open 3" (1 ½" on each side), the primary air shutters are set at ¼", and the WCI gauges read 2" of pressure, and that both flames are burning steady and stable without going out at all.

The Next Morning After a Preheat

- Close the damper to 1" (½" on each side).
- Leave gas at 2" and blower shutters at ¼".
- Wait for body reduction cone to drop (usually takes another hour or so).

It is imperative that the atmosphere remain neutral with absolutely no reduction until you reach body reduction temperature. Carefully check the spyholes for reduction by removing the spyhole plug, standing off to the side, and waving a gloved hand towards your face to smell the fumes.

Make sure that you can smell only the familiar odor of clean-burning gas. If you smell the sweet-acrid odor of reduction, open the damper by 1/8" increments until the reduction smell is gone.

Firing Without an Overnight Preheat

Firing with a preheat offers advantages mentioned above, but sometimes circumstances require omitting the overnight preheat. In that case, expect the firing to take ten to twelve hours from start to finish. If you fire without a preheat, make absolutely sure that your cone packs are properly made and thoroughly pierced with a needle tool. If the load includes a lot of freshly glazed ware or any re-fires, it is wise to still do a preheat as described above for several hours before turning the kiln up to the settings specified below.

To Fire Without a Preheat:

- Turn on the master switch on the back of the chimney.
- Put in both spyhole plugs.
- Turn on the blower rheostats to high.
- Light the pilots as described above.
- Open the damper to 3" (1 1/2" on each side).
- Set the burner shutters at 1/4".
- Open each burner valve to 2" on the WCI gauge. This will circulate warmth throughout the kiln and get the convection currents going in the chimney.

After One Hour at the Above Setting

- Close the damper to 1" (1/2" on each side).
- Keep the blower shutters at 1/4".
- Slowly open the gas valve on each burner until the WCI gauge reads 4".

Again, it is imperative that the atmosphere remain oxidizing with absolutely no reduction until you reach body reduction temperature. Carefully check the top spyhole for reduction as described above and adjust the damper accordingly.

Starting Body Reduction

With an overnight preheat it should take another hour or so to reach body reduction temperature. Without an overnight preheat it will take three or four hours. In this kiln, the body-reduction cone in the upper cone pack always bends first. ***When the upper body-reduction cone is touching:***

- Turn the gas up to 6" on both burners.
- Keep the primary air shutters at 1/4".
- Adjust the damper in until you get a good-sized blue flame at the top spyhole but little or no flame at the bottom spy hole. This will give you a partial reduction (climbing reduction), which allows the kiln to keep climbing but will begin body reduction in the upper part of the kiln where the temperature is higher.
- Keep checking every fifteen minutes, and as soon as the body-reduction cone starts bending in the bottom spy hole, put the kiln into reduction. Leave gas and shutter settings as they are, and adjust the damper in by 1/8" increments until you get a large orange-yellow flame at the top spyhole and a 3" to 6" flame at the bottom spyhole. While in body reduction, the damper will only be open about 1/4" to 1/2" (1/8 to 1/4" on each side).

Important! – Retaining Body Reduction Effects

In order to preserve the effects of body reduction on the claybody or glazes you must maintain a partial reduction beyond body reduction. ***All of the positive effects caused by a body reduction will be lost if you do not initiate and maintain a partial reduction while the kiln is climbing towards maturation temperature.***

After 60 Minutes of Body Reduction, Initiate Partial Reduction:

- Keep the gas at 6”.
- Open the primary air shutters all the way.
- Open damper by 1/8” increments until you get a 1” to 3” flame at the bottom spyhole. This should put the kiln in a gentle partial reduction (climbing reduction), and it should stay at that setting for the duration of the firing until the oxidation cleanup. The damper should be open about 3/4” (3/8” on each side)

If You are Not Doing a Body Reduction

- When the body reduction cone is touching in the top spy hole, turn the gas up to 6 WCI on both burners
- Open the primary air shutters all the way.
- Adjust the damper to get a 1” to 3” flame at the bottom spyhole. This should put the kiln in a gentle partial reduction, and it should stay at that setting for the duration of the firing until the oxidation cleanup.

Progression of the Firing

The time it takes to go from body reduction to glaze maturity depends on how tightly the kiln is stacked, the arrangement of shelves and wares, the outside temperature and humidity, careful attention to burner and damper adjustments, and your karma. It generally takes four to six hours from the end of body reduction to glaze maturation, but taking longer won't hurt anything except your social calendar, whereas trying to fire faster gives an uneven firing and uninteresting glazes.

When Cone 9 Starts to Bend; Dealing with Uneven Temperature

If cone 9 bends evenly top and bottom, leave things alone. If it starts to bend on the bottom first, close the damper slightly to give more back pressure, which will push more heat to the top. If it starts to bend on top first, open the damper slightly to pull more heat to the bottom. At this temperature it will not matter if reduction ceases when you open the damper slightly.

Glaze Maturation – Give It Time!

The period from cone 9 bending until cone 10 down is very important for maturation of the glazes and should not proceed too quickly. Allow at least one full hour, and preferably 90 minutes to two hours. You do not want to hold the kiln at cone 10 for very long, because you risk flowing glazes and slumping wares. The solution is to slow down the firing throughout the falling of cones 9 and 10. If the firing seems to be progressing too quickly at this point, cut back the gas pressure slightly, but always readjust the damper to ensure partial reduction with a 1” to 3” flame at the bottom spyhole (unless trying to even out the temperature as described above).

What if the Cones are Uneven at the Conclusion of the Firing?

Cone-11 touching at the top and cone 10 partway down at the bottom is acceptable, but you should always try to even things out as you approach target temperature. If you make the adjustments described above to even out the temperature when cone 9 starts bending, you should be able to get things pretty equal top-to-bottom. Even if things are uneven, never fire the kiln beyond cone-11 touching in either cone pack. If you push it beyond that point glazes will start to flow and ware will start to warp. It is better to have underfired work than overfired work, because underfired work can be refired.

Oxidation Cleanup

At the end of a reduction firing, a soaking period of ***oxidation cleanup*** will brighten the glazes, encourage reoxidation and thus color-breaking, and help to heal surface flaws left from the inevitable outgassing that occurs with reduction firing. During oxidation cleanup the kiln is put in an oxidation atmosphere and held near maturation temperature for fifteen minutes to a half hour before shutting down. ***To initiate oxidation cleanup:***

- Open the damper to approximately 1 ½" (¾" on each side).
- Close the blower shutters to ¾".
- Decrease the gas pressure to 2" on the WCI gauges.

Even fifteen minutes of oxidation cleanup will help, but for the shiniest, brightest glazes do a half-hour soak. This will have no adverse affect on body-reduction effects or on reduced glazes wherever the glaze coating is thicker, but will reoxidize unglazed and thinly-glazed areas, encouraging color-breaking in the glazes and a warmer tone on unglazed clay areas.

Shutting Down the kiln - At the conclusion of oxidation cleanup:

- Close the burner valves so that the handles are 90 degrees to the pipe.
- Close the damper all the way.
- Turn off the blower rheostats.
- Close the pilot valves.
- In hot weather leave the draft-inducer fan on. In cold weather shut it off.
- After two to four hours, open the damper 6" (3" on each side)

Cooling the Kiln

The desirable crystals that produce visual and actual texture and variety in many glazes form during the cooling ramp from 1900 down to 1700 degrees Fahrenheit, and it helps to cool slowly through this ***zone of crystallization***. At the same time, it is not desirable to slow-cool from cone-10 down to 1900 degrees because it promotes formation of undesirable cristobalite crystals. Fortunately, in a large kiln like this one both situations take care of themselves with no special accommodations. At cone-10 temperatures, heat tends to dissipate very quickly, so you can safely close the damper right away upon finishing the oxidation soak and shutting down the kiln. It will cool very quickly initially and then more slowly as cooling proceeds. For best glaze results keep the damper closed for the first two to four hours of cooling, and then open it 6" to encourage a reasonable cooling rate. If you have to leave immediately after shutting down the kiln and no one else is available to open the damper later, it won't hurt to leave the damper closed overnight, but it will take a lot longer until the kiln is ready to open in the morning.

When to Open the Door – the Paper Char Test

When all red heat is gone open the damper and crack the door one inch, but do not open it farther without checking the temperature. To do so, make a paper twist and insert it in the top spyhole. If it flames, chars, or even discolors, then the kiln is still too hot to open further, and should be left with the damper open and the door at one inch for another few hours. Once the paper twist does not char or discolor at all, the kiln is below 451 Fahrenheit, you can open the door in increments over an hour to ensure that the ware is not subjected to excessive thermal shock. This is especially important with large pieces, particularly those with broad, flat planes.

Cleanup

Chip off any wadding on posts or shelves. Return all bricks, shelves, posts, and other furniture to their designated storage places. Chip or grind any glaze runs from posts and shelves, and rewash any shelves or post-ends that need it. Clean up all debris from inside the kiln (***including the flame channels***) and from the floor around the kiln.