FIRING TIPS

Here are a few tips when considering a firing schedule and potential adjustments to it:

Choosing a Firing Schedule:

Our Firing Guidelines assume relatively simple shapes and thicknesses, and fairly simple or co-mingled color patterns. There are many good reasons for deviating from standard firing tables. Listed below are the most common reasons, and considerations when choosing your firing schedule.

A. This group of difficult firing or design conditions requires choosing a schedule that doubles the firing time. This slows down the ramp rates to adjust for these issues. Do this by doubling the actual finished thickness of the work for an 'assumed' thickness. For example, if the maximum thickness of the fired piece is planned to be 1½" (38mm) and any of the conditions below exists, choose the 3" (76mm) thick firing schedule.

- **Extreme thickness variations:** When the maximum thickness of the design is more than twice the thinnest.
- **Very irregular edges:** When the edges of the work are wavy, inconsistent, have long tapered points, or holes and openings exist.
- **Uneven load on previously fired slab:** When frit or other components are mounded on top of a prefired slab.
- **Your kiln only has top elements** and your design is 1" (25mm) thick. Note: we don't recommend this.

B. This group of firing or design conditions requires choosing a schedule that provides a 50% increase in the firing time. This slows down the ramp rates to adjust for these issues. Do this by adding 50% to the actual finished thickness of the work for an 'assumed' thickness. For example, if the maximum thickness of the fired piece is planned to be 1" (25mm) and any of the conditions below exists, choose the 1½" (38mm) thick firing schedule.

- **Very full kiln:** If the kiln is very full and air circulation area between the work and the walls is limited.
- **Heavy molds:** Thick, heavy molds insulate the glass from the kiln temperature during heating and cooling. When firing in molds 2" thick or more, especially dense ones such as plaster, ramp rates need to be slowed to compensate.
- **Strong color variations:** For work containing strong colors or extreme color variation (such as a checkerboard pattern).

Bubble Management:

If you want to minimize bubbles: Add a 30-120 minute soak step during heat up at 1050°F (566°C). Then ramp up slowly to the 1250°F (677°C) soak. These soaks and the slow up-ramp through the slumping range allows time for the heat to penetrate to the interior of the work, preventing the outer edges from melting and sealing up before the air escapes. The larger the work, the more important this step becomes.

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To decrease bubble rise and limit open bubbles at the top surface: Speed up the ramp-up rate from 1250°F (677°C) to peak temperature. Any trapped bubbles won't have time to rise as far. If your mold features are filling OK you can also decrease the soak time at peak temperature and/or decrease the peak temperature itself.

Devitrification Management:

To decrease devitrification and scummy surfaces vent your kiln up to 800°F (427°C) to insure the kiln atmosphere is clean. Dirty kiln air leaves deposits on the heating glass surfaces. Venting is vital when using plaster based molds, new fiber paper or other unfired mold materials. Be sure to close the vents before 1000°F (538°C), then speed up the ramp-up rate from 1250°F (677°C) to peak temp. The less time spent between 1250°F (677°C) and your peak temperature, the less devit and scum can develop.

When speed is important:

Increasing speed from these firing schedules is certainly possible in certain situations, such as faster heat ups for first firings of frit, for very small objects – under 6 in (152 mm) diameter - or for single color/consistent thickness/smooth edged shapes. The best procedure is to use caution when shaving time off any ramp: take small sequential steps, and test for success before investing a lot of time or materials into a final piece.

Measure temperature differentials between the immediate top and bottom of the work during annealing and cooling to determine the maximum ramp rate for your conditions. Imbed a thermocouple in the mold under the glass if necessary. A good rule of thumb is that there should be less than 10°F (5.5°C) differential between top and bottom of the glass during annealing and less than 20°F (11°C) differential during cooling ramps. If you measure bigger differentials, use slower ramp rates. Richard Whiteley's article and sketches on this topic in the 2008 GAS Journal are very helpful.

Drying plaster molds in your kiln:

Pre-dry your empty molds by ramping a vented kiln slowly to 200°F (93°C), holding then continuing ramp to 600°F (316°C) and hold there until air coming from the vent(s) stops being damp. This drives out the both the liquid and bonded moisture along with the contaminants it contains, and will keep your kiln atmosphere cleaner. This will minimize surface scum on the glass. If you must dry molds during a glass firing vent the kiln and add a soak to your up-ramp at 200°F (93°C). Continue to vent the kiln until mold is dry, at least until 600°F (316°C), at most until 800°F (427°C). Larger molds require slower ramps and longer hold times to get them dry.

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