



Firing Guide

A basic guide to kiln-firing System 96® products

These pages contain guidelines for Fusing and Slumping 12-inch (30cm) projects of various thicknesses, using the System 96 family of Tested-Compatible products. These are guidelines, not strict rules. Times and temperatures will vary with equipment and project size. We've also included an instructive Forming Stages chart, basic technical data and other information to assist you in understanding how System 96 products behave during the kilnforming process. Check system96.com for more detailed information on firing larger projects.

For 4-segment firing: Eliminate Segments 2 and 6 by simply continuing your Segment 1 rate to fusing or slumping temperature. Stop firing after Segment 5, allowing your kiln to cool at its natural rate (door closed, power off) to room temperature.

FAHRENHEIT	Segment	Thickness	Rate	Temp	Hold
		(inches)	(°F per hour)	°F	Minutes
FUSING Project size: 12-inches	1. Heating I	1/8	500	1000	0
	Heat from room temp to softening temp	1/4	400		
		3/8	300		
	2. Heating II	1/8	1000	1465	Desired effect
	Heat to fusing temp	1/4			
		3/8			
	3. Cool to Anneal	1/8	As fast as possible	1000	5
	Cool down to anneal zone and equalize kiln temp	1/4			8
		3/8			10
	4. Anneal I	1/8	600	960	10
	Ease down to anneal point and hold	1/4	300		20
		3/8	200		40
	5. Anneal II	1/8	300	800	0
	Slow Cool through strain zone	1/4	200		
		3/8	100		
	6. Cool Down	1/8	800	120	0
	To room temperature	1/4	400		
		3/8	300		

Technical Data	Strain Point*	Anneal Point*	Softening Point
Fahrenheit:	890 (+/- 10)	955 (+/- 10)	1255 (+/- 10)
Celsius:	476 (+/- 12)	513 (+/- 12)	680 (+/- 12)

* At the Anneal Point of a glass, internal stresses are largely relieved in a matter of minutes. At the Strain Point, internal stresses are substantially relieved in a matter of hours.

Segment	Thickness	Rate	Temp	Hold
	(inches)	(°F per hour)	°F	Minutes
1. Heating I	1/8	500	1000	0
Heat from room temp to softening temp	1/4	400		
	3/8	300		
2. Heating II	1/8	1200	1225	Desired effect
Heat to fusing temp	1/4			
	3/8			
3. Cool to Anneal	1/8	As fast as possible	1000	5
Cool down to anneal zone and equalize kiln temp	1/4			8
	3/8			10
4. Anneal I	1/8	600	960	10
Ease down to anneal point and hold	1/4	300		20
	3/8	200		40
5. Anneal II	1/8	300	800	0
Slow Cool through strain zone	1/4	200		
	3/8	100		
6. Cool Down	1/8	800	120	0
To room temperature	1/4	400		
	3/8	300		

FAHRENHEIT

SLUMPING Project size: 12-inches

Annealing	Simple Advice for Thorough Annealing
	<p>Different colors have different “ideal” annealing temperatures. Generally, opals tend to anneal best several degrees lower than transparents, and hot colors (reds & oranges) are best annealed lower than opals. Most all of System 96 glasses have ideal annealing temperatures between 965°F (518C) and 940°F (504C).</p> <p>Annealing will still occur if you hold 20-30° above or below the ideal temperature; it just takes more time. The further away you are from the “ideal” temperature, the longer it takes to get a good anneal. If you hold at a temperature which is <i>too far</i> away from the ideal anneal temperature (say, 40° or more) you may never sufficiently relieve the internal stresses. It is also important to ramp slowly down from the anneal point to the strain point. If the temperature throughout the project is not very similar, it is possible to create permanent stress.</p> <p>To assure a good anneal, we recommend holding at 960°F (516C), then slowly ramp down (around 150° per hour) to 800°F (513C) Holding time and ramp speed depend on how big and thick your project is. Refer to Firing Schedules for guidelines.</p>

Bubble Squeeze	Guidelines for Controlling Bubbles
	<p>If you're seeking to reduce or eliminate bubbles, try slowing the rate of heating in Segment #2 (Heating II). Inserting a half-hour soak at around 1220° F (660°C) may also help, allowing added time for air to escape from between glass pieces before the edges seal and trap it in the form of bubbles. For large projects, experiment with a “ramp squeeze,” a very slow ramp to tack temperatures, say 60° per hour from 1100-1300°F (590-704°C). If your project has a clear base, consider using our “Double Thick” clear instead of two layers of regular clear. You can't trap air where there isn't a space.</p>

CELSIUS

FUSING Project size: 30-centimeters

Segment	Thickness	Rate	Temp	Hold
	(mm)	(°C per hour)	°C	Minutes
1. Heating I	3	260	540	0
Heat from room temp to softening temp	6	200		
	9	150		
2. Heating II	3	540	800	Desired effect
Heat to fusing temp	6			
	9			
3. Cool to Anneal	3	As fast as possible	540	5
Cool down to anneal zone and equalize kiln temp	6			8
	9			10
4. Anneal I	3	315	513	10
Ease down to anneal point and hold	6	150		20
	9	90		40
5. Anneal II	3	150	430	0
Slow Cool through strain zone	6	90		
	9	40		
6. Cool Down	3	425	45	0
To room temperature	6	200		
	9	150		

CELSIUS

SLUMPING Project size: 30-centimeters

Segment	Thickness	Rate	Temp	Hold
	(mm)	(°C per hour)	°C	Minutes
1. Heating I	3	260	540	0
Heat from room temp to softening temp	6	200		
	9	150		
2. Heating II	3	650	665	Desired effect
Heat to fusing temp	6			
	9			
3. Cool to Anneal	3	As fast as possible	540	5
Cool down to anneal zone and equalize kiln temp	6			8
	9			10
4. Anneal I	3	315	513	10
Ease down to anneal point and hold	6	150		20
	9	90		40
5. Anneal II	3	150	430	0
Slow Cool through strain zone	6	90		
	9	40		
6. Cool Down	3	425	45	0
To room temperature	6	200		
	9	150		

Forming Stage Diagrams

(2 layers of glass in cross section)



Tack Fuse

1300° F (700° C)



Dimensional Surface

1400-1440° F (760°-780° C)



Full Fuse

1475° F (904° C)

Forming Stages information is provided to help users understand the melting characteristics of System 96 products. The temperatures provided are estimates for common kilns firing a project about 12-inches (30 cm) diameter or square, consisting of two full glass layers and a third design layer (fired thickness about 1/4-inch (6mm)).

Use these guidelines as a starting place, then make adjustments to obtain the desired results for your specific project using your unique equipment.

Forming Stage	Definition	Temperature
Slump	Previously fused project softens and slumps to take the shape of a selected form or mold.	1225° – 1250° F (660° – 675° C)
Tack Fuse	Separate Glass layers are fused together with little deformation beyond softening or rounding of edges.	1300° F (700° C)
Dimensional Surface	Separate Glass layers are fused together, edges are soft and rounded, project surface retains a degree of dimension desired by the artist. (any degree beyond Tack but not Full fused)	1400° – 1440° F (760° – 780° C)
Full Fuse	Separate Glass layers are completely conjoined into a single uniform layer, top surface is smooth and void of dimension or relief.	1475° F (800° C)
Combing	Recommended temperature for a 3/8-inch combing.	1660° F (904° C)

New to System 96?

What to Expect if You're Used to "90" COE

If you're used to using "90" glasses, note that our recommended temperature curves are slightly different. For most projects you can use the identical firing cycle for System 96 as you would use for the same project made with a "90" COE product, and see little or no differences in the result. Test, and make adjustments as you like.

Technical Support

Answers, Advice & Assistance

System 96 is the most "fuser friendly" glass ever made. It's easy to cut, exceptionally stable and predictable through the firing cycle, and remarkably consistent from run to run. Still, kilncraft is a many faceted endeavor and there are always questions, concerns and curiosities. The System 96 web site is your first stop (**System96.com**). We maintain a "Common Questions" page as well as a System 96 *Knowledge Base* where issues and concerns are posted, along with our ideas, advice and suggestions. We also recommend the bulletin board at www.warmglass.com. There you'll find a wealth of information as well as a ready group of experienced hot glass artists who are eager to share their knowledge. Still stuck? If the problem is specific to System 96, send us an email at hotglass@system96.com. We'll do everything we can to help.

The Partnership

System 96 is a family of products made by different companies and tested to an identical standard. Spectrum Glass Company and Uroboros Glass Studios are the primary partners. Coatings by Sandberg (CBS) is the licensed manufacturer of System 96 Dichroic glass products. System 96 products undergo three rigorous test firings before receiving their "Tested" label. Each firing result is measured for color-shift, opacification, devitrification and C.O.E. change. The red System 96 triangle logo is your assurance that a glass has been "Tested Compatible" within the System 96 family.

