Firing Guide Celsius

Firing Schedules:	Guidelines for FUSING and SLUMPING 12-inch projects of various thicknesses. These are guidelines, not strict rules. Times and temperatures will vary with equipment and project size.
Technical Data:	Strain Point, Annealing Point, Softening Point
Firing Stages:	Forming stages, definitions, and temperatures for firing System 96 products.
Bubble Squeeze:	Adding a stage during firing to reduce or eliminate bubbles
Annealing:	Simple advice for thorough annealing
4-Segment Firing:	How to easily adapt our 6-segment programs to 4-segment controllers

Fusing	For FUSING and annealing 30-cm projects, of various thicknesses.						
Segment	**Thickness** (mm)	**Rate** (°C per Hour)	**Temp** °C	**Hold** (minutes)		**Step Time** (minutes)	**Elapsed Time** (hours)
1. Heating I:	3	315	540	0		75	1.2
(Heat from room temp to softening temp)	6	200				120	1.9
	9	150				180	3.0
2. Heating II:	3	1100	800	Desired Effect		25	1.6
(Heat to fusing temp)	6						2.3
	9						3.4

3. Cool to Anneal:	3	AFAP *	540	5		15	1.9
(Cool down to anneal zone & equalize kiln temp)	6			8		20	2.7
	9			10		25	3.8
4. Anneal I:	3	315	513	10		20	2.3
(Ease down to anneal point & hold)	6	150		20		35	3.3
	9	90		40		55	4.8
5. Anneal II:	3	200	430	0		20	2.6
(Cool to below strain point)	6	90				50	4.1
	9	65				60	5.8
6. Cool Down:	3	425	45	0		60	3.6
(To room temperature)	6	200				120	6.1
	9	150				170	8.7

* As Fast As Possible.

Slumping	**For SLUMPING and annealing 12-inch projects, of various thicknesses.**

Segment	Thickness (mm)	Rate (°C per Hour)	Temp °C	Hold (minutes)		Step Time (minutes)	Elapsed Time (hours)
1. Heating I:	3	315	540	0		75	1.2
(Heat from room temp to softening temp)	6	200				120	1.9
	9	150				180	3.0
2. Heating II:	3	650	665	Desired Effect		15	1.5
(Heat to fusing temp)	6						2.2
	9						3.3
3. Cool to Anneal:	3	AFAP*	540	5		15	1.8
(Cool down to anneal zone & equalize kiln temp)	6			8		20	2.5
	9			10		25	3.7
4. Anneal I:	3	315	513	10		20	2.1
(Ease down to anneal point & hold)	6	150		20		35	3.1
	9	90		40		55	4.6
5. Anneal II:	3	200	430	0		20	2.5
(Cool to below strain point)	6	90				50	4.0
	9	65				60	5.6
6. Cool Down:	3	425	45	0		60	3.5
(To room temperature)	6	200				120	6.0
	9	150				170	8.5

* As Fast As Possible.							

Slumping Cycle Graphs:	3mm	6mm	9mm	Overlay

4-Segment Firing

Our firing charts are organized in 6 segments. For 4-segment firing, eliminate segments 2 and 6, as follows:

Continue your Segment 1 Rate to fusing or slumping temperature. Then, Stop firing after Segment 5, allowing your kiln to cool at its natural rate, door closed, power off, to room temperature.

Annealing

Simple Advice for Thorough Annealing

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).

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 too far 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.

To assure a good anneal, we recommend holding at 955°F (540C), 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.

Bubble Squeeze	Guidelines for Controlling Bubbles
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(660C) 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 up from softening to tack temperatures, say 60° per hour from 1100-1300°F (590-704C). 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.	

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

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

© 2002 Spectrum Glass Company, Inc. PO Box 646 Woodinville, WA 98072 USA Phone: 425-483-6699 Fax: 425-483-9007 E-mail: Hotglass@ System 96.com