System 96 Tips & Tutorials - Firing Cycles Continued

Forming Chart	Definition	Forming Temp
Slump	Glass softens and slumps to take the shape of a selected form or mold. Note: small molds may need higher temperatures and/or hold times.	657°- 677° C
Tack Fuse	Separate glass layers are fused together with little deformation beyond softening of edges.	732°- 743° C
Contour Fuse	Separate glass layers are fused together, edges are soft and rounded, project surface retains the degree of dimesion desired by the artist (any degree beyond Tack but not yet Full fused).	760°-788° C
Full Fuse	Separate glass layers are completely fused into a single uniform layer, top surface is smooth and void of dimension or relief.	793°-804° C

Bubble Squeeze	To Reduce Bubbles Between Glass Layers

To reduce bubbles between glass layers, fire to encourage a very slow relaxing of the layers, "squeezing" air outward to the edges for release. As the fusing chart indicates, we recommend a lengthy hold at about 566° C, then a slow ramp up to 677° C. Increase the effectiveness of your "squeeze" by lengthening your Hold in Segment I and slowing your Rate in Segment 2.

Note: bubbles are best avoided in the design stage. Large areas of uninterrupted layering invite them. For example, a 10 x 10-inch sheet atop another 10 x 10-inch sheet leaves no easy avenue of escape for the air between glass layers. Alternately, a 10 x 10-inch sheet topped with four 5 x 5-inch pieces provides seams to vent trapped air. Design to avoid bubbles for the best prevention.

Below is our Advanced Full Fuse Firing Schedule with ranges included for a Bubble Squeeze. ***As with any firing schedule, you will need to adjust the schedule based on your kiln, and the requirements of your particular project.***

Advanced 8-Segment FULL FUSE Schedule (For projects up to 9mm thick)			
Segment	**Rate** (°C per Hour)	**Temp** °C	**Hold** (minutes)
1. Heating I: Initial heat from room temperature. Holding here allows the glass to fully accept a moderate amount of heat before ramping up.	139	121	30
2. Heating II: Moderate ramp past thermal shock danger, then hold to allow softened glass time to relax before edges seal together. (Add more time here if necessary.)	139	566	30-60
3. Heating III: Slowing the ramp speed here + lengthening the hold provides more time for bubbles to find an avenue out. Modify this segment even further if necessary.	56-139	677	10-30
4. Heating IV: The hold here gives the glass layers time to settle together before rising to the forming temperature.	139	732-743	20
5. Heat to Forming Stage: Moderate ramp to forming temperature.	167	796	10
6. Anneal I: Ramp down as fast as possible, then hold to thoroughly equalize temperatures.	Fast as possible	510	60
7. Anneal II: Slow cool through sensitive zone, then hold to equalize.	111	427	10
8. Cool Down: Moderate ramp down to minimize thermal shock.	167	38	0

System 96 Tips & Tutorials - Firing Cycles For Thicker Projects

1/2 -inch Thick			
Step	Rate (per hour)	Target Temp.	Hold (minutes)
1	56	150	15
2	139	570	10
3	*variable	815	desired effect
4	as fast as possible	510	90
5	56	425	10
6	167	40	0

*This rate varies based on what you want to accomplish. For instance, heat faster to fire polish, slower to minimize air bubbles.

1 -inch Thick			
Step	Rate (per hour)	Target Temp.	Hold (minutes)
1	56	150	15
2	111	315	15
3	167	570	15
4	*variable	815	desired effect
5	as fast as possible	510	120
6	17	425	15
7	28	370	10
8	139	40	0

*This rate varies based on what you want to accomplish. For instance, heat faster to fire polish, slower to minimize air bubbles.

1.5 -inch Thick			
Step	Rate (per hour)	Target Temp.	Hold (minutes)
1	56	150	25
2	111	315	25
3	167	570	20
4	*variable	815	desired effect
5	as fast as possible	510	180
6	7	425	15
7	13	370	10
8	67	40	0

*This rate varies based on what you want to accomplish. For instance, heat faster to fire polish, slower to minimize air bubbles.

2 -inch Thick			
Step	Rate (per hour)	Target Temp.	Hold (minutes)
1	56	150	40
2	111	315	40
3	167	570	30
4	*variable	815	desired effect
5	as fast as possible	510	240
6	4	425	30
7	9	370	30
8	36	40	0

*This rate varies based on what you want to accomplish. For instance, heat faster to fire polish, slower to minimize air bubbles.

System 96 Tips & Tutorials - How to get a “Tack” or “Full” fuse

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.

Temperatures are given in degrees **Celsius**. Need Fahrenheit?

Forming Stage Diagrams (2 pieces of glass in cross-section)		
		
Tack Fuse	Contour Fuse	Full Fuse
732º- 743º	760º - 788º	793º - 804º

DESCRIPTION	BEHAVIOR	
Slump	Previously fused project softens and slumps to take the shape of a selected form or mold.	660º-675º
Tack Fuse	Separate glass layers are fused together with little deformation beyond softening or rounding of edges.	700
Contour Fuse	Separate glass layers are fused together, edges are soft and rounded, project surface retains a degree of dimesion desired by the artist. (Any degree beyond Tack but not Full fused.)	760º-780º
Full Fuse	Separate glass layers are completely conjoined into a single uniform layer, top surface is smooth and void of dimension or relief.	800º
Combing	Recommended temperature for a 3/8-inch thick combing.	904º

Technical Data	Strain Point*	Anneal Point*	Softening Point
Fahreneheit:	890 (+/- 10)	955 (+/- 10)	1255(+/- 10)
Celsius:	476 (+/- 6)	513 (+/- 6)	680 (+/- 6)
At the 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.			