Enhancing the Color of Life ***Together***

The Compatibility of Glass

By Brandon Byhre, *Executive Vice President, Operations at Oceanside Glass & Tile®*

There is a misconception within the art glass industry that the compatibility of two glasses is solely dependent on the Coefficient of Expansion (COE). What is the COE? is a frequently asked question. The assumption is that the numerical value will determine if two glasses are compatible. That would be a false assumption, matching COE's is not an indicator of compatibility. The viscosity characteristics of any glass need to be considered when determining whether two glasses will be compatible with each other.

The *expansion* of a glass can be calculated through chemical composition or measured over a given temperature range (20C to 400C) using a dilatometer. It is common practice to formulate different glasses to have different, mismatched COE's, to cancel out their potential differences in viscosity curves resulting in compensating differences which leads to the different formulas being compatible when put through the full fusing, blowing, casting, or combing temperature ranges.

The viscosity of a glass can also be determined by calculation using the chemical composition or it can also be measured. To determine the viscosity curve, we need to measure all the points that make up the curve within the full temperature range. These points are listed below:

- Melting Point
- Working Point
- Flow Point
- Littleton Softening Point
- Dilatometric Softening Point
- Deformation Point
- Glass Transition Temperature
- Annealing Point
- Strain Point

The only real test to determine compatibility is through understanding the *chemistry* of the glasses and testing their compatibility through a *chip test* or *butt test*. These tests are fully fused up to 1500C for 15 minutes, then cooled and annealed appropriately. The stress between the two glasses is then measured using a Polarimeter. It is important to ensure the measured retardation between two glasses is kept low for them to be compatible. A measure of +/- 35 nm/cm or less is recommended for two glasses to be compatible.

At Oceanside Glass & Tile® we refer to our compatible product line as "Oceanside Compatible™." It is common to inquire about the COE in order to predict whether or not our product will fit with another manufacturers glass product, however, COE will not determine "fit." It is important to note that we test primarily our own products for compatibility. Oceanside Compatible™ products are carefully formulated and measured to ensure all products will "fit" when used together in hot glass applications.

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I am not aware of any glass manufacturers that test their own glass against other manufacturer's glass for compatibility. Given the sheer number of glass colors and chemical composition variation it would be almost impossible and impractical to even attempt it. There was a time in Spectrum's history that several manufacturers got together to attempt a universal test, however, it was discovered that the vast difference in process and glass composition was preventative to achieving any viable results. With all that said, there can be compatibility across different glasses, however, it is up to the user to test appropriately for that compatibility.

Here is a link to our resources page - https://oceansidecompatible.com/pages/resources - where you can find various information to help with different techniques. Stay tuned for more glass blowing resources, for now please see annealing guidelines here - https://oceansidecompatible.com/pages/glass-blowing-nuggets.

oceanside GLASS & TILE®

Oceanside Compatible ™ Studio Nuggets ® Annealing Guidelines:
1/2"-8" (12mm - 203mm)

Annealing & Cooling

	Step 1		Step 2		Step 3		Step 4	
Target Temps	966 ° F 519 ° C		775 ° F 413 ° C		600 ° F 316 ° C		100 ° F 38 ° C	
Maximum Thickness	Ramp Rate (per hour)	Hold (minutes)	Ramp Rate (per hour)	Hold (minutes)	Ramp Rate (per hour)	Hold (minutes)	Ramp Rate (per hour)	Hold (minutes)
1/2" 12 mm	None	120	100 ° F 55 ° C	10	200 ° F 111 ° C	10	250 ° F 139 ° C	0
3/4" 19 mm	None	180	50 ° F 28 ° C	10	100 ° F 55 ° C	10	200 ° F 111 ° C	0
1" 25 mm	None	240	25 ° F 14 ° C	10	45 ° F 25 ° C	10	150 ° F 83 ° C	0
1.5" 38 mm	None	360	12 ° F 6.7 ° C	45	24 ° F 13 ° C	10	75 ° F 42 ° C	0
2" 51 mm	None	480	7° F 3.9 ° C	60	14 ° F 7.8 ° C	10	42 ° F 23 ° C	0
3" 76 mm	None	720	3° F 1.7 ° C	120	5.4 ° F 3.1 ° C	30	18 ° F 10 ° C	0
4" 102 mm	None	960	1.5 ° F 0.8 ° C	300	3° F 1.7 ° C	45	9° F 5° C	0
5" 127 mm	None	1200	1.2 ° F 0.7 ° C	375	2.4 ° F 1.3 ° C	60	7.2 ° F 4° C	0
6" 152 mm	None	1440	0.8 ° F 0.4 ° C	450	1.3 ° F 0.76 ° C	150	4.5 ° F 2.5 ° C	0
7" 178 mm	None	1680	0.6 ° F 0.3 ° C	525	1.0 ° F 0.58 ° C	225	3.4 ° F 1.9 ° C	0
8" 203 mm	None	1920	0.4 ° F 0.2 ° C	600	0.76 ° F 0.42 ° C	300	2.4 ° F 1.3 ° C	0

Technical Data	
Strain Point	898 °F 481 °C
Anneal Point	966 °F 519 °C
Softening Point	1270 °F 688 °C

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