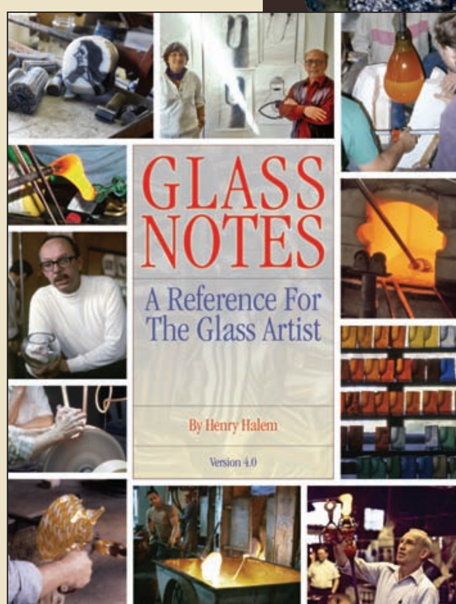
Glasscaster with Marcie Davis
Henry Halem and the Limits of COE

Below are excerpts from a Glasscaster interview featuring hot glass artist, Henry Halem. Glasscaster podcasts feature "hot glass talk in a high tech world." The series, hosted by Marcie Davis, can be found at www.fireladyproductions.com or on iTunes.

Glass Art by Henry Halem

I was always under the impression, Henry, that if you want to figure out if glasses are compatible with one another that you needed to look at nothing more than the COE. Lately, though, people whom I respect have said that COE is just one indicator for compatibility—sometimes the least reliable one. They all said I needed to talk to you about the limits of what coefficient of expansion is, how it works with viscosity, and how we find our way.



Linear expansion coefficient and COE are one and the same, and there are different scales of linear expansion. All you need to know is the first number, which is the big number. Every constituent of a batch has a specific number attached to it as far as its expansion value is concerned. When the glass is hot, it expands a certain amount, and when it cools down, it contracts. That's generally what people know. But it can be misleading, because there's this other factor that has to do with viscosity—where at a certain temperature the glass has a degree of liquidity.

If you have two glasses that have an expansion of 96, most people think they'll fit together. They may have different viscosities, however, which means that their softening point is different. One may begin to soften at 940ºF, and the other glass may soften at 980ºF. That translates to different annealing temperatures, because we know when we establish annealing temperatures, they're based upon the softening point of the glass. We subtract approximately 50ºF from the softening point to determine the high-end annealing temperature. If we have one glass that softens at 960ºF, then 910ºF becomes the annealing temperature. If we have another glass that softens at 900ºF, then its annealing temperature is 850ºF. But they may both have an expansion of 96.

The Lauscha glass that I'm importing now, which is 104 COE compatible, has probably a ten-point spread within its own line from color to color, based on the metallic oxides and other coloring agents in the glass. In Lauscha, they put all of these glasses together, and they all stay together without annealing. I've found with a few colors that if I don't anneal them, they stay together perfectly. But when I do what's "the right thing" and anneal them, the piece breaks.

I'm assuming that the tension of the glasses is what's holding the piece together, and when you anneal them, they're getting farther apart in relationship and you've built in a more severe strain.

Beginners tend to work things a longer period of time to get the job done, and sometimes when people work two glasses together a long time, they don't work well.

Basically you're talking about cadmium-selenium glasses. Red and yellow glass are very, very touchy in relationship to how long and at what temperature you work them, because they're not metallic oxides. They're in what we call the selenide area. What's happening is that their vapor pressure is a very, very low temperature, and the cadmium and selenium are "gassing off." As you're working it, the expansion is changing. If you're making a red bead and you are working it for, say, fifteen to twenty minutes in a very hot flame and then you take the same red glass from the rod that you've had and use some fresh red glass, after you've worked it for an hour or so you will possibly find that the glass doesn't fit itself. That is a problem.

Fusers have the same problem. Bullseye, for instance, tells you to not fuse their red and yellow glasses above a certain temperature, because if you're going to re-fuse them, their expansions have changed if you've gone above this magical number. I don't remember off-hand what that temperature is. You do your first fusing and everything is great. Then you take your diamond saw and cut it up to re-fuse the pieces together in a different pattern, and suddenly you see what you think is bad annealing. What actually happened is that you've changed the expansion of one of those red or yellow linear glasses that's within the matrix of what you've done. Now you have two different glasses of different expansions within that situation that you're working within that fused piece.

If that's a chemical, technical, physical level, are there any rules of thumb that studios can use?

A lot of this is empirically learned. You can't really, in most ways, scientifically give an answer to that question. People doing the work learn their particular material and hope the factory doesn't change the formulation of those rods that they've been buying for years, which they do. When we were buying color bars and so on, companies kept reformulating them, especially when lead laws came in. What I would say is that if you're working yellow and red glasses, work them quickly. If you take your time with them and you're constantly adding new red and yellow color, you're liable to run into problems. Most of your metallic oxide rods won't be a problem. I don't know that much about beadmaking, but since lead is more tolerant to fit, maybe there are some lead-based rods that you can use.

I started out with neon tubing, and that has lead in it. I found that I could work neon tubing and do external striping with something like Moretti. Their COEs are very far apart, and yet ten years later the piece is still together. Why is lead so forgiving? Is it its molecular structure?

I'll tell you a story. Many years ago when the rods first came in, we used to do these thread tests. We would take one glass, our furnace glass, and then we would take a piece from the color rod, a lead-based color rod, a Kugler rod. We would pull these threads and there would be a tremendous differential in the expansion. The thread would just bend at almost a right angle, yet when we used them on our pieces they stayed together.

We didn't know much then—I'm not sure we know all that much now—but I knew Nick Labino, the consummate glass chemist. On a good day, he could give me some information about casting and so on. I was very interested at that time in lead color rods and why they fit our base soda-lime glass. We know a bit about expansion, and on paper nothing should have fit. I expected to get some very convoluted, involved answer from Nick, who just looked at me and said, "I know this happens, and I can't give you an answer. It's just that lead seems to be very tolerant.

This is fabulous information, Henry. I know that you have an updated version of *Glass Notes*, which is an excellent reference book full of this kind of information for glassworkers. Where could we find a copy so we can get more of your wisdom?

If you go to www.glassnotes.com, I have a PayPal button. You can use any credit card you want through PayPal.

Visit www.fireladyproductions.com to hear the entire podcast of the Glasscaster interview with Henry Halem.

FLOW