

## Volume Control

The viscosity of glass is such that when heated in a kiln to full melt temperature it will become 1/4" (6mm) thick. Sheet glass is originally made thinner (usually 2mm or 3mm) by drawing it through rollers. Glass can be made thicker than 6mm by pouring or casting it into a mold to prevent it from spreading out and becoming thinner.

**COE 96 glass will behave as follows  
(COE 90 responds exactly the same way  
but at 25°F higher temperature)**

**Tack fuse** up to 1350°F (730°C) it will stay the original size and shape.

**Contour fuse** at 1400°F (760°C) it will start to migrate and change size and shape slightly. Glass thinner than 3mm will draw in slightly as it begins to get thicker. Any glass thicker than 6mm will spread out slightly as it begins to get thinner.

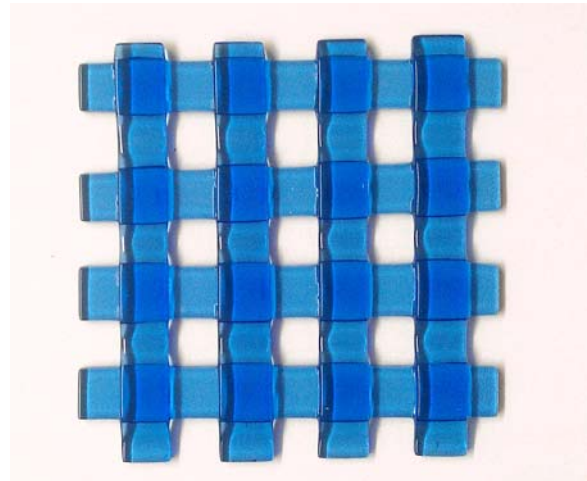
**Full fuse** at 1460°F (795°C) the glass will migrate to become uniformly 1/4" (6mm) thick. Any glass thinner than 6mm will draw in and become thicker. A piece of 3mm glass stacked on another piece of 3mm glass to produce the optimum 6mm thickness will remain the original size and shape. Any glass stacked thicker than 6mm will change shape and spread out as it melts down to 6mm.

Clear float glass or textured architectural glass will behave the same way but at higher temperature (50°F or 10°C)

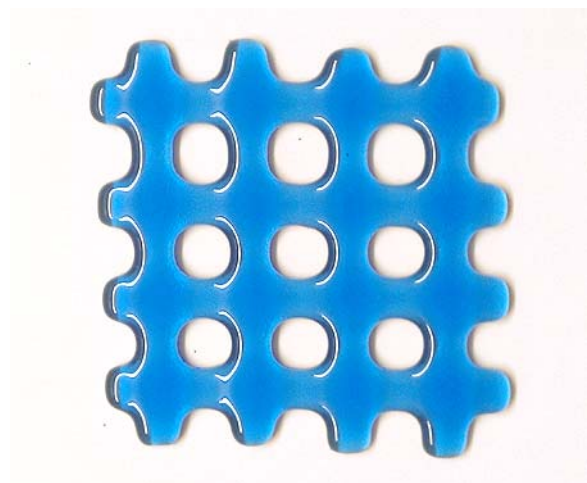
It's important to understand volume control so you can predict what will happen with different designs at different temperatures. The following photos are some examples of identical projects fired to Tack Fuse and to Full Fuse that show how the glass changes size and shape.

In each set of photos, the project in the top photo was fired to **Tack Fuse** 1350°F (730°C) and the bottom photo fired to **Full Fuse** 1460°F (795°C)

### BLUE LATTICE



- 1/8" (3mm) thick pieces folded over each other and fused together without changing shape.



- 1/8" (3mm) thick pieces fused together.
- Pieces narrowed as they thickened to become 1/4" (6mm) thick.

## Volume Control

### MOSAIC CHIPS



- Assorted small chips on 1/8" (3mm) clear base.
- The pieces fused together and onto the clear base without changing shape or size.



- Fused onto a 4mm clear base.
- The pieces fused flat melting to become 1/4" (6mm) thick. In some places, the amount of glass was more than 1/4" thick and caused the glass to spread out.

### STACKED SQUARES



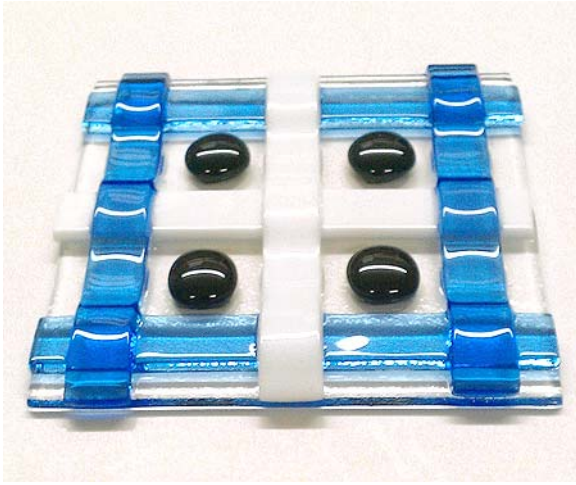
- Assorted size squares stacked on a 1/8" (3mm) clear base.
- The pieces fused together and into the clear base without changing shape or size.



- Fused onto a 4mm clear base, the pieces fused flat to become 1/4" (6mm) thick and spread out as they flattened. The extra volume caused the glass to spread out as it melted down to 1/4" (6mm) thick

## Volume Control

### LATTICE & DOTS

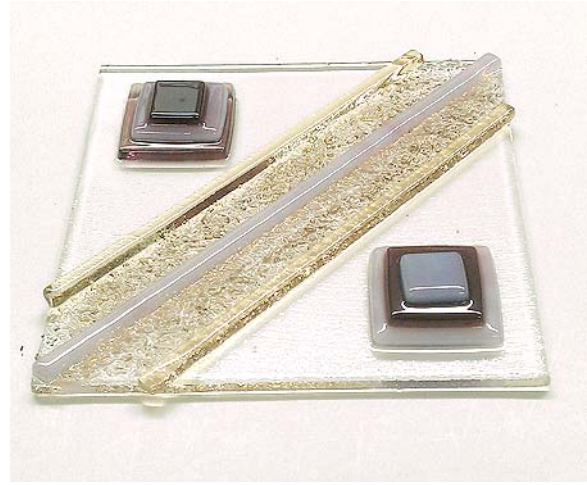


- Single layer strips and pre-made glass pebbles fused onto a 1/8" (3mm) clear base.
- The strips folded over each other and fused onto the clear base without changing shape.
- The pebbles fused to the clear base without changing shape.



- Strips and nuggets fused onto 4mm base.
- The strips and nuggets melted into the clear to become 1/4" (6mm) thick.
- The strips and nuggets expanded as they melted into the base.
- The entire tile spread out where the glass was thicker from each strip.

### STRIPS, FRIT & SQUARES



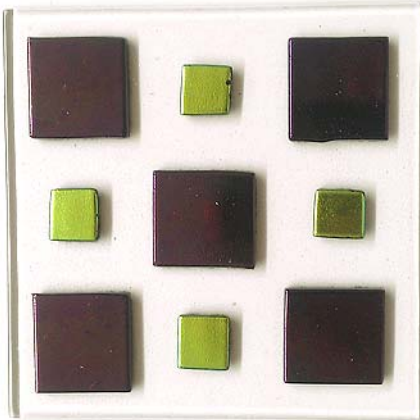
- Assorted small squares, thin strips and frit fused onto a 1/8" (3mm) clear base.
- The pieces fused together and onto the clear base without losing shape.
- The frit retained a rough texture.



- Fused onto a 4mm clear base, the squares, strips, and frit fused flat to 1/4" (6mm) thickness and spread out as they flattened.
- The frit melted into the base leaving a smooth finish looking like regular colored glass.
- The glass spread out where the volume of glass was more than 1/4" (6mm) thick.

## Volume Control

### METALLIC SQUARES

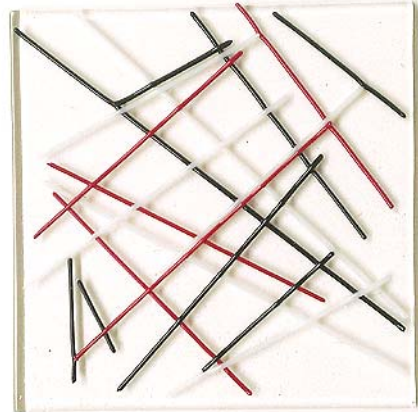


- Single layer pieces of black glass with iridescent black and dichroic gold fused onto single layer 1/8" (3mm) thick clear.
- The metallic surface squares fused onto the clear base without changing shape.



- Single layer pieces fused onto 4mm base
- The pieces fused into the clear base to a common 1/4" (6mm) thickness.
- The metallic black iridescent surfaces cracked as they spread out.
- The black line around each piece is the edge of the black glass that pushed out when the glass flattened out.

### STRINGERS



- Assorted 2mm diameter stringers fused onto 1/8" (3mm) clear base.
- The stringers folded over each other and fused to the clear base without losing original size or shape.



- Stringers fused to 4mm clear base to become 1/4" (6mm) thick.
- The stringers thickened as they melted into the base.
- The stringers weren't big enough to cause the base to spread out.

## Volume Control

Once you understand how glass contracts or expand at full fuse temperature, you can use volume control to create special effects. The photo here is an example where thicker glass pushed out as it flattened to 1/4" (6mm) thick.



- A 6" diameter 1/4" (6mm) thick green screen melt placed on a 12" diameter single layer 3mm dark green base.
- Pieces of opal turquoise blue glass were placed on the transparent dark green base outside the screen melt with the outer edge aligned with the outer perimeter of the green base.
- Pieces of blue dichroic placed on the base between the turquoise pieces.
- Strips of black iridescent were placed on top of each turquoise piece.

What started as a uniform 12" diameter when fired to full fuse produced the ruffled shape in the photo above.

- The green base was only 3mm thick so it pulled in between each of blue and turquoise pieces.
- The turquoise pieces were 6mm thick were they sat on the green base so remained the original size.
- The 9mm thick black iridescent pieces pushed out as they melted down to 6mm thick.

Just as thicker glass will spread out to become thinner, thinner 3mm glass will draw in to become thicker. Here's an example of how that effect can create a unique project.



- The blue is "glass foam" created by spreading glass powder and fine frit about 1/4" (6mm) thick on a kiln shelf and firing to full fuse.
- As the glass powder melts, it pushes out any air between the bits of glass and drops to about 3mm thick.
- At full temperature, the glass thickens to become 6mm thick. In order to thicken, it creates craters as it moves to an all or nothing thickness that looks glass foam.
- The ivory "coral" is made by laying out single layer 3mm pieces of glass and firing to full fuse. The glass contracts as it thickens to become 6mm thick.
- The blue foam and the ivory coral was placed on a round of clear iridescent and fired to tack fuse.
- 4 holes were drilled through the base and mounted on a wood round base with stainless steel standoffs to create a wall hanging.