KILN CAST GLASS for ART and ARCHITECTURAL APPLICATIONS

Available at 90.0 COE and 96.0 COE, Uroboros casting billets offer a cost-effective approach to glass projects of all sizes. If you love the look and feel of hot cast sculpture but don't own a hot shop, you will love casting with these billets in your own studio, at your own pace, in your own kiln.

The casting billets are 6" x 9" x .75" and weigh approximately 3.7 lb each. Billets are thick glass "bricks" carefully formed to have a low bubble count and are stringently inspected to insure their purity and consistency. They are tested for fusing compatibility at 90 COE and 96 COE respectively. Since they are tested compatible you can incorporate any of your other tested compatible elements like frit, stringer, noodles, sheets or pre-fused glass components. They are easy to cut and melt with a thick glassy "hot poured" look.

Uroboros glass billets provide low-bubble count, high purity, lost wax castings. They are ideal for open mold casting of tabletops, cabinet door inserts, room dividers or garden sculpture – your only limitation is the size of your kiln!

ART GLASS

90 COE FUSIBLE

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Seattle architectural artist Maya Radoczy used casting billets for the entry doors in both Seattle and Japan's retail stores of REI, Recreational Equipment, Inc.. (door and detail of cast door panel shown)

Beautiful three-dimensional figure sits 28" x 15" x 20". Made from casting billets by Melanie Hunter, Nicolas Africano studios.

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KILN CASTING a GLASS TABLE with FUSIBLE BILLETS

The August 2001 issue of *Glass Craftsman* **magazine, presented an overview of the steps Gerry Newcomb takes to create kiln-cast architectural slabs and sculpture using casting billets. Here are more detailed steps and explanations about his open face mold process. These steps describe creating a thick, cast glass slab 15"x15"x .75". Gerry uses these slabs as end tables and they have become a very popular product line for him. This technique can be scaled up to much larger sizes with only minor adjustments in the annealing schedule.**

OVERVIEW OF THIS PROJECT

A clay positive is formed. A mold box is built around it. Mold mix is poured onto the clay positive and allowed to set up. The mold box is removed and the clay is removed from the plaster. The new plaster mold is dried and then filled with glass and glass elements. The elements can be frit, stringer, noodles, cane, billets, billet chunks or sheets. The plaster mold, filled with glass, is kiln fired then annealed. The plaster cast is broken away to remove the cast glass object from the mold.

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Slab is size and shape of finished piece

Step #1: **Form a clay positive**

A 3/4" thick slab of clay is rolled out for the positive model.

Place clay on a sheet of heavy paper on top of a smooth flat surface, such as a Formica topped counter.

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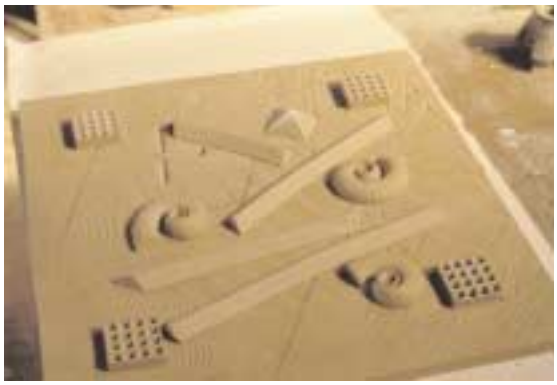
No mold release coating is needed

***Step #2:* Detailing clay positive**

A variety of relief details are possible including undercuts and extremely fine details. Finer clays will give more detail while coarser, rougher clays yield less detail. This “waste mold” process requires no mold release coating.



Undercuts are fine

Mold boards used around clay positive

***Step #3:* Build mold box**

Trim away excess paper around the perimeter of the clay positive. Set up a mold box around the clay using 3/4” thick boards, on all four sides. Leave about 1” clearance between the edge of the clay and the mold box. The height of the mold box should be 1” above the highest point on the clay positive.

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"Splash Coat" acts as mold release

***Step #4:* Apply splash coat**

Face the clay positive with a thin creamy layer of plaster called a "Splash Coat." Pour a steady thin stream, approximately 1/16" to 1/8" thick, trying to flood it on evenly and not trap air. This coat provides a nice release surface and is soft so it pulls away easily from the glass keeping the fine details of the cast.

"Splash Coat" is soft and will keep the fine details of the cast

Splash Coat recipe (by weight):
1 part Pottery Plaster #1
1 part 200 mesh Silica
add water to make a creamy consistency

Over fill mold box slightly

***Step #5:* Fill mold box with plaster**

Use "Gerry's Mold Mix" to finish filling the mold volume. It is a stronger, coarser material than the Splash Coat. The casting mix should have the consistency of a heavy cream. It should flow into the mold box, not so runny that it flows under the box not so thick that it traps air.

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Excess plaster screed off

Step #5: continued

When the plaster is starting to set, it is screed off the surface with a straight edge leaving a flat surface. This insures the top surface is parallel to the bottom. It is this flat surface that will be flipped over and placed onto the kiln shelf.

Plaster mold setting up undisturbed

Carefully remove clay

Step #6: **Remove clay**

After the plaster has set, the mold box is removed. Allow plaster to set at least 30 minutes before flipping over and removing clay. Save clay for weighing when calculating glass weight later. Wash mold gently to remove any clay residue, any small repairs or changes to the mold face can be done at this time.

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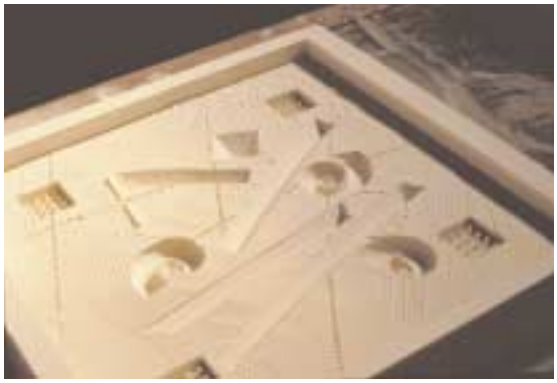

Dry plaster mold ready to fill with glass

***Step #7:* Dry empty plaster mold**

Dry mold with or without forced air or heat for several days. This releases a large amount of water. After air-drying finish drying the mold upside down in your kiln. Ramp 1 minute to 200° F, hold at 200°F for six hours, ramp to 600°F over 12 hours then turn off the kiln and let it cool. The plaster mold should be as dry as possible. When the mold is really dry, it will be more stable, be less apt to warp during the glass cast firing and leave a cleaner glass surface. However, because the molds are so dry, they have to be handled with care. Try not to handle them too much. If possible just turn them over and fill.

***Step #8:* Filling plaster mold with glass**

When filling a mold with glass, consider the type of glass used and the form of the glass used.

Types of glass

There are a variety of glasses that can be used in kiln casting.

The types of glass range from new glass created specifically for art purposes to recycled glass (bottle, window etc.).

When choosing glass to use, compatibility must be considered. To be compatible, two kinds of glass, when melted together, must expand and contract the same amount so that the glasses will not break apart when cool. An example from the ceramic industry would be trying to form a pot with the base being terra cotta then finishing the neck with porcelain. Easy to form but drying and firing has little chance of success. Different glasses will melt together, but incompatible glasses will crack as the formed glass cools, sometimes weeks after the firing. This is due to the physical properties of glass; glass shrinks imperceptibly when cooled and does not like being in contact with other glasses that do not shrink the same amount.

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The science of glass compatibility and chemistry is certainly worth studying and understanding, but some initial experience with glass casting will make such study more meaningful. We can cleverly avoid compatibility issues by using only one kind of glass for casting. Uroboros glass is one of the few glass palettes available in a very diverse color range and formulated to be compatible when used together. Uroboros glass is designed to be fluid in a large range of kiln casting temperatures allowing it to flow and fill your mold. Their glass products resist devitrifying and have good mold release characteristics. Choose the form that will work best for your particular project.

FORMS OF GLASS

Glass comes in a variety of forms.

Frit

Frit is crushed and size-screened glass. It is easy to fill molds with frit. It will lose approximately 1/2 of its volume when fired, so plan accordingly. Fired frit can produce a reasonably clear melt with varying degrees of translucency depending on the size of the frit used.

POWDER
.005"– .01"
.13 mm – .25 mm

FINE
.01"– .03"
.25 mm – .75 mm

MEDIUM
.03"– .1"
.75 mm – 2.5 mm

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COARSE
.1"– .3"
2.5 mm – 7.6 mm

MOSAIC
.3"– .6"
7.6 mm – 15 mm

Frit sizes range from powder to mosaic

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Sheet glass

Sheet glass can be cut and stacked to fill a mold. This can be more labor intensive and can trap air but allows good control of color placement and design elements.

Transparent sheet glass strips

Sheet glass specially formulated and tested to be compatible

Billets

Hand cast billets, 6”x 9” x .75” glass “bricks”, are a new way to get very clear castings in a range of colors. This form lends itself to casting large-scale tiles/ slabs/ panels very quickly. The colors are consistent across multiple molds and multiple firings.

Available at 90 COE in clear only and 96 COE in clear and a range of colors

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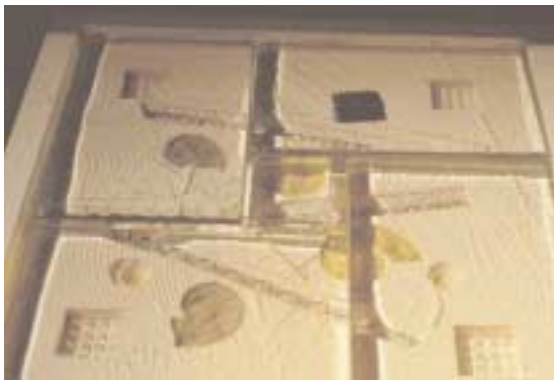
Various frit sizes and colors added to mold cavities

Added cane elements to mold



Casting billets used to fill up the mold

Step #8: **How to fill your mold with glass** (continued)

Filling molds requires some calculating. It is necessary to determine the volume of glass needed to fill the mold volume. Weigh the clay removed from the mold then add 20%. This weight should be the corresponding glass weight needed. For simple square or regular shapes fill volume at the rate of 2.5 grams per cubic centimeter or 156 lb per cubic feet.

Once the amount of glass is known, place the glass in the mold covering the entire mold surface. If using billets or sheets to fill your mold, leave a slight gap between the glass and the mold walls. This will prevent "touch" points (that can be very sharp) from forming. Pile the remaining glass in a shallow mound highest in the center and also over deep cavities. If using sheet glass or billets, make sure the glass is clean! Dust and contaminates like fingerprints can show up in the cast and can contribute to devitrification. As the glass starts to melt it will flow down into the mold details and then flow out to the mold wall and level out. Mounding the glass in the center provides enough material to move toward the mold walls first and then to roll up the side, forming a nice smooth edge.

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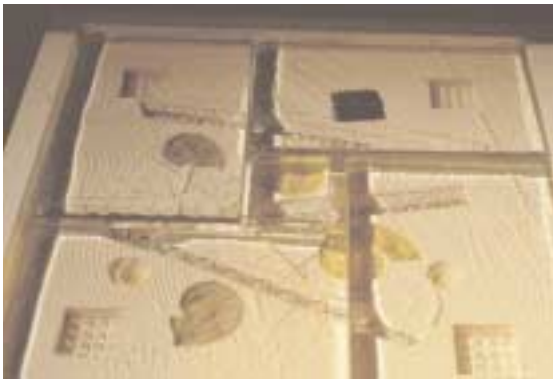
Fired glass mold coming out of the kiln



Close-up of fired glass in mold coming out of the kiln

Step #9: **Firing Schedule**

Firing glass and firing clay are different. Clay requires most if not all the artist's time and attention focused on the climb in temperature and the time spent at the top of the firing temperature range. Glass on the other hand is less concerned with what is happening as the temperature goes up, but is very concerned with the rate at which it is cooled. Slow and careful are the watchwords for successful casting. Below is a firing schedule for this project using billets. A digital controller is the best way to follow this schedule.

Uroboros has some excellent firing schedules, in table format, downloadable from the "specifications" section of this website. Their schedules cover the use of sheet glass in addition to frit and billets when casting.

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Stage A **Ramp from room temperature to 1000° in 4 hours**
Mold is dry. This is probably too quick for large sheet pieces but works fine with billets.

Stage B **Hold and Soak at 1000° 1 hour**
Time spent here pays off later in the firing. Let the kiln and contents soak to even out the temperature. Keep in mind that a pyrometer is reading the air temperature in the free air of the kiln; the temperature in the center of the mold can lag behind that reading. The dry mold is acting as an insulation layer so it takes time for the heat to penetrate into the deepest areas of the mold.

Stage C **Ramp to 1000° to 1550° in 4 hours**
Slow enough so the billets slowly melt together and squeeze the air out as they also slowly flow into the relief and out to the mold walls.

Stage D **Cool to 1525° over 1 hour**
Bubble management. The glass is slowly getting stiffer so any bubbles are being held under the surface. Here the glass is being given the time to melt and level out. All kilns are different and these temperatures may need some adjustment. For example, 1550° in one kiln may read 1575° in another.

Stage E **Cool to 1000° as fast as possible, venting kiln if possible**
Quick cooling here minimizes surface devitrification (surface scum).

Stage F **Soak at 1000° 1 hour, stabilize temperature prior to annealing**
Again, let kiln and contents reach a temperature equilibrium.

Stage G **Anneal to 800° over 12 hours**

Stage H **Cool to 500° over 6 hours, then turn off**
This cooling cycle is for my slow-cooling, fiber-walled kilns. If you use a quick cooling brick kiln, add Stage I.

Stage I **Cool to 100° over 2 or more hours**
Remember, the mold is quite a good insulator, so the glass is only cooling through the top face.

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The work can safely be unloaded when the kiln is off and the glass is barely warm to the touch. Again, if the glass is large or thick or complex, waiting longer to unload is better than unloading too soon. Slow down. You risk breakage if the interior of your piece is significantly warmer to the touch than the surface, when glass is unloaded and the mold is broken away. If there is too much difference in the air temperature and the glass temperature, the glass will break. With large or thick work the kiln can be opened and several layers of newspaper laid down on the glass. This will give a tiny bit of insulation to the face while giving the glass still in the mold time to catch up, but it is not as safe as leaving the kiln closed longer.

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Moldmaterial carefully broken away from the glass casting

Detail of fired casting

Here is the finished cast table

Step #10: **Breaking the mold away from the glass**

This is the fun part. You finally get to see the glass! The molds made with "Gerry's Mold Mix" can be broken away by hand quite easily. Care should be taken with fine or fragile details. Running water and a stiff brush will scrub off remaining mold bits. Also a pressure washer works well to remove any mold bits, especially from rough surfaces or deep cavities.

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