

The Vitrigraph Kiln

TECHNOTES 2 | CREATING A NEW VOCABULARY IN FUSED GLASS

Fused glass is frequently characterized by a cut-and-fit approach to design. Various shapes of colored glass are cut and fired to a base blank, often a tile or plate. While this is a valid method of working the material, it comes more from a collage or mosaic than a painterly tradition.

Originally trained as a painter, Narcissus Quagliata has worked in stained glass since the early 1970s. Probably more than any other modern flat glass artist, Quagliata has succeeded in imparting the fluidity of a painter's sensibility to leaded glass through both painstaking selection of unique glasses and a highly expressive use of the lead line. Invited to take part in the Connections program of artist exchanges at the Bullseye factory in 1993, Quagliata quickly enlisted the assistance of Rudi Gritsch, equipment-builder extraordinaire (and at that time Bullseye's kilnworking director) to devise a way of generating lines in hot glass that could approximate the spontaneity of the pen or brush stroke. These glass lines and the techniques of shading and modeling with frits became the core of a methodology of fusing that Quagliata came to call "light paintings"—a revolutionary approach to working glass in the kiln that combines the expressiveness of paint with the vibrancy of light.

The key tool in creating these lines is an ingenious small kiln, designed by Rudi Gritsch, called the "vitrigraph."* Since then Bullseye has built and tested numbers of them, and sent replicas off to studios around the world. This article describes the equipment and processes developed by Quagliata and Gritsch, in the process creating a whole new vocabulary for fused glass.

Paragon Caldera Kiln Specs

- Interior: 6.75" x 8" x 8" (17 x 20 x 20 cm)
- Exterior: 11.75" x 14" x 19.5" (30 x 36 x 50 cm)
- Electrical Requirements: 120 V / 15 A
- Power Consumption: 1.68 kW
- Plug: Standard (NEMA5-15p)
- Shipping Weight: 46 lb (21 kg)
- Product Number: 008823

* From the Latin "vitri—" (glass) and the Greek "—graph" (writing). Not to be confused with "vitreography," the process of making prints from glass plates.



Above: Narcissus Quagliata during the creation of Summer Buddha, fused panels employing hot drawn glass lines.



The Paragon Caldera Kiln

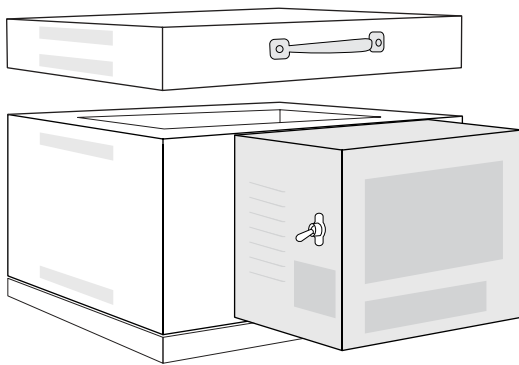


Figure 1

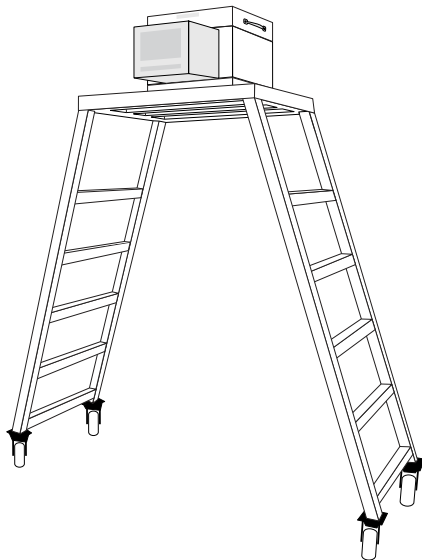


Figure 2

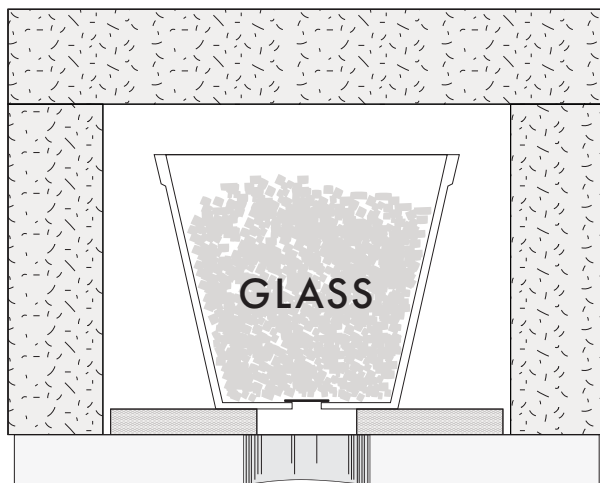


Figure 3

CONSTRUCTION OF A LINEMAKING MINI-KILN

The original vitrigraph kiln was composed of a stack of three component kiln rings. We now use the Paragon Caldera because it has a programmable controller (the original did not), requires less power, and is more versatile. (Figure 1)

To be used as a vitrigraph, the Caldera is set on top of a panel of 1" (2.5 cm) thick rigidized fiber or pre-fired vermiculite board that replaces the bottom of the kiln. This 12" (30.5 cm) square panel has a 2.5" (6 cm) diameter circle cut out of its center. The entire unit is mounted overhead either to a wall or on a sturdy ladder-like structure. Our vitrigraph is mounted with the bottom about 5'9" (1.75 meters) off the floor. It is, in essence, a miniature bottomdraw glass furnace. (Figure 2)

Within the heating chamber, 4 Vitrigraph Pot Supports / mullite strips (the same material kiln shelves are made of) are placed around the hole in the base board to support a clay flower pot 5" tall x 6" diameter (127 x 152 mm). We've had the best luck with unglazed terra cotta flower pots made in the U.S. or Italy. These are generally a single use item. When purchasing, avoid pots with hairline (or larger) cracks, as these will widen as they reach molten glass temperatures. A Sentry Xpress digital temperature controller mounted on the outside of the kiln controls heating to the kiln chamber. Instructions for programming this controller are included with the kiln.

GLASS FEEDSTOCK

Any scrap pieces of Bullseye compatible sheet glass or coarse (-0003) frit can be melted down to make lines or "stringers." Avoid glass granules smaller than coarse frit, as they produce a seedier stringer due to the greater amount of air trapped between the smaller particles.

LOADING THE GLASS

We typically load the glass into the pot outside the kiln, while it is at room temperature, and then place the loaded pot into the kiln so that it is supported by the mullite strips. (Figure 3) When working with frit or extremely small pieces of scrap sheet glass, place a small square of Bullseye compatible sheet glass the same color as the feedstock over the hole to prevent the glass from falling out. Then fill the pot with the feedstock.

FIRING THE KILN

Before firing the vitrigraph, read the safety notes on page 4. Make sure that all electrical cords are secured and the kiln platform you've selected is stable. If your platform doesn't include a ladder system, you'll need a sturdy metal ladder next to the kiln to access the top lid for charging.

Charging

We advise loading the amount of glass needed for a run of stringer while the pot is cold, and then cooling between runs. If time forces you to do continuous melts, or if it becomes necessary to add more glass to the pot during the melt, here are a few things you need to keep in mind:

- Turn the power off during charging.
- Use extreme care in filling the pot. Glass scraps or frit which miss the pot and land on the electrical elements can damage the elements.
- Glass scraps or frit that melt against the refractory brick will corrode it.

Firing Cycles & Process Temperatures for Various Glasses

Different types of glasses behave differently in the melting and forming process. Those with lower melting temperatures, like Black (000100), will need to be heated more slowly and to a lower process temperature to avoid their running too freely. Certain glasses, like White (000113), will cool more quickly than others and have a narrower "working range." Transparent cadmium/selenium glasses such as Yellow (001120), Red (001122), and Orange (001125) have a tendency to opalize in the remelting process. Only by working with the various glasses will you come to understand their idiosyncrasies.

Firing the vitrigraph too rapidly may result in a very seedy melt, with many air bubbles trapped in the resulting stringers. It may also cause the feedstock to thermal shock, sending chips and shards into the elements and refractory bricks. Firing too quickly can also result in an uneven melt, with the glass in the top of the pot extremely hot and the glass in the bottom still relatively cold. As a result, the glass initially flows very slowly before suddenly flowing at an uncontrollable rate. The following cycle works well to achieve a very controlled line for most glasses:

RATE (DEGREES/HOUR)	TEMPERATURE	HOLD
450°F (250°C)	1500–1725°F (816–941°C)*	4:00

*Temperatures depend on the glasses used and the desired working properties. If you want to be able to carefully control and manipulate the lines, cooler temperatures will work best. In general, Black (000100) and transparent colors will flow at lower temperatures than opalescent colors. If you want the glass to flow quickly and freely, most transparent glasses and Black (000100) will do this at process temperatures of 1680°F (916°C), and most opalescent glasses flow freely at process temperatures of 1700°F (927°C). Stiff glasses such as White (000113) and French Vanilla (000137) flow freely at 1725°F (941°C). Depending on your experiences and the types of stringers that you are trying to create, you will find process temperatures that suit your specific needs. If using a transparent pink, purple or coral style include a 2:00 hold at 1225 °F (662 °C) on the way up to the process temperature. See *Properly Pink, Purple & More*.

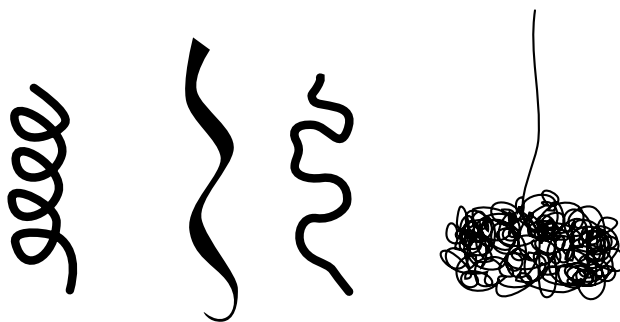
FORMING

During the forming stage the temperature will determine the quality of line produced. Setting the kiln at 1600°F (781°C) while melting Black (000100) should produce a thick, fairly slow-moving stream. At this temperature it is very easy to manipulate the glass by handpulling and using the simple tools described below. Fine-tune the quality of the stream by starting at a low melting temperature and then slowly increasing it. If the glass stream is moving so fast that it becomes impossible to control, turn the kiln off and lift the kiln lid to allow heat to escape. When the glass is back under control, close the lid and restart the kiln.

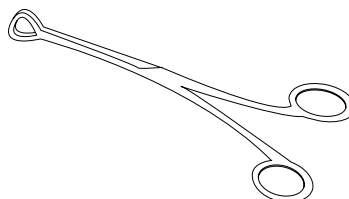
SOME TOOLS & THE LINE QUALITIES THEY PRODUCE

Hand pulling

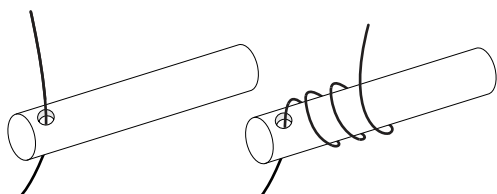
Many types of lines require only handwork (while wearing Zetex or Kevlar gloves). If the glass is viscous enough you can pull it at intervals to create stringers of fluctuating thickness. At these low temperatures the glass can also be pulled into curves. At very high temperatures when the stream is extremely thin and fast moving you can make delicate bird's-nest shapes by allowing the stream to freefall.



Tongs: If you don't feel comfortable hand-pulling the stream of glass, there are a variety of long-handled metal tong-like tools available, such as the 9" (23 cm) long hemostat shown here.



Pipes: You can make stringers in the shape of spring-like coils using a 1" (2.5 cm) diameter steel pipe. These coils can then be carefully cut into sections that will form perfect circles when kilnformed. The pipe illustrated here is 15" (38 cm) long with 0.5" (1 cm) holes drilled through the wall about 1" (2.5 cm) from the pipe's end. Pull the glass stream through the drilled holes. As the glass flows, twirl it around the pipe and then cut or break it at the end of the pipe.



Tray: A 2-foot (61 cm) square stainless steel tray held at a 45° angle about 16" (41 cm) below the bottom of the kiln makes a good working surface for creating flat curlicue S-curves, and other curves.

MELTING CYCLE AND POT LIFE

Because of its long working range, Black (000100) is a good stock for your initial experiments in linemaking. To work in other colors using the same pot, cycle through the spectrum so you gradually transition from lighter to darker colors. Any time you transition from one color to another, the beginning of the run will produce stringers that have a thin, often streaky layer of the previous glass on the outer surface. As the run progresses, this will disappear.

A gray or metallic appearance to the pot after firing is iron in the clay that has migrated to the surface. This indicates that the pot (and the glass inside it) became much hotter than it needed to be.

Note: Rapid cooling will also shorten pot life. Avoid refiring a used pot. The risk of cracking is far greater than the minimal expense of a new pot. As mentioned above, watch out for cracks. They widen and eventually break on firing.

SAFETY CONSIDERATIONS

- Keep the kiln away from flammable surfaces and materials.
- Whichever mounting support system you choose, make sure it's sturdy and non-flammable. Any wall brackets should be firmly connected to structural wall studs.
- A freestanding system needs to be properly counter-balanced so it won't tip over during normal operation.
- Use heavy (12 gauge) electrical extension cords. A standard light-duty cord will overheat and could start a fire.

- Make sure that all primary electrical and extension cords are out of the way and taped down. Taping cords also protects them from the heat of the kiln and the pulled stringer, both of which can melt through the insulation and create a shock and fire danger. If cords are on the floor, tape them down.
- As noted by the manufacturer, the temperature inside the kiln should never exceed 2350°F (1288°C).
- Never leave the kiln unattended, especially above 1500°F when the glass is starting to soften and flow.
- If you charge the kiln using a metal scoop or tool, be certain to turn off power to the kiln first and avoid contact with the elements. There is a significant risk of electrical shock when working with metal tools this close to the kiln elements.
- A piece of sheet metal on the floor directly beneath the kiln will help prevent a structure fire.

PROTECTIVE GEAR

Safety Glasses

A must at all times. Glass will sometimes thermal shock while being loaded into a preheated pot, and bits of glass will tend to fly when stringer is broken from the glass stream.

Gloves

Zetex or Kevlar gloves are necessary for charging the kiln and for any direct contact with the hot glass. However, the bulkiness of these gloves makes it difficult to manipulate the forming tools. A thinner leather glove on the working hand allows you to handle the tool and provides some protection from the heat, while a Kevlar glove on the other hand allows you to break the hot stringer from the glass stream.

Clothes

Wear long pants and a long-sleeved shirt made from natural fibers such as cotton. Also wear closed-toe shoes. Avoid wearing synthetic materials / fabrics as these can melt and pose a safety issue.

ADDITIONAL RESOURCES

[Vitrigraph Kiln: Basic Use](#) (video lesson)

[Drawing with Glass](#) (video lesson)

[Tips for Using Vermiculite Board](#) (article)

[Properly Pink, Purple & More](#) (article)

FEATURED PRODUCTS

Paragon Caldera Kiln ([008823](#))

Vitrigraph Base Board ([008827](#))

Vitrigraph Pot Supports, Set of 4 ([008829](#))