

ROLL-UPS: Blowing Glass Without a Furnace



Klaus Moje, *Nijima Series*, 2000. Kilnformed and rolled-up glass, 6" to 23" (152 – 584 mm) high.

A BRIEF HISTORY OF THE ROLL-UP

In 1993, Klaus Moje and Dante Marioni took part in the Connections project at the Bullseye factory in Portland. Together they explored the idea of blowing fused pieces. Moje would make tiles in the kilnforming studio, and Marioni would then pick them up on a bubble of furnace glass in the hotshop. The result was a series of vessels with intense colors and carefully controlled designs that were unlike anything previously achieved through either kilnforming or blowing alone.

While the idea was promising, it still had one major drawback: the furnace and the considerable time and expense associated with maintaining one. Moje continued to explore the technique at the glass workshop he founded at the Australian National University's Canberra School of Art.

In a series of collaborative projects called Latitudes held at Canberra starting in 1995, Moje and glassblower Scott Chaseling adapted the logic of the traditional Venetian murrini-cane pick-up technique. Chaseling and his team picked up Moje's fused tiles on a disc or "collar" of glass at the end of a blowpipe. This collar could be made from sheet glass fired in a kiln, thus eliminating the need for a furnace.

The result has come to be known as the roll-up: blown glass of pure color and carefully controlled design created using only sheet glass, a kiln, a glory hole, and basic hotshop tools. Because furnace glass isn't necessary, the roll-up is accessible to a far broader range of working artists than other blowing methods.

HYBRID PROCESS

This TipSheet describes a hybrid process of fusing and blowing. However, it is not intended to teach anyone how to blow glass. Hotshop and blowing experience are required. We encourage kilnformers to partner with blowers to execute this process.

Tools

- Normal hotshop/blowing equipment, including a glory hole
- At least one kiln that can be used for fusing and pick-ups, and ideally one kiln for annealing
- π divider/calipers
- Ferro(s)
- Pastore/fork
- Normal kilnforming tools

No furnace required.

Glass

The entire palette of Bullseye compatible colors in sheet glass, frit, stringer, etc., is appropriate for this process. (See notes under Viscosity on page 6 for more information.) In addition, be sure to have some Clear blowing cullet (001501-0066) to make the collar and punty to roll up the kilnformed tile.

THE PROCESS

The Kilnformed Tile

The roll-up begins with a kilnformed tile that measures 8" x 10" (203 x 254 mm) and 3/8" (9 mm) – or three standard sheets – thick. The actual design area is only 6" x 10" (152 x 254 mm), with an 1"-wide (25 mm) strip of clear glass along the top and the bottom edges. This strip of clear will be eliminated in the rolling and blowing process.

Because glass heated to a full fuse will flow until it reaches a thickness of 6 mm – also known as the 6 mm rule – plan to dam the sides of the tile in the kiln to contain it. Dams can be made from cut-up kiln shelves, soft bricks, vermiculite board, or fiberboard. If using cut-up kiln shelves, coat them shelf primer to keep them from sticking to the glass. After each firing, scrape this material off and reapply it. If working with soft brick, vermiculite, or fiberboard, use strips of fiber paper as gaskets to keep the dams from sticking to the glass.

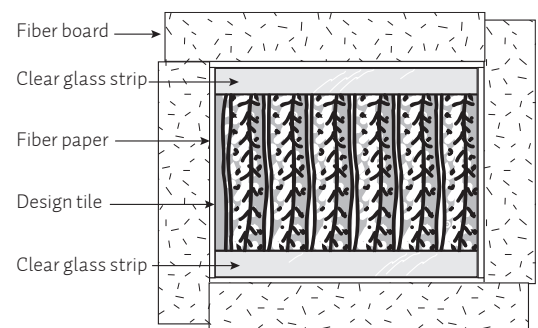
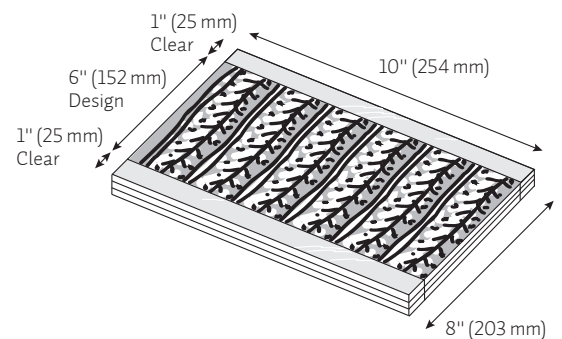
Although all kilns fire differently, we recommend the following full-fuse schedule (for a Paragon GL-24 AD) to fire tiles for rolling up:

Firing Schedule

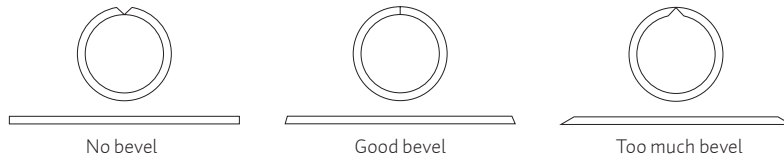
RATE (DPH)	TEMPERATURE	HOLD
600°F (333°C)	1250°F (677°C)	:30
AFAP ¹	≈1500°F (816°C)	:15
AFAP ²	900°F (482°C)	:45
100°F (55°C)	700°F (371°C)	:00
AFAP	80°F (27°C)	:00

¹ As Fast As Possible – use full power.

² As Fast As Possible – cut kiln power using controller. We do not advocate crash cooling. Leave the kiln closed, allowing it to cool naturally.



Once the piece is cool and has been at room temperature for 24 hours, bevel the two edges of the tile that will be joined together in the roll-up process. This will ensure that they meet evenly and cleanly for a strong seal. This bevel should be around 30°, but will vary with the size of the piece. The thicker the piece, the more important the bevel will be to properly closing the seam.



Load the beveled tile into a pick-up kiln on a prepared ferro^A and slowly bring it up to temperature. A front-loading kiln with the shelf at around hip height will be much easier to pull loaded ferros out with the pastorage than a top-loading kiln.

The heat-up schedule for the tiles in the pick-up kiln is:

Heat-Up Schedule

RATE (DPH)	TEMPERATURE	HOLD
350°F (194°C)*	1115°F (600°C)	8:00**

* Thicker tiles will need to be heated at a more conservative rate.

** Hold for at least one hour at 1100°F / 593°C before rolling up the tile. The hold time should correspond with the amount of time it will take to get all of the tiles out of the pick-up kiln.

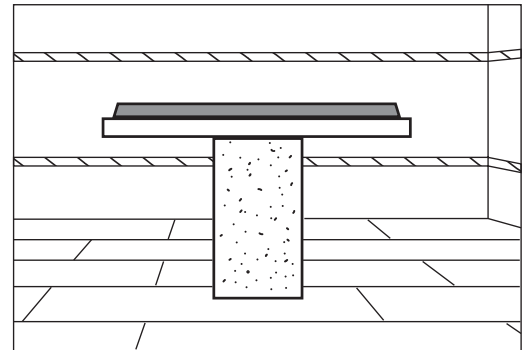
STARTING THE ROLL-UP

Preparing the Collar

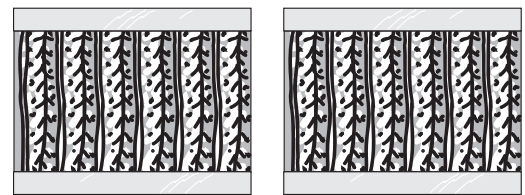
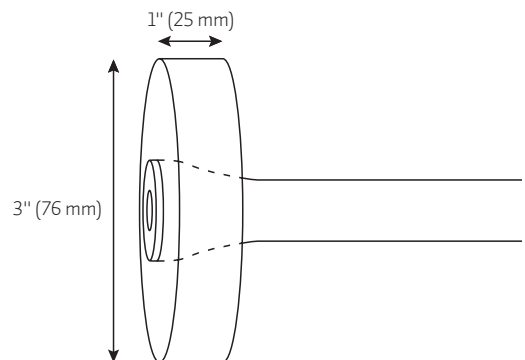
Form a collar of clear glass on the end of a blowpipe.^B This collar will be used to roll up the kilnformed tile off the ferro. Position the collar just a bit in from the end of the pipe so that heat doesn't close up the hole.

The thickness of the collar should be 1" (25 mm), the same size as the clear glass area on the edges of the kilnformed tile. The diameter of the collar should be the length of the kilnformed tile divided by π (3.14).^C

Another easy way to determine the diameter of the collar is to use a π divider, or calipers.



The beveled tile loaded onto a prepared ferro in a pick-up kiln.



$$\text{Collar diameter} = X / \pi$$

π Dividers

A Traditionally, ferros are made from 1/4" to 3/8" (6 to 9 mm) thick mild steel and prepared with an even layer of fine clay. For the roll-up process, especially when working with tiles thicker than 9 mm, this presents a problem. Invariably, it is difficult to get the kilnformed tile hot enough without also getting the steel ferro so hot that the clay layer spalls off and sticks to the glass. An alternative is to use 1/2" (13 mm) thick kiln shelves. Shelves should be cut so that there is approximately 1/2" of space around the kilnformed tile. For example, an 8" x 10" (203 x 254 mm) tile would require a 9" x 11" (229 x 279 mm) shelf. Mix a batch of separator at 1/3 alumina hydrate, 1/3 china clay, and 1/3 talc by weight and then mix it with water at a 1:5 ratio of separator to water by volume. Apply 5 coats of this mixture to the shelf and then dry it in the kiln at 500°F / 260°C for 20 minutes.

B If working without furnace glass, you will need to make the collar from cullet. Theoretically, the collar can be made from any glass, because it will be cut off, and therefore need not be made of compatible glass. In practice, however, it should be the same glass as the kilnformed tile because then it will behave in the same way as the rest of the glass on the blowpipe. Have the cullet in a pick-up kiln (this can be the same kiln where the kilnformed tiles are holding at 1115°F / 600°C). Heat the pipe until it is red hot and then pick up a very small chunk of glass. Work that chunk until it is goeey, then use it to pick up a larger chunk of glass on the side of the pipe. Continue in this fashion until you have completed the collar.

C It is better to err on the small side when making the collar.

When the collar is almost complete, have an assistant remove the kilnformed tile on the ferro from the pick-up kiln with the pasturale and begin to heat it in the glory hole. It is essential that the tile receive even heat, so it may be necessary to pull it out of the glory hole, rotate the ferro 180° on the pasturale, and return it the glory hole. As the tile heats, look for the very beginnings of orange heat and edges that are slightly softened.

At this point, the tile is ready to be rolled up.^D During repeated heatings in the glory hole, the beveled edges will invariably soften and round-out, losing their angle. Be sure to reestablish the angle of the bevelled edges with a tagliol before attempting to roll up the tile.^E

Placing the Collar

Roll the tile up along the clear glass that borders the top of the design. Begin about 2.5" (63 mm) in from the beveled edge furthest from your body, rolling the tile towards yourself. Once the collar is 2" (51 mm) from the beveled edge closest to you, stop rolling, lift the piece off the ferro, and bring it to the glory hole to begin heating.

Closing the Seam

After rolling up the tile, heating in the glory hole should be done using a "flipping" technique rather than constant turning. Heat the piece with the open edges of the cylinder face down until it begins to sag and then quickly turn the pipe 180 degrees so that the open edges of the cylinder are face up and the piece begins to sag in the other direction. Continue flipping the piece in this fashion until the piece becomes pliable.

Bring the piece out of the glory hole with the seam facing down, and then flip the seam up when to begin closing the seam. Begin joining the seam at the end furthest from the collar. Use two pairs of pincers to pull the beveled edges together, connecting the inside, front edge first. Then continue to draw the edges together towards the collar to close the seam. Use the back of your pincers or a tagliol to avoid excessive tool marks.

Next heat the piece to a marvering temperature and marver it until the seam is fully incorporated into the body of the vessel. Jacks can be used on the inside of the piece while marvering to smooth the inside seam.

D If the tile is too cold, it will be difficult to roll up and may crack. If the tile is too hot, it will stick to the ferro, or be very sloppy when you roll it up.

E Some practitioners prefer to use very light heats in the glory hole to preserve the beveled edge and to keep the ferro from becoming too hot and sticking to the tile. They rely instead on torching the center of the tile to heat it. This is especially true for thicker Roll-ups.

Process photos taken during development sessions at Bullseye with Klaus Moje, Scott Chaseling and Kirstie Rea. Photographer: Russell Johnson.



Placing the collar...



...and lifting the piece.



Closing the seam.

Closing the Cylinder

Close the cylinder using jacks along the joint between the clear and the design portions of the tile. The clear glass serves both to conserve the design and to hold one end of the cylinder together with a ring of uniform viscosity. Without it, the different glasses in the design can flow at different rates and deform. After the cylinder is closed, cut with diamond shears.

You now have a bubble, and you are blowing glass.

A common alternative to closing the cylinder with jacks is to attach a kilnformed disc to the end of the cylinder to create the bottom of the piece. To do this, the kilnformed disc (on a ferro or shelf) is taken out of the pick-up kiln and heated in the glory hole in essentially the same way that the kilnformed tile was. At the same time, the end of the cylinder is heated so that it will be pliable enough to stick to this disc once it has been adequately heated in the glory hole. Attach by holding the rolled up tile vertically by the blow pipe and then lowering onto the disc. Next, marver the piece to ensure an adequate seal.

Once again, you have a bubble: You are blowing glass.

Annealing

Move the blown pieces to an annealing kiln that is holding at 1000°F (538°C). When you have put away all of the blown work, follow this schedule for pieces rolled-up from 9 mm tiles:

Annealing Schedules

RATE (DPH)	TEMPERATURE	HOLD
AFAP	900°F (482°C)	1:00
75°F (41°C)	700°F (371°C)	:00
AFAP	80°F (27°C)	:00

or

TIME	TEMPERATURE	HOLD
:01	900°F (482°C)	1:00
3:30	700°F (371°C)	:00
:01	80°F (27°C)	:00



A kilnformed disc is taken out of the pick-up kiln...



...heated in the glory hole...



...and attached to the rolled-up tile to close the cylinder.

IMPORTANT CONSIDERATIONS

Viscosity

Different colors of sheet glass have different viscosities. In general, transparent glasses will heat quickly and become very soft, then cool quickly and set up. Opalescent glasses will tend to heat more slowly, but then hold their heat for a longer time. However, Black Opalescent (000100-0030-F) is very soft and responds quickly to heat. To address this, we recommend using Bullseye's Stiff Black Opalescent (000101-0030-F) instead. White Opalescent (000113-0030-F) is stiff and may be slower to respond to heat. Clear (001101-0030-F) will be somewhat stiff, but can be replaced with Clear Blowing Cullet (001501-0066) which is formulated to have a longer working range for blowing.

Glasses of different viscosities will behave differently in the glory hole and in blowing. This can present challenges in terms of controlling shape and form. On the other hand, it can be utilized as a design element (to create a ribbed effect, for example). In the design stage of the tile, before the fusing process, differences in viscosity can be exaggerated or balanced through your choice of glass.

Design

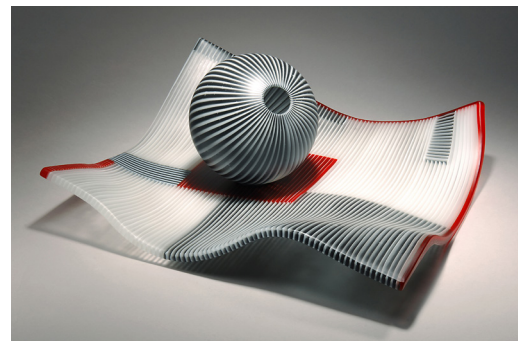
- When you fuse the tile, the side fired against the shelf will appear to be very "tight" and lines will be more straight and crisp than the top surface of the tile. Decide which of these sides you want to be the exterior of the vessel, and lay that side face down on the ferro. Remember that what will eventually be the top of the vessel is the edge along which you will attach the collar and roll up the tile.
- Design with the seam in mind. Many practitioners make the seam a vertical feature in the composition of the roll-up.
- Remember that you may lose a small amount of glass in the beveling process. Furthermore, you may need to vary the angle of the bevel depending on the thickness of your tile.



Yoko Yagi, *Taga Sode III*, 2008. Blown and coldworked murrine glass, 6.5" x 8" x 8".



Marc Petrovic, *Avian Pair*, 2012. Hot sculpted, blown, fused and cold worked glass murrine, 7.75" x 13.75" x 12.75" installed .



Steve Klein, *Exploration 130*, 2009. Kilnformed, blown and cold-worked glass, 6.75" x 16.625" x 17.25" installed.