All About Your New Ceramic Ring Mold

Details, Instructions, and Tutorials

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Getting To Know Your Mold

Your Glass & Stone Pottery mold was hand-thrown on a potter's wheel from a red stoneware clay body. Each mold is then trimmed, dried, and fired to Cone 6 - over 2200 degrees Fahrenheit. This results in a strong, durable mold that should hold up for many firings in your glass kiln. These molds do not need to be pre-fired before you use them. Take care to protect the channel surfaces and your mold should last for years.

Most commercially available glass molds are slip cast. Slip casting is great for mass-production of ceramic goods; a mixture of clay and water (called slip) is poured into a mold and allowed to dry till firm. The slip cast piece is de-molded and then bisque fired. The resulting molds are very uniform, lightweight, and inexpensive to make - but also relatively fragile and less able to withstand repeated firings.

Our wheel-thrown molds are more durable. The denser, heavier design ensures a more even heating and better finished product. The tradeoffs are that, being hand-made, our molds will have more variation than a slip-cast mold and the fully vitrified stoneware is non-porous, making it somewhat difficult to use traditional kiln wash. Glass will stick to the stoneware surface, so you must use a separator like aerosol ZYP boron nitride spray. Techniques for applying separators on a fully vitrified mold are more similar to using stainless steel than porous bisqueware molds.

Check our website at https://glassandstone.art/store/p/fused-glass-ring-mold for updates, tutorials, and project examples. Glass & Stone Pottery is first and foremost a community of artists and craftspeople; producing these molds for other artists is exciting for us, and we can't wait to see what you make.

Always use a respirator or appropriate particulate filtering mask (N95 masks work) when using glass frit, glass powders, or glass separator.

TL; DR Notes

- Every kiln is different, and the suggested schedules given here are a starting point. You may need to adjust the schedules to suit your kiln.
- Because each mold is hand thrown, there might be slight variations in the channel width and depth. Please adjust the fill volumes as needed.
- All glass casting molds must be primed with a glass separator to prevent the glass from sticking to the mold. We recommend ZYP aerosol boron nitride as a glass separator.
- Never mix glass with different COEs. Even glass with the same COE is sometimes incompatible, so test if you mix brands.
- The contents of this document are intended to provide you, the artist, with information and useful tips and suggestions on how to best use your ring mold. We can not guarantee results or the suitability of the ring mold or items created with it for any particular purpose. Any issues, including damages, injury, or liability not directly related to the design and manufacture of your ring mold are the sole responsibility of the end user.

Preparing Your Mold

In order to prevent glass from sticking to the surface of the mold, you must prime the surface with a glass separator. We recommend ZYP aerosol boron nitride rather than kiln wash or other separators designed for use on porous surfaces.

Extra care must be used in priming the mold with ZYP the first time.

1. Shake the can of ZYP for one minute after you hear the mixing ball moving inside. Spray outside or in a well-ventilated area. Consider using a spray booth or a large cardboard box to catch overspray.
2. Prop the mold up vertically and spray for a few seconds from about a foot away to lightly coat the mold. Allow a few moments for the first layer to dry.
3. Turn the mold ⅓ turn and spray again, and allow to dry.
4. Rotate ⅓ turn and spray a third time.

To prepare the mold for subsequent firings, clean loose ZYP from the mold, spray it, rotate ½ turn, and spray again. Be sure to vary the angle of the spray can to ensure that there is ZYP on the sides of the channel walls. Some of the ZYP from the previous firing will still be present, so you don't have to be quite as thorough with subsequent applications.

Notes for Priming

- Make sure to vary the angle of the can during each spray so that all of the sides of the channels have a light coating. Shake the cans between coats.
- The dark color of the clay used in our ring molds makes it easier to determine where your ZYP application may be too thin or light to provide good coverage.
- If the mold surface starts to look wet, stop spraying immediately. Allow the ZYP to dry and respray using a lighter coat.
- Full cans of ZYP deposit more product than half full or near-empty cans, so you might need to spray for a second or so longer to make sure you have good coverage.
- We have not tested with different brands of boron nitride separator. However, not all BN sprays are designed for glass use, and other artists and mold manufacturers have said that some other brands do not cover as well as ZYP.

Filling Your Mold

The rings can be filled with any combination of fusible frit or murrine as long as the glass types are compatible. Never mix glass with different COEs. We do not recommend using stained glass or bottle glass in this mold. While it is possible to use these types of glass, the varying properties of these glass types make it difficult to achieve successful results. Bottle glass often requires higher temperatures to melt, increasing the chances of sticking, while stained glass may change colors when heated in the kiln or be prone to devitrification.

Any spoon or scoop can be used to fill the mold's channels; if you are careful you can pour directly from the frit container. For production testing, we used a drizzle dessert spoon. A turntable makes it easy to turn the mold while you are filling the channels, which generally makes it easier to control the pour.

Just a few of the many useful tools in manipulating frit for filling the mold

Frit has a lot of air space and the glass frit will compact down and pull together when fused.

Be sure to spread the frit evenly throughout the channel. Tapping the side of the mold can cause the frit to shift to that side; instead use a twisting motion or **gently** “bounce” the mold on a flat surface to level the frit. You can also use a finger to level out the frit in the channel to help ensure an even fill.

We recommend an ear wax vacuum to clean up any stray frit that goes into the wrong channel. You can also use tweezers to remove stray frit, but be careful not to scratch the ZYP separator. If you use a brush, be careful not to brush ZYP into the channel.

Another tool that can be helpful for placing fine frit is a ‘Wilton Sugar Writer’ sanding sugar pen.

When loading your kiln, prop the mold up on kiln posts or other supports to allow air flow under the bottom, at least ½ inch (13mm) of space. This will help ensure even heating during the firing.

Filled molds loaded and ready for firing. Note the kiln posts raising the molds off the surface of the kiln shelf.

Full Volume Rings

Normally, it's best to fill the mold level to the top of each channel; this makes it easier to level the frit and move the mold to the kiln without spilling. It is possible to mound the frit up in the center of the channel if you need a thicker ring.

These fill weights are provided so that you can premix the right amount, but the amounts needed for your mold will probably vary; use these weights as a starting point and guide, not a precise requirement.

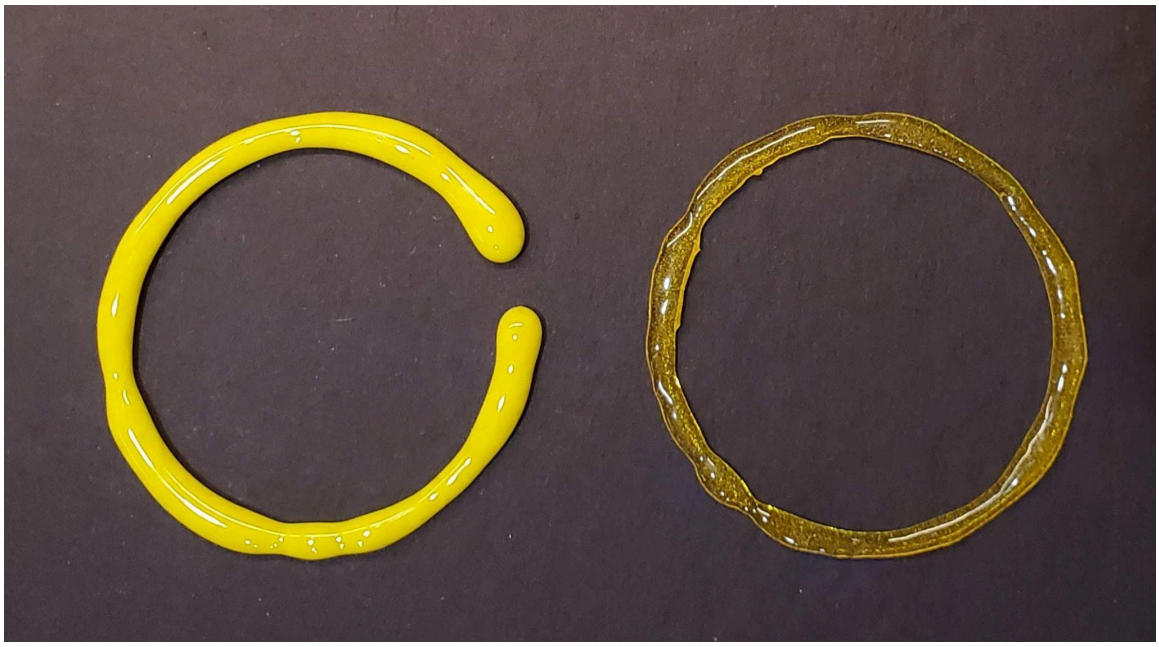
10" Full Volume Fill Weights		
	grams	ounces
1st (innermost)	13	0.459
2nd	32	1.129
3rd	55	1.940
4th	80	2.822
5th	108	3.810
6th (outermost)	139	4.903
Total	**427**	**15.062**

8" Full Volume Fill Weights		
	grams	ounces
1st (innermost)	10	0.353
2nd	16	0.564
3rd	22	0.776
4th	29	1.023
5th	40	1.411
6th (outermost)	45	1.587
Total	**162**	**5.714**

Low Volume Rings

Fusing glass ‘likes’ to be 6mm thick. Melted glass will try to level out to 6mm if you don’t dam or press it. The higher the kiln temperature, the more likely the glass will move.

This is especially important when trying to make thinner rings with low volumes of frit. If you have a low volume of frit in the channel and take it to a full fuse, the glass will pull in to try to get to 6mm. This can make the ring wobbly, uneven, or even cause it to separate in places.



Low-volume rings fired to a high temperature. Note the uneven surfaces and the break in the left-hand ring.

If you want to make a thinner ring you need to use a contour fuse schedule with a lower top temperature and longer hold to make sure that the glass particles melt together without significant movement. You will also need to make sure that the frit is level and even before you fuse it since the reduced movement means the glass can’t level itself during the fuse.

Low-volume rings using mixed clear and colored fine frit (left) and clear fine mixed with colored transparent powder (right.)

If you are mixing colors/clear for a low volume casting keep in mind that the lower volume of glass can show uneven spots of color more easily. For intense colors like red and purple, we suggest using fine clear mixed with colored transparent powder to make sure that the color is evenly distributed.

10" Low Volume Fill Weights		
	grams	ounces
1st (innermost)	4	0.141
2nd	8	0.282
3rd	14	0.494
4th	20	0.705
5th	24	0.847
6th (outermost)	37	1.305
Total	**107**	**3.774**

8" Low Volume Fill Weights		
	grams	ounces
1st (innermost)	3	0.106
2nd	5	0.176
3rd	7	0.247
4th	9	0.317
5th	12	0.423
6th (outermost)	15	0.529
Total	**51**	**1.799**

Firing Schedules

The following schedules have been successfully used with our molds; bear in mind that every kiln is different and you may need to adjust these schedules for your particular kiln. These schedules should provide you with a useful starting point but cannot be guaranteed to produce the desired results without additional testing. One of the differences between these molds and the typical slip cast molds is that these are much heavier and hold onto heat longer, so you may need to extend the anneal hold and reduce the final ramp rate to anneal the glass properly.

Full Fuse Schedule - 90 COE			
	Ramp	Temperature (F)	Hold Time (minutes)
1	300	1100	20
2	100	1225	30
3	500	1465	10
4	9999 (AFAP)	900	60
5	100	700	off

Full Fuse Schedule - 96 COE			
	Ramp	Temperature (F)	Hold Time (minutes)
1	300	1100	20
2	100	1225	30
3	500	1450	10
4	9999 (AFAP)	950	60
5	100	700	off

The below schedules are those for Low Volume rings; larger frit sizes or mosaic glass will keep more texture with this schedule.

Contour Fuse Schedule - 90 COE			
	Ramp	Temperature (F)	Hold Time (minutes)
1	300	1100	20
2	75	1315	55
3	9999 (AFAP)	900	60
4	100	700	off

Contour Fuse Schedule - 96 COE			
	Ramp	Temperature (F)	Hold Time (minutes)
1	300	1100	20
2	75	1300	55
3	9999 (AFAP)	950	60
4	100	700	off

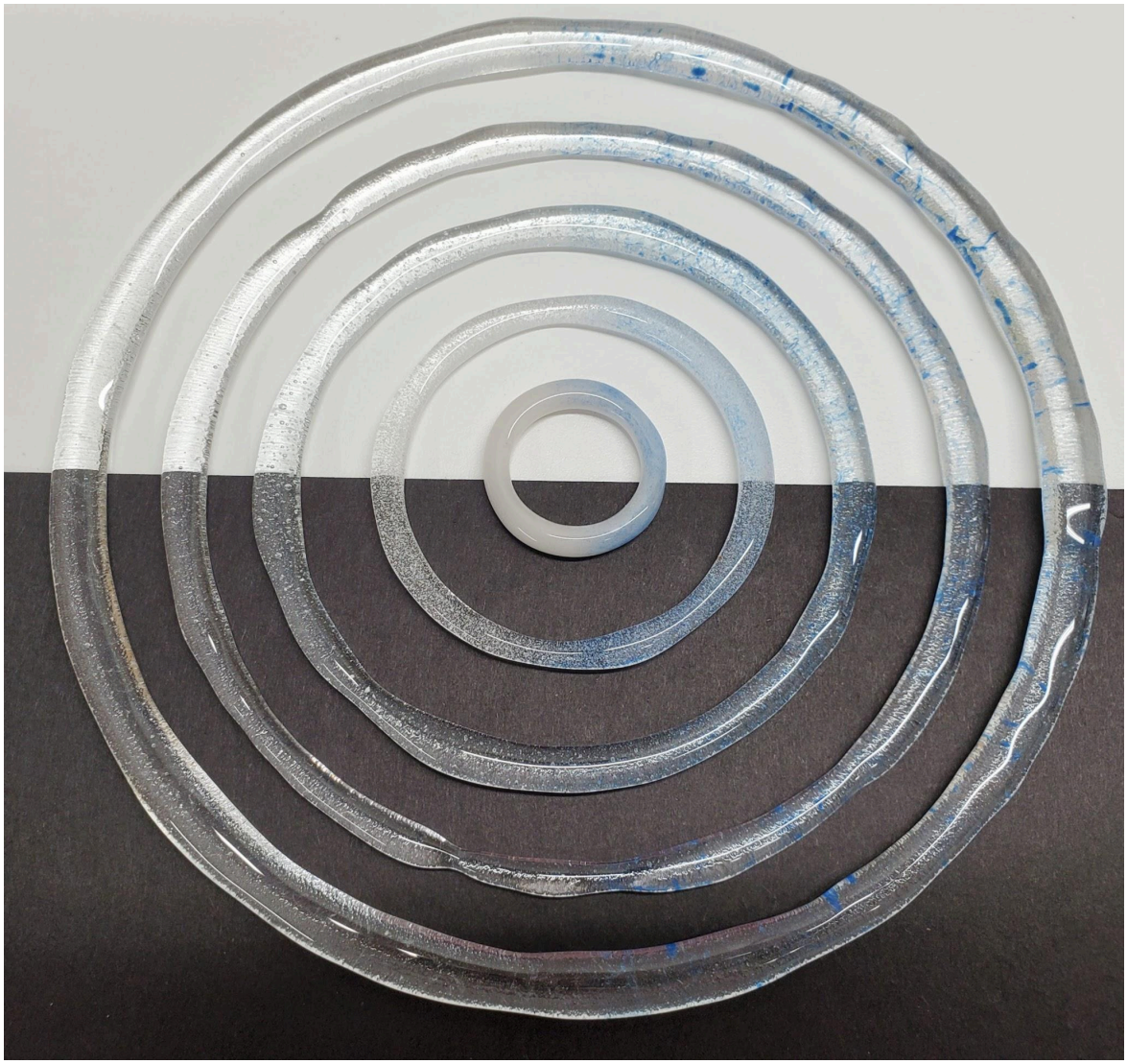
Firing Notes

Controlling bubbles is a constant concern with glass fusing. Bubbles aren't always bad, but understanding how frit size and kiln schedules impact bubble entrapment will help effectively execute your vision for your projects.

In general, smaller frit sizes will trap more bubbles. Glass powders can trap so many microbubbles that transparent glass can look opaque. Microbubbles trapped in clear powder can give it an unattractive grayish color.

Larger frit sizes result in fewer bubbles, but larger frit sizes tend to create more casting spurs. Casting spurs can easily be removed using a diamond file or diamond hand pad. Using a small brush to push the frit away from the walls of the channel prior to fusing can help reduce the chance of casting spurs.

The example pieces below were created with different size frits. All of them are clear, with half the ring dusted with transparent dark blue powder to help show how the frit settled. The outer ring is mosaic frit, followed by coarse, medium, fine, and powder. These were fired with the recommended Full Volume weights and Full Fuse schedule.



Sample Full Fuse rings made with different sizes of glass frit.

These example pieces are much the same. All of them are clear, with half the ring dusted with transparent dark blue powder to help show how the frit settled. The outer ring is mosaic frit, followed by coarse, medium, fine, and powder. These were fired with the recommended Full Volume weights and the Contour Fuse schedule.

Sample Contour Fuse rings made with different sizes of glass frit.

You can see the differences in the bubble size, bubble quantity, overall transparency, and surface texture, particularly in the close-up images provided below.

Side by side comparison of Full Fuse Schedule (left) and Contour Fuse Schedule (right) rings showing bubble size and distribution.

We recommend putting a base of coarse in the bottom of the ring when using mosaic size frit, or mixing the mosaic frit with coarse frit to make sure that there aren't large gaps between glass pieces that could weaken the ring.

Controlling Bubble Creation

Adding a bubble squeeze to your kiln schedule can help reduce bubbles. A bubble squeeze is a series of holds and/or slower ramps between the temperatures where the glass starts to soften (at around 1050 or 1100) and when the risk of devitrification increases (at around 1300). This slower ramp allows the glass to 'settle' and for air pockets to work themselves out of the spaces before the glass melts and seals bubbles inside.

Devitrification (or devit) is when the glass starts to form crystals, resulting in a scuzzy haze on the surface of the glass. The soda-lime glass typically used for fusing is especially susceptible to devit from 1300 to 1550 degrees Fahrenheit. Surface contamination of the glass can also contribute to devit, which is just one of the many good reasons why you don't want a dusty workspace or ZYP dust left from a prior fusing in a mold. Long holds on the ramp up can create crystals that persist even after the top processing temperature is reached. If you are using a glass manufactured for fusing and you experience devitrification, try reducing the ramp times or holds through the bubble squeeze.

All of our provided schedules include bubble squeezes. If you want more bubbles, you can skip the squeeze and use the initial ramp rate all the way up to the maximum processing temperature.

Slumping

You can slump glass on this mold for a gentle ripple effect.

Cover the ZYP primed mold with a layer of shelf paper. The ZYP is extra insurance in case the shelf paper tears. Prop the mold on ½" (13mm) kiln posts or other support to allow air circulation underneath the mold.

If you are doing a deeper slump, cover the center of the mold with either an extra layer of shelf paper or fiber paper to prevent the maker's mark from imprinting in the glass.

Suggested Slump Schedule 90 COE			
	Ramp	Temperature (F)	Hold Time (minutes)
1	300	1000	20
2	100	1230	10
3	9999 (AFAP)	900	60
4	100	700	off

Suggested Slump Schedule 96 COE			
	Ramp	Temperature (F)	Hold Time (minutes)
1	300	1000	20
2	100	1215	10
3	9999 (AFAP)	950	60
4	100	700	off

Sample pieces created using a ring mold for slumping.

After Firing

After fusing, any excess ZYP powder on the cast glass can be removed by a quick rinse or wipe-down with a moist towel. If you notice that ZYP is sticking to the glass see the Troubleshooting sections on sticking.

Can of Boron Nitride Aerosol Lubricant and our favored soft brush

ZYP turns to a powder after one firing. We recommend you use a soft bristle brush, such as a soft car tire detailing brush, to remove any loose powder after each casting. Brush the mold outdoors to avoid contaminating the studio work areas with dust. If you leave any loose powder in the mold, it can become trapped between glass particles on the next firing. ZYP cannot be removed chemically, which means that vinegar, citric acid, CLR, and any other chemical formulation you may have used with other separators will not work. If ZYP gets embedded in the glass you must remove it mechanically.

Troubleshooting

These are some of the most common causes of glass sticking in the molds:

- **Inadequate Separator** - be sure to spray from several angles so that the sides of the rings are covered. Use extra care when priming the mold for the first time. It takes less time to prime the mold properly than it does to try to remove stuck glass. Use the contrast between the dark color of the mold and the white ZYP powder to identify thin spots or areas you might have missed while applying your separator.
- **High Firing Temperatures** - the higher the temperature, the more likely the glass is to stick. Both glass sticking to the mold and separator sticking to the glass are signs that you may be firing too hot. Try reducing your top temperature by 15 to 20 degree increments if you encounter sticking problems. Remember that each kiln is different, and the suggested schedules are a starting point that will need to be adapted to your kiln. ZYP cannot be removed chemically, so you will need to use a sandblaster, lap grinder, diamond hand pads, or other abrasive method to remove the ZYP.

Hand sanding blocks for dealing with embedded ZYP or casting spurs.

- **Opalescent or Opaque Glass** - We have found that these glass types are somewhat more likely to stick. After applying ZYP, dust the mold with a layer of clear powder or try mixing opal frit with 50% transparent. The thin layer of clear powder doesn't change the look of the opal glass and it is easier to

create consistent pieces than mixing opal with transparent glass, but some people like the depth that mixing clear with opal glass adds.

Removing Stuck Rings

If glass sticks **DON'T PANIC**. Find a towel (you know where your towel is, right?) and then try these steps to get the glass out without damaging the mold. If the glass doesn't drop out, then move on to the next step. It is important to be patient and avoid causing damage to the mold.

1. If a ring doesn't come out right away, try holding the mold vertically, resting the edge of the mold on a firm flat surface for support. Make sure that the hand holding the mold covers the stuck ring to prevent it from falling out and breaking. Use your other hand to gently pry the ring away from the mold with a dental pick or other sharp tool. Take care not to scrape the mold and be sure that you don't push against the mold channel wall for leverage; gentle pressure is often enough once gravity is no longer working against you. Move on to the next step rather than using more force with this method.
2. Invert the mold over a flat surface covered with a towel, cardboard, or several layers of newspaper for cushioning. Tap the mold against the padded surface a few times and see if the ring pops out of the mold. You can also gently tap on the bottom of the mold to try to release the glass.
3. Place the mold in the freezer for 20-30 minutes. Invert the mold over a cushioned surface as in step 2; the cold temperatures can loosen the glass as it will shrink at a different rate than that of the mold.
4. Finally, invert the mold on ½ inch (13mm) kiln posts in the kiln over a prepared kiln shelf. Make sure that just the edges of the mold are resting on the kiln post corners and that the rings can drop freely. Use a piece of shelf paper, silkemat, or fiber paper to cushion the surface of the kiln shelf. Use the following schedules, but monitor your kiln closely and skip to the anneal as soon as the stuck glass is released.

Stuck Ring Schedule 90 COE			
	Ramp	Temperature (F)	Hold Time (minutes)
1	250	1000	20
2	100	1315	30
3	9999 (AFAP)	900	60
4	100	700	off

Stuck Ring Schedule 96 COE			
	Ramp	Temperature (F)	Hold Time (minutes)
1	250	1000	20

2	100	1300	30
3	9999 (AFAP)	950	60
4	100	700	off

If any small patches of glass remain stuck in the mold after the inverted fusing cycle, it is possible to use a dremel with a diamond ball point to drill off the glass, using care to avoid pitting the mold.

Broken and Cracked Rings

There are several things that can contribute to broken or cracked rings.

Schedule too hot combined with low glass volume

Characterized by wobbly, lumpy, or incomplete rings with gaps. If the ends near the gap are thicker than the rest of the ring, then the glass probably pulled together during the fuse to try to make a 6mm section. Increase your frit volume or use a cooler (either contour or tack) schedule so that the glass won't move as much.

Inadequate separator

If the glass sticks to the mold then it can't move freely when expanding and contracting which can cause cracks. See the section on sticking for more information on removing stuck glass, and use extra care when priming the mold for the next time.

Inadequate annealing

Glass needs to be annealed after fusing. This is a hold and slow descent at temperatures appropriate for the glass and the layup to allow the temperature in the glass to equalize and cool at the same rate on the inside and the outside of the piece. If the rings have hairline cracks but are loose in the mold, or if the rings break easily after you've fused them then you probably need to adjust the anneal.

Make sure the annealing hold temperature is appropriate for your glass; your glass manufacturer will have this information. Try adding 60 minutes to the anneal hold, and reducing the cooling ramp rate to 50 degrees per hour Farenheit down to 500 degrees. These molds have a lot of thermal mass and it will take longer for the glass in contact with the mold to cool than the glass exposed to the kiln air. Extending the hold will allow the temperatures to equalize before you start the annealing decent ramp.

Make sure you are elevating the ring mold on kiln posts to allow for better air circulation under the mold. Elevating the mold exposes the bottom of the mold to the air in the kiln and ensures a more even temperature.

If necessary, continue to slow the ramp rate and extend the time of the cooling ramp. Glass exposed to the kiln air is going to cool more quickly than the glass that is touching the mold. Slowing the rate of descent and holding that controlled cooling rate longer will help the glass cool evenly.

Thermal shock during cooling

If your kiln is located in a cold room and loses heat too quickly once the fusing cycle completes the glass can shock and crack. Remember that the temperature readout on your thermocouple is the reading for the kiln air temperature and that the glass touching the mold is likely hotter than the air temperature. If your kiln is located in a cold area like an unheated garage, consider controlling the temperature decent to 100 degrees F (38 C) instead of turning the kiln off and allowing an uncontrolled descent.

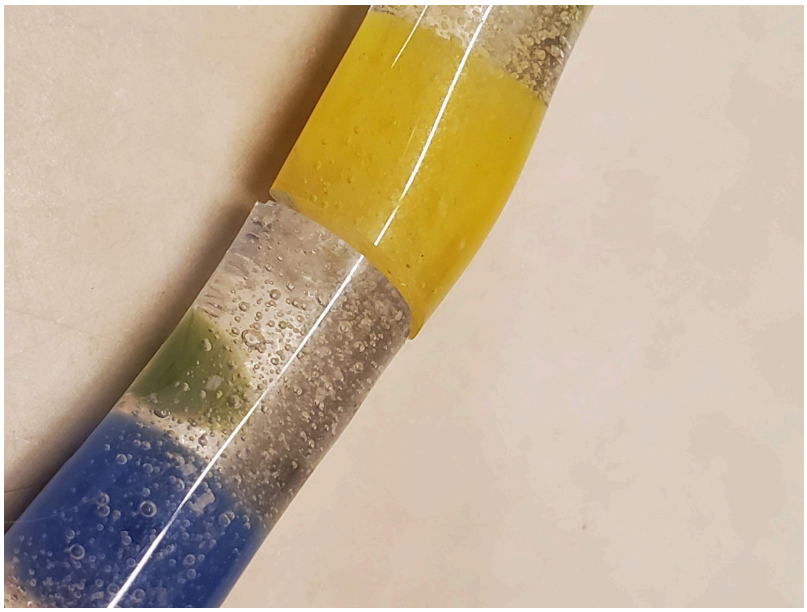
Thermal shock can also occur if you open the kiln too soon. Do not open your kiln above 100 degrees F (38 C).

Using incompatible glass or compatibility shift during fusing

If you use glass from different manufacturers then you must test to confirm compatibility. There can still be compatibility issues between different brands of glass that have the same published COE. It is also possible that glass that starts out at the same COE can shift after multiple fusing cycles. Each time the glass is heated and cooled more chemical changes take place. Higher temperature fusing cycles are more likely to cause the glass to shift, and some colors and glass types are more prone to shifting than others.

It can be difficult to distinguish compatibility issues from annealing schedule issues. If you're not sure, try using fresh glass that hasn't been previously fired and is all from the same manufacturer.

Using polarized film can also help determine if there is stress in transparent glass.



Appendix A: Additional Kiln Wash Notes

It is possible to use Primo primer but not recommended. Because these molds are high fired stoneware they are not porous and the kiln wash doesn't 'stick'. In bisque fired molds, the mold absorbs the water leaving the wash stuck to the mold surface. In a fully vitrified mold like this one, the mix of water and kiln wash just runs off the sides and puddles making it difficult to get an even layer.

I've had success with heating the mold to 400 degrees F before carefully spraying the kiln wash on in thin layers. I used the normal 5:1 ratio of water to kiln wash and put it in an inexpensive pump spray bottle (like the kind for hairspray - I got mine from the travel/sample size section at a drugstore). The kiln wash settles to the bottom of the bottle, so shake well and frequently.

The spray evaporates almost instantly at first, leaving the kiln wash on the mold in a thin layer. The mold cools rapidly as the water evaporates, so you'll notice that it stays wet longer the more you spray the mold. If the mold gets too wet, the kiln wash will drip, stripping off previously dry layers. If you can't get good coverage before the kiln wash starts to run off the sides, put the mold back into the oven and reheat before adding more layers.

The spray bottles that produce a super fine mist aren't suitable because the kiln wash particles will clog the sprayer. I found that brushing is difficult because the brush disturbs previous layers of wash and it is tough to get even coverage.

I don’t mind doing this process for slumping molds that don’t have to have the kiln wash refreshed often, but glass casting uses higher temperatures that degrade kiln wash. You will need to clean and reprime the mold after every casting which is time intensive. Primo is easier to clean off and releases better than regular kiln wash that is meant for kiln shelves, but be aware that heat changes the chemical structure of both of these products and they do need to be replenished on each fuse to avoid sticking.