Fun with Float

Glass Art is More Than Art Glass

An introduction to working with float glass

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Glass Campus Publishing
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Table of Contents

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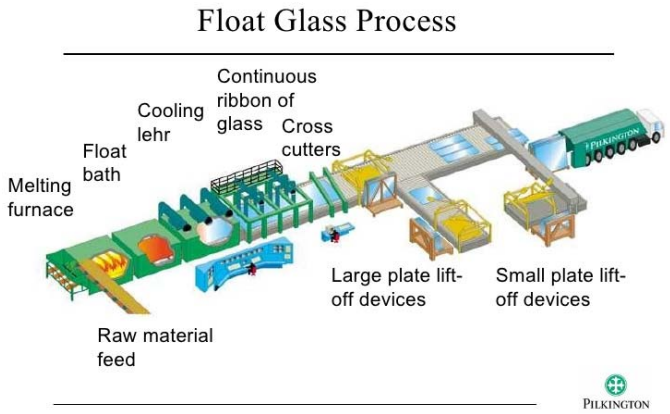
Fun with Float

What is float glass?

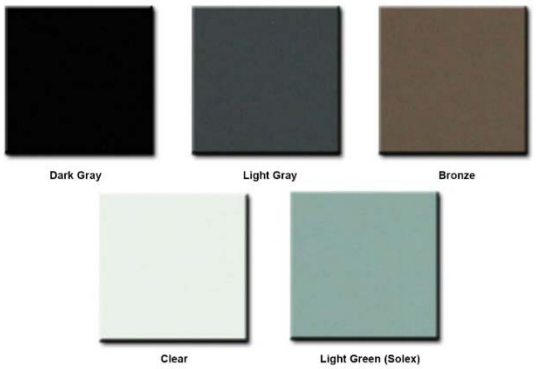
Float glass is common window glass. It's called float glass because it's made by pouring molten glass onto a bed of molten tin – unlike art glass that is made by pouring the molten glass out onto a steel table and rolling it out. Previous to the invention of float glass, window glass was made the same way as art glass and was called plate glass.

Because it's produced in much larger quantities than colored art glass, float glass costs much less. It's often even available free as scrap.



Colored Float

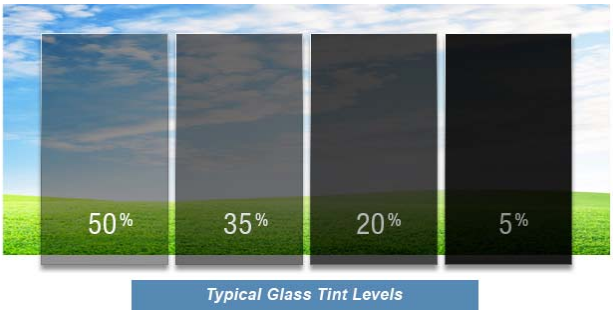
Although float glass is most often clear, it's also available in various tints of bronze, grey and green.



Armstrong Glass sells a variety of colored glass called "Float Fire" that is compatible with float glass. This is not float glass but is art glass that has been formulated to be compatible to fuse with float glass.

Tinted Float

Float glass is available in different degrees of tint from barely enough to be noticeable to almost full black.



Thickness

The thinnest float glass is 1mm thick but it is extremely rare and very difficult to find. 2mm thick glass is popular for picture framing. The most common window glass is 3mm but float glass is also available in a variety of greater thicknesses. For art projects were 6mm thick glass is desired, instead of fusing together 2 layers of 3mm glass, artisans often prefer to start with 6mm thick glass. For special projects, much thicker glass allows for unique effects. 12mm thick glass is popular for deep carved sandblasting and for special kiln casting effects.

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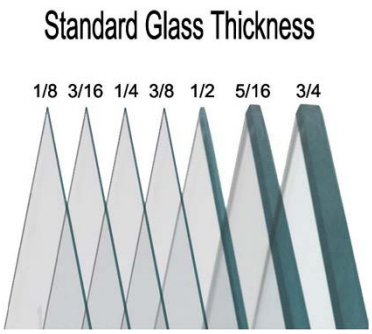


Textured Architectural Glass

Horticultural Glass

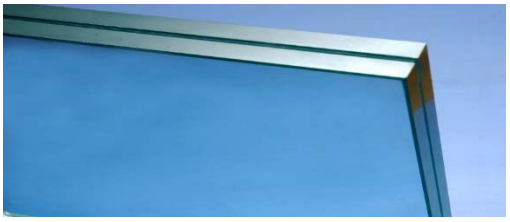
Some clear window glass is not float glass but is instead horticultural glass. It is made by rolling out molten glass the same way art glass is made. Because it was not made by floating on molten tin, there is no need to test for tin. However, horticultural glass is EXTREMELY susceptible to devitrification. You might want to check with your supplier to be sure you're getting float glass and not horticultural glass.

Architectural Glass

Architectural glass is clear glass made with a textured pattern. It's made the same way as horticultural glass. Because it has no tin side there is no concern for what side you fire up or down. Although architectural glass is made mostly for wall panels and inserts in entry doors and cabinet doors, there are loads of interesting ways you can use it in kiln work.

Laminated Glass

For safety purposes, laminated glass is produced by laminating 2 layers of glass sandwiched with plastic film between them. Windshields on cars and trucks are almost always made with laminated glass.



Laminated glass

Tempered Glass

Tempered glass, also called toughened glass is made from already annealed float glass taken through a furnace to heat it to around 1150F (620C).

You cannot cut tempered glass into smaller pieces but if you give the corner of the sheet a sharp tap with a hammer, it will break (more like explode) into little pieces about the size of a pencil eraser. These can be fused together to make some interesting and attractive projects.

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Tempered glass broken into chips

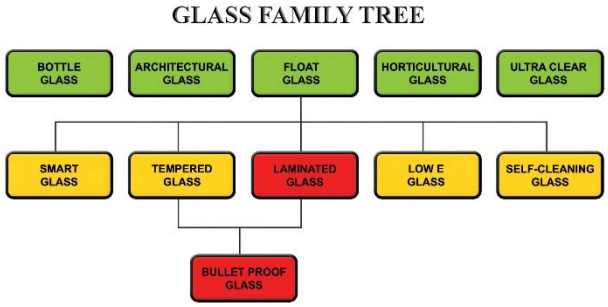
Clear tempered tray on float base

Glass bowl made with bits of tempered glass

Starfish cast with bronze tempered glass chips

Glass Suitable for Fusing

Not all glass is float glass and not all glass can be using for kilnforming.



Green for GO

Float glass and horticultural glass are all safe to use for kilnforming.

Amber for CAUTION

Tempered glass and specially coated glass can be used for kilnforming but require special treatment and special consideration.

Red for STOP

Laminated glass can NOT be used in a kiln**.**

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Compatibility

The COE of float glass can vary from 80 to 90 depending on the glass maker and even depending on different production runs from the same glass maker. Sometimes you can fuse pieces from different sheets but you can only fully trust it to be fuse compatible if you use only glass from the same original sheet. Artisans that use a lot of float glass will often buy full cases so they can expect all the glass to be from the same production run and therefore fully compatible.

Freeze Compatible Test

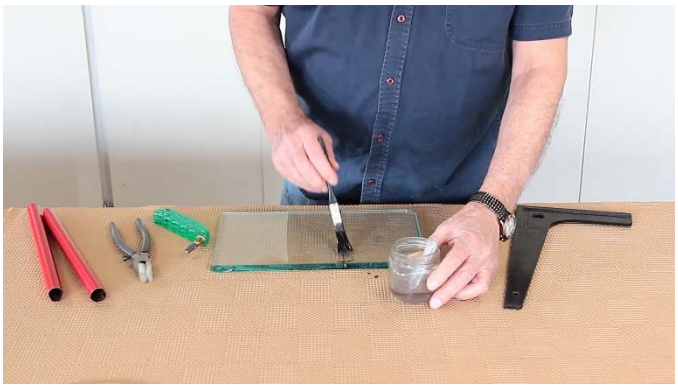
Mixing pieces of float glass from different sheets is a risk but it often works. If you have done that, you might want to test to see if the glass you used has been compatible enough to produce a trustworthy fuse. It takes specialized equipment to do a scientifically valid test but a simple test you can do at home works well. Wrap the project in a cloth or paper towel and put it in your freezer for a few hours. Take it out of the freezer, unwrap it and allow to thaw. If the glass used was significantly incompatible, thawing will cause it to crack.

Cutting Float Glass

Float glass is more consistent than art glass so it's easier to cut. A lot easier. In my beginner classes I tell students to go to a glass shop that sells mirror and window glass, not art glass, and ask for scraps to practice on. Put in a few hours practicing. If you can't get good consistent reliable cuts with float glass, you'll never be able to get any kind of acceptable cut on any glass.

OIL – oiling the cutter wheel isn't essential but it WILL prolong the life of the cutter and it WILL produce a score more likely to break where you want it to. You can use the kind of cutter that will wick oil onto the wheel or you can dip the cutter into oil before scoring.

It's different for thick glass. Using oil is important with regular thickness glass but the thicker the glass is you want to cut, the closer to essential it becomes you use oil. On really thick glass, skilled artisans don't settle for just the oil that wicks out or from dipping the cutter into oil. They pour or brush oil onto the glass BEFORE scoring it. They slather on enough oil they score THROUGH the oil.



Brushing on oil before scoring.

You can get away scoring dry on thin glass but will NOT get reliable trustworthy scores on thick glass without using oil. Lots and lots of oil

The objective when making the score is to get a smooth consistent speed consistent pressure score. On thinner glass, you can get away with a little variance in speed and pressure but NOT on thicker glass. If you don't get a great score you will NOT get an acceptable break. It's a lot less easy on thicker glass. Cutting thick glass takes practice. You could waste a lot of expensive glass working through your practice experience. Maybe it's a good idea for a while to practice on any scrap you can find and for finished projects buy precut thick glass?

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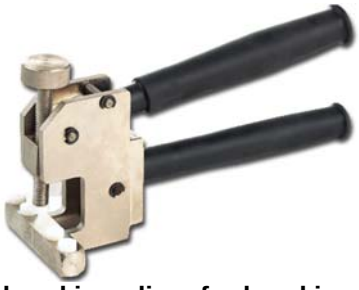
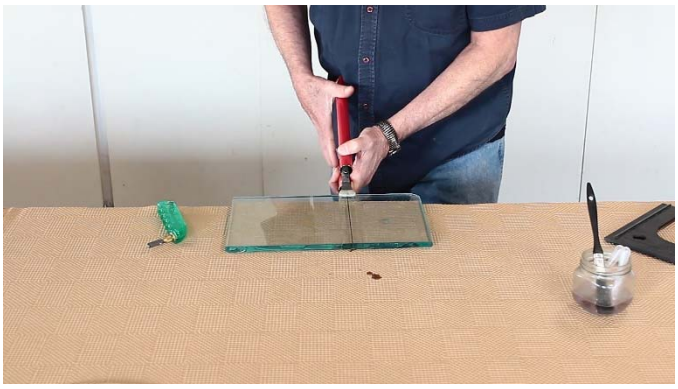


Heavy Duty breaking pliers for breaking thick glass

By putting a length of pipe on the handles of regular running plies to provide extra levers, you can use them to cut glass as thick as ½ inch (12mm).

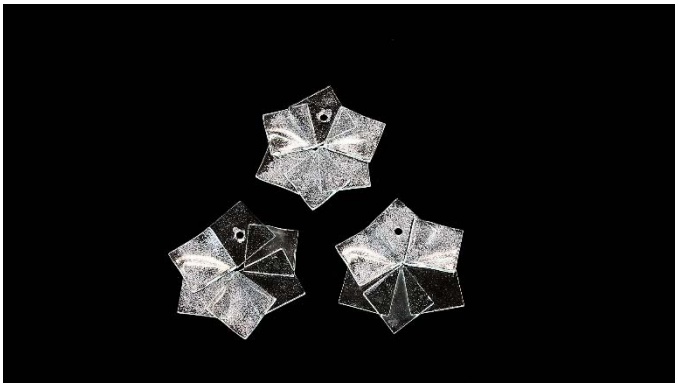


Breaking with extensions on regular running pliers

Devitrification

Float glass is especially susceptible to devitrification. This appears as a milky foggy haze on the top surface of the glass. Glass molecules heated in the kiln crystallize causing the glass to become opaque and brittle. Some artisans like the appearance of devitrification but most consider it undesirable and unattractive. An effective way to reduce the likelihood of devitrification is to fuse glass with the tin side facing up. Fired this way, your project is more likely to have a clear shiny finish.

Closeup of devitrification



Some pieces were tin side up and others air side up.

An easy way to remember which side to place up is to remind yourself to "TUP it" – tin up.

Preventing Devitrification

If your project designs require firing tin side down, using a devitrification spray (like Spray A or Super Spray) will help.

WARNING *– some devitrification sprays contain lead or chemicals that will make your project unsafe for contact with food. Check what you're using before assuming it will be food safe.*

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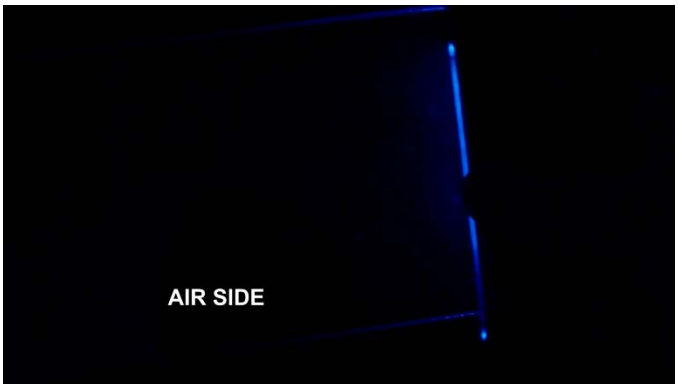
An effective and inexpensive devitrification spray you can make yourself is to just dissolve borax in water and either brush or spray it on the glass. Be sure to get a thorough coating.

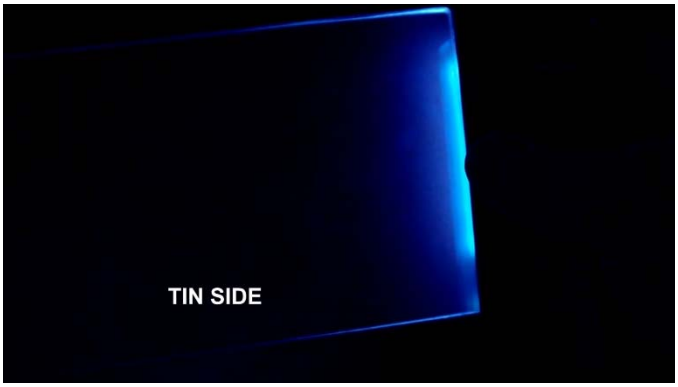
You can also eliminate devitrification by completely covering the air side of the glass with sifted frit, confetti, powder or mica.

Tin test lamp

Tin Side Testing

When the molten glass is poured onto the molten tin, some tin is absorbed into the glass. This causes an invisible haze on the surface of the glass that floated on the tin and is referred to as the "tin side". The side of the glass that was facing up is referred to as the "air side". When you fire float glass in a kiln the results can be affected by whether the tin side was fired facing up or facing down. To be able to control results, you will want to test to identify which is the tin side and which is the air side.





Ways to Test for Tin Side

Short Wave UV - With a short wave ultraviolet light (flashlight, fluorescent bulb, etc.) shine the light through the glass at a 45º angle. If you have the tin side of the glass facing down, you'll see a slight blue-white fluorescence on the tin side and a purplish shine on the air side. Turn the glass over and repeat the test to confirm which is the tin side and which is the air side.

NOTE *– this does not work with the long wave UV light used to cure UV glue but only with short wave UV light.*

Turning the off all other lights will help you make an accurate test.

WARNING *– when doing this test DO NOT look directly at the UV light source. Exposure to UV light can cause serious vision problems.*

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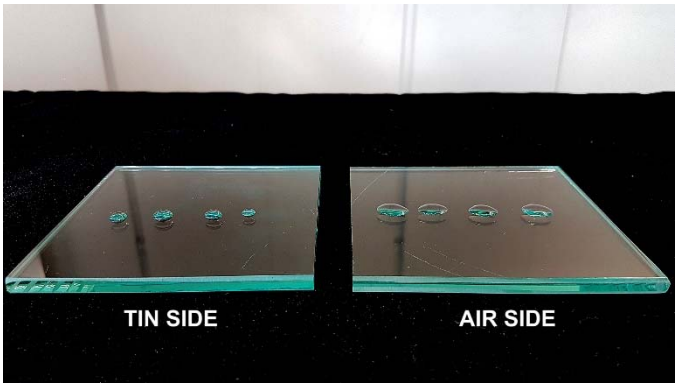
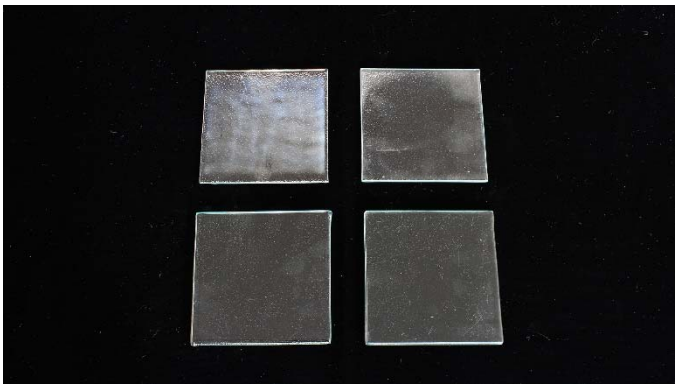
Water drop test - Thoroughly clean both sides of the glass. Place drops of water onto the glass and watch how much the water drops spread out or thin out. Repeat this on the other side of the glass and compare what happened on each different side. The water drops will spread out and thin out more on the air side than on the tin side. The tin side restricts the water drops from spreading out and encourages the drops to hold together in a raised dome shape.



Touch test - Some artisans claim they can identify tin side by touch because the air side feels smoother than the tin side. I tried this haven't been able to feel any difference. Maybe it's just a kind of special zen experience. Maybe I just don't have enough zen to make it work?

Taste test - I've heard claims you can identify tin side by taste. Apparently the tin side has a more metallic taste. I tried this. Other than feeling like a fool licking a piece of glass, I couldn't tell the difference. Maybe others have more sensitive taste buds.

Firing Test - A consistently reliable way to identify tin side is by firing in the kiln. Cut two small pieces or strips off the original pieces of glass. Mark one piece to identify it and turn it over. Fire both together in your kiln to 1450º F (788ºC). You could do this test firing in the same load as a full fuse firing. The tin side will remain clear and the air side will have a foggy haze.



Tin Bloom

Tin bloom appears as a white discoloration on the tin side of the glass and is often mistaken for devitrification. It appears looking like stretch marks between the foggy frosted areas. While many artisans dislike tin bloom, others think it's attractive and will even intentionally induce it.

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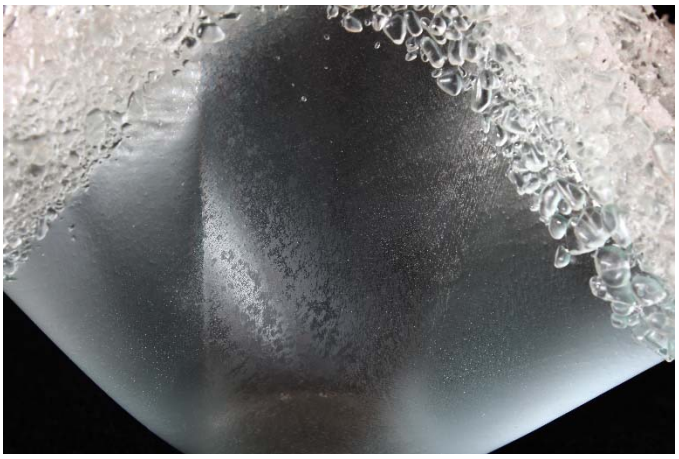
Float glass vase with tin bloom



Close up of tin bloom

Adding Color

There are lots of different materials that can be used to apply color to glass and lots of different way to apply those materials.

PAINT

For painting on glass, the greater clarity of float glass better displays the true colors of the paints. There is a huge variety of paints intended for glass. Some paints are applied cold and some intended to be fired to fuse on in a kiln. "Pebeo" is a make of paint that when fired to 375F fuses reliably to glass. You can do it in your kitchen oven.

LISA DAYVOLT – paint on glass

ENAMELS

Because enamels are ground into very fine particles and have a very low expansion rate, they can be fired onto any glass. You can use the enamels intended for metal but it's not reliable and not recommended.

Low fire enamels will fuse on as low as 1200F and form full gloss at 1300 to 1350F so you can fuse enamels on during a slump firing.

High fire enamels fuse on at 1400 to 1450F so could be fused during a tack fuse firing on float glass. Tack fuse temperature for float glass is 1425F.

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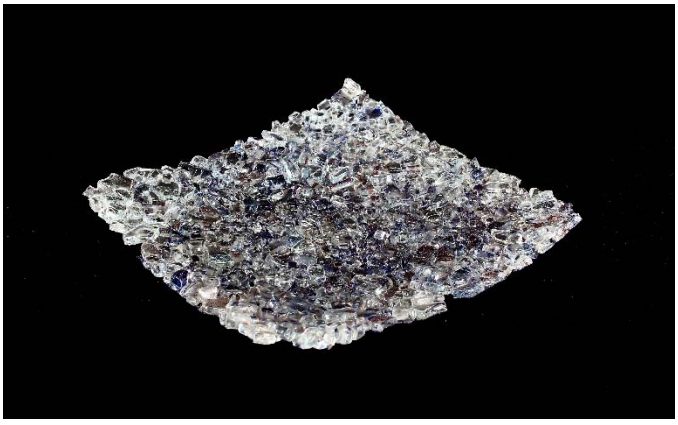
Enamels can be applied dry or wet. You can buy enamels premixed as a liquid to be applied as paint or buy them dry and mix them into liquid form to brush on, spritz on, air brush on or silkscreen on. The liquid can be water based material like “Klyr Fire” or it can be organic materials like “Glastac”, aloe vera, agar, lavender oil, clove oil, etc. It can even be water but the powder tends to settle quickly in water.

MARGOT CLARK – enamels on glass

ANJALI VENKAT – Enamels on glass

FUSE COMPATIBLE FRIT

Armstrong Glass and Youghioghenny Glass make glass frit that is intended to be fuse compatible with float glass. Ed Hoys in the USA imports a brand of float compatible frit from Germany.



Tempered glass tray with float compatible frit

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ALCOHOL INK

Alcohol Inks can be painted on or sprayed on. They look gorgeous but cannot be fired in the kiln and are not dishwasher safe. They can rub off while being handled and need to be coated. Some artisans use “Krylon” but it leaves a rather sticky surface. I’ve had good results with spray-on automotive clear coat.

LINDA DEAN – Alcohol Inks

FABRIC DYE

You can use fabric dyes (like the ones use to change color on cloth or for tie dying) either sprayed on brushed on. Because dyes aren’t intended to stick to glass, they can’t be trusted to not come off. I’ve found spraying after with automotive clear coat produces a good protective surface that well protects the added colour during handling.

Tempered glass bowl colored with blue fabric dye

MICA

Because mica has no COE, it can be fused to any glass. It can be especially attractive on clear float glass and spectacular on chips of tempered glass.

A caution. Particles of mica will only fuse to glass and not to other particles of mica and not all colors of mica survive kiln firing. It’s a good idea to do some research and some tests before trying mica on an important project. You can apply it sifted on dry or as a liquid with a brush or eye dropper.

Mica will not fuse to other mica but it will fuse to enamels as well as to glass. You could apply colored enamel and fire it to fuse in your kiln then apply mica and return it to your kiln for another firing.

Painting Mica onto Glass

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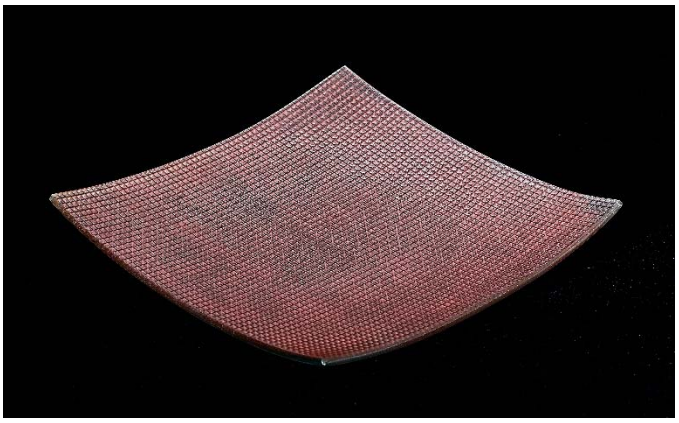

Mica on architectural glass

GILDING

Verre Eglomise (that's French for gilded glass) is a centuries-old decorative art process in which the back side of glass is gilded with gold or metal leaf.

PEGGY PETTIGREW STEWART – Verre Eglomise

DICHROIC COATING

Some of the companies that make dichoic glass will coat any glass with dichroic. You can order dichroic coating or complete a project with float glass then send it off to be coated.

PEGGY PETTIGREW STEWART– Embossed Dichroic

Casting with Float Glass

Glass made for fusing can be cast into molds to produce relatively transparent castings. You can cast float glass but you won't get the quality of casting you might expect with fusing glass.

You can fire float glass in a kiln to imprint/emboss a textured or sculpted design the same way you do fusing glass but because float glass is much harder and has lower viscosity, you will have to a much higher temperature to get the glass to pick up fine detail.

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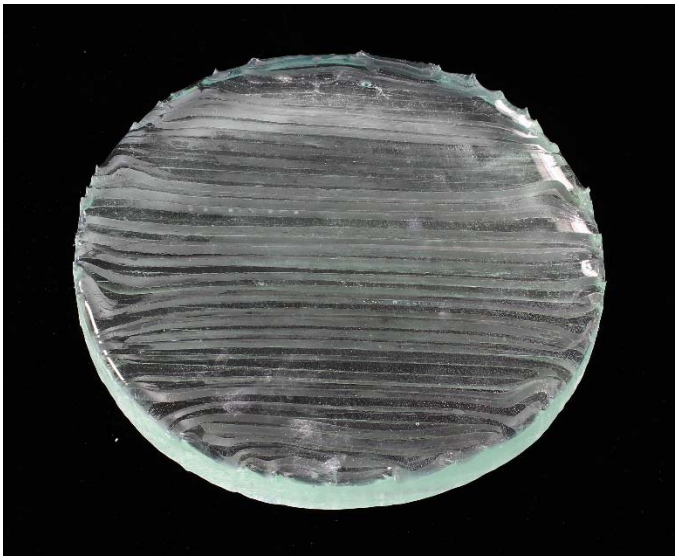


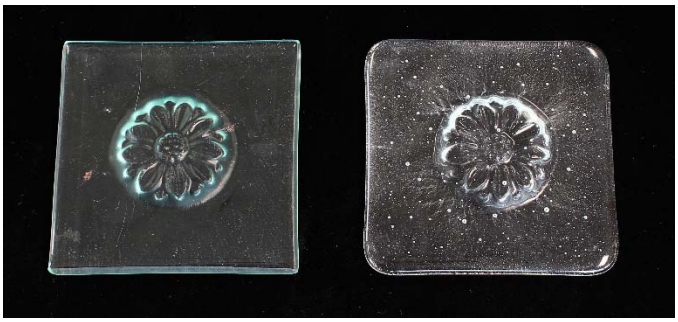
8 inch round cast from strips of float glass

The stripes left from the tin side of strips of glass created an attractive design on a drop

Heart cast from strips of float glass

Embossing with Float Glass

Firing float glass over ceramic fiber paper or plaster/investment casting will pick up just as much detail as you could with fusing glass but just takes a higher temperature to produce the same results.



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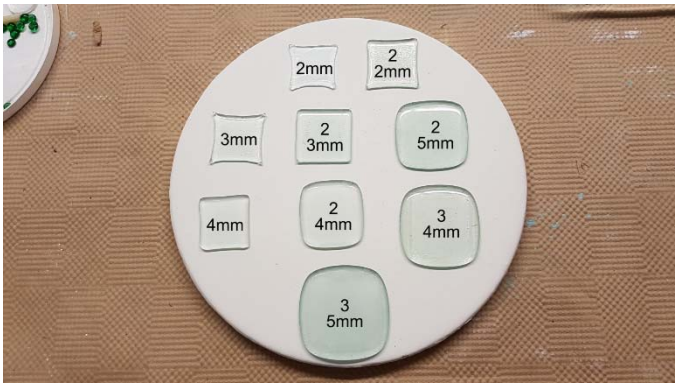
6 mm Rule

Is float glass governed by the same “6mm Rule” as fusing glass? To test this question, I fired a series of different size single and multi-layer firings of float glass. The photo demonstrates that float glass will contract or expand in the same way fusing glass does.



Test firing to confirm 6 mm rule

Firing Schedules

Because float glass has such a wide variance in COE and in materials consistency, it’s not possible to provide firing schedules that can be fully trusted for all float projects. Glass from different glass makers will require slightly different schedules and glass of different thicknesses even more differences. Float glass is stiffer than art glass so is slower to soften and requires higher temperatures. Most artisans that work with float glass use basically the same firing schedules as for art glass and just allow for higher performance temperature and higher annealing point:

Some Special Factors

Ramp speed – Float glass can be ramped faster than the art glass we use for fusing. Because float is so susceptible to devitrification, ramping faster helps reduce the likelihood it will happen.

Hold times – Holding at high temperatures encourages devitrification so it’s better to fire higher with a short hold than to fire lower with a short hold.

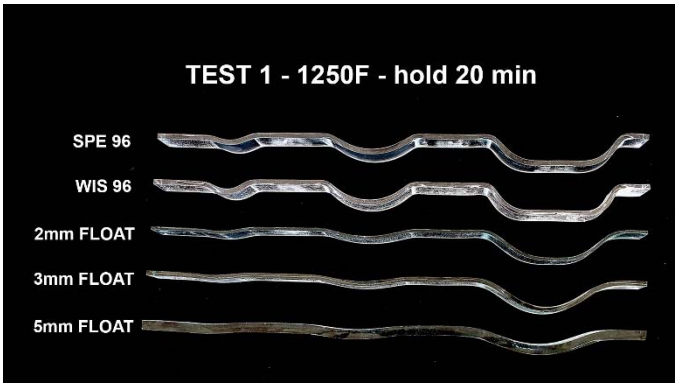
Anneal – Anneal temperature for float glass is 1050F – that’s 565C

Slump resistance – With all glass, the wider the span, the greater the resistance to slumping. Because float glass is harder than art glass, it’s even more resistant to slumping.

Performance temperature – Because float glass is so much harder than art glass, it require much higher temperature. For example, where COE96 glass will form a crisp tack fuse at 1350F and COE90 glass produces the same result at 1370F, float glass must be fired to 1425F to produce the same effect.

Devtrification – Float glass is much more likely to exhibit devitrification than art glass.

Slump Comparison Test



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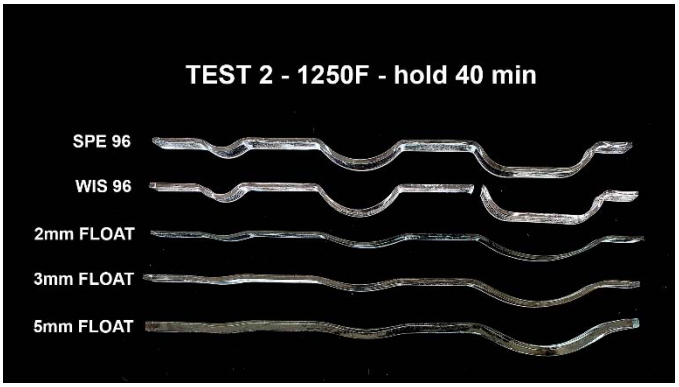
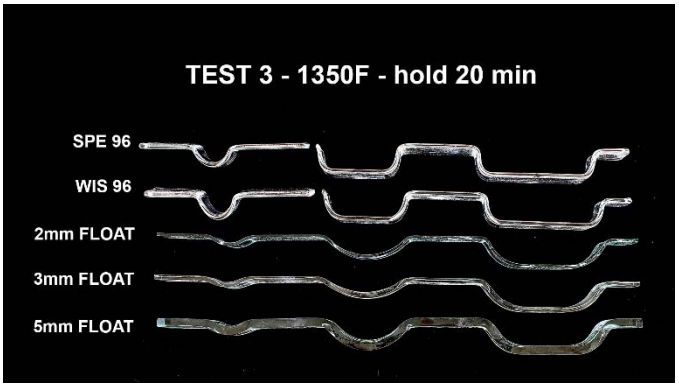
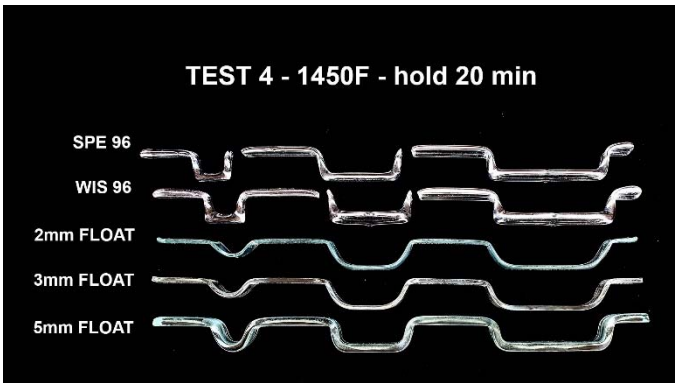
Fun with Float







Repurpose – Recycle - Relove

There are two big benefits from recycling glass.

- You can get it cheap – sometimes free.
- You contribute to sending less material to landfills.

Shops that sell glass and mirror discard a lot of float glass as scrap and may be willing to sell it to you cheap or even donate it to you. When you're scrounging for discards, it's a good thing to demonstrate gratitude. If you ask them to set scraps aside for you, make a point of bringing something. Home baked cookies or muffins are always appreciated. If you can't cook, buy a box of donuts for the shop. Perhaps even a sample of what you make with the glass they give you. Show your appreciation for their help.

Advantages to Using Float Glass

Low cost – Float glass costs less than half the price of the cheapest art glass and is often free as scraps

Widely available - Window glass is everywhere. If you can't get window glass it's unlikely you can get any glass of any kind.

Variety of thicknesses – Float glass is available from as thin as 1mm to as thick as you want.

Greater clarity – Even regular window glass with its slight blue green tint is a lot clearer than any art glass. If you're willing the pay the premium price, you can get "ultra-clear" glass that doesn't have that tint.

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Crack resistant – Float glass is less susceptible to thermal shock than art glass – it can be ramped in your kiln at almost twice the speed of art glass.

Stiffer – This allows float glass to be fused more vertical than art glass – many projects that are impossible with art glass can be done easily with float glass.

Harder - Because float glass is a lot harder, it can be used for shelves, dams and molds for working with softer fusing glass. You can even use it as a platform to lap grind glass on.

Disadvantages to Using Float Glass

Higher temperature required - Float glass requires higher temperature to soften. This is a pretty small issue – especially since it can be ramped so much faster without cracking.

Limited color variety – Float glass is available only in clear and a few tints of grey and bronze.

Compatible only to itself – Sometimes you can get away with fusing pieces from different sheets but it's a gamble. Artists that use a lot of float glass will often buy large full sheets to be sure they have a lot to work with. Maybe instead of buying 2' x 4" sheets of art glass buy 4' x 8" sheets of float glass.

More difficult to coldwork – Float glass is harder so will take longer to grind down but that disadvantage is offset but the advantage of being of more reliable consistency so can often be worked with slightly greater pressure during coldworking.

More susceptible to devit – Fusing glass has been formulated to resist devitrification. Not so float glass – so it's MUCH more likely to collect devitrification – especially when fired multiple times.

Need to identify tin side - Which side is fired facing up determines how likely it is to collect devitrification. PLUS it's important if adding paints, enamels or mica to avoid applying on the tin side.

Float Fear Factor

The more I experiment with float glass the more I've come to realize a lot of the warnings against using float glass are fearmongering foolishness For anyone that wants to use float glass for kilnforming, there are some issues to be concerned with but no more issues than with any other glass that isn't specifically formulated for, and specifically tested, for fusing.

Float glass is a great deal more susceptible to devitrification than fusing glass – but that does NOT mean it will always devitrify. In fact, float glass is less likely to devitrify than the art glass traditionally used for stained glass.

Float glass can't be always trusted to fuse to other float glass unless it is from the same original sheet – but the same applies to all glass that hasn't been specifically tested to be fuse compatible. It doesn't mean it won't fuse reliably. It's just means you can't be certain it will work.

Some materials (like mica) will refuse to fuse to the tin side of float glass – but it also won't fuse to the dichroic or iridescent side of fusing glass.

For every disadvantage float glass has, there is an equal advantage. Do NOT be frightened away from working with it. I've come to learn there are more advantages then disadvantages.

Working with float glass can be fun. A lot of fun.