

Stained Glass Tips

By Chris Jeffrey

**Chris Jeffrey Stained Glass, LLC
201 North Main Street
Studio Place Arts Building
Barre, VT 05641
(802) 479-0020
cjeffrey@sover.net
www.chrisjeffrey.com**

Glass Cutting

When you are cutting glass, try to break it away from the cartoon, not over it. Otherwise, you will get small, often almost invisible shards of glass on the paper that can cut you or scratch your glass. Since shards are inevitable when cutting glass, keep a brush handy and regularly clean off your cartoon and work area.

Don't wait until after you have cut your piece to notice a scratch. Check your piece of glass for scratches before you cut it. Scratches are more of an issue with transparent glass than opalescent glass, and they are particularly noticeable with clear glass.

Machine rolled glass often has a smoother and a rougher side, and it's easier to cut on the smoother side. This generally is the better looking, shinier side, and is normally the side you will want facing up in your panel anyway.

If you are cutting glass with a pronounced texture on one side, such as glue chip or ripple glass, cut on the smoother side. If you want the textured side to be facing up in your design, turn your cartoon over and cut on the smoother side of the glass. For this you will generally need a light table to be able to see the lines through the paper. If you don't have a light table you can cut out paper patterns of the pieces you want to cut, and place the patterns upside down on the smooth side of the glass.

Use lots of lubrication when you cut glass. This is especially important when you cut opal art glasses such as Yougheginy or Uroboros, for which your cutter should be really soaked. Lamp oil works very well and is not expensive. Specially formulated "cutting oils" sold by some stained glass suppliers are expensive and probably don't perform any better than lamp oil.

Cut a piece of cloth to put into the bottom of your oil jar. It will help protect the cutting head when you dip the cutter into the jar.

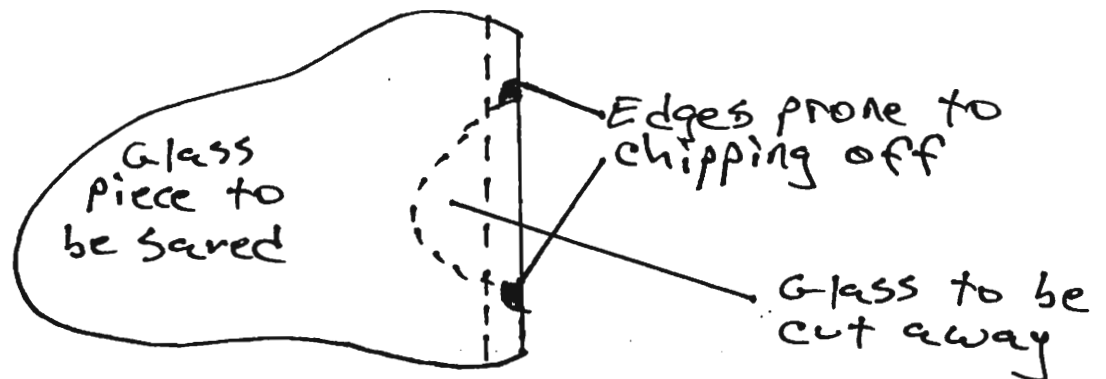
Cutting oil works well for removing labels and glue on glass. Just wipe some on, let it soak in for a minute, and then the label and glue should be much easier to remove, especially if you use a razor blade. For really stubborn glue you can use acetone, but read the health and proper usage warnings on the can first. The whitening used in the putty mix works well for removing Sharpie and other markers from glass. Put a little on your finger and then just rub it on the glass.

If you are cutting large and small pieces from the same sheet of glass, cut the larger pieces first and then use the left-over glass to cut the smaller ones. This helps to reduce waste.

If a score line doesn't break from the end where the cut started, try turning the piece of glass and breaking it from the end where the cutter came out. Sometimes score lines don't break because there wasn't enough pressure applied to the cutter at the beginning of the cut, but often there will have been enough pressure by the end of the cut to allow the glass to break from that end.

If a piece of glass has some hard cuts and some easy ones, you generally should cut the hard ones first. That way, if you mess up a hard cut, you haven't wasted your time doing the easy cuts on a piece you end up throwing away. There are times, though, when you may want to do an easy cut first if you can minimize waste that way.

If you are cutting a curve into a piece of glass, very often the edges of the glass will break off. To prevent this, cut and break out the curve before you cut the rest of the piece. For example, in the piece below, the two cuts are represented by dotted lines. Make the curved cut first (using relief cuts), before the straight one. This way, if the ends of the curved piece chip it doesn't matter since you are going to cut them away when you make the straight cut.



If you are trying to break a very narrow piece of glass out of another very narrow piece of glass, so that you can't get a good grip with your hands on the glass, you can use two grozing pliers, placed on either side of the score line. Place the pliers directly opposite each other, as close to the score line as possible.

If you cut a piece of glass that doesn't quite fit the lines of your cartoon, and you don't feel like trying to cut that shape again, it's really okay to change the cartoon to match the shape you've cut and white-out the lines you're having trouble cutting to. Just be sure to check whether that changes some of the other pieces you've already cut.

Number your pieces of glass with a Sharpie marker as you cut them, and number the cartoon as well. That not only helps you remember where each piece of glass goes on your cartoon but it also lets you know which pieces you still need to cut.

Glass Grinding

Mark your glass with a Sharpie marker where you want to grind it, so that you know exactly where to grind.

Always thoroughly dry off your piece of glass after you grind it before placing it back on your cartoon. If you get the cartoon wet it will crinkle up and then the pieces of glass won't lie flat on it, which can be a big problem when you try to assemble the panel.

After grinding a piece of glass that you are going to copper foil, thoroughly clean off any powdered glass from the edge of your piece. Otherwise the powder will keep the foil from sticking properly to the glass.

Clean off the surface of the grinder periodically, and check for small shards of glass which can scratch the piece you want to grind.

Periodically, lift off the top surface of your grinder and scoop out the powdered glass that accumulates in the water reservoir. Too much glass powder in the reservoir will keep it from being able to hold enough water to properly lubricate the grinder head.

Be sure the grinder has enough water, and refill it regularly. It usually only takes a couple of days for the water to evaporate enough to require refilling. If you see a lot of white powder while grinding it means that the grinder head is too dry. That can cause your glass to chip, and will wear out the grinder head much faster.

Always wear safety glasses and/or use a shield when grinding, since small shards of glass are often thrown up by the grinder. If you get a piece of glass in your eye, **don't rub your eye!** Remember that the tiny pieces of glass that the grinder throws up are essentially sand, and will work their way out of your eye in a short time, but if you rub your eye you can cause serious damage. It's a good idea to have a bottle of eye wash in your work space, just in case.

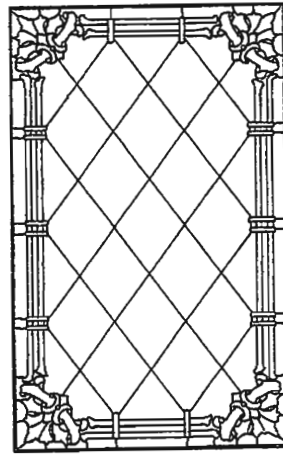
It can be hard to evenly grind a long straight edge. If you have enough room it can help to cut a score line where you want to grind and then grind to that line.

Sometimes it's more effective to grind a piece of glass in a spot other than where it's too big. For example, in the piece below where the right-hand side is too big, maybe if you just take a bit off the left side it will fit, keeping you from having to grind the bigger right-hand section.

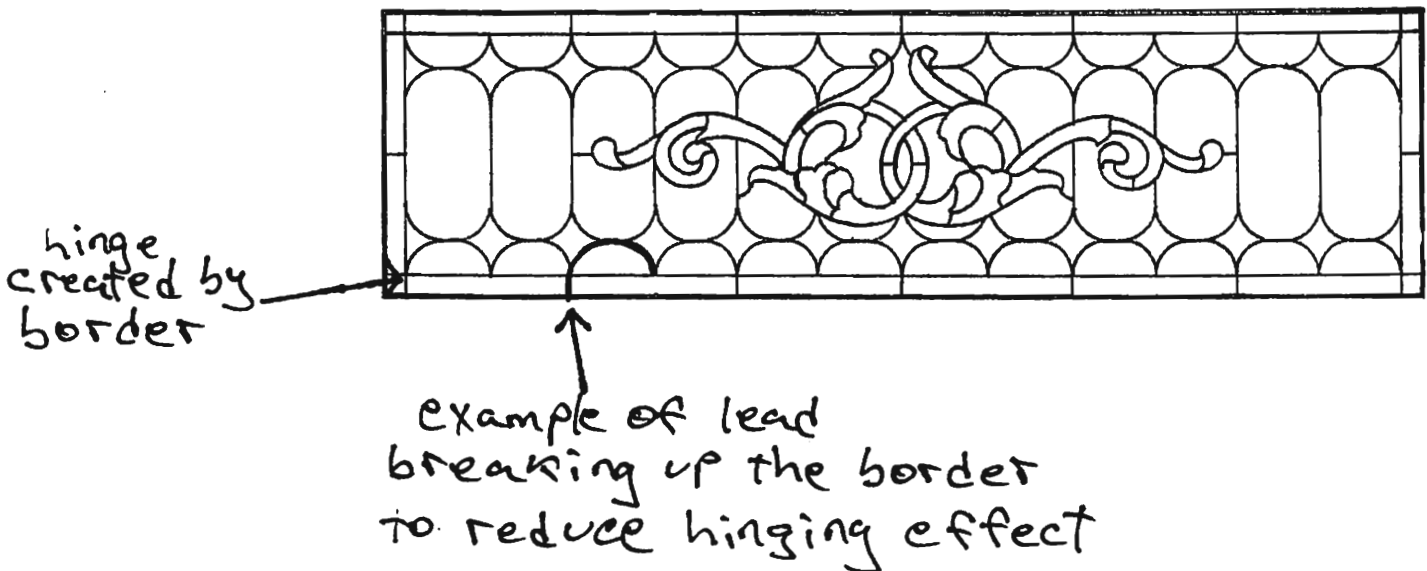


Leading

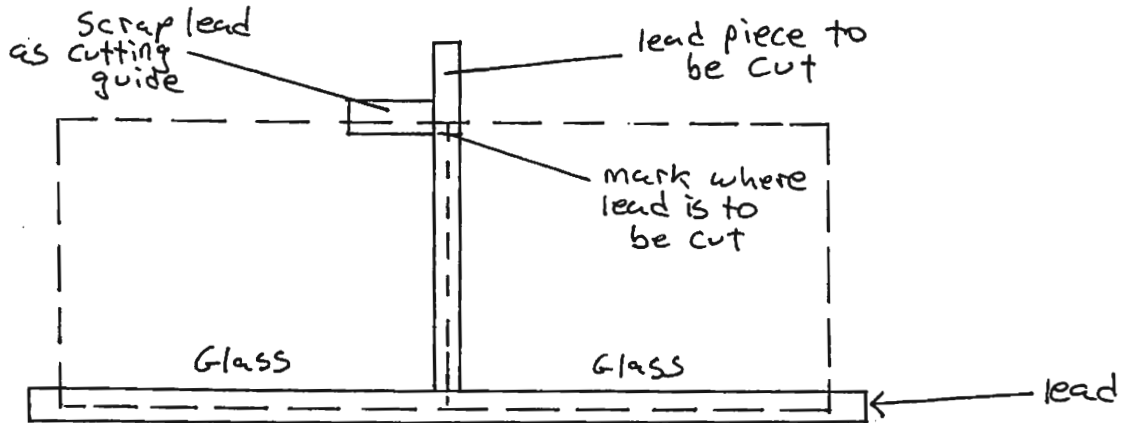
When designing and building a leaded window, try to avoid hinges, which are long, uninterrupted stretches of lead that tend to bow out over time as gravity pulls on the window. A way to minimize hinges is to “weave”, which entails criss-crossing the leads. For example, in the traditional diamond pane below don’t make any of the diagonal leads a single piece of lead that runs from one edge of the panel to the other. Instead, break up the diagonal leads to make shorter lengths that go in alternating directions.



Hinges can occur if there is a thin glass border around the edges of the stained glass panel. Try to design the border so that the leads are broken up and the border can be incorporated into the rest of the design. This kind of hinge is especially a problem at the bottom edge of a window, which has to support the entire weight of the window.



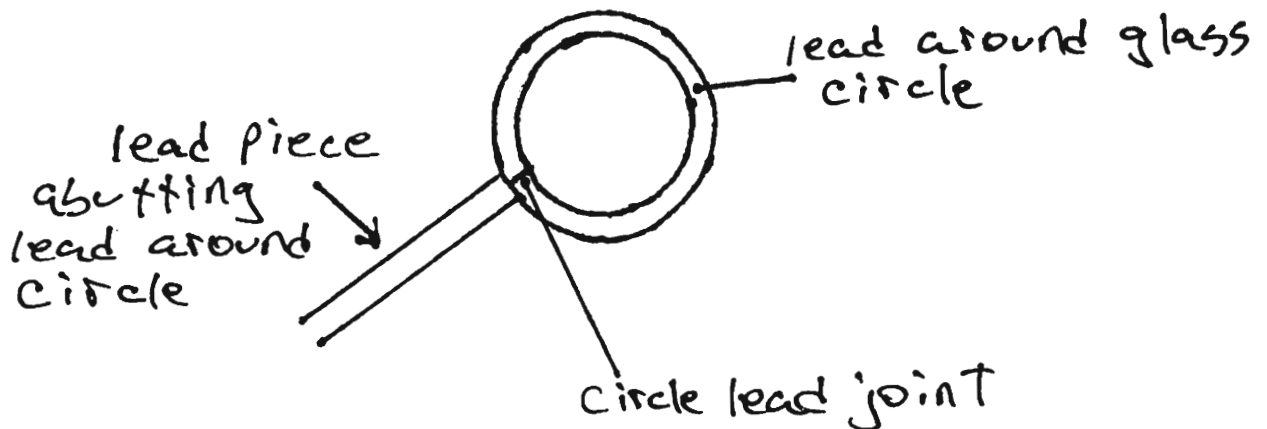
To ensure really tight joints, use a piece of scrap lead, of the same size as that used in the window, as a cutting guide. Remember to use a piece of the border metal for measuring leads that go up to the border, since this will usually be a different size than the lead used in the rest of the panel.



When you are stretching lead, always keep in mind that it might break. Brace yourself so that you won't fall backwards if it does break, and don't have glass or anything dangerous behind you. To protect your knuckles in the event the lead breaks, place your hand flat on the table underneath the hand holding the pliers.

If you need to lead small circles, such as glass gems, wrap a strip of lead around a wooden dowel that's slightly thicker than the size of the circle you need (If necessary you can thicken the dowel by taping paper around it). Then cut out the lead circle and keep trimming it until it fits your piece of glass.

When leading a circle always place it down on the cartoon so that the spot where the lead circle closes up abuts another piece of lead. That way you can hide with solder the lead joint on the circle.



LEAD SAFETY

Lead is very toxic, so take precautions:

Small pieces of lead can get into your clothes and shoes, so to avoid spreading lead around your living area it's best to work in old clothes and shoes that you keep in your work-space. If that's not possible, then at the very least check your clothes and shoes, both the tops and the bottoms, after you are done working. Remember that solder contains a lot of lead, so check for small blobs of solder on your clothes and shoes as well.

After working with lead, clean your hands with Goop or a similar cleaner (available at most hardware and automotive stores) and then wash with soap and water. It's also a good idea to clean under your fingernails with a stiff brush. Stained glass dealers and many hardware stores sell cleaning compounds that are specially formulated to clean lead off hands, and are worth buying if you work with lead a lot.

Don't eat or smoke when you are working with lead until you have thoroughly cleaned your hands, and keep food away from your work area.

It's especially important to take precautions with lead if you have small children, since it can cause devastating harm to them. Don't allow them into your work-space without very close supervision, and be sure that the space is locked or otherwise inaccessible when you are not around. Be especially careful that you don't accidentally expose them to lead through small pieces on your clothes or shoes. Remember that blobs of solder contain a lot of lead, are very shiny and appealing looking to small children, and are easy for them to slip into their mouths.

Don't throw scrap lead away, since it can be harmful in landfills and accessible to small children in the garbage. Store your scrap lead, including solder blobs, in a safe place and periodically take it to a scrap metal dealer, who will pay a few cents a pound for it.

If you work with lead a lot, it's not a bad idea to get your lead levels checked every couple of years. A simple blood test is all it takes.

Copper Foiling

Use black backed foil if you are going to foil clear or light colored transparent glass. Otherwise you will see copper underneath the solder in the finished panel. You can use silver backed foil instead of black backed if you are not going to patina the solder but are instead going to leave it in its original silver color. Silver backed foil also can be used if you are foiling mirrored glass. Use regular foil for opal and dark transparent glass. It sticks to the glass better, and is less expensive.

Dry off any cutting oil or water from the glass before foiling, and wash off any powder left over from grinding. Otherwise it will be much harder to get the foil to stick to the glass properly.

When you burnish down the foil make sure that none of the adhesive side of the foil ends up facing up, since the solder won't stick to it. This is most often a problem when you make a right angle with the foil such as on a square piece. Use a fingernail to pry up the foil, and flip it over.

Unless you can center your piece of glass absolutely perfectly in the middle of the foil, it's better to err on the side of having more foil on the front of the piece than on the back. This way, when you look at the finished panel from the front you won't be able to see any exposed foil through the glass. You can also use an X-acto knife to trim the foil on your piece of glass before soldering, if you don't want any exposed foil to show through.

When you are foiling pieces for a panel that you will put a metal border around, don't apply foil to the glass edges that are going to be covered by the border. It's a waste of foil and time, and can result in distracting glimpses of copper underneath the border. Mark the edges you don't want to foil with a Sharpie so that you can easily tell where to leave off the foil.

Soldering

Try to avoid touching the glass with a hot soldering iron or letting blobs of molten solder land on the glass, as the heat could crack the glass.

Have a damp sponge handy, and periodically clean off the tip of the iron on it. You can also use a razor knife to scrape off excessive solder build-up, but be sure to let the iron heat up first.

If you are using mirrored glass, spray the back with a sealant (available at most glass and stained glass stores) before assembling the mirror into the panel. Otherwise the flux from soldering will eat away the silvering on the back of the mirror and ruin it.

The act of soldering drains heat from the iron, so if you are soldering for an extended period you may need to let the iron sit periodically to let it build up heat again. This is especially true when soldering a copper foil panel. If the solder does not flow smoothly it could mean that the iron is too cool. Larger, heavier soldering irons, such as those manufactured by Hexacon, hold the heat much better than hobbyist irons, and are a worthwhile investment if you will be doing a lot of copper foil work.

When you solder iridized glass it's possible that the flux might eat away some of the iridized coating, so apply flux sparingly and only on areas that you are going to solder right away. Wipe away the remaining flux with a paper towel as soon as you have finished soldering. If it continues to be a problem, cut out pieces of card stock and, before applying the flux, place them on the iridized glass near where you will be soldering, as a way to protect the glass.

Buff your border lead or zinc with steel wool before soldering. Removing corrosion from the border metal will make it much easier to solder.

Soldering safety

Never put a hot soldering iron down on your worktable or any other combustible surface. Always set the iron down on something that can't catch fire, such as a brick or a metal coffee can.

When you set your iron down, be careful that you don't have any of the metal parts of the iron near the cord. It's not uncommon for a carelessly set down iron to burn through the cord.

Molten solder will pool up on the tip of your iron as you solder. Be careful that you don't accidentally fling some of this solder onto yourself or someone nearby.

All of the metal parts of a soldering iron will be very hot as it is used, not just the tip, so never pick up or touch a hot iron except by the handle.

Soldering copper foil

Normally the border of a copper foil panel is attached after the rest of the panel has been soldered together. To ensure that the border metal will fit, don't solder a rounded bead all the way to the edge of the panel. Determine how much of the panel will be covered by the border metal, and just solder that area flush. Begin the rounded bead after you have cleared the area that the border metal will cover.

50/50 solder (50% tin and 50% lead) is the traditional solder used for copper foil work. It flows more smoothly than 60/40 solder, and is less expensive. Lead free solder is available for items that will be handled a lot, such as jewelry and boxes, but it is much harder to work with since it doesn't flow very smoothly.

When soldering the back of a panel, be sparing with the flux. A lot of flux will have already come through when you soldered the front, and if there is too much it will bubble and spatter.

Don't brush flux onto the copper foil unless you intend to solder soon. Flux that sits for longer than a few hours will start to corrode the copper foil, making it hard for the solder to adhere to the foil. If a piece of glass has been foiled and then left to sit for a few months it will probably also corrode. It's best to remove the corroded foil and re-foil the piece of glass before soldering.

If you have stray blobs of solder you can place them on the foil and solder them into your joint, just like solder from the spool. It saves you a little solder, but more importantly it reduces the amount of lead that you end up sweeping into the garbage. Remember that blobs of solder will be very hot for about 30-60 seconds after they form, so don't touch them right away.

If you pick up your panel brush away any blobs of solder, both from the table and from the panel itself, before you set it down again. If you put the panel down on top of a blob of solder it can crack or scratch your glass.

Scrape away loose blobs of solder from your joints before you apply patina. Otherwise, the loose blobs can come off afterwards, and you'll see a silver spot where the solder didn't get patina.

Very thin solder lines look elegant and it's generally easier to get a smooth, even bead of solder with thinner lines. Those thin lines come from a combination of careful cutting with very little space between the pieces of glass, and narrow copper foil. But keep in mind that it's the solder that supports the window and gives it strength, so don't be obsessed with making every solder line extremely thin. Those thicker lines give the window much needed support.

Soldering Lead

60/40 solder (60% tin, 40% lead) is the traditional solder to use for lead came. It melts at a lower temperature than the 50/50 solder, reducing the danger of melting your lead since you can have your iron at a lower temperature.

To avoid the risk of melting the lead you are soldering, periodically touch the tip of the soldering iron to a piece of scrap lead. If the lead melts, the iron is too hot. Turn the temperature controller down if your iron is equipped with one, or unplug the iron if it isn't, and keep testing it on the scrap lead until it has cooled down enough so that it does not melt the lead. It's especially important to test the iron if it hasn't been used for a few minutes, since heat builds up when the iron sits idle.

Avoid brushing or spilling flux on any part of the lead that you don't intend to solder. A stray blob of solder can be scraped off of lead that doesn't have flux on it, but if there is any flux on the lead, the solder will stay there permanently.

If lead has corrosion on it it's much harder to get the solder to flow smoothly when you are soldering the joints. If you are assembling a window using lead came that has some corrosion on it buff up the lead with steel wool before using it. It's best to do that before stretching the lead so you don't risk bending already stretched lead.

If you are repairing an old window and have to re-solder some of the old joints use a wire brush or razor knife to scrape away the corrosion from the joint before you solder.

Often a messy solder joint can be cleaned up by just re-applying a little bit of flux and re-heating the joint with your iron. Sometimes it helps to also add a little more solder. Remember to keep the iron as still on the joint as possible and let the heat of the iron smooth out the solder, rather than moving the iron around in an attempt to smooth out the joint.

It's a good idea to solder a window as soon as possible after you have leaded it, since the oils on your hands will start corroding the lead as soon as you touch it. Try to solder within a day or two after assembly if possible.

Puttying

Puttying a leaded stained glass window makes it weather tight, keeps the glass from rattling and gives the lead a pleasing dark patina. The formula I use is:

- two parts plaster of Paris;
- four parts whiting (athletic filed marking chalk that you can buy at hardware stores or Agway).
- A handful of black powdered concrete colorant (this darkens the putty, making it less noticeable underneath the lead after it has dried).

Mix with equal parts of turpentine and boiled linseed oil to the consistency of toothpaste. If it is too wet the putty will ooze out of the came before it can harden. If it is too dry you won't be able to brush it all the way under the came.

There is some controversy about whether you should add Portland cement to the putty mix. Enough people with a lot of experience have come down against using it to convince me to leave it out of my mix.

Don't apply too much force when puttying or you may break a piece of glass. Long, thin pieces are especially vulnerable to cracking.

When puttying the border you may need to hold onto the border came to keep it from bowing out and getting putty in the groove, which will make the border came bow out permanently. This is especially a problem if you use lead rather than a more rigid metal for the border, or if you have a length of border came that is not connected to the panel with a solder joint for a while.

Used putty brushes can be stored submersed in water to keep them from drying out and hardening. Get excess water out of the brush with paper towels before re-using.

Putty mix isn't particularly hazardous, but it's still a good idea to wear rubber gloves when using it. It makes clean up a lot easier, and prevents your hands from getting dried out. Disposable examination gloves can be bought at medical supply stores, and hardware stores also carry disposable gloves.

Wear a dust mask when puttying, particularly when applying whiting powder. Disposable dust masks are available at hardware stores.

Check your wet and dry brushes before using to be sure they don't have any hardened putty that can scratch your glass. Try to remove wet putty from your dry brushes after use to prevent the putty from hardening on the brush.

Putty the back of your panel first. This forces the glass towards the front of the panel with more of the putty behind it. This way you see less of the putty from the front after it has dried. Storing the panel while it dries with the front side facing down also helps.

If you are putting glass with a lot of texture or that has been sandblasted or painted, use contact paper to mask the glass to keep the putty off of it. Otherwise cleaning the putty off the glass will be much more difficult. Be sure that you don't apply the contact paper to the part of the glass that's underneath the lead, where you do want the putty to go.

Always store panels flat while the putty dries, not on their sides. If a panel is stored on its side the putty will ooze out before it has a chance to harden.

The side of the panel facing up dries more quickly than the side facing the table. That may be an issue if, for example, you can't clean the window for a few days and one side has textured glass that's harder to clean after it has dried.

Plastic chopsticks, available at any Chinese grocery store, work very well for cleaning up putty from a panel. Just sharpen them with a pencil sharpener or razor knife first. Dental picks are great for getting into hard to reach places, and you can sometimes get old ones from dentist offices.

After you have puttied the window brush off the excess with a stiff brush, but don't obsess with getting it perfectly clean. The putty will ooze out from under the lead for a couple of days but you don't want to keep cleaning away the putty as it comes out. Let that form a barrier for a day or two so that the rest of the putty stays underneath the lead came and can harden in place. If you keep cleaning off the putty while it's still wet and runny you eventually won't have any left underneath the came.

Cartooning

To be sure that your cartoon is square, always measure the diagonals after you have drawn in the outside border. Put your ruler or measuring tape on one corner of your drawing and then measure the distance to the diagonally opposite corner. Then do the same with the other two corners. If they are the same distance, or off by just 1/16th or so, your drawing is square.

If you plan to use reinforcing bars in your window it's best to draw them in on your cartoon before anything else. Or, at the very least, keep reinforcement in mind as you draw the cartoon. That way you can make your design accommodate the reinforcement. You want to be sure there are sufficient places for the reinforcing bars to be soldered to the window, and in a way that they don't go right through a major design element such as a face.

When inking in the lines on your cartoon, use a new Sharpie for a window that will be copper foiled since you don't need all that much space between your pieces of glass. For a leaded window use a Sharpie that has been used some. That will give you a somewhat thicker line, roughly equal to the thickness of the heart of the lead that separates the pieces of glass.

Ovals are really hard to draw. When I need an oval shape I have the local frame store cut a mat to the size I need and use that as a template.