

A Photo Resist Primer

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Our message in the past couple of articles in this series has been that photo resist provides a real opportunity for glass artists and stained glass shops to make good money and good art with glass etching. You can do everything from one-of-a-kind pieces of etched glass art to hundreds or thousands of personal and corporate gifts, architectural etchings, etc., quickly and easily with photo resist. And you can create images of amazing complexity with photo resist that you could never cut by hand.

By now, we figure if you are at least faintly interested in glass etching, you should already be investigating photo resist yourself. We had originally planned this article to explain how to use photo resist for multiple stage etching, but we have had a number of requests from readers to clarify the process we've been writing about with visual examples. We will take you through a project, just as we would do it in the studio. This is the best way for you to understand how to fit the photo resist process into your own studio.

Project: Etched Beveled Glass Box Top

Let's say you are creating a line of gift items for your own shop or to sell at craft fairs in your area. You live close to the ocean and images of sea life are popular in gift shops in your areas on things like T-shirts, caps, etc. You want to create similar images etched on glass gift items for something really unique. You regularly carry wood boxes to sell to your stained glass students who use them for stained glass box tops. You realize that one of these boxes might be nice with an etched top. You want to make a sample to see what it looks like, and to get reactions from customers.

You know the opening for glass to be installed in a particular box top for a round wood box is 6" diameter, and in a flash of revelation, you realize you also carry a 6" piece of beveled glass. The bevel is inexpensive, yet looks great when put into the box top, and it would look even better with an etched design on it. Now all you have to do is draw or locate an image to etch, and go to work with photo resist.

Maybe you are not such a great wildlife artist, so you go to your reference library of designs. There, in a clip art book of water sports designs, you locate a nice design of a sea turtle with a diver. Unfortunately, you want the turtle but not the diver. No problem - there are a couple of different ways you can work with the design, the high-tech way or the low-tech way.*

The High-Tech Way to Prepare a Design for Photo Resist Etching

You need to create a master image from the clip art book for making your photo resist. Scan the design into your computer and use the eraser tool (or one of the cutting tools) in your software to get rid of the diver. When you measure the turtle image, you see it is quite a bit smaller than the glass size, so you will want to enlarge it to fit better. You enlarge it proportionally by dragging one of the corner handles of the design on the screen. You will also notice there are a lot of tiny black dots in the plates of the turtle's shell. These are so small that not even photo resist can reproduce them, so you take most of them out with the eraser tool. (Note: If you have one of the more sophisticated software programs like CorelDraw or Adobe Illustrator, you will probably have other, faster tools to edit the image. But this is an etching article, not a computer article, so we'll stick to the basics). Then print out the design on plain paper to see how it looks full size.

Some of the outlines of the plates on the turtle's back are too thin, they may not etch well (at the rear of the turtle's shell, there are even skips in the lines), and the edges are much rougher now that they are enlarged. Once again, you use your graphics software to thicken-up the lines that need it and to smooth out the rough edges. In addition, you can manipulate the image as we did, turning the plates on the turtle's back solid black. We thought they might look better etched solid white rather than clear with white outlines. If you have trouble visualizing what will be etched and what will be clear, remember that with most photo resists black = blast. That means whatever is black on your design will be blasted on the glass.

You may have to print out again to see additional places that need touching up, then work on the design again

in order to get it just right. Always remember the first rule of photo resist - what you see is what you get. That means the etching can never be any better than the photo resist, which can never be better than the black and white master you start out with, so spend some time polishing-up the image. The last thing you need to do is print out the design onto a translucent paper called vellum, or even better, onto a frosted drafting film adapted for photo resist use. Both of these types of media take a dense coating of toner from your laser printer, which is much better than the thin coating achieved if you try to use transparency film made for laser printers and copiers. Remember that if you etch on the back of the glass, you will have to reverse the image on the printout to keep the etched image facing the same direction when viewed through the glass. This is always true whether you hand cut your design or use photo resist.

A laser printer is much better than an ink jet printer, as ink jets leave microscopic splatters of ink at the edges of the image, making it difficult to impossible to get a clean edge with your photo resist. This is especially true with fine lines. Your printer should have at least 600 x 600 dpi resolution and produce good-quality, solid dark blacks. Any streaking or spotting in the black areas can produce problems in trying to make the photo resist image.

When you have your final printout, you are ready for the exposure and washout phase, when you actually make your image on a piece of photo resist.

The Low-Tech Way to Prepare a Design for Photo Resist Etching

If you are one of those people still living in the 19th century (remember, the rest of the world is in the 21st now) and not into computers at all, you can still use photo resist. In this case, make a copy of your original design and use liquid paper correction fluid or Whiteout (for typewriters) to eliminate the diver from the design. Then enlarge the design at least double the size that it will be in its final form.

Make your changes by hand (like making thin lines thicker, smoother and full) using a good quality black marker. Many markers will bleed into surrounding white space when used on copy paper, so you should seal the paper with a spray fixative (available at art supply stores) first. As long as you are going to the art supply store, you will be much more accurate with your drawing if you get a set of technical drawing pens and/or opaque India ink to make your changes.

Then reduce the design to the size you need for your finished etching. When you enlarge the pattern, you magnify the irregularities in the design. If you correct the problems on the enlarged version and then reduce the pattern to the desired size, the quality of the finished pattern will be better.

Once you get the image to look the way you want it, the next step is to print it out on a piece of translucent paper or film that you can use for your photo resist master. You can do this in either of two ways. First, you can take the pattern to a print shop or one that does typesetting and layout for printing and ask for a film positive, which is your black image reproduced on a clear film with opaque, solid black. This will probably cost about \$10 for an 8" x 10" design and may take a day for them to get it back to you. Second, you can copy the design onto vellum or drafting film. The problem with this is that most copy machines don't have good solid blacks, and this could ruin your photo resist. Just make sure the copier you use provides solid black images, with no streaks or spots or thin areas. Don't use copier transparency film, since it does not absorb toner and the black areas are not dark enough.

Now you are ready for the exposure and washout to make the photo resist. The resist you will be using is a self-adhesive photo resist, which does not require any separate application of glue on the glass you will be blasting. This means it is much faster and easier to use, and you can easily reposition the resist if you align it incorrectly the first time.

Exposing the Photo Resist

You will need to produce the photo resist in a bathroom or other area where you can control the light and where you have a source of water and a drain. Equipment you need is an exposure unit, a spray washout system, a couple of clamp lights with reflectors and yellow bug lights, a clipboard or other method of affixing the resist to a flat surface, the photo resist film and a hair dryer.

Exposure units for film sheets up to 11" x 14" are readily available from photo resist suppliers for around \$200

to \$250, and provide a source of UV light that is held at a uniform distance from the design and the film being exposed. Larger exposure systems can be purchased for higher production, but these generally start at around \$1,700 for one that can produce resist up to 20" x 22".

A washout system can be as simple as a special garden hose sprayer (\$25) that provides a high pressure, fine spray pattern, to a high-pressure washer like those in car washes (\$250 to \$500). (For high production situations, completely automated systems are available that cost \$5,000 to \$10,000). In either case you need a sink or shower to contain and drain the washout water. You could use a laundry sink, shower or bathtub, or you could build your own larger unit complete with exhaust system. You also need some type of backboard to attach your resist to while washing it out. Since water splashes sideways when it is directed at the backboard, the backboard should have short sidewalls to keep the water from getting all over your room. Plexiglas works well for this purpose. (Note: This photo resist is biodegradable and safe to wash down the drain).

Close the drapes on any windows to the outside of the room, and turn off all inside lights except the yellow bug lights. At 60 watts, you won't have any trouble seeing - it will just be a bit strange to work in yellow light until you get used to it.

Open the light-safe box the photo resist comes in, take out a piece of film, and cut a piece slightly larger than your design (1/4" to 1/2" larger all around). Lay your design onto the film, with the toner side of the design touching the dull side (called the emulsion side) of the film and align the design in the middle of the film. Place the design and film into the exposure unit, with the design in between the light bulb and the film, so the light passes through the design before it hits the film.

Turn the timer of the exposure light to the prescribed amount of time for the thickness of the photo resist you are using - about 25 to 30 seconds for 3 mil film. Make sure the exposure light comes on before you release the timer. (Sometimes the exposure light takes a few seconds to warm up and turn on). While the light is on, it is exposing the film in the clear or white areas, while the black areas of the design are blocking the light.

The reason photo resist works is what happens when light hits it. Unexposed, photo resist is water-soluble. Exposure to light causes molecules in the resist to cross-link and become insoluble. In the areas where the design covered the film, and no light penetrates, the photo resist is still water soluble, but it has become insoluble where the light has hit it.

The Washout Process

When the timer turns the exposure light off, you can open the exposure unit and remove the resist film. You will see no indication that the film was exposed because you will see no image until you begin the washout process. For this reason, it is important to keep exposed film separated from blank unexposed film. If you have a self-adhesive resist such as the PhotoBrasive UltraPro we are using in this example, you now have to remove the slip sheet from the dull side of the resist. This is a very thin, almost clear material that protects the adhesive during handling and exposure. After you remove the slip sheet, the adhesive is exposed and will stick to anything it touches, so handle it carefully by the edges, and don't lay it on anything adhesive-side down.

Attach your exposed resist to the backboard of your washout sink with masking tape on the edges, or clip the edge of the resist to a clipboard and lean it up against the backboard. Be sure to attach it with the adhesive side facing you. Position one of the clamp lights so it shines directly on the resist from the front, or position it behind the backboard shining on the resist through the backboard (if the backboard is transparent material). Turn on the water and sweep the nozzle back and forth across the resist, holding the nozzle several inches away from the surface. As soon as the water hits the resist, you will see an image appear. It is light in color compared to the surrounding resist. As you continue to spray, the resist within the image begins to wash away, until it completely disappears after about 15 to 45 seconds (depending on the pressure of the washer you are using). When the resist is fully washed out, the areas of the design that were black are now completely clear and areas of the design that were white are still the original color of the resist.

Be careful! If you wash for too long, the whole piece of resist will soften and wrinkle up or slide off the clear Mylar carrier sheet, so you should stop just as soon as you see all the resist residue wash out of the design. Then, place the resist on a paper towel or piece of newspaper, face up, and dry the water off the resist by blowing a hair dryer on it for a couple of minutes. Be careful not to let the dryer blow the resist off the paper or

the table, as it will undoubtedly stick to something and ruin the adhesive.

When the water drops are all dry, but before the resist is completely dry, it will have a somewhat milky appearance. It must be completely dry, with a clear appearance, before you can use it. You can continue to use the hair dryer until the resist is dry, but this will take another 5 minutes or so. The resist will dry completely on its own in 15 to 30 minutes anyway.

If you make lots of photo resist, or if you are located in a humid area, a separate resist-drying oven is a worthwhile investment. It can handle up to eight page-size sheets of resist at one time and dry them out in about 5 to 7 minutes. The cost is only about \$350, and it can really decrease your production time. In addition to making the drying process easier, the oven is great for keeping dust and dirt off the adhesive.

Applying the Resist

When the resist is dry, you can apply it to the glass and blast it. Remember in handling it that one side has the resist with adhesive on it and the other side is the Mylar cover sheet. Be sure to clean the glass first, eliminating any dust or fingerprints that would keep the adhesive from sticking.

Handling the resist carefully at the edges, pick it up and turn it over, so the adhesive side is down. Position it over the glass where you want the image to be etched and carefully lay the resist down. Let the resist sag a little in the middle so it will touch the glass in the middle first, then lower the left and right sides to the glass. At this point, if the image is not aligned on the glass the way you want it (particularly important with lettering and geometric designs), you can carefully lift it back off the glass and reposition it. Repositioning is difficult if you have not dried the resist sufficiently. When it is positioned the way you like, squeegee the resist down on the glass, starting in the middle and bring it to the right and left sides, squeezing out any air bubbles as you press the resist firmly down.

With the tip of your stencil knife or your fingernail, raise a corner of the cover sheet so you can hold it between your fingers, then remove the rest of the cover sheet. If any of the resist tries to stick to the cover sheet as you remove it, carefully press it back down to the surface of the glass, then continue. When the cover sheet is removed, use masking tape to tape any exposed glass not covered by the resist. To be sure the resist is firmly adhered to the glass, you can carefully press it down again with your finger or thumb, but do not squeegee now that the cover sheet has been removed. From now on, avoid touching the resist as it can easily be loosened or rubbed off by rough handling.

Blasting the Image

You can blast the glass at 15-30 psi with a pressure blaster or 50-60 psi with a siphon blaster. Hold the nozzle no closer than 4 inches away, perpendicular to the glass, or the resist may be torn off. Even 3 mil resist is quite tough, allowing you to etch a noticeable depth into the glass. If you want to blast deep, take your time. The only reason the resist should fail, and come off the glass while blasting is getting impatient and holding the nozzle too close, turning the pressure up too high, or moving your hand too slowly.

When you start blasting, you will immediately notice a very thin membrane coming off the areas exposed to the blast. Sometimes, people think the resist is coming off, but that is not true. It is only a blastable membrane that helps hold the resist together as it is being transferred to the substrate. This membrane makes it easier to lift the resist off the glass and reposition it if you need to, before pressing it down with the squeegee.

After finishing the blasting, remove the glass from the blasting cabinet and remove the tape and resist. This is easy if you can soak the glass in warm water for 5 minutes or so - then both tape and resist practically float off. Otherwise, remove the tape by hand, spray the resist with window cleaner, let it sit for a few minutes, then peel off the resist.

Now you simply install the glass in the box with your preferred method, and admire the work. This would be an elegant gift you would be proud to offer in your own shop, at a craft fair, or to other gift shops. And just think, this is only the beginning of a whole line.

Excluding the preparation of the artwork, this piece can be completed in less than 30 minutes if you do only one. If you produce these in a production setting, they can be completed in about 5 to 10 minutes, depending

on how many at a time you wish to do. The true test of a valuable glass gift line is if you can make money on your items when selling not just at retail, but at wholesale. This is certainly possible when etching with photo resist. Give it a try!

Norm and Ruth Dobbins have been in the glass etching business for almost 25 years. They did some original consulting with [The Chromaline Corporation](#) several years ago which resulted in the formation of the PhotoBrasive Systems division, dedicated to manufacturing and marketing both imaged and blank photo resist. They also have published four books and a set of four videos on abrasive etching techniques, and they teach their seminars throughout the US and in their own studio. You can contact them at Professional Glass Consultants, 2442 Cerrillos Rd, Suite 350, Santa Fe, NM 87505; PH: (505) 473-9203, Fax: (505) 473-9218; e-mail: etchmaster@aol.com; website: www.etchmaster.com.

*It is important to understand that although photo resist gives you the ability to reproduce almost any black and white design, it does not give you the right to do so. It is unfair and unethical to use other artist's copyrighted artwork without permission. Read the copyright use permission printed in the front of most design books. Use only copyright-free artwork unless you get permission from the artist who holds the copyright. Expect to pay a royalty of 2-5 percent of the items you are making, which is only fair and reasonable. Note that most stained glass and etching books only give the permission to use the designs for personal use. If you use them for commercial purposes, you must get permission or subject yourself to possible lawsuits and damage.