



From left to right: Maggi Debaecke, Paul Bierker, Anna Hattendorf, Julia Bareilo, Aline Bykowski, Boris Baßy, Lu Heintz, Tzu-ju Chen, Sue Amendolara

TECHNICAL ARTICLE

Vacuum Forming Acrylic

By Kris Patzlaff

This issue's article is by Kris Patzlaff, former SNAG President and Associate Professor at Humboldt State University. This article is the result of her research into the application of vacuum forming for small scale sculptural and jewelry work. It is an extremely clear set of instructions on how to build your own equipment, rather than needing to purchase a machine that could cost hundreds, even thousands of dollars.

I'm very happy to report that interest in writing articles continues to rise, with authors scheduled for more than twelve months in advance. Even if you aren't interested in writing an article, please contact me with any feedback, requests, or suggestions. Also, if any of the articles inspire you to create something, please send me an image – I would love to share it in an upcoming newsletter!

– James Thurman

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The most common vacuum forming process utilizes molds called bucks or patterns. The buck or pattern is placed on a vacuum table and a sheet of softened acrylic or other plastic is placed over it. Suction from a vacuum pump pulls the softened sheet over the pattern or buck. Forms created from this type of vacuum forming are typically used for packaging and model building. The vacuum forming process described in this article will utilize the matrix dies that are commonly used with the hydraulic press. The acrylic sheet is heated and sucked into the negative space of a matrix die. The resulting acrylic form is similar in shape to a metal form that is created in the hydraulic press with matrix dies.

Equipment:

Vacuum pump – I use the vacuum pump pictured below. Other sources to create a vacuum can be used as well. I have read articles that claim a vacuum cleaner can produce enough suction to form acrylic. Also, it is possible to use a vacuum casting unit to provide the vacuum needed.





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By Kris Patzlaff, *continued*

Vacuum table – The table was built using scrap wood. The size of your table depends on the size of your matrix dies. I chose a 6-inch by 6-inch table because I use matrix dies from the 6X6 box that is used in the hydraulic press. This size will also accommodate smaller dies. It is important that the sides of your table are tall enough to accommodate the plumbing parts and hose that connect to your vacuum pump.



Making your vacuum table – Determine the size of the table that you would like to build. Use wood that is at least 3/8 of an inch thick or thicker for larger tables than shown. It is important that the table does not sag in the center or is flexible when pressure is applied to it. In the center of the vacuum tabletop drill a hole with a 1/4 of an inch drill bit.

and female parts that fit together, creating a connection between the 90 degree threaded part, and a fitting that fits into the other end of the hose. Create a configuration as shown below. Have the fittings come out past the table for ease in disassembling. Attach the 90-degree fitting to the bottom of the vacuum table, centering it over the hole. Use a silicon caulking. Allow drying time before attaching the remainder of the plumbing parts. Attach the rubber hose to the plumbing parts with a hose clamp. Attach the other end of hose to the pump using a hose clamp.

Connecting the vacuum table to the vacuum pump – A trip to the plumbing section of your hardware store will give you a number of choices to create this section. As many pumps are different, you will need to measure the fitting on the pump that provides suction. Purchase 2 feet of rubber hose that fits snugly to this section first. Choose a 90-degree PVC plumbing part that is at least 1 inch in diameter at one end and is threaded on the other. Find different male





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Vacuum box – The vacuum box needs to be airtight. Large plumbing sections of PVC are used to create the sides of the box. The diameter of this PVC section is determined by the size of the negative space of the dies. Its length is determined by how deep you wish to form the acrylic. The top and bottom of the box are made from 1/4 inch Masonite that is cut to the same size as the vacuum tabletop. Find the center of both boards. Drill a hole with a hole saw in the center, leaving at least 1 inch from the edge. Be sure that the size of the hole you are drilling is smaller than the PVC plumbing part you chose for the sides and larger than the negative space of your matrix dies. Cutting one size hole on the top and a different size hole on the bottom will provide greater flexibility with one box. Additionally, the top and bottom holes in your vacuum box can be used directly to create round forms. Attach your bottom and top to the PVC, so that the PVC is centered. Use silicon caulking to attach together. Clamp or place a weight on it during drying.



Heat Gun – A heat gun is used to heat the acrylic, making it soft enough to form. The heat gun pictured has multiple settings allowing for greater control. I use the 730–970 degree setting. At this temperature, the acrylic is heated quickly but not too hot to melt the surface.





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Matrix Dies – Any matrix die that is used in the hydraulic press can be used with this process. Matrix dies with brass faceplates will produce a crisper edge from the flange to the form of the plastic than dies made of Masonite. Considerations for die shapes are similar to the concerns when making them for the hydraulic press. Like metal the acrylic follows the path of least resistance. Dies with small complex shapes will see relatively no forming. Shapes other than a circle would need conforming dies if there were plans to later fuse the two halves together. Ideally, the negative space of the matrix die should be no less than 1/2 of an inch from the edge.



Cover/Sealing Plate – This board was made from a piece of 3/4 inch scrap plywood. The size of the board needs to cover the surface of the vacuum box. A handle was put on it for easier handling.



Sheet of Rubber – A sheet of 1/16 of an inch thick rubber is cut to the same size as the vacuum table with a corresponding 1/4 inch size hole in the center. This provides a seal between the vacuum table and the vacuum box.



Clamps – Clamps are used to secure the vacuum box to the vacuum table.

Flat head screwdriver – A screwdriver is used to test the softness of the plastic while heating.



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Acrylic – I use acrylic and Lexan sheet in vacuum forming. Other thermo plastics should provide good results as well. I have experienced a higher success rate with 1/8 inch thick or thinner sheet. The overall size of the acrylic sheet should be no less than 1 inch larger than the negative space of your matrix die in which you are forming into.

Ok! So, we got everything together, let's vacuum form!



Work on a sturdy table. You may need to clamp down the vacuum pump to keep it from "walking" during the process. When heating plastic there is some off gassing. Work in a well-ventilated area.

1. Place the sheet of rubber material onto the vacuum table, lining up the center holes.



2. Place your vacuum box onto the vacuum table squaring up the edges. Use two clamps on each side.



3. Place your matrix die on top of the opening in your vacuum box. Check to make sure the edge of the hole in the vacuum box cannot be seen through the negative space of your matrix die.



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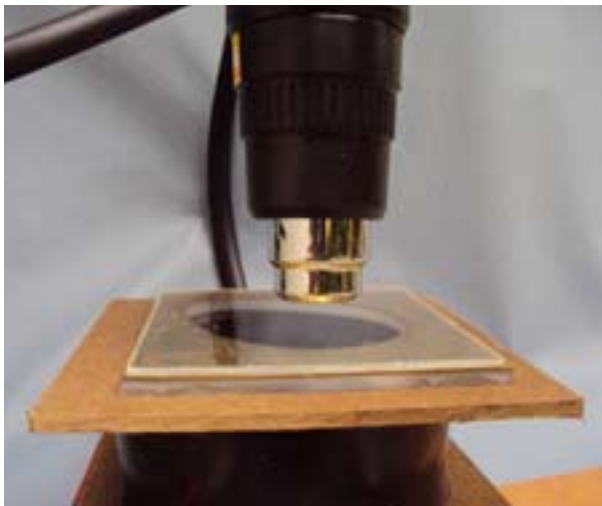
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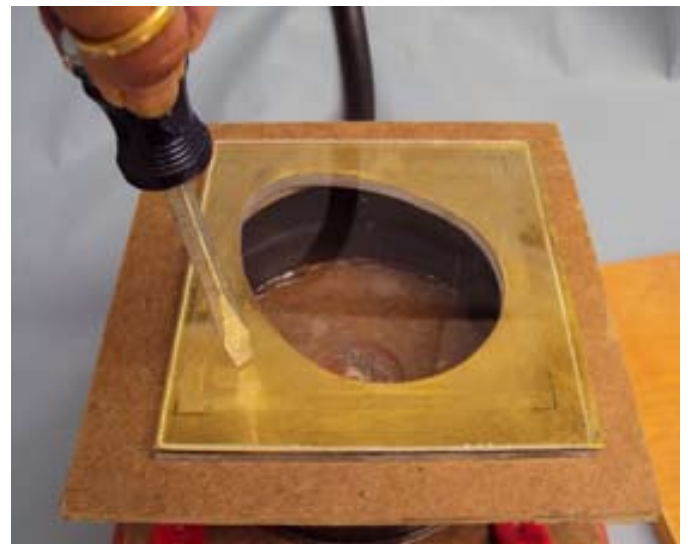
4. Place your piece of acrylic sheet over the matrix die. Center it so that there is at least 1 inch of acrylic extending past the negative space.

5. Using the heat gun at the 750-degree setting, heat up the sheet of acrylic. Keep the heat gun at one to two inches from the surface. Heat the acrylic up evenly by moving back and forth over the whole surface. Uneven heating will cause the acrylic to form irregularly.



6. Heat the acrylic for 5 to 10 minutes. The time will vary depending on the thickness of the acrylic and the overall size. As a test to determine if the acrylic is soft enough to form, use a flat head screwdriver and push it into the surface of the acrylic. Choose an area that is not in the negative area of the matrix die. When the screwdriver easily pushes into the surface of the acrylic, the acrylic is soft enough to vacuum form. Keep the heat gun on the acrylic during this test.

7. When the acrylic is soft enough, put the cover/sealer plate onto the surface of the acrylic providing pressure and turn on the vacuum pump.



8. Hold down firmly for 15 to 20 seconds.

9. Turn off vacuum pump and lift off cover/sealer plate to check on form.



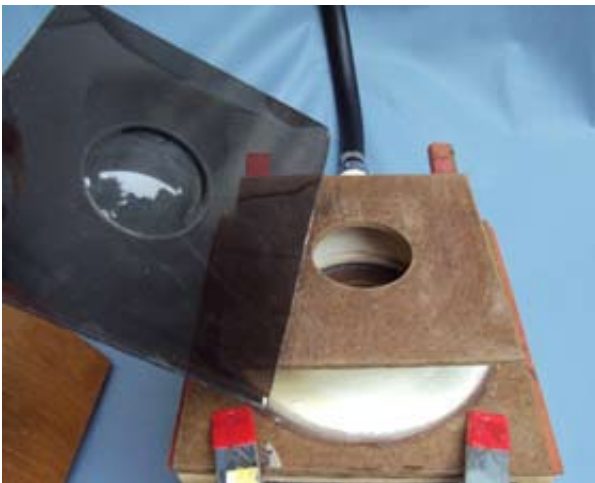
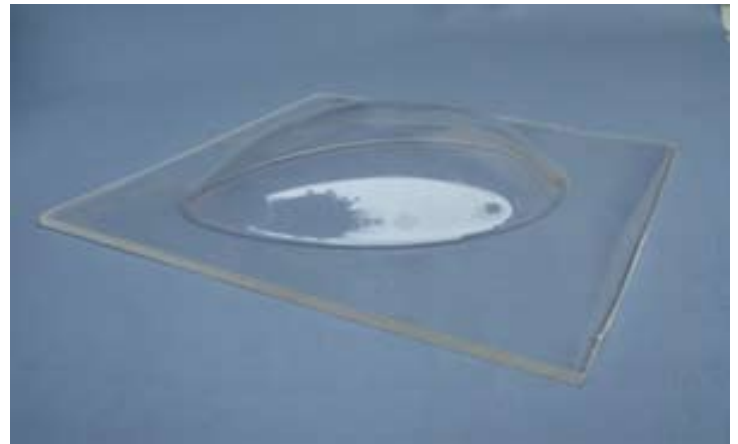
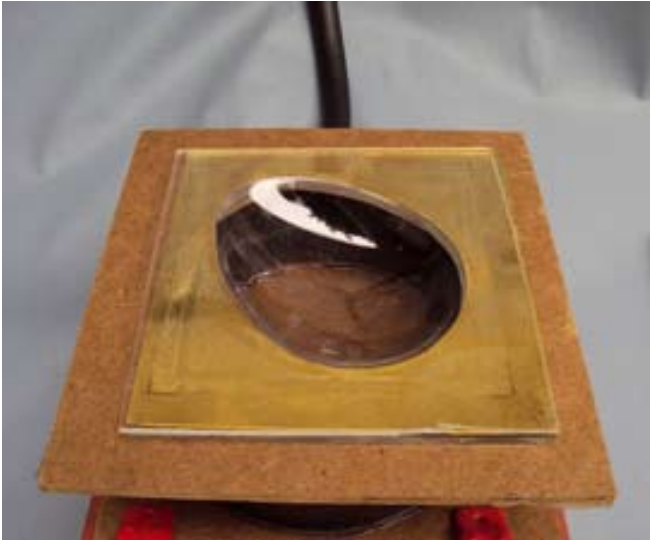
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10. If satisfied, replace cover/sealer plate applying pressure and turn vacuum pump back on for 45 to 60 seconds. This step is necessary as the acrylic has memory and will lose some of its form while cooling. The vacuum pump will not create more form but will help the acrylic maintain its form during cooling.



11. If unsatisfied with your results, you may reheat the same piece of acrylic and begin again. Since acrylic has memory, it will go back to the flat sheet it once was during reheating.

The resulting forms using this method will be thinner than the original thickness of the sheet acrylic. There is a point to which the acrylic can no longer stretch and a blow out will occur.

Using the vacuum box directly to create round forms.

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