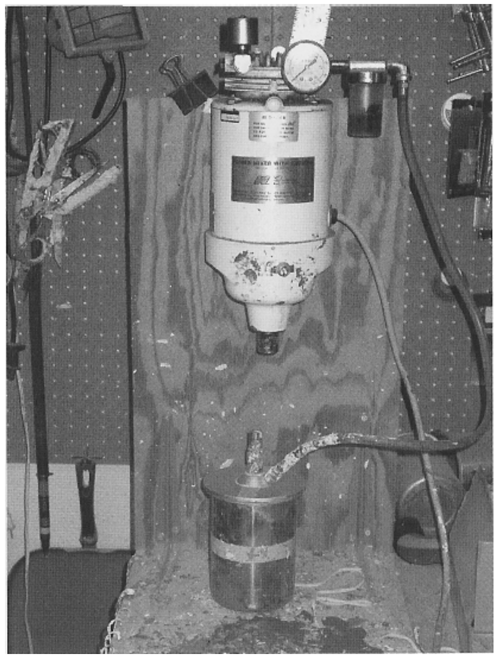
# Putting Vacuum and Pressure Chambers to Practical Use



By David Parvin, A.L.I.

This is the last in a series of four articles about using vacuum and pressure chambers in casting. The first explained the "why" and second and third described how to make low cost yet very functional vacuum and pressure chambers. This last one will explain bow to put them to practical use saving time, improving quality, and even doing some things that would be impossible otherwise. So that I do not have to repeat myself and make this article so long that the whole deforestation (for the additional paper), global warming, end of civilization, extinction of mankind, and rise of giant intelligent cockroaches to rule the earth scenario happens, I would suggest that the readers review the first three articles.

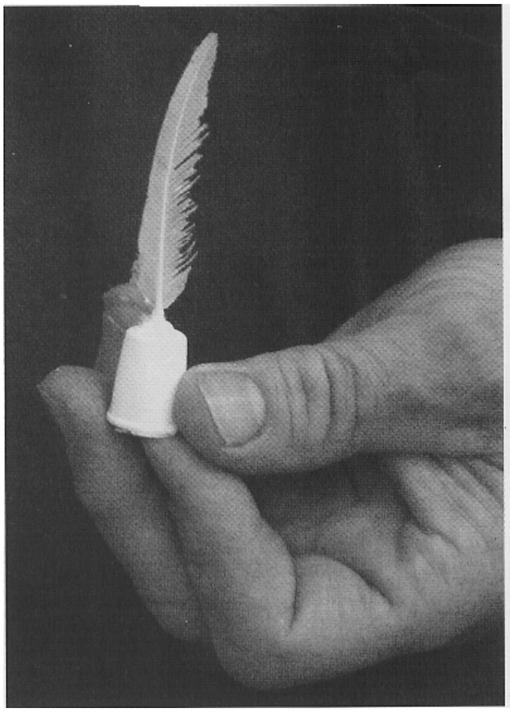
While not my first application, the thing that I most often use my vacuum chamber for is de-airing rubbers. All that one has to do is mix some rubber and place the container into the vacuum chamber and suck out the air. Almost at once, looking through the clear lid you will seed the rubber increase in volume. After several minutes, the volume may be two to three times the original. Obviously, it is essential that the mixing container be large enough to contain the additional volume. If the rubber has a low viscosity, i.e. is thin and runny, the bubbles will combine and once large enough will rise to the surface and escape, sometimes with enthusiasm. If however, the rubber has a high viscosity such as those with thixotropic additives, the bubbles may not be able to rise to the surface without a little help. Just pick up the vacuum chamber and rock it slowly from side to side. This will allow the rubber to slosh up and down the sides of the mixing container exposing the bubbles and freeing the air. Once the volume has returned to its original level, de-airing is complete.

Some "store bought" vacuum systems have the chamber attached in such a way that it is impossible to lift it and agitate the rubber to assist the rise and escape the bubbles. These may work fine for low viscosity rubbers but not for high ones.

Getting the bubbles to rise is more of a problem if you live at a higher altitude such as in Denver where my studio happens to be. I can only pull a vacuum of 24 to 25 inches of mercury. At sea level one should be able to pull 28 to 29 inches. A professional mold maker once told me how she de-aired rubber. She would allow the rubber to rise to its full volume and then release the vacuum accomplishing nothing sense she was not allowing for enough time for the bubbles to escape or helping them to do so. You can tell if the de-airing is complete if when you release the vacuum, there is no change in the volume.

De-aired rubber makes better molds. This is true whether you are pouring the rubber around your sculpture to make a block mold or painting it on the surface for a skin mold. The rubber is much more likely to be bubble free both on the surface and throughout the rubber. This will result in cleaner castings which will require less chasing while the denser rubber will make the mold last longer. Molds that are bubble free inside the rubber allow you to get even better castings by casting under pressure. I'll come back to this later in the article.

This is how I made the mold of the feather in which I cast the urethane feather that I am holding in the photograph. I simply glued a feather to a thimble, glued a plastic cup around the feather and thimble and filled the cup with a low viscosity silicone rubber. There is a trick to getting the urethane to flow the feather and thimble and filled the cup with a low viscosity silicone rubber. There is a trick to getting the urethane to flow into the very narrow space



*A feather cast in urethane by the author*

*A feather cast in urethane by the author*
*"Fly Away Home" a small bronze by the author withl the ax*

that was in the rubber after the feather was removed which I reveal above.

Let's go back to making the mold. There are two ways that can be used either separately or in conjunction to produce bubble free rubber. The first is as I have been explaining, using vacuum. Reducing the air pressure around a liquid causes air to be removed. When the liquid is brought back to atmospheric pressure, it is pressurized relative to what it was in a vacuum, just under 15 pounds per square inch at sea level. You can get the same results by curing the rubber under pressure. Let's assume that you have something that you want to mold. If you either pour rubber around it or paint a skin of rubber over it and pressurize it (50 p.s.i. is sufficient), the resultant rubber mold will be bubble free. The advantage of pressure curing the rubber over simply applying de-aired rubber is that the rubber will be forced into every nook and cranny capturing more detail. Of course, if you so desire, you can de-air the rubber first and then allow it to cure under pressure for the best possible results as long as you are mindful of the following.

Most things sculpted out of clay or wax will have some air pockets inside. Applying pressure will probably collapse the air pockets causing major flaws in the mold. What I do is place the object in a pressure chamber at 50 p.s.i. overnight and repair any collapsed places prior to applying the rubber and pressurizing. I did not want to take a chance with pressurizing the feather because I was sure that at least the stem would collapse and there would be no way to repair it. But just pouring de-aired rubber around it worked fine.

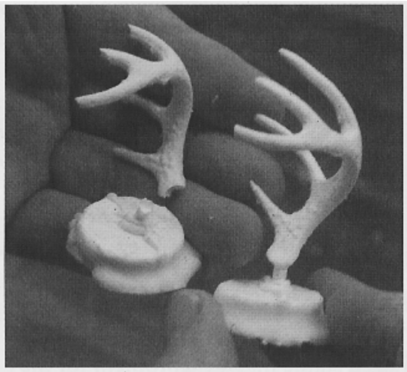
The second was that I use a vacuum chamber to de-air almost any substance that I pour into molds. These include urethane and polyester resins as well as Forton MG. Generally, the only things that I do not de-air are ones that set-up so quickly that there just isn't time. Very fast setting urethanes are a good example. But all of these including the fast setting ones I pressure cast.

I first discovered pressure casting when I was trying to figure out how to cast bubble free clear urethane. (See "It's Very Clear, One Sculptor's Experience With Urethane and Acrylics," "Sculpture Journal, January 2002"). Clear materials are especially critical because it's not just the bubbles on the surface that are a problem but those inside are also visible. Pressure worked so well with clear material that I began using it for everything that I was casting. But, unfortunately, you can not pressure cast in just any mold.

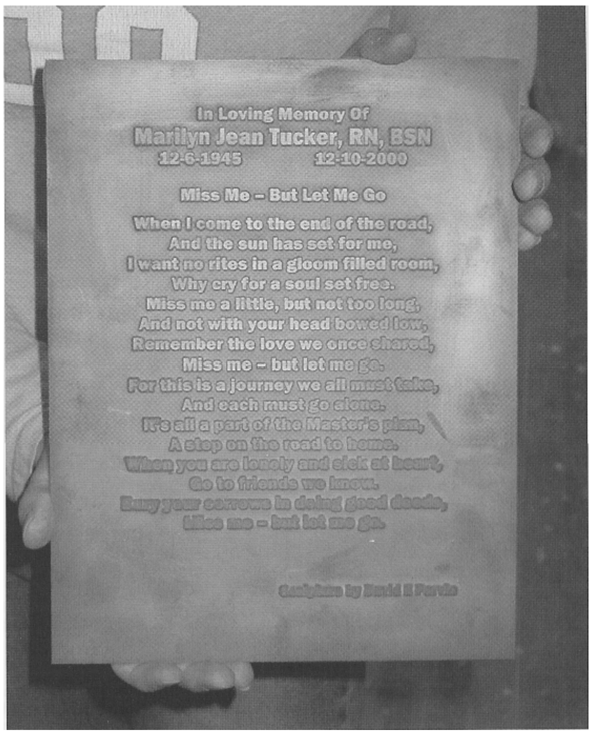
Pressure casting requires that there be no bubbles inside the rubber of the mold. If the rubber contains any bubbles, these will collapse under pressure and the casing will have a bump on the surface for each collapsed bubble. I discovered this the hard way when my casting looked as if it had chicken pox.

I was surprised to find that I could cast waxes (for lost wax) under pressure. One of the major problems that I had over the years was the time I spent chasing waxes for small bronzes. No matter how carefully or how experienced one is at pouring waxes. There were always enough small bubbles that were tedious and time consuming to repair. The fingertips of small hands were particularly bothersome. Any piece small enough to cast solid is a snap to cast perfect waxes. The only trick for casting a perfect small solid wax is for the mold to have been heated to just above the melting point of the wax so that the wax will stay liquid long enough to be subjected to pressure before solidifying. You will probably be able to use wax that is cooler than it would have to be if the mold were cold. This cooler wax will have less shrinkage than it would if the wax were hotter. A good example of what can be done is in the photograph "Fly Away Home". Both the body and the arms come out of the molds in nearly perfect condition requiring almost no chasing.

It is possible to pressure cast waxes for larger pieces that will be cast hollow, but it is a little more complicated. The normal way to prepare these waxes is to pour wax into the old and either fill it up or slosh it around so that all the surface is mold and either fill it up or slosh it around so that all the surface is covered and then dump the excess wax back into the pot. This process is repeated until the desired thickness is attained. To pressure cast, do not heat the mold as I did above, but just pour in the wax filling the mold.



*Two miniature antlers, one incomplete and the other complete*




*A plaque for a memorial cast in Forton MG*

Pressurize the mold. Wait about five minutes, release the pressure, and dump out the excess wax. Since the mold hadn't been heated, a layer of solidified wax will have coated the inside of the mold. It may take some experimenting to discover the perfect temperature for the wax and exactly how many minutes to leave it in the pressure chamber. If necessary, additional thickness can be obtained by pouring wax in and out in the usual way. Only the first layer need be pressurized.

I have found that flawless waxes are a tremendous advantage, not only saving time and money but also assuring more consistency in quality. On those occasions when a foundry loses a casting supplying a replacement wax is not nearly as troublesome. If I expect that a particular part of a statue may be a problem for the foundry, I simply supply several waxes without having to spend a lot of time and trouble preparing them.

Notice the photograph of the plaque which is an inscription for a memorial. The good news is that with modern technology, one doesn't have to actually sculpt the letters. l simply printed what I wanted in block letters on a word processor and had an engraving company mill out the letters about 1/16" deep on a 1/8" sheet of aluminum. I made a mold under pressure, heated it to about 150 degrees F, poured in the wax, and pressure cast it. The wax was flawless and required absolutely no chasing. The final bronze was perfect. The actual plaque shown in the photograph, being held so well by my studio assistant, Morgan (lest you think that I have unusually delicate hands of an old sculptor) was cast in Forton MG with metal powder to produce a low cost example for my studio. It was also flawless.

Let's consider something a little more difficult. Notice the photograph of the small antlers. A participant in one of my life-casting workshops had a set of these in lead. She had been trying without success to duplicate them in resin. She asked if I could help. Always looking for a challenge, I replied "of course! I think I sounded more confident than I actually was. The first thing I did was make a mold in very soft silicone rubber, 10 durometer, soft enough to remove the cast antlers without breaking them. I had attached the base of the antlers to a small wad of clay so that the mold would be a reservoir to hold enough resin to fill the space needed for the antlers. As an experiment, I filled the reservoir with resin and let it set-up under atmospheric pressure. What I got is the antler in the photograph that is missing its tips and had a buckle in the stem that weakened the stem to the point that it broke.

The next time I did the same thing except that I pressurized the mold after pouring in the resin. While not shown, it was better but the tips were still not completely captured, the trapped air was preventing the resin from reaching the tips even under pressure.

Third time was the charm. Using the small pressure pot that I explained how to make in last month's article, I placed into it the mold filled with resin and attached a vacuum line. I don't normally use a pressure chamber as a vacuum chamber because you can not see into it. However, in this case I knew exactly what was happening. The vacuum drew out the air. When I released the vacuum, the atmospheric pressure forced the resin into the mold. For insurance, I attached a pressure line and pressurized the chamber to 50 p.s.i. The result was the complete antler you see in the photograph. This was the method I used to cast the feather.

There is a devise called a "Nip Mixer" that is made for dental labs and mixes material in a vacuum. It has two problems. The first is that it costs about a thousand dollars. The second is that it will only mix a small amount of material, about 200 c.c.s. While I find it useful, I will save the story for a future article.

We don't mean to imply that many things can be cast in wax, resin, Forton MG, etc. "o-natural", i.e. without using pressure and/or vacuum chambers with excellent results, however, the proper equipment can save time and frustration. I am confident, however, that you may find that what was difficult to impossible, may become routine with the proper equipment.

*Dave Parvin is a Colorado sculptor whose primary subject is the human form in a variety of material. He may be reached at: 303-321-1074*