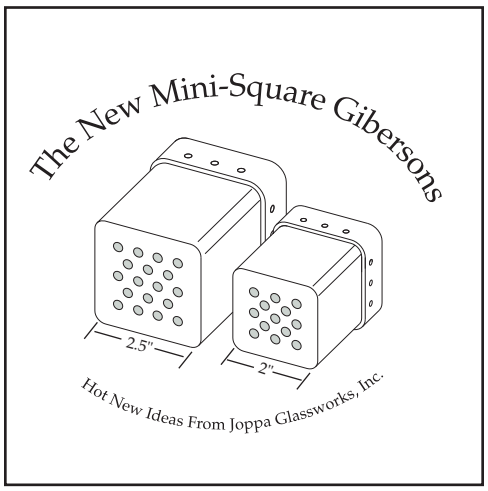
The Development of a Mini-Foundry Protocol ©

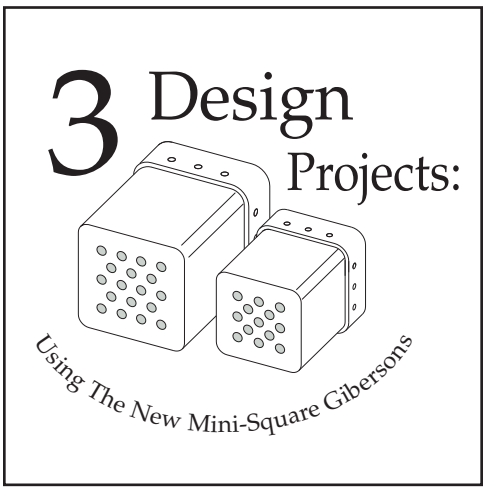
by Dudley Giberson,
Warner, NH

My undergraduate work was a lot about foundry arts. I loved making complicated sand molds using greensand or gassed CO2. Occasionally we poured Ludo molds in bronze. After I graduated from RISD with a BFA in sculpture I took a course at the Kalamazoo Institute of Art in Ceramic Shell Molding. And over the years I have made good use of these techniques though I have hardly had a career in metal pouring. But every so often I have pulled out the metal pouring gear and made stuff. In the early years of my studio life I built a rather large foundry furnace and purchased several large crucibles, all of which sat ghost-like on high shelves in the back of the shop while I made glass and developed a technical expertise in burner technology which used information garnered from the Kalamazoo experience. With a couple of patients under my belt I spent my middle years developing and producing technical burners for the hand blown glass industry. At the same time I also kept my glass shop in production mode.

In recent years I have developed a series of burners for use in small spaces. These are called the Mini-Square Giberson Burners. I have placed on the web two documents that cover the preliminary possibilities for these burners (http://www.joppaglass.com/burner/mini_square.html):



This paper outlines how to use the new Mini-Square Giberson Burners



This paper outlines how to build a mini-foundry, a small glory hole and a small burnout kiln, etc.

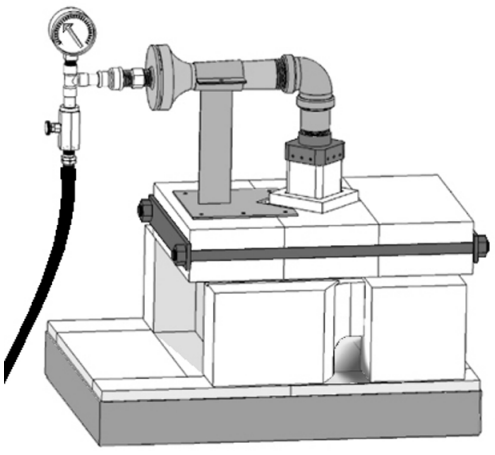
	Model	Orifice for HP Propane	**Venturi Mix** Btu Range (1000s)	**Forced Air** Btu Range (1000s)	Various Uses	No. of Holes	Hole Size
New Mini-Square Burners			HP Propane	Nat. Gas			
	SQ 2 3/16	75	6-24	6-28	❑ for mini-glories and furnaces (5 Tto 10 lbs.), pipe warmers, bead furnaces, & gas annealing kilns	13	3/16"
	SQ 2 7/32	72	10-34	10-40	❑ for small foundry furnaces and glass furnaces (5 lb) small 4-5" glories	13	7/32"
	SQ 2.5 3/16	73	9-31	9-39	❑ for small furnaces and annealers, furnaces (5 lb) small 4-5" glories	18	3/16"
	SQ 2.5 7/32	69	13-47	13-52	❑ for small foundry furnaces and glass furnaces (10 lb) small 5-6" glories	18	7/32"

A little background to the next phase of this paper. I have a few allies in this project: first is my good friend Richard Remsen, from West Rockport, Maine. Richard maintains a foundry and glass blowing workshop and we have been friends for many years. It is a kind of busman's holiday type of deal when I go to Maine. I get to sit in one of his high-backed director's chairs, sip soda, and watch him make glass lobster claws. Sometimes he is pouring bronze bank plaques. Later we go to some local restaurant and enjoy the fish and real lobsters. Richard was the first to point out the value of video for documenting the ancient glass technology projects which culminated in "Dudley's Core Vessel Video (CE. 2004)." He also generously helped edit, as a reader, my book, ***A Glassblower's Companion***, 1998. The point is he has been a great help to me over the years and I value his knowledge and friendship.

My second ally in this effort is a college chemistry professor named Darrell Iler, Ph. D., who teaches a "Caveman Chemistry" course at Greenville College (contact info: H. Darrell Iler Ph.D., Asso.Prof. of Chem., Dept. Chair, Greenville College, 315 E. College Ave., Greenville Il 62246). In 2006 I met Darrell over the phone. My nephew, Louis Giberson, was one of his students then and told him that I knew something about ancient technology. Darrell subsequently gave me a phone call and out of this conversation he acquired from me a small burner set-up (a B-250S Complete Package) for doing simple experiments. To put in perspective the B-250S is capable of melting a 75 pound crucible of glass, not really small enough for work in a chemistry class. But it worked to some degree and I occasionally had conversations with Darrell. One time I was reading about the Civil War and how the rebels were saving their urine and turning it into niter for the gunpowder business. I asked him how that worked. It went something like you first have to put the urine in a concrete vat and over time somehow calcium nitrate is formed. And then you add.... My curiosity was happy just knowing I could pee in a vat and eventually blow myself up.

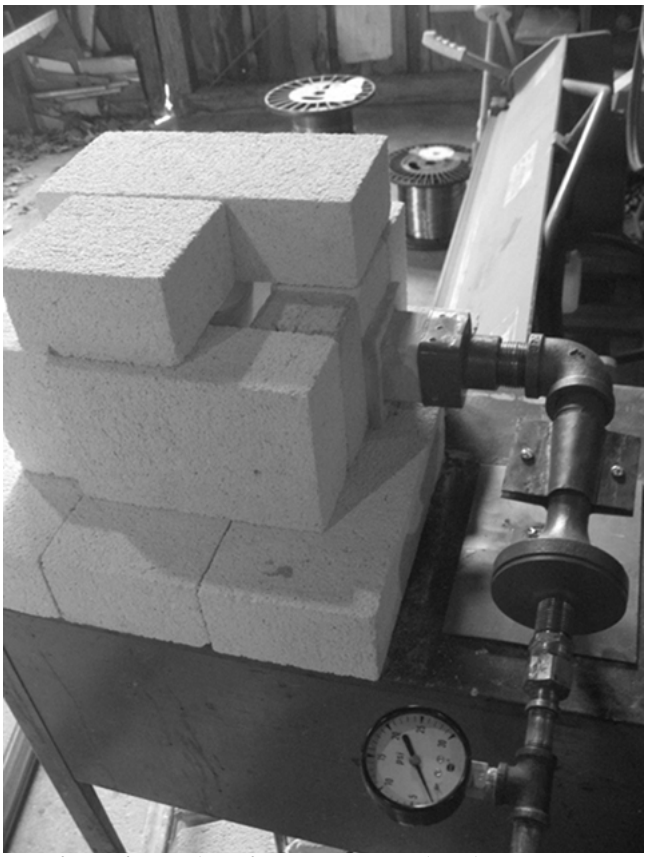
I knew Darrell's testing problem was probably not solved with the burner I had sent but it was the best I had to offer at the time. To put perspective on the issue, in the glass world 75 pounds is a small amount of glass. Most industrial furnaces melt tons of glass so most of my burner solutions have dealt with a "smaller than that" mentality. Who knew the great economic slowdown of 2008 was about to occur? And with it I had plenty of time to contemplate the issue. Many people were switching to electric to avoid the high cost of propane. People were melting small amounts of glass. I made elements for one guy who had a five pound color furnace.

So the technical problem presented itself in the question of how could you make a small furnace in which you could place a 5 pound crucible, say an interior of 6.5" x 6.5" x 6.5" (275 c.i.) that could attain glass melting temperatures of 2500˚F? With a little work I devised a new burner with a face measuring 2" square. Mated with a special burner block, this mounted very precisely in the wall of my now new test furnace and fired to and exceeded expectations. I built this small burner model with two sizes of holes, 3/16" and 7/32". Next I made a little larger version with a face measuring 2.5" square. This too was developed in two sizes, 3/16" and 7/32". Now I had a range of burners that could fire spaces from 90 c.i. to 3000 c.i. or even greater to temperatures up to and exceeding 2500˚F. The development of this burner series had its tenacious roots planted in knowing that there was a need for this range of burner but also in having a downturn in economic opportunity which delivered to me the time necessary In which I could experiment. The ups and downs of our economy are fortuitous indeed.



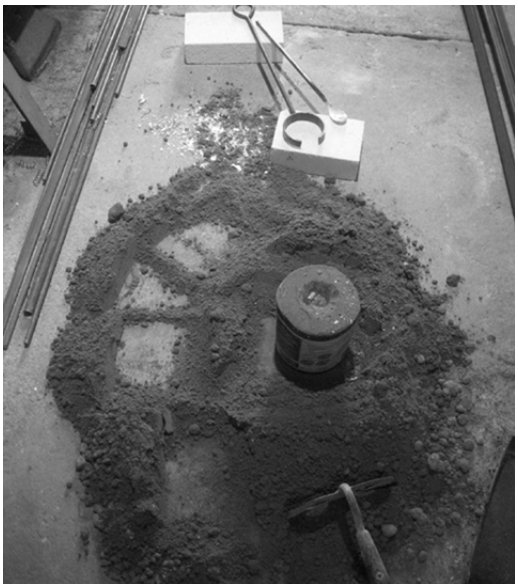
One of the first things I built to test these burners in was a small forge shown here to the right.

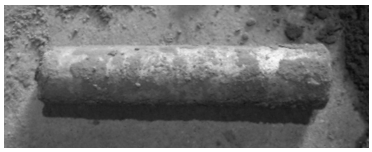
The first items I made with the forge was a set of foundry tools: the image on the left shows the 4″ crucible with the three tools: a skimmer, a pouring handle, and a pair of crucible tongs for lifting the crucible from the furnace.



My first foundry furnace was built using loose bricks. The burner was mounted using a burner stand and burner block as shown in the image above.

The mold and foundry tool arrangement were as shown below.





From this I was able to pour a round bar of bronze about 1″ in diameter and about 6-1/2″ long. With a little wire brushing this material cleaned up great.

It was a terrific success. Knowing I had a system that worked and knowing Darrell was a person who could use such a system, I sent him an e-mail with a set of images such as above. This was the dead of winter, like December of 2011.

Well, sometime in May I got a call from Darrell. He had thought a lot about the project and wanted to go ahead and purchase the burner system and tools necessary to do a rudimentary pour. Great! At the end of May he finalized the purchase and I shipped his stuff about 10 days later.

Later in June I got a call from Darrell wanting to know more about casting processes and we talked about greensand and I promised to call Richard Remsen and pass on his advice.

An E-mail:

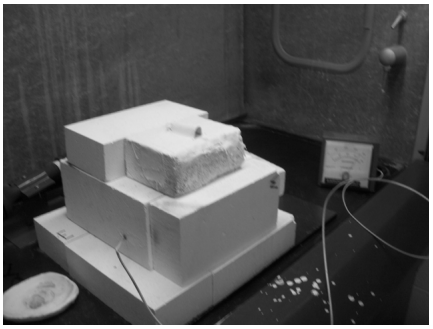
> From: Dudley Giberson [joppaglass@mcttelecom.com] Sent: Saturday, June 30, 2012 7:27 AM To: Darrell Iler Subject: metal casting
>
> Hello Darrell, I talked to my friend Richard Remsen from West Rockport Maine yesterday. He has a business of foundry work and glassmaking. He suggested you purchase a book called the ***Metalcaster's Bible*** by C. W. Ammen. I found this used on Amazon for around $10.00, hardcopy.
>
> He also suggested you could make a greensand from a mixture of sharp sand, clay, and wood flour. Sharp sand is a natural occurrence in some parts of the world. I think the Ottawa, Illinois, sands might be of this type but also there are some from Pennsylvania. The clay component is supposed to be Southern Bentonite. Wood flour is very fine sawdust.
>
> Formula by weight: Parts per hundred
>
	formula 1	formula 2
Sharp sand (160 mesh)	94.5	95.0
Southern Bentonite	4.0	4.0
Wood flour (200 mesh)	1.5	1.0

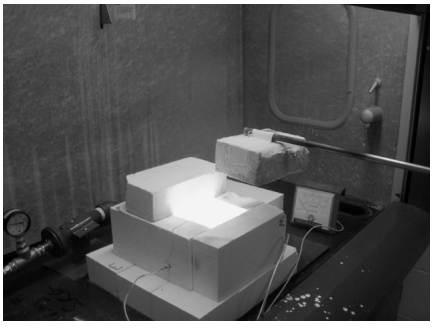
> I really don't think you would have to be too fussy. I have made a greensand like material just using regular river sand and fire clay. The organic material helps keep the surface of the metal from fusing with the sand.
>
> If you could please send me photos of your progress. I would like to make more of this on the web site to get others involved with small foundry operations. Good luck, Dudley

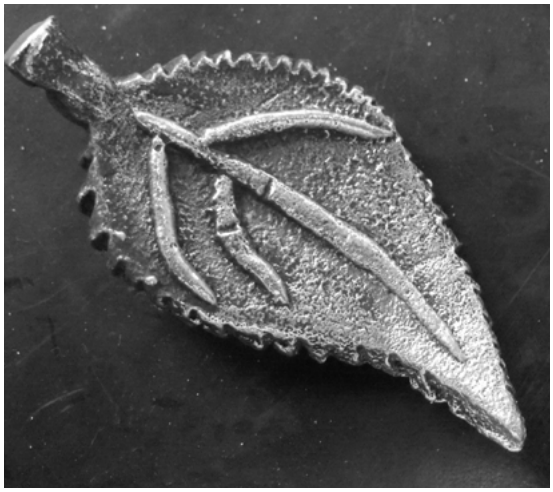
An E-mail:

> On Jul 25, 2012, at 6:03 PM, Darrell Iler wrote:
>
> Hi Dudley.
> I bought a premixed green sand called Budget Blend. Its a mixture of fine sharp silica, wood flour, bentonite and water. I have tried using it in a lost wax approach and it seems to work pretty well. I make a wax replica with a wax pouring spout, then pack it in the green sand in a metal water bath that has a side spout (see picture). I then cover the sand surface with the water bath concentric plates that leave just a center circle open, turn it upside down over the furnace and burn out the wax. I hook a vacuum line to the side spout to a vacuum source then pour the bronze. I have attached some pictures. I think this will be a great "Caveman Chemistry" project. Thanks for all your help! Darrell

Along with this e-mail came a few images:







I can report to you that the above material made me smile with joy. Darrell has developed an unusual mixture of technology. He is making something similar to an oil sand mold. It is also a lost wax technique, but not purified of the carbon. It truly is something unique.

So of course I had to make some comments about that as I wrote:

> I've looked over your photos with great interest. It looks like you are having a lot of fun with this.
>
> So you have developed a little mixed technique, or cross technique. Green sand is usually placed in a split mold. For instance, look up the words "cope and drag" on the internet, say at ***youtube***.
>
> I am preparing a photo essay for you on greensand technique. Some of the pitting and surface defects you are getting have to do with your wax melting into the sand. When the metal hits this carbonized barrier (the melted wax/sand interface) there will be bubbling and some gassing, called "out-gassing". If you used the split mold idea you could remove the wax pattern entirely before pouring the metal.
>
> But all my comments aside you have created a great beginning. I look forward to seeing what develops and to also see the student work as you develop your project.

An e-mail:

> From: Darrell Iler <darrell.iler@greenville.edu>
> Subject: RE: metal casting
> Date: August 3, 2012 12:47:13 PM EDT
> To: 'Dudley Giberson' <joppaglass@mcttelecom.com>
>
> Hi Dudley. I will check out the cope and drag approach. One of the nice aspects of what we have right now is time economy. The approach is simple and relatively fast which is important for a class like Caveman Chemistry. I have included a few more pictures of other new items we have recently cast. I have been trying to vaporize the wax prior to casting to minimize the out-gassing you described. You can use any of the picture or descriptions of our technique on your web site. Thanks again for all your invaluable help!
> Darrell

And again he sends some images that are very delightful:

From here at **Joppa Glassworks** I want to say to Darrell, "I think your class is going to be booked!" And thanks for sharing your information. Dudley G.

Published by The Joppa Press
86 East Joppa Road
Warner, N.H. 03278

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