



From left to right: Robert Ebendorf, Ginger Meek Allen, Jim Chameski, Joanna Goldberg, Mary Filapek, Linda K. Darty, Geoffrey Giles

TECHNICAL ARTICLE

Constructing a Cheap and Efficient Furnace to Melt up to 40lb of Bronze By Olivier Duhamel

As the Editor for the SNAG News Technical Articles, I am very pleased to report that author inquires and submissions have been steadily increasing, with articles now scheduled more than a year in advance. However, I am always looking for new and interesting topics so please don't hesitate to contact me – having sufficient lead time really increases the overall quality of the articles.

This issue's international author shares information about how to build and operate an affordable melting furnace for small sculptural pieces, which can seem daunting, particularly for those of us more familiar with smaller jewelry-scale castings. As with all of the information in the Technical Articles, I want to reemphasize the importance of taking all appropriate safety precautions.

-James Thurman

Introduction

If you are melting metal or are planning to melt non ferrous metal such as bronze, you probably already know that it is important to have an efficient furnace as the metal must melt as quickly as possible to reduce the risk of oxidation and to save on fuel.

Professional art foundries have a purpose made furnace to melt bronze. Hobbyists and sculptors could spend vast amounts of time and money building or buying a heavy duty, sophisticated furnace without any significant gain in efficiency.

In this article we will simply show how one can quickly and cheaply construct a very efficient temporary furnace using LPG gas as a fuel. The design of this furnace has been successfully used over many years to melt amount of bronze from 4lb and up to 40lb.

There are many factors and complex physical equations to design an optimum furnace. Such considerations are beyond the scope of this article and certainly beyond the extent of my knowledge. I will provide you with simple instructions to build a simple furnace that has been proven to melt bronze in about 25 minutes.

The advantages of the furnace described in this article:

- Extremely cheap
- Quick to build
- Lightweight, temporary, fold away, portable
- Easily adaptable to any size crucible
- Works every time
- Fast melt

Tools and materials

- About 10 square feet of 1 inch thick ceramic refractory blanket
- 8 firebricks
- Scissors

To find refractory blanket in your area, search for Kaowool, Superwool, Cerablanket or Durablanket. That is about all you need to construct the furnace. To use it, you will also need a LPG burner, something like a weed burner torch. Your burner's nozzle diameter should not be smaller than 1½ inches (35mm). It must be mounted on a neck tube (20" long – ½ metre).



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Construction

The furnace must be built outdoors in a space wide enough to give at least 5' clearance all around it.

The first step is to cut a band of ceramic blanket twice as wide as your crucible is tall.



Put your crucible on the ground and roll that length of blanket around it, leaving a space of about 3 cm (1 1/4") between the blanket and the crucible.

Cut off excess blanket so that there is only a small overlap (10cm, 4").

We have the luxury of being able to custom build a furnace perfectly adapted to our crucible. As a rule, the walls of the furnace should be as close as possible to the crucible. Try making this gap slightly narrower than the diameter of your gas torch's nozzle. It does not have to be exact and perfect.

Arrange four fire bricks as shown.

This is for a small crucible. If you are building a furnace for a 40lb crucible, you will need more bricks to make the base and back.





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Cut a piece of blanket large enough to cover the base bricks.

Cut a hole at the base of the furnace body. The flame will enter the furnace through this hole which is sometimes called a tuyere. This hole is slightly smaller than the diameter of your crucible, eyeball it.

Set the furnace's body on top of the base.



Cut another square piece of blanket large enough to cover the top opening. When the furnace is in operation this lid will only partially cover the furnace, leaving an exhaust vent which can easily be adjusted by moving the cover back and forth.

The furnace is now ready to be used.



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To complete the work area, we must set up the torch. The hottest part of the flame will have to hit the crucible inside the furnace. Adjust the position of the torch so that it is level and aligned in front of the furnace opening and at about 30cm distance from the crucible (12") The distance from the torch to the furnace opening will vary with each torch. (More on this later.)

I have used 3 bricks to keep the blowtorch handle in place. It will be easy to later adjust the distance to the furnace if needed.

The most important quality of a good furnace is its ability to keep heat inside. It must be well insulated. Make sure that your installation is air tight with the exception of the tuyere and the vent.

Melting the metal

This is the most exciting part of the bronze casting process because it is hot and noisy and because at the end of the day you will hold in your hand something that did not exist in the morning, a beautiful, durable, solid bronze sculpture.



Set the crucible inside the furnace. It must sit in the middle of the oven. Close the cover leaving a small venting gap on one side. Light the gas burner and gradually increase the output to full capacity.

After 5 minutes, the crucible should become bright yellow.

After 15 or 20 minutes the metal will start melting. Wearing a face mask and welding gloves, use the tongs to lift a corner of the furnace cover and have a peek inside the furnace.



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The metal should be bright orange and even starting to melt and collapses at the bottom of the crucible. If on the contrary the metal is still dark and shows no sign of melting, your furnace may be in need of some fine tuning. Wait 5 minutes, take another look inside and if there is still no sign of melting there is something wrong with the tuning of the furnace.

Tuning the furnace

The efficiency of the furnace is dependent on a number of factors: design, size, heat source, and distance from the heat source, heat circulation, venting and insulation.

The two parameters we can start adjusting easily are the distance of the flame and the size of the vent.

Try slowly moving the burning torch back and forth and observe changes in the color of the crucible. The

brighter the crucible, the hotter it is. When you have found the position of the burner where the crucible is the brightest, you have found the optimum position of the burner.

If the vent's opening is too large, flames will escape through it. This will be very visible. Try closing the vent a bit more.

If the vent is too small, it will force heat to escape back from the tuyere towards the torch. This may even extinguish the torch. If this happens, quickly shut the torch, and reignite it the proper way (lighter near the nozzle, open the torch slowly and gradually open up to full capacity).

Once you have adjusted these two parameters and if the furnace was built according to my direction, the metal will soon start to melt. After 25 minutes (more if you had to play around and tune the furnace) the metal will have melted. Have a look inside.

Evaluating metal temperature

Bronze melts at about 976C° (1790F°). You generally want to pour it at about 1100C° (2012F°). You must therefore leave it in the furnace for a while longer. If the furnace is well tuned the temperature of the metal will climb at a rate of 100C° (212F°) every 5 minutes.

Unless you are equipped with a pyrometer, you have no way to accurately measure the temperature of the metal. We will instead assess its readiness to pour by a simple method.

Wearing a face mask and welding gloves, lift the cover with the tongs and dip the tip of a steel rod into the crucible. Count to 4 seconds and remove. Put the cover back in place.



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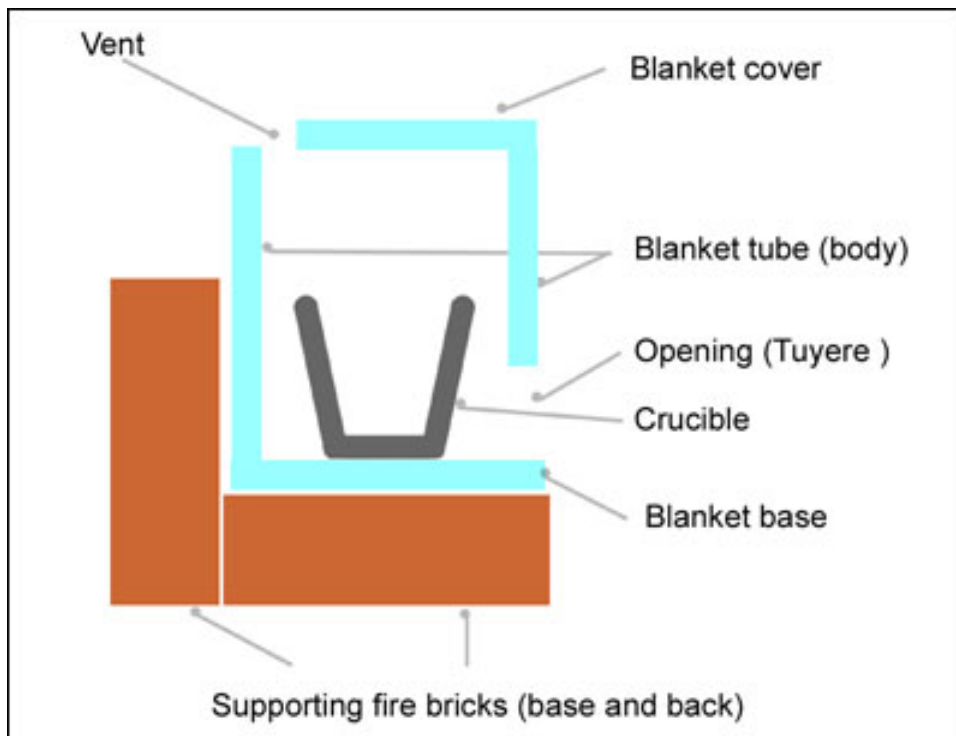
If there is metal sticking to the rod as it comes out, the metal is not quite hot enough. Let the torch burn for another five minutes and repeat this operation until the rod comes out clean.

We are now ready to pour the metal.

Key parameters

Here are some of the key parameters to respect when constructing the furnace.

- Thickness of the blanket: At least 1 inch
- Height of the body: Twice as tall as the crucible
- Size of the opening: As large as the widest part of the crucible
- Size of the vent: Adjust when in operation
- Distance between burner and the furnace opening: Adjust when in operation





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Storage, reusability, reinforcing

After use, and once it has cooled down, the blanket can be folded away until further usage. This furnace will not degrade quickly and can be reused many times. It will perhaps be good for ten to twenty melts.

It can be reinforced and made to last longer by painting the blanket with colloidal silica before each melt. This will rigidify the blanket and the furnace can no longer be folded but it will protect the blanket from slowly becoming thinner after each usage and eventually becoming too weak to stand its own weight.

Safety consideration

There is no particular danger when constructing the furnace. Wear gloves when cutting the blanket as it can irritate the skin.

There are a number of safety precautions to follow when melting and pouring the metal:

- Wear trousers and long sleeved shirt
- Wear a face mask and welding gloves
- Make sure the area is dry
- Have a fire extinguisher ready
- Have an assistant present
- Never leave the area unattended

A video clip illustrating the whole procedure can be seen on <www.youtube.com/watch?v=iUdPomafBKA>.

Happy casting!

About the author

A New Zealander since 1987, French born Olivier Duhamel is a sculptor specializing in the human form. He makes delicately crafted small bronze figurines.

After having been introduced to the fine art of metal casting by sculptor and founder David Reid, Olivier has set up his small home foundry and has since cast over 500 pieces using basic tools and ingredients. He takes pride in the quality of his castings. His bronze works are sold in art galleries across New Zealand and also in Australia, China, France and Belgium.

He is also the author of the Body Casting Manual and Bronze Casting Manual published on <www.bodyscape.net.nz>.

SNAG News will pay up to \$125 per page (up to 4 pages) for informative technical articles aimed at any level – from intermediate to advanced, from student to the highly skilled professional. If you teach a workshop, have a clever bench trick or technique of interest to other jewelers and metalsmiths, or have more academically based technical research, please share it with our SNAG community.

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