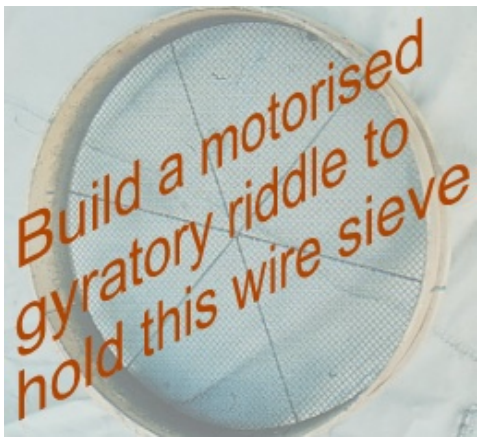
Metal Casting Made Easy.
A complete guide for the hobby metal caster.

Learn the techniques for green sand casting.
How to select scrap aluminium & bronze,
How to melt metal in your hobby foundry.

Section two of this hobby foundry ebook will show you all the details and complete specifications to build a **"Gas Fired Crucible Furnace"**.

The last section will show how to build the best labour saving device any, hobby foundry worker could wish for. **"The Motorised Gyratory Riddle"** will deliver silky smooth freshly conditioned sand every time.

Eliminate "manual sieving" of your sand forever!



This hobby foundry ebook has been written and compiled by
Col Croucher. Australia.

Introduction to the backyard foundry.
A worldwide hobby metal casting renaissance is occurring, people from around the globe are re-discovering the metal casting skills and techniques of the, and just like the old Masters, you can also achieve excellent results using ordinary home built tools & equipment. Know how is simply that which has been learnt through many years of trial and error, which provide proven methods & techniques. Don't ever be afraid of making a mistake, for, without mistakes, you will never truly learn! The author has been metal casting for well over thirteen years. All of the equipment required for your backyard foundry can be built in the home workshop.

This 3-part volume hobby casting guide ebook will give you information on how to build all of your own foundry gear. You will need some basic metal workshop tools, e.g. Welder, angle grinder, power drill and other small hand tools that most people entering into foundry work already seem to have. Hopefully this will be the case with you. If you don't, then why not do a joint project with a friend. Share the cost**,** and share the fun**.**

The subjects covered in this ebook:

1. How to melt & cast metals.
2. Building a Gas Fired Furnace.
3. Building a Motorized Gyratory Riddle.

Section One: **Metal casting Made Easy.**
The topics covered in this ebook will range from making simple wood patterns & cores, preparing foundry sand & ramming up your mould boxes.
How to select bronze and aluminium scrap metal to break up & melt into ingots to use later for your casting work.

The various tools & equipment you will need for moulding work will be explained. We'll discuss the different furnaces that can be built to melt your metal, (covered in the next section) plus a host of other material you will need to know, to begin this age old craft of "METAL CASTING"

In this ebook you'll find good quality photographs that accompany the text all the way through. The step-by-step sand moulding photographs and description will help you to fully understand the methods & techniques involved with moulding and casting metal. If there is something you don't understand, feel free to contact us through the contact form on the about page of the web site.

Hobby metal casting is highly contagious, and after a couple of sessions of melting and pouring, you'll be hooked on the process. Your imagination and the skills that you develop will be the only limiting factor in your progress & success.

When I started out fourteen years ago, there was very little info around for the home metal caster that made any sense, I searched high and low for the right books, (especially for info on die cast Al pistons) but found that most were for the foundry industry specialists or career people. While these books were excellent for the purpose, they were not much help to the home foundry worker!

Whether you intend to just make things for your own enjoyment**,** or you aim to get serious & gain enough skills to start making things for payment, is entirely up to you. Whatever you do, **Don't Rush** into trying to make money out of your venture, take it slowly, learn your craft, and practice all you can, which will help you to make the best product possible.

Castings from metal.

Bronze & Aluminium items are the result of greensand casting. Produced in the author's home foundry. Greensand casting can produce quite fine details. Each of these items presented their own particular casting techniques, especially the crocodile nutcracker.

Sand casting techniques.

Have been used for thousands of years to Cast Iron, Bronze, Gold & Silver artworks, & simple tools and implements, even weapons used by ancient civilizations. The Egyptian craftsmen produced some amazing bronze castings utilizing simple tools & equipment. Imagine a team of people taking turns blowing air down long tubes provided the heat to the primative melting furnaces.

Society has now become more reliant on new technology, the old techniques of hands on small-scale metal casting have started to rapidly disappear into the annals of history. Except for the small band of interested people like you, who'll help to keep the craft alive.

Today there is a great resurgence in backyard metal casting; people wanting to melt & pour metal, can do so right in their own backyards, There is no rocket science involved!

Whether you want to cast vintage car or motorcycle parts, or you want to cast your own artworks in bronze or auminium. Or even if you just want to have a go at metal casting just for the fun; this book has been written for you, the novice & semi advanced metal caster.

There is nothing more satisfying than creating something from nothing, and showing you're new found skills to your friends and family. This ebook will show & describe how to achieve metal casting results that maybe you never thought possible.
As you learn the basic foundry skills, you will be amazed at what you can achieve by learning and applying the simple skills of this intriguing craft.

There are plenty of foundry sites around on the net that will show you some photos of home built items, but they do not cover the full details required to enable you to build the same item. Feel free to print one copy of this manual, but please respect my intellectual property & copyright. It is illegal to provide pirate copies of copyright work. If you want to use text from this ebook for some reason, then please email us for permission. I want you to treasure this ebook.

You may print your own hard copy instruction manual to have by your side, to refer to when required. You can quickly look up and read about certain subjects or articles, or look at the pictures and plans, which help you to learn how to do all the different

processes required during the moulding & casting processes. Or to build the equipment you want for your home foundry workshop.

About the author.

My interest in metal work stems from my boyhood days, I was fascinated as I watched my father work the farm “Blacksmith Charcoal Forge” to heat metal to do repair's to farm machines etc.

As a teenager I went to Tech College and studied all the trade courses I could find, even attending night classes over many years.

Furthering my studies into foundry work, I have experience in all foundry areas Inc, sand moulding, core production, foundry practice & pattern making. But I can assure you that the early days of my casting were done with much trial and error. (Plus plenty of failures.)

Building a go-kart project started me on the road to ”**Home Foundry Work”.** The go-kart needed wheels, so the quest for ”casting know how” began. (Later you will see the turned patterns for the wheel project). By following simple pattern making methods I made some wheel rim patterns to cast the aluminium wheel rims. (Success at last)

The Basic Charcoal Furnace.
This was a crude charcoal fired contraption, but it worked, we were able to melt enough aluminium to cast the kart wheels, after a couple of initial failures? (Remember, you learn from your mistakes).

The furnace was built from old house bricks stacked on the ground, in a circle shape to hold a pile of home made fuel charcoal. A short length of 2” pipe was placed in the bottom of the charcoal bed, to provide the air blast from the household vacuum cleaner. A steel pipe crucible was used to hold the molten metal.

Don’t ever underestimate the melting capability of charcoal. It is an amazing fuel. With the correct air blast, it will melt most metals (especially when used in a cupola furnace), it is quite effective in melting aluminium, many hobby casters start out with a charcoal furnace. The only problem is with the charcoal supply; if you cant make your own, then you may find it difficult to find a reliable supply. (We have a free charcoal-making guide available from our web site)

Every furnace requires “Air blast” to build heat. One of the best furnace blowers available comes in the form of a good second-hand domestic vacuum cleaner. They are ideal for melting Aluminium or Bronze in a **Gas Fired Furnace**.

The domestic vacuum cleaner is also an excellent choice to provide the blast for a charcoal furnace. Just be sure before you buy a vacuum cleaner, that the hose can be attached on an outlet socket to make it **blow** instead of suck**,** most important!

There is nothing more satisfying, than creating something unique in your own workshop. Especially when you conceive an idea**,** make a pattern, ram the sand mould, pour the casting, and then finish it on your own lathe, etc**.** There are home metal casters all over the world creating their own unique products; you will be joining these ranks of backyard founders, creating your own special items.

You don’t need sophisticated equipment to achieve good results with your home foundry operation, it is the skills and techniques that you develop that make the difference.
You probably can’t afford to have the best right from the outset, understand that you don’t need it. Several years passed before I was able to build really good equipment, but, it was only after operating very simple equipment, which enabled me to custom design and build an excellent Gas Fired Furnace**,** and the associated gear that went with it. I am still making equipment as required. The equipment is really just a miniature version of the big commercial gear. Always keep your eye out for good ideas that you can adopt to your foundry operation.

DISCLAIMER.
Foundry work is lots of fun.

You will get much enjoyment from your metal casting creations, but please take **CARE** when handling molten metal. Temperatures from 740DegC to 1300Deg C can inflict a very serious injury due to unsafe practices. **Don't ever put wet scrap metal or ingots into molten metal, it will explode, showering you with molten metal. You are dealing with old technology here; the associated risk of injury should be fully understood by all who attempt this craft!**

Please buy some **protective clothing, eye & face shields**, Leather apron & good quality leather work boots. Nothing will spoil your fun more than a serious burn on your body. I have experienced the pain of small splashes of hot metal. I can tell you it is “NO FUN”

This ebook, provides an introduction to hobby metal casting and how to go about setting up your own backyard foundry. One section read by itself will “Not fullfill” your needs, although there is enough material covered for most people to grasp the methods required to build your own equipment & tools to help you to do good sand castings. This hobby foundry ebook collection, which you have just downloaded has had worldwide acclaim and support for the instruction provided, but your learning should not stop with this ebook alone. Hobby foundry work is a journey of discovery & fulfilment as you learn the techniques of this intriguing craft. Seek out others with an interest in metal casting & learn from them also.

Building your own foundry equipment.
The tools and methods explained in this ebook have worked extremely well for the author. There are several tools & other foundry equipment that you should be able to construct. Arc welding will be involved in the construction. You need to be a reasonably competent welder to make your own tools. Please be careful if you are constructing a pair of Crucible Tongs. Think of the consequences if your lifting tongs “Failed” while removing a full crucible of “molten metal” from the furnace! Being burnt with molten metal is extremely unpleasant to say the least.

If you are not a competent welder, go find someone who is! Perhaps you have a friend who is interested in what you are doing. Combine your talents to create the things you need for your foundry. With a combined effort, you will soon build the basics to get started. Then you can move onto the more advanced facets of sand casting.
You are accepting responsibility for your own actions.
The Author “WILL NOT” be held responsible for carelessness on your behalf. I have no control over the way you conduct the practices in your home workshop. All I can do is warn you to be very careful in the way that you carry out your craft. If you use common sense & safety precautions then everything will be fine. Be careless and you will INJURY could occur.

Your foundry equipment can be fabricated with normal tools, machines & equipment found in well-equipped home workshops. At times you will need to have access to a lathe. The machined parts will not be complicated or difficult to make. Basic lathe turning methods will suffice, & I’m sure that most people who are attracted to metal casting would already have reasonable machines in the backyard workshop.
If not I would suggest that you talk with friends who may know of someone who can help you out.

Another way to gain access to good workshop facilities is to enrol in a night class at the local Tech College, with the aim to work on your own projects…simple. The course will be worth every penny you pay for it.

Operating and reading this ebook.

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- All images displayed within are copyright of "Coljan Photography" Australia, May 2003
- International Copyright protects all Images & text appearing in this eBook. Images are Low - Res, watermark embedded.

- If you are new to metal casting, please read the book as a whole**,** and not just in sections, the more experienced metal caster may choose to read individual chapters if they are already familiar with certain operations.
- Navigation from start to finish is quite simple, choose any page from the bookmarks or contents shown, and use the black **forward & backward arrows** to go from page to page. You can also enlarge or reduce the font size to fit your computer screen for easier reading.
- Click on the bookmark tab and the entire **major subject heading** titles will show as an index for easy reference & selection.
- If you place your mouse arrow on the side scroll bar and click the mouse & hold it down you will notice a small side bar with all the page numbers shown. This method can be used to find a certain page very rapidly if you know the page location or page number.
- This ebook requires an encrypted operating **password.** If you obtained the password other than from our website then you may have an illegal copy, please email us for details of how to correct that situation.
- For more information visit our web site: http:\\www.myhomefoundry.com

Or email us at: mailto:emails@myhomefoundry.com

Quote.

Use what talents you posses.
The forests would be very quiet indeed
If the birds that sang there
Were only those that sang best.

Author unknown.

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"A man only learns in two ways, one by reading,
and the other by association with smarter
people"
==Will Rogers==

*****

Tuition is high in the school of experience and there are no free scholarships.
Benefit by the experience of others.
== ANONYMOUS==

Casting shake out time.

Quick Tip.
This is the part of foundry work that you look forward to, checking the success or otherwise of all your hard work.
This casting looks OK at this stage & most do, however after extracting the casting from the sand, give the casting a thorough check to make sure there are no cold shuts, miss runs, or metal pulls, shrinks, caused by insufficient metal feed to heavy parts of the casting.
Sometimes it may take two or three goes at getting a perfect casting from a new pattern.

Opening the mould box.

This is what you will find when you open the sand mould box (Cope & Drag). A sound sand-casting, & hopefully without any faults. Notice how the sand has lost most of its moisture; you can see the dry line the hot metal has created. The bulk of the sand mould still has large amounts of moisture; it is only the sand right near the hot casting which has had the moisture driven out of it. This moulding sand will be far to dry to do further moulding with, after the casting has been removed it is time to put the sand back through the **Motorized Riddle** or hand sieve to recondition and temper (Add water, no more than 6%) to get it ready for another moulding session.

Reproducing small parts.

Often, an **original** part can be used for the **pattern**, if you can accept some shrinkage and it is fairly flat all over and has not got any undercuts, then you may be in luck. Find the edges or line that would make the parting line. Ram up a drag mould box and screed of excess sand; Sprinkle some graphite over the sand to act as a parting powder.

1. Your small part can be imbedded face down into the sand, (tap the pattern with a light hammer and piece of dowel) to the parting line.

Follow this with the top half of the mould (Cope) and ram it up also, you will find that you have a very well defined impression of your object in both parts of the mould. All you would need to do now is to.

Cut the gates and runners, as well as make the down sprue hole and you are ready for pouring. The down sprue can be made with a short piece of ½" dowel pressed into the sand near the pattern, simply cut an in-gate from the sprue to the pattern.

This is one of the easiest ways to reproduce small castings. You do need to practice making your impressions. Don't forget to use your parting powder in between your moulds, other wise, the sand will stick together, and parts of the mould will pull away. When you first start to mould you will have to think what you have to do, but after some practice it all becomes automatic. You won't even think about what the next step will be.

The step-by-step sand moulding instructions will be shown soon, and this will make the process a whole lot clearer for you to understand. There are several steps & procedures to follow when ramming your sand moulds. To a beginner it may look a little daunting to try and remember all the steps, but once you have done it a few times you wont even think about what comes next.

Reconditioning foundry sand.

Due to the intense heat of the metal castings, the moisture that you so carefully put into the sand will be driven out. This used moulding sand will now have to be put back through the sieve to have the correct amount of water added to it.
Reconditioning of the sand (By adding a small percentage of water, about 4 to 6%) is essential after every moulding & casting operation. You can use the hand sieve, or if you want to make life easy, a **"Motorized Gyratory Riddle"** will reduce the effort for you.
Full construction details are shown in the last section of this ebook **"Build the Gyratory Riddle**". This machine is simple to construct, which is powered by a small 1/3rd HP washing machine motor.

Foundry sand has to be able to breathe within it self. This is known as permeability. When hot metal is poured into the mould cavity, quite a bit of steam and gas is generated while this is going on. There will be steam shooting out of the vent holes in the moulds, as well as working its way through the sand within the mould.

Sometimes your sand will have an excessive build up of burnt clay fines and other waste, the clay fines can have the effect of reducing the breathing ability of the sand. If it gets really bad, the sand may have to be discarded, and a new batch made up. A batch of sand can be rescued by mixing fresh **olivine sand** and more Bentonite. After a couple of mould/pouring cycles it seems to be OK again.

WARNING ABOUT WET SAND.

DO NOT pour hot metal into a WET sand mould, you will create an instant STEAM BOMB, hot metal will BLOW BACK out of the sprue hole with much force. NEVER PUT your face directly over the pouring hole for this reason, and always wear your safety gear

Sand Types.

There are many different types of moulding sand, some founders say you need special sands for this and that; this may be true if you get into making name plaques etc. For the type of work you will be doing in your home foundry set up, I would say that the green sand that you have, will be fine for most casting that you undertake. If you look after it, keep it clean. It will last a long time.

I still use a base stock of green sand that I bought over 10 years ago, it has had additions of NEW olivine sand & some binder, (Bentonite) but, apart from that, it is still the same stock. It has been used for Aluminium and Bronze with very satisfactory results. And provides a high class of finish to the casting.

Oil Bonded Sand.

The very best sand for very fine detailed work, such as plaques, nameplates art castings etc, readily available from various foundry suppliers, it is well worth your while to check this product out. The free ebook Petro Bond you received with this ebook, will make a good edition to your foundry library, read it and learn about this excellent moulding sand.

Other methods of sand moulding include **CO2 gas & sodium silicate to harden sand moulds. Cold set resins** are also used in large foundries, we won't be covering any of those systems in this e book, and later on you can contact suppliers to obtain info on these products if you wish.

Baked sand core rods ready-made core rods.
The cores in the above photograph were blown and baked in commercial core making equipment.
There is no shortage of small foundry operations that supply other foundries (your foundry) with ready-made sand cores; there will come a time when you don't want to make your own cores. The cost of buying 5/8" Dia ready-made cores is not expensive (under $1.00AU), the rods come supplied in 18" lengths, allowing you to cut them into whatever size you require for the job at hand.
Resin Coated Silicate Sands.
Using cold set resins, mixed with the silica sand can also be used to make cores. These resins allow you to work the sand for a short time until it starts to go of. Generally only available in 20 litre drums or larger, so it is not really feasible for the home founder to do this until some sizeable production runs are planned. There are several foundry companies that supply these products.

Foseco, a worldwide foundry supply house, has many different kinds of products to cover every foundry situation. It is well worth your while to investigate using these products, as they are easy to use and give very repeatable results with all types of metal casting applications. Ask for the information sheets to be sent to you.

There is no, one, correct way to do things with foundry work. If three different foundries were visited you would find that they all have different ways & methods of doing things. You will discover certain methods that will work well for you.

The idea is to get **"**REPEATABLE RESULTS", It helps to make notes as you work on your projects, don't rely on your memory for details. If you don't go near your foundry work for a month or two, you might be lost if you can't remember a certain process or method that you used to get a particular result.

An easy way to create special shaped holes in castings is to make up steel cores in the lathe; they are then set in the pattern before you start ramming up. When the mould is complete, and the pattern extracted, the steel core is held captive by the sand. After the pour is complete and the casting has been retrieved from the sand, you can cut the gates and runners off.

The steel core is then pressed out of the casting. I use this method to make the spring caps, which are shown in a previous discussion. The method is quick and easy, and works every time. The steel core is smeared with oil and dipped into a container of graphite powder. (The graphite coating prevents condensation on the steel core, which will blow when the hot metal hits it)

Method 2 (My Favourite)
If you happen to have a charcoal forge stored in the corner of your workshop, drag it out and get it ready to do some serious melting. Firstly you need a good supply of charcoal. (Read…. A good large bag full)
You can make it your self. Complete instructions are available free at our web site
http://.www.myhomefoundry.com
Now, you have to make up a square or rectangular shaped iron pot with a handle attached to one side. Light up the forge and attach your blower, and set the blast to a low setting, once the bed of charcoal is burning nice and hot, place the steel pot in the hot coals, place the first chunk of cylinder head in and just leave it, it will take awhile to start to show signs of melting. With a good supply of charcoal, and the right blast, it won't be long before you will have to pour the melt into your ingot bar.

The illustration above shows the shape of the ingot bar that I have used, it was made from a piece of folded heavy gauge metal, the notches were formed from pieces of angle iron cut to fit and welded inside the ingot bar.
The ingot bars in the photograph weight about 6 Kilos each. When the bar has solidified, knock it out and get ready to pour the next melt. The stacks of ingots in the photo were made in an afternoon's work…. The cost = $00.00. Plus fun time.

Melting scrap bronze metal.

Sourcing & melting Bronze is going to present another problem for you to solve. The heat involved in the actual melting is considerably higher than Aluminium, and the metal losses involved as you melt will also be much higher.

Finding suitable sized scrap bronze is going to make you search harder than you would for Aluminium. Hunting around junkyards and private places for your metal may well turn up what you require.

Probably the best source of good bronze metal is going to be by purchasing your supply from an ingot supply house. Buying it here will give you the exact metal composition that you need, eg. Silicon bronze is one of the best types of bronze to melt in your crucible. It is easy to cast, and does not present any problems while melting, and needs very little if any fluxing before the pour.

It won't be cheap to buy, but you will know the exact make up of the metal. If you were to continue collecting scrap bronze, you will have difficulty determining whether it is silicon bronze, manganese bronze* or perhaps Aluminium bronze*, gun metal bronze etc. All these metals have different fluxing & degassing requirements for melting and pouring. Some are just too difficult* for the hobby caster to even attempt to melt & cast.

There is nothing wrong with you experimenting and melting your own scrap, just don't get too upset if some of your castings are not turning out as good as you may want them to. Try to keep your different metals apart if you can, but with scrap bronze it can be very hard to tell the difference between the mixes used commercially, even for the professionals! (Without chemical tests & analysis etc)

An excellent source of bronze is buying the sprues and runners from a foundry involved in casting bronze art castings for sculptors, they will most likely charge you only half the normal ingot cost. Art casting foundries use silicon bronze…, which is very easy to melt & pour.

7. If the flame blows out SHUT EVERYTHING DOWN INSTANTLY. The starting process will have to be carried out again. (Put The blower back on to blow unburnt gas out of the furnace interior, if you don't do this, any residual gas will explode and burn you when you go to relight, **LPG gas is heavier than air)**
8. The furnace will most likely be too hot at this stage, to put your hand in to light the paper with a match, so use a long instrument to light the paper on the second time around.
9. Once the lighting sequence has been carried out a few times and you have come to grips with the behavior of your furnace, lighting up should be a success every time that you attempt to light up.

- **WARNING: DO NOT** leave the furnace unattended while it is running, If there is a power failure the blower stops, but the gas keeps going, this is a **potentially very dangerous situation**, It only requires a small amount of LP Gas MIXED WITH AIR to create a life threatening situation…Read…. **"EXPLOSION"**

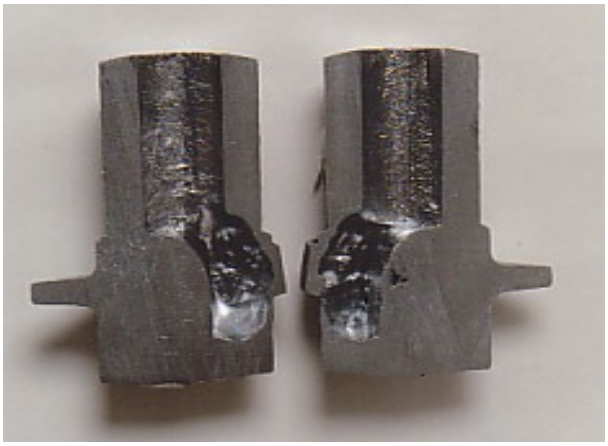
Common Sand Casting Faults.

Casting Mismatch.

This is what happens when you are not thinking what you are doing while reassembling the Cope & Drag moulds. The mould was poured only to find the boxes had been turned around. This is the very reason we said to colour match one corner of your mould boxes to avoid this mistake. You think I got mad when I saw this… You bet… Only one solution, scrap the casting (& remelt it), and re-mould & pour it again!

Cold Pour or Cold Shut.

The metal was poured way to cold; it cooled even more while traveling through the cool sand and stopped right at the casting cavity. Sometimes a low sprue height will also cause this to happen. A combination of factors can at times confuse you to what actually caused the problem. Some form of temperature control should be used to monitor the exact temperature that you will pour at. Usually smaller items have to be poured at higher temps than larger items, simply because larger amounts of hot metal will keep hotter for longer.



Quick Tip.
Using uncoated steel chills or cores can also cause steam blows. A good method I have found to prevent this is to smear some oil on the steel core or chill and then dunk the core in a box full of fine graphite flakes or powder. Place the core or chill carefully in the mould. When the metal is poured, the graphite acts as a barrier to moisture. It does not affect the chilling action on the metal.

Steam induced Core Blow.
This steam blow originated from the sand core. The likely cause was the core not baked long enough. The core may have absorbed moisture from lying around for too long.

The casting is a clutch slave cylinder. The steam blow has just destroyed the casting. Looking from the outside you wouldn't know what was wrong with it, as it looked quite normal, looks can be deceiving. As a pressure vessel this had to be a very good quality casting, steel chills were inserted while moulding along the barrel & at the end of the cylinder to promote a dense grain structure. (Chill effect)
Needless to say, some new cores were made and some fresh moulds were made up and they turned out just fine.

Glossary: Common foundry terms.

Absorption: Ability of any material to absorb certain gases from the atmosphere. Use a good flux & degasser to purge gasses from molten metal, especially Aluminium
Aerating: Reworking & reconditioning your moulding sand with hand sieve/Shovel/or Motorized riddle. (A great machine for any Foundry!)
Binder: A material such as Bentonite used to bind sand particles together. Foundry sand and bentonite is mixed in a Muller.
Blowholes: Gassy metal due to lack of de-gassing before pouring. Can also be caused by wet foundry sand, sand should not stick to your hand when squeeze tested.
Cast: To pour molten metal into the sand mould. (Cavity)
Chill: Cast Iron or steel objects used to promote rapid solidification of metal, reduces porosity. Creates very tight metal.
Core Shift: The result of a core moving with the pressure of the metal entering the mould. Make sure that core prints on the pattern are the correct size for the core being used.
Crucible: You're melting utensil, quality crucibles are made from silicon carbide materials, buy the best you can afford. (Cheap Clay Graphite items are available also). A make shift crucible can be lined with fire clay.
Dross: The rubbish & oxides that form on top of the melt. Always degas the metal.
Fluidity: The ability of a metal to flow freely when in its molten state. (Correct temperature)
Flux: Special powders available from foundry supply houses, helps to remove oxides etc from the melt. (Sprinkle on top of melt to prevent gas pick up from atmosphere)

Looking at hot metal and trying to estimate the temperature is really just a guessing game. You have to view the hot metal under dark conditions. A little difficult if you're melting metal in bright daylight. Aluminium is even more difficult to determine what temperature it is at, because it does not change in colour like molten cast iron or bronze.

Aluminium looks silver at solid & looks a silvery pink colour when it's at full melt. The colour can vary with the amount of light in the foundry. I still like the pine stick method that I discuss in the book. However the most accurate method is with an industrial optical pyrometer. You can also make up a thermal couple device and use a cheap multi meter calibrated to determine the temperature of the melt.

The meter is made using two pieces of dissimilar Alumal metal; they have been proven to be quite accurate for measuring molten metal, although it can take awhile to dial in the accuracy.

The Home Metal Foundry.

Your home metal foundry will be a constant source of satisfaction & amazement to you and your friends. As you acquire more confidence with the projects that are attempted, you will find that after a while, people will ask you to cast small items for them. If you feel confident with your skills, by all means, do some outside jobs, whether for fun, or a paid service is up to you. Don't take on a job if it is outside your foundry skills, it is better to carry out trial and error casting jobs of your own, rather than practice on other peoples work, which may end defeating you and suffer the embarrassment of not being able to do the job.

Some people will pick up the required foundry skills quicker than others, that's OK, it is better to learn at your own pace, rather than rush things through and not grasp the skills and techniques needed to successfully mould and pour your own castings.

When you become totally familiar with metal casting, everything will become second nature, it is a bit like driving a car, you don't think twice about what to do next do you? All it takes is practice and lots of learning. Don't be afraid to seek out others that might be doing the same as you. Visit mainstream commercial foundries for guided tours; you're bound to pick up some really good ideas & new technology.

I still remember the tour we had of the General Motors Holden Foundry at Fisherman's Bend, Melbourne, Australia, during a foundry course that I was undertaking. On the last day of the course we were able to take a look at this large fully computerized manufacturing foundry plant. The principles of this large foundry were basically the same as what we were doing during the course, only the scale of the operation was simply huge. The memory still lives with me today.

Build as much of your own equipment as you can, you will not only save lots of $$$, but the custom-made gear will suit your operation perfectly. If you have a reasonable workshop, it should not be too much trouble building your own equipment.

In the next section of this ebook we will be taking you through all the steps to build your own gas fired furnace as well as a motorised riddle. It's time to start getting up

The long tapered raised piece forms the runner that joins up with the short in-gates attached to the patterns. If you took these images and placed them back-to-back you would note that all the parts of this layout would match up together. The hole in the mount board between the patterns on the right (above) is used to place the down sprue to secure it while the sand is being rammed.

The long runner joins up with the short in-gates attached to the patterns. The lower bosses on the underneath of the pattern board will match up with the top part of the pattern. The boss is bored out to accept a thread at a later stage of the production.
If you study the images, and read through this section again you will understand the idea behind mounting your patterns on a pattern board. Especially if you get into doing small production runs with your mini foundry operation.

Sometimes it is difficult to get your head around the pattern making process, it is kind of like photography where you need a negative before you can make a positive print.

The negative is always a reverse of the positive, and that pretty well sums up a lot about pattern making. If you can understand this concept then you will get to understand pattern making in a new light.

The door hinge patterns could have been all separate components and then assembled on the mount board before making up the sand moulds.
Simple split patterns are created using this technique; while that is fine if all you want to do are just a few odd castings. But it can be a real pain to have found all the pattern bits plus the gates and the runners, and then fiddle around and try and make your sand moulds.

By mounting the split patterns carefully on the board along with the in gate's and runners, will ensure good accurate sand moulds every time you ram your sand.

When mounting the patterns and runners etc. you have to be extremely careful when measuring and laying out everything on the board,

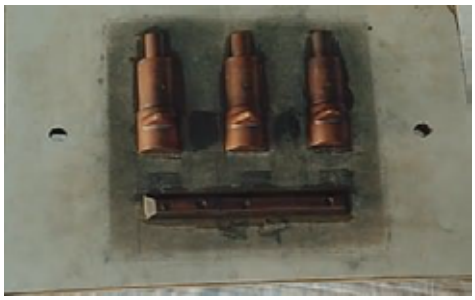
Start at one side of the mould board and mark out the centre line of your patterns.
On the door hinge patterns above, we marked out three centre lines. When mounting pattern bosses or projections on the under side, drill very small guide holes through the patterns and through the mould board. These will serve as your alignment centre holes.

Next you can determine where you will place the in-gates and runners and any spots where a riser or feeder may be needed. If your casting has a heavy section close to a lighter section, feed it generously with metal other wise the heavy section will pull metal away from the light metal section leaving you with a weak hot tear, and a porous casting.

The door hinges above may not look like heavy castings, but even they needed to have generous feeders on the top of the heavy boss at the front of the hinge, the feeder or riser had to feed metal into the casting for the upper and lower boss!

Sand Cast Slave Cylinder.

Slave Cylinder Patterns. (Cope side)



Slave Cylinder Patterns (Drag side)
Split patterns were mounted on the mould board for quick moulding of small production runs.

The slave cylinder illustrated here was born out of the necessity to replace an obsolete part for a car being restored. The original equipment supply of parts had dried up. There was no other alternative but to put on the thinking cap and make some patterns to reproduce a new cylinder. This project turned out to be quite a challenge!

Some lateral thinking had to be done to develop this project. The original cylinder was an unusual shape, which did not lend itself to sand casting very well. As you can see with the patterns mounted on the board, we have used the set up of three. This number of three was arrived at because this was all we could fit into the steel mould boxes available .The configuration and layout of the patterns took awhile to sort out. If you study the photo opposite you will notice the core prints at the end of the cylinder, and the feeder or riser's at the other end and also the in gate a channel.

The cope or underside of the mould board secures the other half of the patterns plus the runner, which delivers the molten metal to the in-gates. The riser's shown above are short & stubby to provide sufficient feed metal while the casting's are cooling in the sand mould.
The holes drilled through the mould board either side of the patterns allow the registration pins on the ends of the mould boxes to pass through and engage with the alignment brackets on the cope mould box.
The mould board is sandwiched between the cope & the drag. You simply mould the drag box, and then roll the whole assembly over and then mould or ram up the cope part of the box. This system makes the whole process a lot easier than having to assemble the patterns gates & runners separately in the mould.

The patterns were turned from a timber called jelutong, this timber machines and sands very well. To get two halves of the pattern we used the old wood turners trick: (Glue two pieces of timber together by placing brown craft paper between the pieces being glued, do not over glue.)

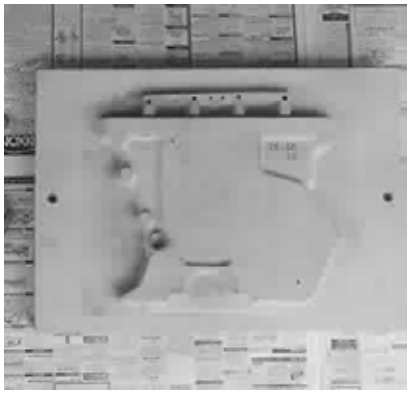
After the patterns have been turned carefully to size, split the patterns by inserting a fine blade into the glue line. The paper will start to part company, keep working the blade into the glue joint until the paper splits and the two pattern halves are separated.
Pattern making can take up many hours of your time; there is really no easy way to achieve good patterns for casting work. If you farm your pattern making out, be

prepared to fork out a lot of money for even relatively simple pattern designs. Do not be afraid to tackle a pattern-making project.

Project 03: Timing chest back-plate.

Finished T/Chest Casting.
Inside View.

Outside View



Timing chest back plate pattern.

The timing chest project was undertaken as a request from a professional car-rebuilding firm, wanting replacement parts.
The pattern was made by an experienced pattern maker; note that I said experienced and not professional. The results were quite satisfactory as everything machined correctly and the casting was sound and showed no porosity. This project is a very recent accomplishment. It is a far cry from those first few efforts at metal casting well over a decade ago.

This casting machined far better than we expected. The machine marks are quite visible even in this digital image.
While not a totally complicated casting, it was complex enough to get the gating and feeding of the casting right.
Note also the numbers used to identify the casting, these are **cheap stick on plastic letters** from the local craft shop. They did the job very well.

The opposite photo shows the mounted pattern used to reproduce the timing chest with green sand moulding; in fact all of the above projects were cast in green sand moulds.
The pattern is very simple to ram up and cast, now that all the feeding and gating problems have been solved.
The first couple of pours produced castings with cold shuts & incomplete filling of the mould cavity.
Pouring too cold and not having enough static height in the sprues and risers caused the problems. After this was determined and corrections made, every casting has been a complete success since.
This project is not for the first time metal caster to attempt, this is shown to let you know that the equipment explained in this ebook and the other publications was used to produce these castings. And if there are any doubters out there they are welcome to come and watch a melt & pour session using this equipment.

You **do not require** complicated equipment, or expensive tools. If you have the ability to apply the basic principles and knowledge of sand casting, you will be able to produce quality sand castings in your own backyard foundry workshop.

The trick is being able to improvise & build as much of your own equipment as you can. Learn new skills. Successful metal craft workers need the following skills:

- Basic Charcoal Forge operating know-how.
- Welding skills: Manual Metal Arc or MIG welding.
- Basic lathe & machining skills.
- Basic workshop fabricating skills.

Simplicity!

You see, all through this ebook I have preached the simplicity of home metal casting, yet, I still see people doing casting at home who get them selves tied up in so many knots regarding the metallurgy, chemistry or the critical temperature of liquidas, that they miss the whole point of the backyard metal casting craft, and that is to experiment and create things in metal, working at your own pace without getting bogged down with the technical aspects of the craft. Some people even give up on metal casting, and take up lawn bowls!

Now, it is unlikely that NASA will call you to do any wiz-bang hi tech Aerospace castings.

Start out small; you have to crawl before you walk. Maybe one day you will cast some high tech castings, this would be a great achievement for you if you did. Then you can get into some really nice foundry equipment and sophisticated instruments required for this type of work.

We hope you have enjoyed reading this ebook, I want to encourage you to get your hands into the sand and start to ram up some moulds, melt some metal and pour your moulds and hopefully have many successes with your metal casting.

Your imagination and ingenuity will be the only limiting factors to the success with metal casting. And beware those that tell you that their way is the only way to do a certain process, there is always an alternative way to carry out a certain process, you will no doubt come up with your own special ways of doing things.

Good Luck with your moulding & casting work.

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The end of volume one.
Metal casting made easy.

The next part of this ebook guides you through building your gas-fired furnace.

Please continue.

Part 02.

A fully illustrated - How to build project.

Illustrations & Written instructions on

How To
Build a gas-fired furnace.

Gleaned from over Fourteen years of
Practical Metal Casting experience

Written & compiled
By
Col Croucher.

Building a propane gas fired furnace.

Introduction.

Efficient melting of any metal requires a well designed & easy to operate furnace. A well-designed furnace does not necessarily mean the furnace is complicated to construct or operate.

If you're just starting out in metal casting, there can be a multitude of questions that need to be answered; the learning curve can be very steep at times because of the amount of info you have to absorb. Do not fall into the trap and "cram" the learning; this could be a mistake for you. Take your time to get things clear in your mind from the outset.

The worst thing that you can do is rush the learning, there is nothing worse than trying to speed learn a lot of technology and information all at once. This furnace building e book is designed to take you one more step, along the path to being able to build and maintain a very important piece of equipment that is the heart of your home foundry set up. Without an efficient furnace your melting and casting experience could well be one of frustration & disappointment.

The furnace featured in this **"how to build"** ebook was basically built from scrap materials found around the author's workshop. This is not to say that it looks trashy or is poorly made, far from it, the point I'm making here is that you do not need to build everything from NEW materials. The only material bought for the furnace featured here was the refractory for the furnace walls, and a few brass fittings from the local plumber for the gas line and the custom made gas jet.

Some of the parts in this project need to be custom machined on a lathe, if you don't have the luxury of a lathe in your workshop, then perhaps one of your friends will have one. Although, a lot of metal workers seem to have a lathe these days, it is almost a must have for the average home engineer in this ever increasing DIY age.

The furnace building project detailed within, is not a difficult one to undertake. If you follow the instructions and the detailed illustrations, then I feel sure that you will end up with a furnace that you will feel proud of to show to your fellow metal casters. You will also need a MIG or ARC welder (Max 150 Amp) to fabricate the furnace.

Please be very careful with your gas connections, although there are no great line pressures involved with the gas feed to the burner, but a small leak could lead to the possibility of a dangerous explosion.

Propane gas expands between **sixty** to **one hundred times** once **exposed to air**. So be very aware. The worst thing that will most likely happen to most people is that the furnace flame may blow out during the start up of a melt session. (With the correct start up procedure, burner blowouts are eliminated)

It is not a good practice to light the burner flame of the hot furnace wall. Shut everything down, blow residual gas out of the furnace and re-light as detailed in the "furnace operating instructions".

Enjoy your "How to build project", use the scroll bar to move to the next page, and we will get you started with your furnace building project.

Cheap starter crucible.

OK, OK. I can hear you saying that you don't want to spend X $$$ on expensive crucibles when just starting out. Then why not try this idea….

Make up a steel pot from an old piece of heavy walled pipe. Weld a thick plate on the bottom, & make a pouring spout on the lip. If you want to get real fancy, you could make up a mixture of fire clay and graphite, and line your steel pot with this. It will be messy, messy, messy to make, but it won't cost you much!
If you use an unlined plain steel pot, the iron will flake off and end up in the melt, this is not good melting practice. (Try a fire clay & graphite wash)

Authors disclaimer.

All engineering workshop activities have a very strong chance of accidents or mishaps; foundry equipment and operations are no less dangerous than any other activity involving equipment & materials running at very high temperatures.

The furnace design shown in this ebook is not a registered design. It is built on the principle typical of many backyard equipment designs.
It is a simple efficient design for melting small quantities of metal in the backyard foundry.

You are dealing with old technology **(Read… Dangerous)** that has no safety devices, such as automatic gas shut of valves. Incorporating such devices into this type of equipment would render the exercise useless because of the inherent cost factor to the home metal caster.

The builder and operator of this furnace…**read… you.** Must take full responsibility for the quality of the apparatus, & the safe operation of the said furnace.

This furnace design has been in operation in the author's home foundry for many years without harmful incident. There is no guarantee that another builder or operator of this furnace will find or have the same level of success. (We can show you how, but we can't hold your hand during construction.)

No warranty of any kind is given or implied with the furnace design shown within this ebook.

As purchaser of this ebook you relinquish all rights to any claims placed against the author for damages of any kind whatsoever.

Now, it's time to get you started on your furnace-building project.

Designing and building the furnace burner.

The burner is the heart of the furnace:
And is **THE** most important part of your furnace, without the burner there is no heat and definitely no melting. During the promotion of this ebook and writings on our web site I stated the simplicity of this burner. The description and explanation of this burner in comparison to other designs is probably going to upset a few dyed in the wool metal casters who insist on trying to design & build the next best thing in high output heat furnace burners.

I won't be drawn into arguments over which design is best, or how many B.T.U's is given out on this or any other design.
All I know is that LP or propane gas is the cleanest, most efficient high output fuel one can use for home or backyard hobby foundry work.

There are lots of hobby caster's out there who swear by using smelly old sump oil for heating their furnaces, while the zero cost factor is a huge attraction, the problems associated with building an efficient burner and having to handle stinking dirty old sump oil has no attraction for me whatever.

Then you have the problem of straining and keeping the oil clean so that the jet in the burner does not clog up. You may even have to preheat the oil if you live in a cold climate. How do you heat the oil? With a gas heater?

The inconvenience of having a clogged burner jet midway through a melting session would drive me insane.

The efficiency of a gas fired furnace enables a quick start up, melt & pour of a single mould within one hour if required, try doing that with an oil fired furnace.

The satisfaction of knowing that I can ram up several moulds the night before or during the morning. Followed by the simple preparation & firing up the gas fired furnace, help to make my metal casting sessions very rewarding and satisfying knowing that:

The furnace is going to keep running without a hitch as long as gas is in the tank.
The furnace can go from a cold start to full melt of about **5KG of AL** in well under the hour. (45 Minutes to be exact)
With no mess, no smell and easy… very easy operating procedure.

Now, isn't this hobby metal casting is all about? Being able to carry out your hobby in the simplest way possible while enjoying good, or maybe fantastic results from your efforts.

While I do not proclaim to be the expert on hobby metal casting, no sir, I still have lots to learn with other methods of metal casting. The last 13 or 14 years have been spent learning how to get incredibly good results with plain old green sand casting,

After this has been done and all the rough swarf left from drilling has been removed, Slide the outer tube over the burner pipe, what you have now is the perfect air waste gate. (Infinite air delivery adjustment is achieved)

Rotation of the sleeve to open the ports should enable you to waste about 90% of the air blast. This waste gate system will be as effective as the sliding speed control on the vacuum cleaner. I.e. you will have full control over how much air is being delivered to the furnace. Using the sheet metal slide on the burner pipe in conjunction with the waste gate just described, should give you full control over the gas mixture and air blast. You can now light your furnace in confidence knowing you have full control.

Controlling the total gas flow.

Gas regulator mounted on 100Lb (45KG) LP or propane tank

The fully adjustable regulator is the best way to control the gas flow to your furnace. Previously, I used a simple ball valve for adjusting the gas flow. It was **not** an easy task to give a very small reduction or addition to the gas flow with the ball valve.

The regulator shown has been a very worthwhile addition to the foundry gear.
The gas regulator enables total control during start up and during running. A small adjustment on the knob gives a very small fine reduction or increase in gas flow.

I would not use any other device for gas delivery & control.
Take note of the dial pressure reading, it is almost zero, this shot was taken during a melting session.

The price of a gas regulator is going to cost you about $50.00 to $80.00US; you will find it is money well spent. The regulator is a special propane or LPG gauge; they are available at most welding supply shops.

You may even pick up a used item, keep in contact with people you know who work in the gas supply industry, you may even get one given to you!

The gas supply tank is situated not far from the furnace so that it is within easy reach, should an emergency shut down be required, another idea would be to place a shut-off valve on the delivery pipe feeding the gas jet on the burner.
Always have your safety and that of others in mind when working in your foundry.

By now you should be able to see that there is no Rocket science involved with the construction of the burner pipe, anyone with basic workshop fabrication skills should not have any trouble building and constructing the components for this furnace.

If you come up against something you are not to sure about, ask around your circle of friends. There is always someone around that can help you machine or weld something together if you do not have the skills.

Don't ever give up on your projects, if you get a little bogged down, leave it alone for a day or a week if you have to. When you return, you will work more easily on the project with out frustrations etc.

During the set up phase of your mini foundry you will have other projects to work on, it could be possible to have two or three projects happening at the same time. When you get a little tired of one, change over and work on another.

The refractory material.

This material acts as an insulator to help retain the high heat required to melt your metal. It is possible to make your own and I will include a recipe used by old foundry workers in the days when many materials were made up onsite in the foundry.

If you wish to take "the home made" route then that's fine, but remember the quality and consistency may not be as good as the high quality refractory available from the many companies that specialise in supplying this material.

Bags of refractory. Qty in each bag is 25Kg. (55lbs).

Close up of the castable refractory. The material is quite fine, gives an excellent finish to furnace walls when the sheet metal former is used.

While not having any financial interest in the company of Foseco, I have found their products to be of the highest quality & consistency.

Repairs to the furnace shown in this ebook have been minimal over the six years of very solid use.
The refractory has not fallen apart or spalled from the walls. If you follow the mixing instructions for preparation and installation it is no more difficult to use than common cement or concrete.

Note.
Please do not attempt to use ordinary sand and cement to make your furnace walls. Normal cement is not designed to withstand the severe heat during prolonged heating and melting of metal in your furnace.
The walls will simply explode and just fall apart, rendering all your good fabrication work useless, not to mention the disappointment you will suffer.

If you can afford them, buy the silicon carbide crucibles; they are far more robust than the clay graphite crucibles. Silicon carbides are more expensive, but will give a much longer service life. I have used only two Sil/Carbide crucibles in twelve years of constant metal casting.

If you do not want to spend money on expensive crucibles it is possible to make a cheap crucible by using a heavy walled steel pipe of the correct diameter for your furnace and line it with a fire clay & graphite mixture the lining will, it needs to be about 3/8” to ½” thick, it will be the messiest job you have ever done, but if you cure & fire it slowly you should end up with a reasonably cheap starter crucible.

A plain steel pot can used for Aluminium but the steel will flake off the inside and contaminate the melt, this can be halted if you apply a clay, graphite & water glass wash on the metal, then dry thoroughly.

This furnace should give you many years of very efficient melting for your casting projects. There is no need for complicated burners, which depend on critical line pressure to operate correctly. When you have completed your project we would like to hear from you. If you are having difficulties with anything please contact us for help.

"Don't let the fear of the time it will take to accomplish something stand in the way of your doing it. The time will pass anyway; we might just as well put that passing time to the best possible use."

..... Earl Nightingale, Author and business person.

---The End---
Of
Volume 02.

Are you ready to learn how to build your:
Motorised Gyratory Riddle.
Have you been printing this three-part ebook?

By printing the entire ebook, and placing it in a folder or book binder, will enable you to refer to the instructions while you build your projects.

Part 03.

The hobby foundry motorised gyratory riddle.

A Fully Illustrated Design project

For the home workshop engineer.

Designed & Built by a Practising

Backyard metal caster.

Dec 2002.

You are about to read about how to build a low cost
Motorised gyratory riddle.
This machine will save you many hours of hard work, conditioning and preparing your foundry sand.

The Motorised Gyratory Riddle.

Introduction.

The sieving of **Green Foundry Sand** is one of the operations necessary to produce castings in a backyard foundry operation; it is the most tedious & time-consuming task you will undertake in your home foundry operation.

If you do not sieve or riddle your sand, it will always be lumpy & difficult to mould with. The moisture content most likely wont be correct or evenly distributed throughout all of the sand, making good tight moulds almost impossible to achieve.

Badly prepared sand will lead to total frustration for you as a home metal caster and hobby foundry operator. To do good metal castings with basic equipment, you need to have everything in your favour.

After you begin your metal casting journey, you will quickly realize that being able to recondition & temper your sand quickly and efficiently will make the whole experience a hell of a lot more fun & more enjoyable. I did, and I know you will to.

This illustrated Gyratory Riddle Design shown in this ebook was born out of the desire to be able to work smarter and manage this side of the craft easier, quicker, and with out the back braking work that goes with sieving sand by the hand method. (Read…. boring Chore).

The design of this riddle has been fashioned along the lines of the large commercial riddles that have been available for decades to the big foundries.

This machine has been down sized to fit in with the home foundry worker's operations. The basic rugged design is that of simplicity, the home engineer should not find the project difficult to fabricate & weld together.

Cost can be kept to a minimum by using recycled materials or second-hand items, such as the ¼" wire sieve, bought new will cost a lot of money, a second hand item will be bought at a fraction of the new price. As will the tubing to build the frame.

The riddle can be made bigger than the design shown in this E book, just remember to also increase the dimensional size of the steel square tube used to construct a larger version.

When you have finished constructing the riddle, some experimentation will have to be done to find the optimum shaking or sieving effect for your machine.

The small weight attached to the round steel disc determines how much shaking action is produced. If the weight is near the centre of the disc a very small vibration motion will be set. Move the weight outwards from the centre and a more vigorous shaking action is made. Trial & error will determine the correct setting.

Your personal safety.

The Safety Guard.

What ever you do please do not forget to make a safety guard for the rotating shaker disc & weight, serious injury could result if you fail to install this safety guard.

It does not matter what type of workshop operation is being performed; accidents can & do happen. It is the workshop operator's **(Read …Yours)** responsibility to ensure that all equipment is in safe working order.

All types of foundry operations are potentially hazardous. It will pay you to be conscious of the potential for accidents to happen.
You would be at a loss if you were unable to work on your projects for sometime due to serious injuries

Disclaimer.

The author does not & will not take any responsibility for injury caused to you or anyone or other who builds or uses this machine. **The person** who **constructs and operates** this gyratory riddle **must accept total responsibility** for any injury caused through design or component failure.

The author has no control over the said constructors engineering skill level or fabricating quality control.

The gyratory riddle described within this ebook has given excellent service in the author's home foundry. Many hours were spent making sure that the integrity of all components was designed to withstand the rigours of operation.

Safety Hints.

- Check your machine before starting.
- Regularly check all nuts or fasteners on machine.
- Secure the electric lead to the outer main stay with plastic zip or loom ties, to prevent entanglement with shaker device.
- Beware of frayed electrical leads.
- Check to make sure shaker guard is in place and secure.
- Inspect the frame of the machine at regular intervals for metal fatigue cracks.
- Check the sieve clamp for tightness.
- Make a visual check of the steel frame for fatigue cracks in the frame tubes, especially around weld joint areas.
- Maintain the riddle in good condition and it will reward you with many years of excellent service.

Note: Foundry workers are not the only ones that use this type of machine. Hard plasterer's, bricklayers and concrete rendering workers are also very keen to get their hands on these machines. (Does this spark a business opportunity for you)?

The End.

Well, what do you think? Metal casting is an amazing process isn't it? Once you learn and understand what can be achieved with this basic technology there'll be no holding you back.
We trust you have enjoyed reading and learning about the some of the methods & techniques of green sand moulding - building your gas-fired furnace and understanding how to melt metal for your castings, and building the labour saving motorised gyratory riddle.

If you think others may like to begin exploring hobby metal casting, then please direct them to our web site where they can download a copy of the ebook.

Good luck.
Col Croucher.
Australia.
http://www.myhomefoundry.com
mailto: emails@myhomefoundry.com

The Complete Hobby Foundry ebook Package:

Metal Casting Made Easy.
Design Of Gates & Risers.

Plus, eight free ebook downloads included with the package.

1. Petro bond users manual.
2. How to build sand mould boxes
3. How to build crucible lifting tongs.
4. RTV moulding & repro pattern manual.
5. How to build A Hot Wire Foam Cutter.
6. How to build a sand Muller.
7. Instant calculation software. (Easy to use)
8. The HME hobby foundry Article collection.

This is the complete package for the home hobby foundry worker, you would be hard pressed to find another collection of hobby foundry info ebooks on the net like this, and for the price of only **$39.95US,** you will save many weeks, perhaps months in setting up your hobby foundry.

Click Here: To visit the library page where you can download everything you need to begin right now to help set up your own hobby foundry.

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