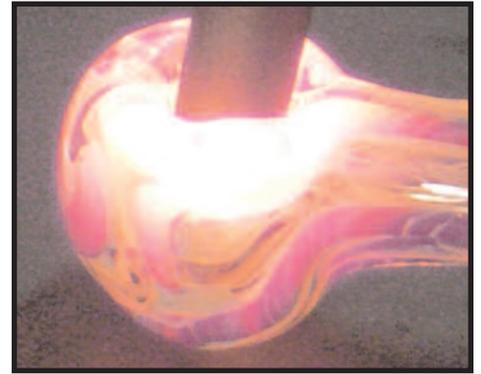
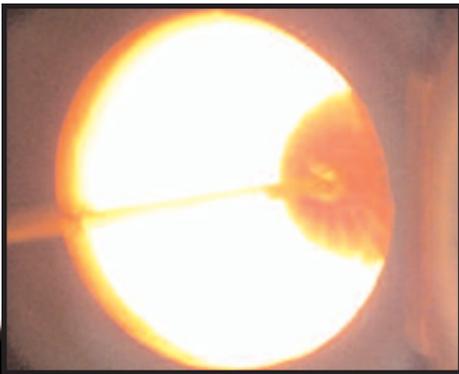


The Glassblowing

BIBBLE

Discover Everything Under the Sun
on Glassblowing — *The Easy Way!*

FROM BOWLS TO BEADS TO PIPES!



By Craig Bellinger



Welcome to “The Glass Blowing Bible”, a one-of-a kind book of instruction intended to quickly launch you on the rewarding path to glassmaking. It will cover the most asked-for uses of various glassblowing techniques. Our goal is to present the budding glass blowing enthusiast with a step by step basic understanding of glassblowing, lampworking and the basic information to make cups, vases, beads, pipes or anything else your imagination may suggest in this highly creative endeavor.

“Glass Blowing Bible” differs from other books on this topic in its manner of presentation. Our aim is to present a journey into the world of glassblowing and its many forms in an easy-to-understand way -- to let that light bulb in your brain go on and in your head with an ‘Aha! So that’s how it’s done!’ as fast as possible. In other words, this is meant to be a kind of instant gratification for glass blowing enthusiasts.

If you’ve ever searched for information of glassblowing on line, or tried to read any books on glassblowing, you’ve probably seen how overly complicated and confusing they can be and how much of the detail in them is unnecessary to get started. “The Glassblowing Bible” is a clear, concise and simplified explanation of glassblowing that has never before been attempted and will save you from reading hundreds of pages to learn the basics in lampmaking, bead-making and pipe-making.

It's what you need to get started quickly, safely and with success. After that, how far you go in this wonderful pastime – or for some, a business – is up to you. Instruction in any reputable glassblowing studio would be a great way to build on what you learn here. Nothing succeeds like hands-on experience over a long period of time. A bit of artistic talent doesn't hurt either.

BASIC UNDERSTANDING OF THE PROPERTIES OF GLASS

Did you know that glass does not have a melting point, like other metals and solids? It just continuously softens! Actually, glass is a liquid in its hardened form. Hard as it may be to believe, when you are holding a glass of water in a glass, you are really seeing one liquid containing another liquid. We all learned this in school chemistry classes, but now this really comes into play when you want to understand the basic fundamentals of glass and glassblowing.

Glass is made from oxides, the most important one being sand. It is the other oxides in glass that make it harder or softer. For example, soda oxides produce softer glass, so less heat is needed to work with it. Lime makes glass harder. Also, oxides produce a vast array of color. For example, glass is naturally light green, but when you add tiny amounts of nickel or magnesium, you can produce purple glass. Cadmium makes red glass, and silver oxides can produce yellows.

Obviously, the hotter the temperature, the softer the glass gets. Why is this important to know? Heat is the key element in glassblowing, and many beginning glassblowers make the mistake of not understanding that it takes more heat to work with a large piece of glass than a smaller one. Let's say you want to fuse a small handle to a larger cup. In order to do this, both pieces of glass must be heated

to the same temperature, and it's easy to make the mistake of overheating the handle if the same amount of heat is applied to it as to the cup.

It can not be overstated that two pieces of glass that are to be joined together must have the same heat temperature. If you do not understand this concept, you will wind up with weak joints- in other words, your handle will break off or just not adhere properly. This is commonly called a cold seal.

Common sense comes into play as well, meaning you must be able to assess whether two different pieces of glass are ready to be joined- you have to time whether the smaller piece has cooled too much or the larger piece is too hot. Also be aware that heating a chunk of glass too quickly can cause the glass to break. We will be referring back to temperature and glass when we discuss the different glass-blowing techniques.



TYPES OF GLASS

The two main types of glass are hard glass and soft glass. Hard glass is also known as borosilicate glass, which itself is sold in three forms: Clear tubing, clear rods and colored rods. One thing to remember is that the two different kinds of glasses will not adhere to each other.

The glass that is most commonly used by glassblowing artists is hard borosilicate glass. The Corning Glass Company produces this glass and it is known to the consumer by the “Pyrex” name. There are many other companies that manufacture glass, and it is fine to use them, but remember that all the glass you use must have a COE (coefficient of expansion) between 31 and 34. If it is within this range, it will be compatible with Corning’s glass 7740.

Please note: Do not confuse Corning's Pyrex cookware with Pyrex glass blowing glass. They are entirely different. When you go to order glass, you will find that small orders of glass come in premixes which contain a few pieces of different sizes. The most common sizes, especially for beginners, is 6-8 millimeters.

Colored glass, which can be used with the borosilicate glass discussed above comes in colored rods and can be purchased from most suppliers of lampworking.

The most popular manufacturers of colored glass are Reichenbach, Kugler, Zimmerman and Gaffer. We will be discussing adding color to glass in the bead making section.

GLASSBLOWING EQUIPMENT

There are innumerable tools that different glassblowers employ in their craft, and some even invent their own, but there are the basic tools that everyone uses and must have. These are the implements you will need to be very familiar with to get started in glassblowing and to understand the process itself. Later on you can add to them as your work becomes more specialized.

THE KILN: This is your glass-melting furnace. It's a heavily insulated box which is kept hot all the time in order to melt the batch, or raw chemicals, that make up the glass formula. When the batch is melted, it turns into molten glass. The furnace can reach up to 2000 degrees or more, and is heated electrically or with gas, depending on which type of furnace you get. Day Furnaces can be heated up the night before and used the next day. They are expensive and are usually found in studios and professional places. Pot Furnaces are much smaller, and free-standing. Because of their smaller size they are often found in private garages or other small spaces which are safe for glassblowing.



GLORY HOLE: A glory hole is a second furnace used to heat glass, and it is turned on and off as needed to reheat glass in the glassblowing process. It is usually a driven drum gas and forced air. It is the place where a pipe or punty (description to follow shortly) with a mass of glass on its tip is placed to reheat.



THE TORCH: Nothing in glassmaking proceeds without heat and once the molten glass is removed from the kiln, the torch is the way additional heat is applied. The torch has an outer flame that allows you to work a large section of glass and an inner flame that's very sharp and allows for details. Working at glassblowing with a torch is also known as lampworking.

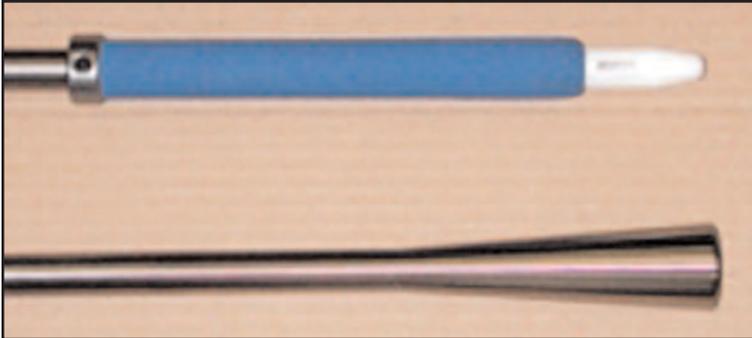
THE YOKE: This is a resting place on which the glassblower put his pipe when he is working. Ball bearings are attached to it so the glassblower can rotate the pipe or punty.



THE PUNTY: A punty is basically a solid or hollow rod, often stainless steel or graphite, used to transfer a piece from the blowpipe onto the punty. This allows

another section of the piece to be opened. Glassblowers use it to also bring small amounts of glass from the furnace to add to a piece and finish blown glass objects. It can also be used to make solid objects such as paperweights and add handles or decorations on the glass object. They range in size from very small to very large and can accommodate virtually any size glass piece you are making.

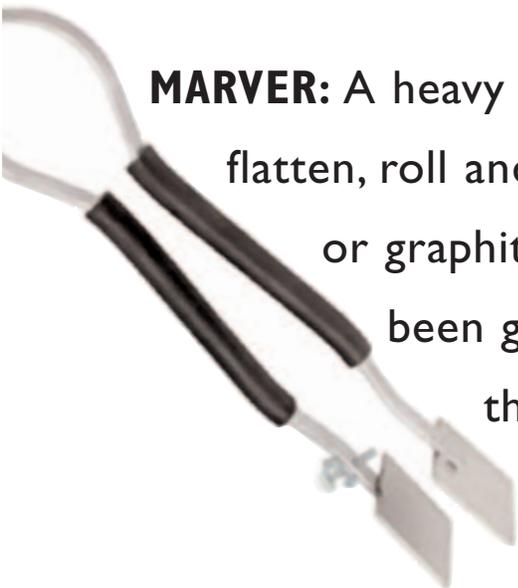
THE PIPEWARMER: This is a place where a glassblower warms up his pipes and punties. If these pipes are not warmed up, glass will not stick to them. The pipes need to be hot enough so that they cast a red-hot glow.



THE BLOWPIPE: As its name suggests, the blowpipe allows the glassblower to blow a bubble of molten glass. They are of course hollow, run about five

feet in length and their width is anywhere from one half inch to two inches. Blowpipes also make it possible for the glassmaker to pick up his hot glass and work with it. You can get shorter blowpipes for smaller projects.

MARVER: A heavy fireproof flat surface or plate used to flatten, roll and shape molten glass. Manufactured from steel or graphite, it is used to cool and shape glass after it has been gathered in its molten state. Glass is rolled on the marver until the right look and dimensions are formed.



BLOCKS: Blocks are usually made out of cherry wood, which has the greatest tolerance against high temperatures, and are used to shape and cool glass. They are often used after the marver stage to further work a piece into a desired shape. There are different shaped blocks for different purposes. They look very similar to a ladle and must be kept wet all the time to keep them from burning. There are blocks for things as small as marbles to very large spheres!



HAND-HELD TOOLS TWEEZERS & JACKS:

An indispensable part of glassblowing, tweezers allow you to pinch and maneuver hot glass and add that special touch. Jacks actually shape the glass and are very useful for creating a neck on a glass bubble that's been already blown. Jacks are also called mashers among glassblowers because they 'mash' or press the hot glass.



SCISSORS OR SHEARS: These are used to cut the glass when it is hot. Japanese bonsai shears are becoming very popular among lampworkers.



NIPPERS: These are tile cutters very useful for snipping cold glass rods.

SCORING KNIFE: This knife is essential for cutting rod and tubing. Carbide steel knives are being made now which do not get dulled from cutting.

A BUCKET OF WATER: A tool you probably already have experience with. In glassblowing you can always expect to have some hot tools! Hot tools can stick to glass and become very annoying, if not ruin a work in progress, so make sure you have a handy bucket in which to cool them off. Make certain the tools are dried off once you use them again to avoid cracking.



ANNEALING OVEN: This is a chamber to gradually cool glass down to room temperature. Because it gradually cools the hot glass down, it prevents the glass from cracking. It takes about 24 hours to properly cool a piece down. Proper annealing maintains the longevity of your piece as well.

THE BENCH: This supports the blowpipes as they are rolled back and forth. They are made out of metal or wood

A HOT POT: A fireproof metal container that is readily available to throw scraps of hot glass into.

VENTILATION EQUIPMENT: Any number of appliances such as attic fans or hoods that are used to exhaust the fumes created by oxygen and propane and the combustion process, which can produce high levels of carbon monoxide. No glassblowing should proceed without proper ventilation.

HOW THE TOOLS COME TOGETHER

Here's the way many of the tools we've just described are used in sequence to produce a piece: When glass turns molten in the Kiln, the tip of the blowpipe, which has been preheated, is dipped into the glass to pick it up. The molten glass is collected or 'gathered' on the blowpipe by several dips of the blowpipe, like gathering honey on a spoon. The marver is next used to roll the glass and to shape it, the outside forming a thin crust. The glassworker then blows into the pipe to form a bubble.



If a larger work is being attempted, more molten glass can be gathered again from the Kiln and added at this stage. For further shaping and cooling of the gathered

glass, blocks can be used. Shears can be used to make linear cuts and for cutting off large sections of glass. Jacks come into play for shaping when the piece is in a later stage of completion and tweezers used to create detail or pull parts of the glass.

When the glasswork is pretty much the size and rough shape desired, the bottom of it is completed first, the piece is transferred to a punty, and then the top if finished.



IMPORTANT SAFETY PRECAUTIONS

Whenever you are in an environment of extreme heat and noxious fumes, common sense should always be used. Avoid flammable situations in the home by working in an area like a garage. Your worktop surface should also be fireproof. Minimize flammable combustion by checking the area you are working in and any surrounding chemicals. Look out for portable heaters and motors that can spark a flame. Be aware of the air flow in your work space- make sure there are no down drafts that push hazardous fumes or fire towards you from your torch if you are using one in lampwork, and always have adequate ventilation as mentioned before. Some lampworkers use a fan which is pointed so that all ventilation is aimed out a window and away from the glassblower. Make certain when you are working that you have an open window and an exhaust fan. Always analyze your airflow and make sure that it draws gases and vapors away from you. Ventilation is as important as flammability. If you are using propane (for lampworking), pipe the propane in from outdoors. **DO NOT** use bottled propane indoors. **ALWAYS** use outdoor tanks. Most important, make sure that any tanks with gas in them are tied to a wall or any other secure surface. This will prevent them from falling over and the regulator breaking off. If the regulator falls off the gas will escape at a much faster rate and can turn the canister into a guided missile. Don't forget to have a working fire extinguisher

handy as well as a first aid kit, and always tie back long hair and do not wear shirts with loose sleeves.

Of course you will need protective eyewear when you are blowing glass, and the best ones are made out of didymium. They are specially made to filter out the yellow glare of hot glass and flame. Long term exposure to such glare can harm your eyes. Some people use welder's glasses, however, they are so darkly tinted that they are difficult for many people to work with them. Remember, there is a lot of infrared and ultraviolet radiation involved with glassblowing. Most of all, never get complacent or cocky about safety.

DISCLAIMER: THE AUTHORS CAUTION YOU TO APPROACH GLASS BLOWING AS YOU WOULD ANY OTHER PURSUIT THAT REQUIRES A GREAT DEGREE OF SAFETY PRECAUTIONS. GLASSMAKING INVOLVES HOT AND GASEOUS MATERIALS WHICH MUST BE PROPERLY PREPARED FOR, AND NOXIOUS FUMES WHICH CAN BE INJURIOUS IF NOT PROPERLY VENTILATED. ALTHOUGH WE HAVE TRIED TO SPELL OUT THE MANY PRECAUTIONS TO BE TAKEN, THE AUTHORS ASSUME NO RESPONSIBILITY OR LIABILITY FOR INJURY RESULTING FROM USE OR MISUSE OF ANY OF OUR GUIDELINES AND PROCEDURES. SIMILARLY, THE DESCRIPTION OF THE PROCESS OF PIPE MAKING IS NOT INTENDED AS AN ENDORSEMENT TO SMOKE ANY ILLEGAL SUBSTANCES IN THE FINISHED PIECES.

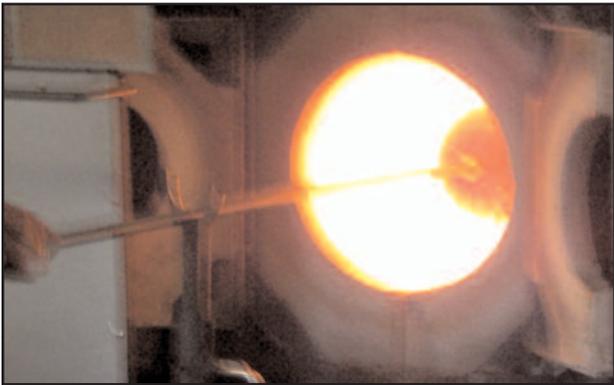
A GENERAL OVERVIEW OF GLASSBLOWING PRINCIPLES

Although there is a real mystique about glassblowing, fundamentally it can be broken down to a relatively simple procedure. Looking at the mechanical aspects of it, it is very much like blowing a bubble from the end of a straw, with one major exception: the material you are blowing is molten hot! Blobs of molten glass are gathered from an oven onto the end of a tube, and the glassblower blows through the tube to make a bubble in the glass at the tip. The glass needs to be frequently rotated, cooled and reheated so it can be shaped to roughly the desired dimensions of the job.

The magic or the art of glassblowing occurs when the glassblower starts to rotate, pull, shape on the marver and add color. Rotation is critical in glass-blowing because this action determines how the molten glass will react. If you rotate too slowly, the glass could droop; if you hold the glob of molten glass on the tip of your rod too high, you will not achieve the circular form you probably want. It is critical to keep the rod horizontal. Therefore, the three most important keys of glassblowing are heat, rotation and a horizontal stance.

NOW FOR SPECIFICS

Get your glass melting furnace (Kiln) going as well as your gloryhole, a secondary furnace for heating. Again, the gloryhole is used to reheat a piece of glass while you are working on it.



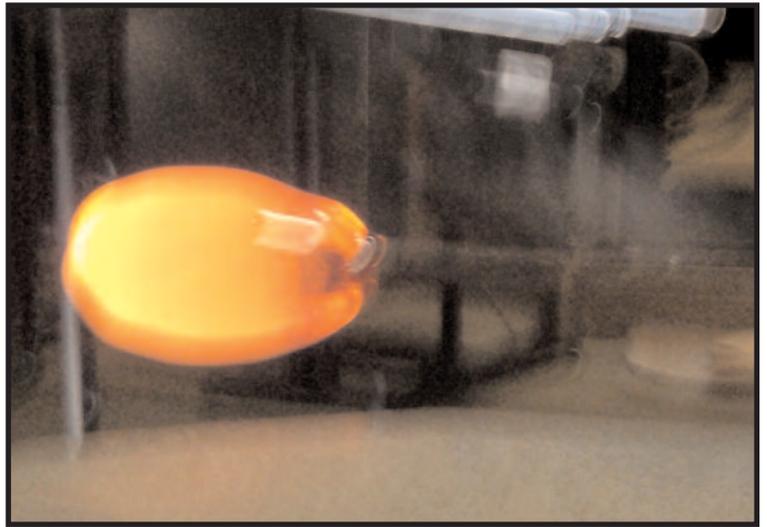
In order to get started, the tip of the blowpipe is preheated and then dipped into the molten glass in the furnace. This is called “gathering.” The

hot glass is gathered in much the same way you would try to gather honey from a jar. Experimenting with honey is such a good learning lesson, that many glass-blowing instructors require their students to practice with this medium. It truly gives the student a first hand feeling of how gravity acts on a semi-liquid substances, in this case, its effect on thick gooey material like molten glass.

In order to get a decent size bubble to blow, you will probably have to gather molten glass a few times, dipping that spoon in and out of the honey. After the molten glass is gathered to the size you would like to see on the tip of the blowpipe, it is then time to roll it on your marver, a thick fireproof metal or graphite flat surface. The marver forms a cool exterior skin on your bubble and helps shape it. Make sure you keep the glass at the edge of the surface you are

working on; it may feel as though it is going to fall, but it won't unless you really roll it off the edge. Keep rotating and you should be able to see your bubble taking a shape. At this point you should concentrate on keeping your rod horizontal and of course keep rotating. The walls of the sides should start evening up. When this is accomplished, and you will have to practice it a few times if you are a beginner, you then tilt the pipe up so you can achieve a more oval or cone-shaped appearance.

It is very important to keep your movements fluid because it's the continuous rotation and movement that helps you achieve the desired results. If you are unhappy with the way

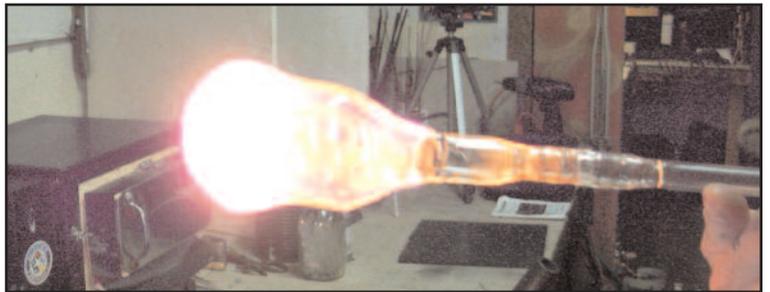


your cones and its sides are shaping up, you can reheat in the glory-hole or start from the beginning with a new gathering and blow a new bubble. (You haven't wasted much time at this point if you have to do that, so don't worry about it.) When you are finally happy with the beginning shape of your bubble, you can gather even more molten glass to make it larger. Blocks are then used to cool your creations in their early stages. Basically the block provides a space which is a type of mold for you blob of glass. It allows you to get and hold onto a very basic shape.

When you have reached this point, you can take out your glass blowing tools to shape and pull the glass. This is where the glassblower's bench becomes so important. It is here that this early new piece of glass is placed so the glassblower can be free to start shaping. The bench holds the tools and also has two rails that the pipe or punty rests on while the glassblower is working his craft. Which tools you use depends upon what object you are trying to make and which part of it you are making. If you are trying to make a flat bottom to a cup or vase, use your graphite paddles. If you are trying to open the bubble to form the opening of a object, use the tweezers. Tweezers come in many different sizes. Like the paddles, they are available in graphite as well. If you want to add color to your creation, color is bought in solid rods from glass blowing stores. Simply select the rod of color you want and lampwork it until it is pliable, This will be described in greater depth in the BEADWORKING section.

MAKING A TUMBLER, VASE AND BOWL

Now that you're on your way to making a bubble, and been provided with a general overview in making a glass tumbler, the following will guide you to the specifics of making a glass, a vase and a bowl. You are ready for the next steps so get a bubble that pleases you and let's go for it!



1. Blow your initial bubble.

2. Gather more hot glass on the bubble. As we said before, it takes several gatherings at a minimum to forge ahead (no pun intended), so keep dipping your bubble into the gloryhole to head it up to accept more glass. If you are planning to make a tumbler or bowl, you will definitely need several gatherings. When you gather, make sure the entire bubble is coated with the molten glass, always turning the blowpipe in order to achieve a nice even coating. Just as you practiced making bubbles, you should also practice gatherings. It's the all-important foundation of your glass, bowl or vase.

3. Blocking: As we mentioned before, blocking is a kind of mold, often made of cherry wood, into which you put your gathering which you just made. It is a kind of primitive mold to manage your large blob of glass, and it will provide the symmetry for the object you are making.

Blocks come in many different sizes, so you should select the size blocks that most appropriately fit your gathering of molten glass. The block also enables you to rotate your molten glass and thus cooling its exterior skin. Do not expect to see an exact replica of your glass object appear at this point; for now you are trying for its basic symmetry. Only the marver and your hand held tools, like jacks and tweezers , will begin to shape your object.

4. Shaping your masterpiece: Having reached this part of the process, you will probably have to blow your glass again. If it cooled off too much it must be reheated in the gloryhole. Try to only reheat in the area or areas that seem cooled too much. When you achieve the consistency you want, you may then blow the glass until it is presenting the thickness of the glass you desire. When the correct thickness of the walls is achieved, you are ready for the marver.



5. Marvering for shape: As we discussed before, a marver is a flat, fireproof surface used to shape hot glass. They range in different sizes, from very small marvers for beads to marvers as large as tables. After selecting the correct size marver for your glass piece, drop your amorphous glob onto your marver. At this point it will resemble a droopy mound of soft dough. Start moving the marver from side to side, so your dough-like

mound starts to roll back and forth. The goal is to make the blob of hot glass look more cylindrical, like a tumbler. The shape will become more defined because the marver is a cool surface which will stiffen the exterior of your molten glass. Marvering takes practice and artistry, just as the art of making bubbles does. And since the angle at which you marver will determine the size of your glass piece, there is no substitute for PRACTICE!!! Another way to shape the molten glass is much more hands on, literally. Believe it or not, skilled glass workers use wads of folded wet newspaper to hand shape their work. It functions much like a block does, but it bends in any direction you want it to. Hot gas forms between the molten glass and the newspaper so the molten glass can be turned smoothly. Obviously, the newspaper must be rewetted frequently to keep from being burned.



WHAT TO DO IF YOUR GLASS GETS TOO BOTTOM HEAVY:



Angle your rod up. Remember that gravity plays a huge roll in glassblowing; allow it to help you achieve the shape you want when you are marvering. You will be continuously adjusting the angle of your marver to create your walls of your tumbler, bowl or vase. Also, remember, that you still have the option of blowing air into your object to further determine its size and shape.

6. *Creating a neck:* Have your jacks handy because they are primarily responsible for creating the opening of your glass or bowl or vase. Jacks are like large tweezers. Before you ‘jack’ the neck of your glass, you will have to reheat the glass again in the gloryhole. After reheating, simply take your jacks and squeeze them at the end of your bubble. Make sure you do this at the end of your blowpipe. If you don’t you will have difficulty transferring your glass later. Remember to continue rotating the blowpipe when you are necking your piece with your jacks. The rotation of the blowpipe keeps the piece centered.

Centering your piece is **ABSOLUTELY ESSENTIAL!!!** The last thing you want to end up with is a lovely large piece that keeps toppling over when you set it down. Also, use your jacks very gently; it is quite easy to break the neck of your glass by rushing or applying too much pressure with them. It make take several tries to determine



just the right amount of pressure. Like all of the steps we’ve discussed, necking with your jacks will require practice.



7. *Creating the bottom of a piece:* Back to the gloryhole again! After necking your piece, you will have to reheat it, but possibly only at the bottom, depending on the malleability of the rest of the work. Flattening the bottom of your piece so it forms a stable base for your glass requires

pressing the paddles gently against the bottom of your object. Do not push so hard that you make the bottom of your piece concave. Also, when you are working on the bottom of your glass, remember that, in general, the base of a piece is usually wants to be thicker than its sides; so, do not make it too flimsy.

8. Separation anxiety! Now it's time to take your masterpiece off the blowpipe, so get your punty ready. Remember, a punty is the rod used to help you move a piece of hot glass. (It is also used later to decorate pieces with bits of hot glass). Once again, punties come in different sizes, so evaluate the punty which is the correct size for the piece you are making. The punty's diameter must be wide enough to securely handle your piece.



It's back to the gloryhole again to reheat the bottom. Once it's soft enough make certain that you center the punty in the middle of the bottom of your piece! Again, make gravity work for you.

Now dip everything into a bucket of water with particular emphasis on cooling off the neck. The water will harden the neck and thereby create a perfect fracture point to break the piece off the blowpipe. Lightly knock on your blowpipe and hopefully your glass will break

away from the blowpipe. Then quickly take your glass, which should still be attached to the punty, and reheat it in the gloryhole.

Speed is critical at this juncture of glassblowing. Although the whole piece needs to be reheated, the neck needs to be heated most because it has to be pliable enough to be opened up, don't forget! We are trying to make a tumbler, vase or bowl and they all requires openings! Not providing for an opening in a vase is like painting yourself into a corner, and boy do we feel stupid when that happens!

9. *Turning your vessel into a tumbler, bowl or vase:* Get your jacks ready again and insert them into the neck of your vessel. Use just the tips of the jacks, since you are focusing on the neck area. Turn you punty with one hand as you are inserting the jacks into the neck with the other hand. Very gradually open up the lips of the neck until you achieve the size opening you want. If you want a straight-sided tumbler, keep the jacks parallel with each other. If you want a glass with a wider mouth, angle the jacks upward.

Believe it or not, the angle at which you use your jacks, in fact, determines whether your piece will become a glass, a bowl or a vase. To make a bowl, use exactly the same techniques as up until now, however leave more glass at the bass and make the neck larger. If you want to make a vase, replicate all of the steps described in

making a tumbler with one major exception. You will need two necks, one lower down from the opening and a second one where the flowers will be inserted. You will need to make the opening with the jacks much smaller. Create the lower neck first. Reheat the vessel and then make the second opening at the top. Make your transfer, like you did for the tumbler, and hopefully you will be placing flowers in your vase before you know it!

10. Separating from the punty: This is the point where, ready or not, it is time to prepare to remove the punty from your piece. You can't end up with a tumbler or vase with a rod sticking out of it! So, tap the punty with any small utensil and rotate it while you are tapping. Make sure you are wearing fireproof gloves because you will be carrying it to the annealing kiln to stabilize

11. Annealing kiln: As we discussed before, putting your vessel into an annealing kiln provides the glassblower with a means to gradually cool off his piece. This gradual cooling insures the sturdiness of your glass and helps prevent cracks. Depending upon the size of your piece, annealing can be expected to take from 12- 24 hours. Small things like beads obviously take much less time. Whatever you do, don't rush the process. This is no time to undo all the good work you've done.

12: Adding handles or other decorative pieces to you glass: Gather up a bit of the desired glass on your punty, keeping the rod turning so the little bit of glass doesn't fall off. It is helpful to have an assistant during this process. Bring the molten glass to them and they will grab hold of the punty with graphite shears (scissors). The molten glass is then quickly applied to the vessel. The identical technique is used for attaching handles onto your vessel, however the hot glass that is initially attached is then pulled up to the spot where you want the other end of the handle to be attached. A handle, remember has two junctures. The remaining extra glass may be cut off with the shears. As quickly as possible, pick up your tweezers and make sure the ends of the handle are securely attached.

Meanwhile, slowly turn your punty, which is still attached the glass. Preheat the vessel with the handle in the glory hole. When you remove it, you may still add any finishing touches with your tweezers. Please remember, that the vessel and the handle must be the same temperature in order to avoid a cold seal...or a handle could fall off!

HOW TO MAKE A GLASS BEAD

Bead making is an ancient art and, as with all early glassblowers, the tradesmen kept their techniques secret. For them it was a matter of not sharing what they knew with their potential competition. But bead makers today know the easiest way to make a bead: can be as simple as lampworking it with a torch. Today, what most separates the many bead workers are not the basic processes but individual artistry.

The simplest explanation of bead making is that you take a very hot rod, put molten glass on its tip and then rotate it until you get the desired shape and size. (See, we told you that it was simple.) One important difference in beadmaking is the glass itself. Remember that almost all glassblowing is done with hard glass, or borosilicate? Well, beads are the exception. Beads are made from soft glass, which is also called soda lime glass. It has lower melting point and is therefore easier to work with for bead making. Like hard glass, though, soft glass comes in rods in a wide array of colors.

Now that you have the basic principle of bead making, let's get specific about the actual steps.

FIRST THE EQUIPMENT

Many of the tools you will need here are the same as for glassblowing in general, and they are listed below. The new ones are covered in more detail.

A propane or oxygen/propane torch

A stand to rest the torch in

Small annealing kiln to finish cooling the beads off

A marver - a flat fireproof surface to roll and help shape the glass

Tweezers

Graphite tweezers

Pliers

Mandrel - A stainless steel rod to hold the hot glass and/or to make large holes in glass beads. The handle is thin enough to make quicker rotations and marvering easier.

Bead Rake - a metal tool with a hook used to create designs on beads

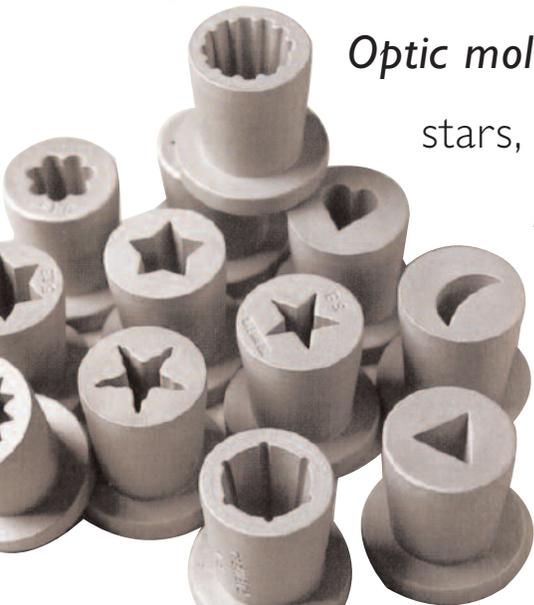
Tungsten pick - a heat resistant pick to make a hole in the glass

Optic molds - to make beads into different shapes, such as stars, etc.

Bead Reamers - Cleans the hole of the bead out after you are done making it

Tile Nippers - To cut the glass

Bead Release Separator - A bead release is a



thick liquid coating that prevents glass from sticking to metal. This mixture is used to coat the mandrel so that the glass can be removed from the mandrel when it cools.

Frit Powders - Frit powder is colored glass that is crushed. Bead makers use it to add color to their beads. It has the consistency of sand.



Dichroic Glass - This is a type of glass that is put on the surface of glass beads to make them shimmer and reflect light.

Stringers - Thin strips of colored glass to decorate the exterior of beads

Copper Tubing - This is used as a decorative base for beads. After putting a small piece of it on a mandrel, you can apply glass over it for a very beautiful effect.

SAFETY PRECAUTIONS: Use the same precautions that you would use for glassblowing. Wear didymium glasses, work in a fireproof area, also make sure you have excellent ventilation and wear gloves. Please refer back to safety precautions discussed in the beginning of this book.

It is not the publisher's responsibility to protect you from the risks that go along with glass bead making, or any of the procedures explained herein, which can be burns, fire, or inhalation of noxious fumes. Use common sense and think twice before handling hot equipment.

LET'S MAKE A BEAD!

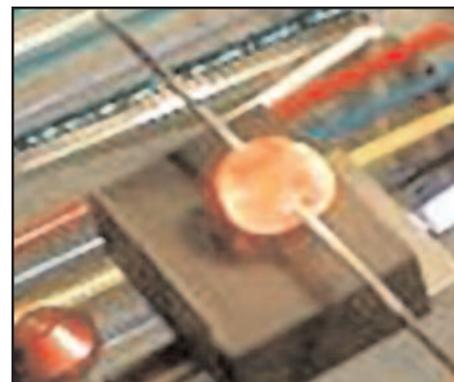
Take your mandrel and dip it into bead release separator, then heat your mandrel with your torch. Make sure you are fully familiar and comfortable with your torch before doing this and that you have a safe place to lay it down as you are working. When the mandrel gets red hot, move it slightly away from the torch and start heating your glass. Move the rod back and forth over the flame, and always keep rotating so that the glass will become a molten blob. The gravity of rotation will keep the glass round, and it will appear to look like a ball of honey.



After heating the white glass rod, wind it around the preheated mandrel, above the flame. The different colors of glass do funny things when they melt.... white turns transparent, red turns black, orange turns red..... You have to have a good memory for what you're doing when you work with hot glass ! Bring this glob of molten glass to the tip of the mandrel. Pull the glass rod away when enough of the new beginning bead is on the tip of the mandrel.

Keep turning the bead around in the flame. When you reach the size and basic shape you want, take the new molten bead out of the flame and roll it over a graphite marver to shape it as you wish. Do not

stop turning the bead until the glass stops glowing. If you want to have your round-shaped glass bead take more of a tear-drop shaped bead, hold the mandrel up before it dries and the molten glass will droop down, giving you the desired shape. Good old gravity at work again.



In order to properly dry your beads you should use an annealing kiln.

Some people use vermiculite, a natural non-toxic mineral that helps permit slow cooling of hot pieces in glassblowing, lampwork and glass bead making.

It takes about 30 minutes for a bead to cool. After it is cooled, grab the mandrel with a pliers and the bead in your other hand and twist the bead off from the mandrel. Clean the bead off and brush out the inside of the bead hole. Soaking the bead in room temperature water will help remove any bead release substance that remains.

If you would like to move onto other shapes of beads, an elongated or oblong bead is the next easiest choice. After your round

glob of molten glass turns red, let it start to cool down a bit from bright red to a dull orange color. At this point, roll it out on your



marver in much the same way you would roll out a cylinder of dough. A graphite paddle can be used to even the ends up. If you want to make a bead with a groove or pattern, you can roll it

out on a marver with indentations.

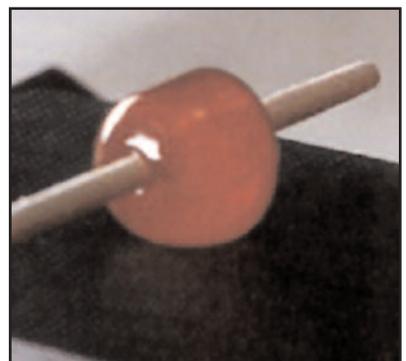
HOW TO ADD COLOR TO A BEAD

One of the easiest ways to add colors to your bead is to simply stack one color glass at a time using the mandrel. The trick is to allow the first color to cool slightly before adding the second color. This will result in two individual mounds which can then be rotated on the marver for smoothness. After you've selected your choice of color, you may want to try decorating it with frit, or crushed colored glass. Frit is available in small packets in individual colors and is sold at bead making stores. Frit is added to a bead when it is molten. Simply sprinkle the color frit you want on a marver and roll the heated surface of the bead in the frit mixture. The frit will melt because the bead is so hot. In order to give the bead its final smooth finish, put it back into the flame for a final fusing.

Making Cane is a great aspect of beadmaking. There are two types of cane. One is decorative and its purpose is to decorate the exterior of a bead. These types of cane are known as murrini, and millefiore. Latticinio cane is twisted ribbon cane, like a striped candy cane. These different types of cane vary quite differently in technique, but perhaps the three most basic caning techniques to learn for the beginner is the simple ribbon.

To make simple ribbon cane, you'll need a few rods of different colors, because you'll want the ribbons to have contrast with each other. The rods should all be the same diameter in order to achieve the proper result. You will need two rods of filigrana. Filigrana rods are simply rods with opaque cores which are then covered with clear glass. You will also need a contrasting opaque rod. The contrasting rods will ultimately be put in between the two filigranas.

To start, heat a filigrana on one of its sides until it glows. Flatten it with a graphite marver. Place it aside and do the same thing with the other filigrana, but don't place this one aside; keep it near the flame



of your torch. Now its time to heat the contrasting opaque rod until it's very soft and apply it to the second filigrana. Heat the first filigrana and layer it on top of your two strips of rod. Heat the entire three layers until they are molten. Now it's time to pull and twist the cane to achieve the ribbon effect. When you are pleased with your result, the cane should be annealed, slowly cooled. Caning by the way, we be as short as a few inches to many feet long! Long caning is a lot of fun and an assistant is required.

THE JOY OF MAKING GLASS PIPES

Now that you know many of the basics of glassblowing you are ready to start learning about the making of glass pipes. Hand blown glass pipes are a relatively new phenomenon, and more of them are probably being blown today than ever before in history. Of all the kinds of glassblowing going on these days, pipe-making is one of the most common. Their shapes, forms and varieties run from very plain to extremely elaborate, from a single color to a spectrum of combined colors, to colors that change as the pipe is used. Glass pipes cost more to make, but for most people they are worth it. For many it combines an extremely artistic hobby that allows self-expression, and, of course, for smokers, it offers the practical side of a great and unusual smoking apparatus. Others will use the art of glass pipe-blowing as the basis for a business.

Secondly, glass pipes are made both for their beauty and their practical use, but some people make them to be used for the smoking of tobacco, marijuana and other substances. This book is in no way intended to promote the use of pipes with such substances, as this is illegal, can damage to your health and lead to addiction.

WHY MAKE GLASS PIPES?

It's pretty easy to see why many people choose a glass-blown pipe over the briar, clay, metal and other alternative materials. Since glass adds no flavor of its own, it adds nothing to the flavor of tobacco when used for that purpose. The purist smoker who only wants to taste his tobacco, and use one of the cleanest substances available to do that, naturally turns to glass.

One esthetic reason people use glass pipes is the color and contrasting patterns the built up tars in smoke add to the glass itself. A more practical reason for a glass pipe is the amount and accessibility of smoke produced in a glass pipe. With many glass pipes that have a small hole on the side, a smoker can inhale more continuously, then cover the hole and mix the smoke with different amounts of air, just as the carburetor in a car does. This is why the hole can be used to 'choke off' air and why it is also referred to as a 'carb.' With practice, the pipe smoker can create a custom blend of air and substance which can make the greater amounts of smoke available smoother to inhale.

For these reasons, and because glass pipes are not porous and thus do not suck up part of the chemical substance being smoked, these pipes are preferred by those who enjoy smoking on a different level than is available in other kinds of pipes as well.

GLASS PIPEMAKING EQUIPMENT

As with bead making, most all of the equipment discussed earlier comes into play in glass pipe. But because pipe making is a very specialized form of glassblowing, a few new things need to be mentioned.

TORCHES: While there are innumerable sources, types and descriptions of all kinds of equipment including torches that can be found, it is worth mentioning that when it comes to TORCHES, one stands out from the rest. Due to the special demands of glass pipe making, the choice of many pipe makers is called the Carlisle CC. This torch can be used for projects that require a large flame as well as those that require work on fine details. It is very expensive (somewhere around \$1000) but may be worth it for the more advanced glassblowers or those who are planning to go into business. Amateurs who are most cost-conscious, however, can expect to purchase an adequate torch for under \$100.

As before, you will need a GRAPHITE PADDLE, a GRAPHITE MARVERING PAD, TUBING, OXYGEN and PROPANE REGULATORS AND TANKS, A REAMER, A BOWL PUSHER, a pair of HOTFIN- GERS, the GLASS and GLASS COLORING MATERIALS.

OXYGEN and PROPANE are readily available from welders' supplies and other commercial suppliers, and have to be handled with care. The most important thing is to make sure the regulator on the canister cannot get knocked off. This can turn the canister into a guided missile. Chain your canisters to something firm so it cannot get knocked over. Keep the canister in lightly trafficked locations away from people passing by.

Every new glass pipe maker wants to know if they need a KILN. While it is possible to make a pipe without a kiln in the beginning, you will soon realize you need one to go beyond the simplest kinds of pipes, especially if you are planning to sell the pipes you make. Your customers expect a lot, and you'll have a lot of competition. Therefore you'll want your pipes to be as awesome and unique as possible, and that requires a KILN. The best reason for the use of a kiln for pipe-making is the same as for any kind of glassblowing, from simple cup making to sophisticated artwork. The temperatures reached by kilns help keep all your glass shapes from becoming brittle and breaking. Heating molten glass, blowing, shaping and manipulating glass puts it under stress which has to be taken out of it. If not, the finished pipe can suddenly break or shatter in your mouth, not something you want to happen when it is being smoked – to you

or your customer. When a kiln is used, it gets rid of the stress in worked glass; this function of a kiln is described as “annealing” the glass. So our advice is: use a kiln right from the beginning, and use it safely.

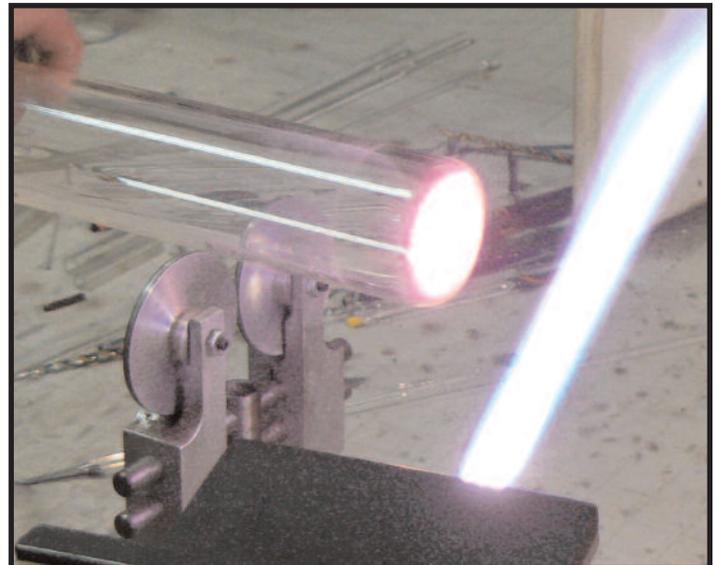
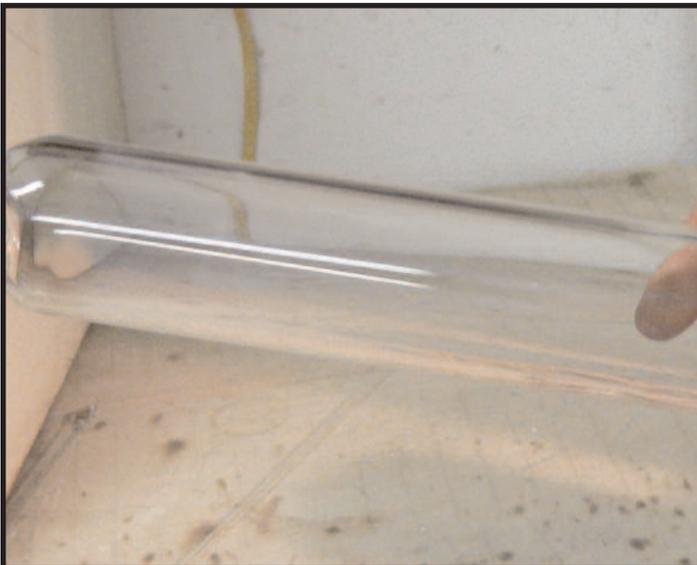
As opposed to bead making, most pipe makers choose to use hard glass, or borosilicate. Aside from the obvious reason, it’s also more compatible with other types of glass that may be affixed to it.

Of course, *protective glasses*, and *a good system of ventilation* to get rid of toxic fumes and glass dust are a must. There is risk of a buildup of carbon dioxide from the torch, plus there is a danger that your garage may build up high levels of propane and oxygen which could lead to an explosion. You wouldn’t mix most chemicals in your garage without having a way to exhaust the fumes, so why would you not need to get rid of propane fumes and dust that can get into your body? In addition to ventilation for the glass dust an air purifier is recommended. Attic fans are a great backup system, too. Your safety and those around you is at stake. Don’t scrimp on safety systems.

STARTING ON YOUR PIPE

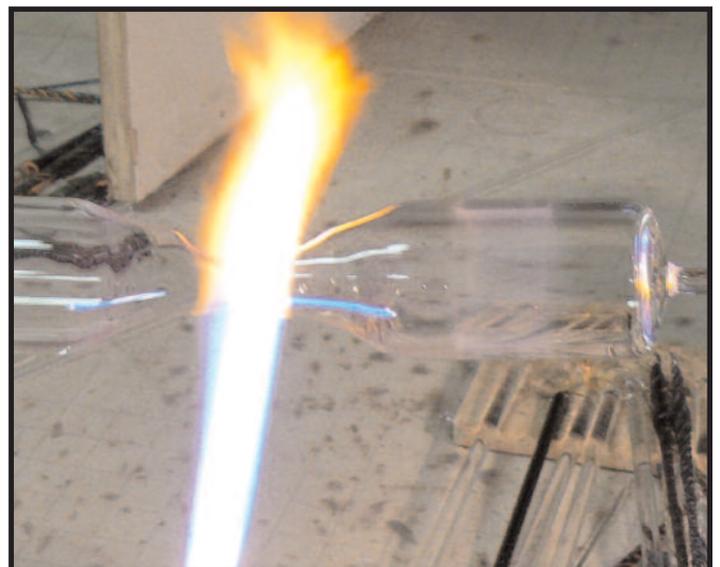
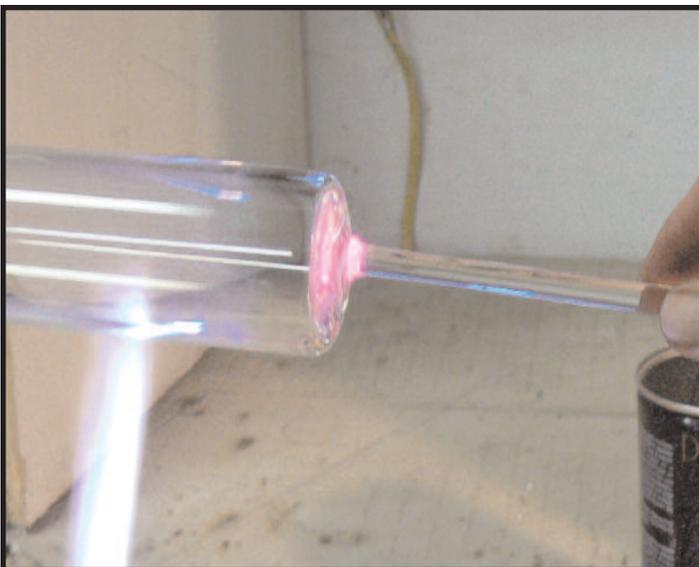
What follows here is a quite specific and step by step view of the glass pipe making process, detailed with exquisite photographs never seen before on the internet or anywhere. But remember, there can be as many steps to glass pipe making as there are glass pipe makers, and each person develops his or her own techniques. This description will, however, give you much of what you need to know to get started and understand the many processes that go into making a fine work of glass pipe art.

The first step in blowing glass pipes is to get your glass into a manageable size. Start the pipe by using glass tube 50mm thick cut to a length of about 3.5 inches. Carefully gather the end to at least 6mm thickness. As with other projects, working with a glass pipe will require occasional attachment and dis-attachment of a punty rod to be able to hold and work with it.

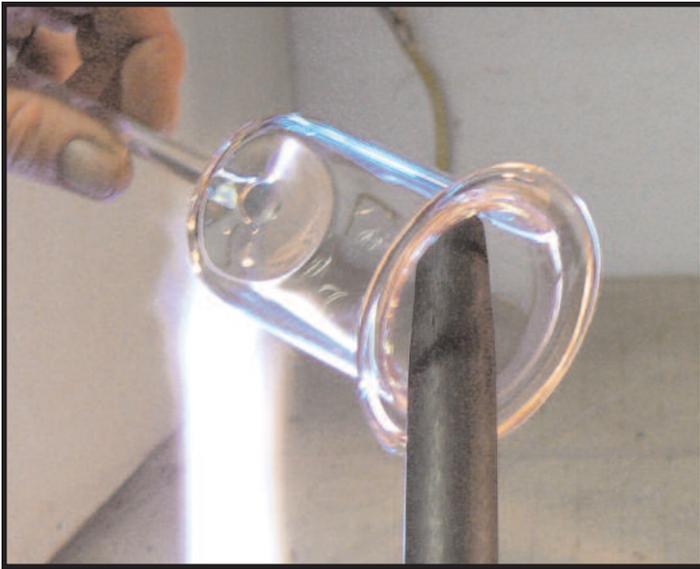


For a glass pipe, place the punty in the center, then and cut the tube with the torch flame. Heat the mass evenly until you have the desired size of molten glass and then blow the bowl. REMEMBER WHEN YOU BLOW INTO THE BLOWTUBE INHALE BEFORE YOU BLOW. INHALING WITH THE TUBE IN YOUR MOUTH CAN BURN YOUR LUNGS WITH HOT GASES.

One way to check to see how evenly it's been heated is to see how the bowl has been formed. If the bowl is lopsided it's because you heated some of the glass hotter than others. If so, start again. You haven't wasted much time so far. It's always better to go forward with something done right than to have to live with a mistake all along the process.



OPENING AND CLOSING FLARES



In order to add some kinds of distinctive designs in your pipe, you will need to open a flare. One way to make a flare is to open a hole at the end of the point. Then, keeping a reamer stationary within the hole, and holding

the hole in the flame, rotate the point to get the flare you want. You can also just heat the point itself and spin it. Done right, the hole will flare automatically.

Later on, closing a flare can be accomplished by getting it hot, then marvering it back over the hole by using a graphite paddle. Heating it some more will then smooth the flare back into the main body of glass.

Now blow the pipe, gathering glass at its end. This is the time that you can draw any design you wish. Or, if you want to create something even more eye-catching, you can now fume it.



FUMING

Fuming is another fancy term, but quite simply it's the process of coating or covering glass with a metal oxide coating, usually gold or silver, for ornamental reasons. This requires you to heat your work until it is almost red hot. It has to be this hot or the coating material will not adhere to it. Experienced fuming artists can create designs that dazzle the eye and are real works of art in themselves.

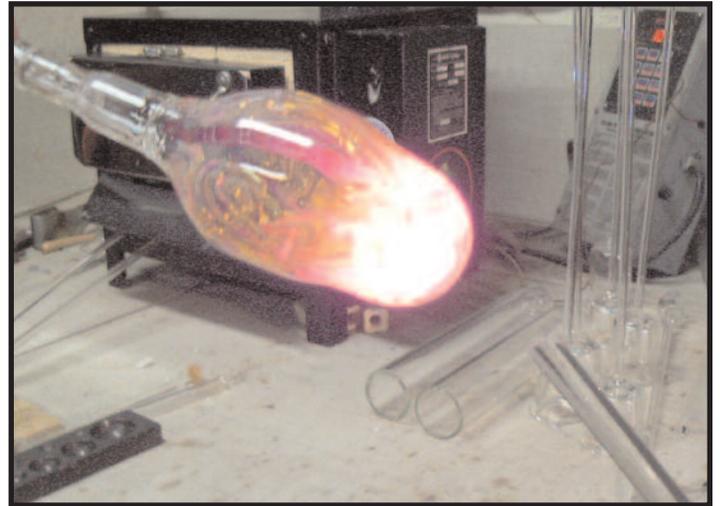
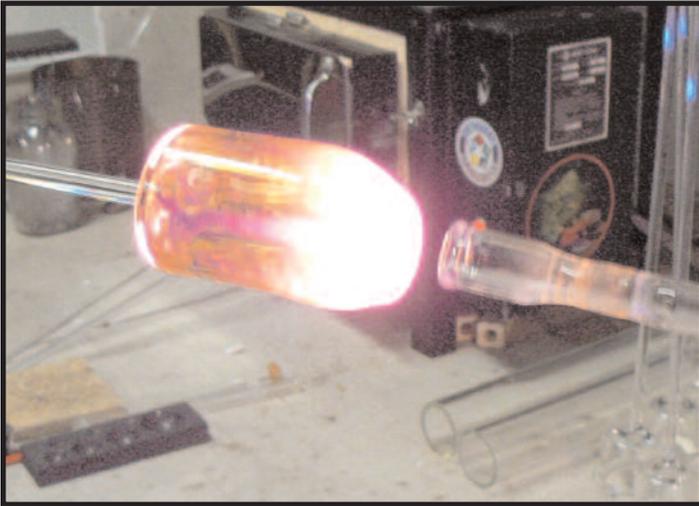
INSIDE OUT

This is another common term used to describe design style. Some designs look a lot better when the color is applied from on the inside of the piece rather than the outside. This is what "inside-out" means. You perform an 'inside-out' coloring job by opening a point in your piece and creating a flare with it for access. Once you add color you simply close the flare up again as described above.



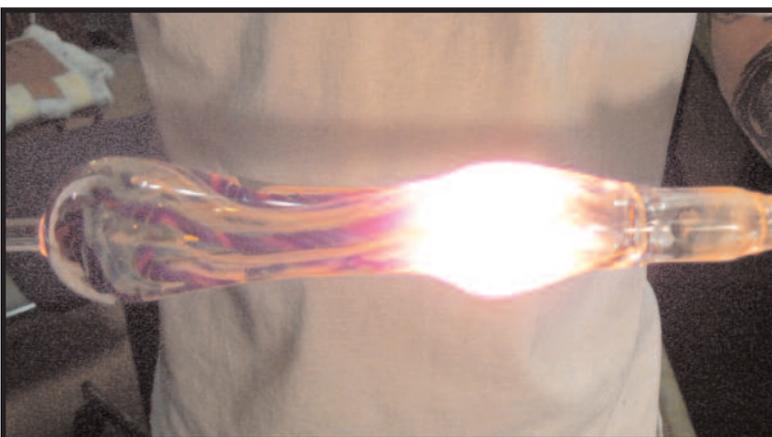
Now it's time to heat the open end of your cup, after which you will immediately marver it down to a size that can accept the size of a blowtube which is needed at this point.

Attach the cup and blowtube to the white piece at its center. And use a hot flame to blow the end out and round it out gently. Let gravity condense the end until it becomes a thick gather.



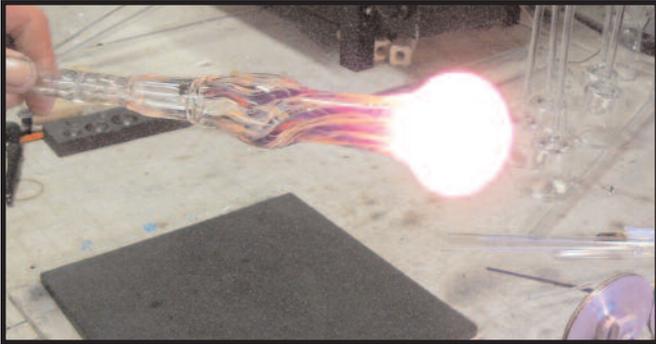
Attach a punty again at the center and heat the middle of piece.

When it's soft enough, begin your second marvering to condense the shape. After that's done you'll want to blow the pipe and turn and keep turning it to the desired tube size. Then draw out the middle portion and let it cool.



Now we're getting near the finished pipe, and it's beginning to look awesome. The next step is to re-heat a portion of glass near the blow-

tube and being to shape it by hand. This where the artist in you really comes into play. The more experience you have doing this the more you will begin to pick up the subtleties of movement required to create unusually artistic shapes.

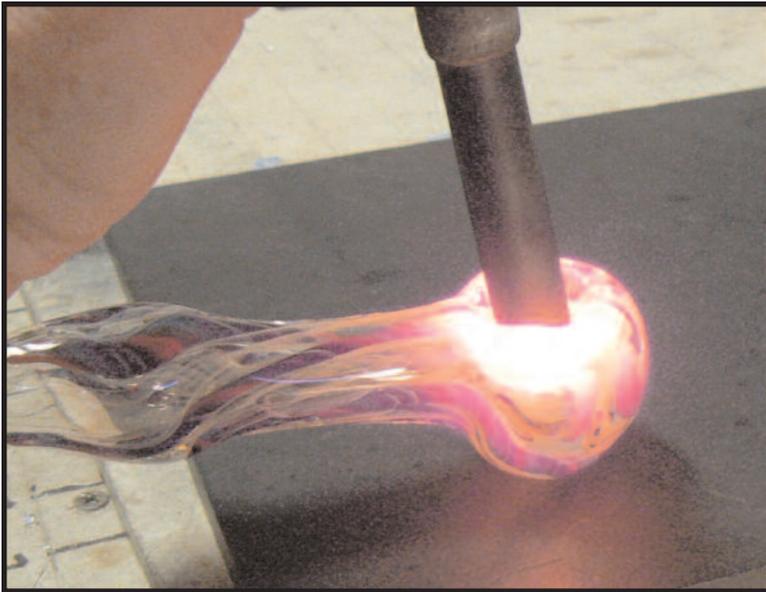


You should now remove punty and wipe that section clean, then again heat the piece and blow the end into a rounded shape.

MAKING THE BOWL HOLE:

By blowing into blowtube you can now open up a small blow hole. Using a tightly focused or 'needlepoint' flame, heat the part of the bowl where you've chosen to blow the hole. Blow hard with the glass still in the flame and a hole will open up through the side because the heated glass is weaker and will give first. Remove the glass from the flame and stop blowing or else the hole will get too large. You can make the hole smaller by holding it close to, but not in the flame, and in a short time the hole will shrink until you take it away from the flame.





This is the time we actually create the bowl where tobacco is smoked. We simply apply heat around the hole and press out the bowl itself with a carbon rod. A typical bowl opening is done most easily by using a carbon rod 5\8" in

diameter. Of course, you can use a larger or smaller rod, depending on the pipe you wish to make. Heat a larger area of the bowl where the hole is and press the carbon rod into the heated area to make a hollow. Keep the bottom of the part of the bowl at a lower temperature to let it form a stable base.

When the basic bowl is formed to your general specifications, apply flame around its perimeter until it gets red hot, then work it on your pad and push on the bowl gently, all the while turning the carbon tool with your fingers.



When the basic pipe is formed, you can remove the blowtube and attach the punty again to work on the finishing touches of your pipe, including cutting off the end with disc cutter.

When you remove the punty for the final time, clean and smooth down the opening it has left.

By now you have created a thing of beauty and must treat it as such. Remember to handle it carefully. Glass pipes are as fragile as they are beautiful, and once broken, for all practical purposes, there is no easy way to fix them. Hours of painstaking work can be destroyed by a moment of carelessness.

Your pipe's design as individual as you are, and, like any great work of art, absolutely unique. If you are making a business of selling glass pipes, your customers can rest assured that they possess something no one else has.

FREQUENTLY ASKED QUESTIONS:

In addition to all of the basics, from time to time we get very specialized questions. Here are some fast answers to a bunch of the more frequently asked topics:

What is Venetian Glass?

Venetian glass is fine soda glass and colored glass which is pinched together in a highly ornamental and intricate style. It is always thinly blown. Made in Venice and widely copied from artists from the 15th century, Venetian glass beads use many colored varieties of opaque glass and transparent glass. They are fused into copper foil tubes. The tubes are then dissolved with acid. They are always hand made.

What is a Witches Ball?

Witches Balls are very similar to glass ornaments. The main difference is that they have internal strings inside them.

Can I use recycled glass?

You can only use recycled glass if you know if the COE (Coefficient of expansion) is compatible for your needs. Remember, different glasses have different COEs, and you can not mix glasses with different COEs.

What are the legal ramifications of glassblowing?

It is of utmost importance to acquaint yourself with the local, state and federal regulations of where you live. For instance, many municipalities will not allow glassblowing furnaces or the tanks used for lampworking unless certain criteria are met. Get to know the laws and regulations of where you reside. Also, the pipes discussed are suggested for tobacco products only. Use of them for other substances may be deemed illegal, depending upon where you live.

How do I sell my glass works and buy my equipment?

Glassblowing has exploded as an art form since the 1970s. There are many glassblowing studios all over the country, as well as galleries. Most of the artists who teach these glassblowing classes can direct you where to purchase your equipment as well as where to display it. There is also a plethora of glassblowing websites where people sell their own artwork and all of the supplies you may need. Browse around and comparison shop. Everything you need to buy can be purchased online or at your local glassblowing supplier.

A FINAL NOTE AND SOME SOUND ADVICE

We hope that you have enjoyed reading about glassblowing in the “Glassblowing Bible”. We are glad to have provided you with the most important concepts, procedures and techniques, and that they will serve as the foundation of your knowledge about this craft. We hope also that you’ve appreciated the simple, easily-accessible way in which a wealth of specific information was presented. For that reason we do not believe there is any source like this book. More than anything, we hope “Glassblowing Bible” has opened a new path for you to travel and sparked your creativity to an exciting new area. Glassblowing is truly a craft that can give you a lifetime of pleasure and profit.

— *Craig Bellinger*