Arrow Springs

Tips and Tricks

FROM THE STAFF OF

Arrow Springs

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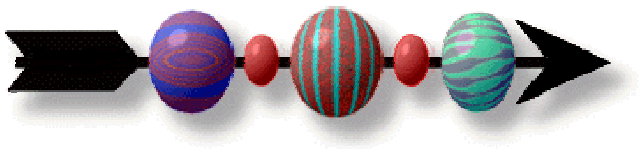

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Monday - Friday: 10 AM - 4:30 PM

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IF YOU EVER HAVE QUESTIONS ABOUT USING ANY OF OUR TOOLS OR SUPPLIES, JUST GIVE US A CALL AND WE'LL BE HAPPY TO ANSWER THEM

CONNECTING PRESSURE REGULATORS

Improper installation and use of pressure regulators can be dangerous and may cause damage to the regulators. Before connecting pressure regulators to their respective tanks, position the tanks in a safe location away from flame and out of walk ways. The fuel tank, usually propane, must be in its upright position sitting on its intended bottom. Fuel gas is usually pressurized to a liquid. The tank valve must be positioned above the liquid, in the gas, for the pressure regulator to work properly. The oxygen tank can be positioned in any position. It is usually best to stand it up. Before removing any safety caps, secure the tanks to a wall or the work bench, if it is stable enough to give proper support.

Remove the caps from the tanks and connect the pressure regulators. Connect the torch to the output side of the pressure regulators with proper hoses. Propane must only be used with a Grade T hose. Regular welding type Grade R hose, which is fine for acetylene, will rot with propane. Be sure that there is not any oil, grease or debris in or around the tank valves, hoses or on any part of the pressure regulators. Grease and oil are explosive in the presence of oxygen. Debris on the fittings will not allow for a proper air tight seal. The thread pattern on the oxygen tank valve is right handed. The thread pattern on the fuel tank is left handed. Left handed threads are indicated by a notch around the fastening nut on the pressure regulator and the hose. The fittings on both pressure regulators and the hoses are flair fittings and only require moderate tightening. All fittings are made of brass and are easily destroyed if the wrong tools are used to tighten them. Only use the proper size open end wrenches or quality adjustable jaw (Crescent) wrenches. Vise Grips or channel lock wrenches will quickly destroy the fittings and will not tighten them properly. It is not necessary to use a thread sealer. Test for leaks with soapy water.

Before opening the tank valves it is important that the pressure adjusting handles are backed off to a zero pressure delivery. This is done by turning the handle counter clockwise until the resistance of the handle turning becomes easy. It is alright if the handle comes off the pressure regulator. Just screw it back on one full turn. If the pressure adjusting handle is not backed off when the tank valve is opened, the fast inrush of gas will damage the diaphragm inside the pressure regulator. Check that all torches connected to the regulators are off. Before opening the tank valve, stand next to the tank, positioning the tank valve between you and the pressure regulator. If the pressure regulator is damaged it may blow off the tank when the tank valve is opened. Standing behind the tank valve is the safest location. The oxygen cylinder is under high pressure and uses a special double seat valve. The valve only seats with an air tight connection when it is fully closed or fully open. Any position in-between will slowly leak oxygen from around the valve stem. Open the oxygen tank valve slowly for the first turn, then fully and firmly. The fuel tank is usually under much less pressure and uses a different kind of valve. Open this valve slowly for the first turn, then only to one or two turns. This makes it faster and easier to turn off the propane tank's valve in an emergency situation. Turn the pressure adjusting knob clockwise to allow gas to pass through the pressure regulator. The more the handle is turned, the greater the delivery pressure will be. The pressure gauge closest to the tank valve indicates the tank pressure. The other pressure gauge indicates delivery pressure to the torch. To reduce delivery pressure, turn the adjusting knob counter clockwise. The delivery pressure gauge will not indicate a lower pressure until the pressure is relieved on the output side of the pressure regulator. You can do this by having the torch running while turning the handle counter clockwise. To shut down the system, close the tank valves, burn off the pressurized gas in both gas lines by lighting the touch. As the flame goes out turn off the torch. Back off the pressure adjusting handles as described earlier.

The best pressure to use for oxygen is between 20 and 25 pounds. Use 10 to 15 pounds for the propane.

Using these pressure settings will make the pressure regulators perform better and have a longer life. Some propane pressure regulators have a red danger zone on the delivery pressure gauge. This only applies when the pressure regulator is used with acetylene. Disregard it when using propane. Many torches give suggested pressure settings that are lower than what is stated here. These pressures are actually what the torch works best at, at a minimum. Supplying higher pressure does not affect the torch or increase gas consumption. The actual pressure that the torch will operate on is what you manually set using the torch's valves.

Installing And Using Oxygen Mix Torches

Only use the appropriate diameter Grade T hoses to connect your torch to its oxygen and fuel supply. Regular welding type Grade R hose, which is fine for acetylene, will rot with propane. Most flameworking torches connect to hoses with hose barbs and hose clamps. Some torches use the same B size screw on fittings to connect the hoses to the torch that is at the other end of the hoses, which connects to the pressure regulator. For torches with screw on connections, simple screw the fittings of the torch to the hose using an 11/16" open end wrench. The oxygen hose uses regular right hand threads. The fuel gas hose uses left hand threads. For torches that use hose barbs to connect the hoses, split the two hoses apart to about 8" from their cut end. With the torch sitting in a position that it will be most used at, hold the cut end of the hoses along side of the hose barbs and flex the hose so that it runs down towards the floor. You will notice that as the hose is bent in this manner, that the hose ends will change their relative position to the hose barbs. Mark and cut one of the hoses so that the length of both hoses will align to the length of the hose barbs. The red fuel gas hose connects to the hose barb that leads to the torch's red gas valve. The green oxygen hose connects to the hose barb that leads to the silver or green gas valve. You will find that on a Minor Burner, the green hose is about ¾" shorter than the red hose. All Glass Torch Technology (GTT) torches have hoses at equal length. Before putting the hoses onto the hose barbs, loosely slip the hose clamps over the ends of the hoses. Have the screw of the hose clamp orientate so that it does not sit near the torch's gas valve, after tightening. This is so your fingers do not bump into them. Push the hoses onto the hose barbs at least three quarters of the way, if not all the way, on. Slide one of the hose clamps over the area of the hose that covers the hose barb and center it. Tighten the clamp only enough to slightly bulge the hose, but not cut into it. Do the same to the other hose clamp. If the hose if difficult to push over the torch's hose barbs, wet them with water only. NEVER use grease or oil anywhere near oxygen. This combination is always explosive. If the hoses are reversed, the torch will not work properly.

Flameworking torches are typically used with oxygen and either propane or natural gas. To use hydrogen usually requires a special torch. MAPP gas does not perform well. Acetylene will not work with glass and will destroy most flameworking torches.

Connect hoses to properly installed pressure regulators. See our instruction sheet for proper pressure regulator installation and recommended pressures.

Typical oxygen consumption for a Minor Burner is 9 to 11 standard cubic feet (scf) per hour. Propane is approximately 1 gallon per 250 scf of oxygen. Torches of similar size will have similar gas consumptions.

To adjust the flame properly: Using a flint striker, light the torch with only a small amount of fuel gas on and then add oxygen. Adjust both gases until the flame has a small, crisp looking inner dark blue flame with its very tip ever so slightly fuzzy. This inner blue flame will be about 1/4" to 3/8" long on most torches. For a normally used neutral flame, the general shape of the whole flame is rather straight. If the tip of the inner dark blue flame is very fuzzy and the general shape of the whole flame is slightly barrel shaped, you have a reduction flame and, while this is sometimes a desirable flame, you will find that some colors will reduce to grays or some other unexpected color. Increase the amount of oxygen or decrease the amount of propane to make a neutral flame. If the tip of the blue flame is extremely sharp and well defined and the torch starts to make a whistling sound and the overall shape of the flame is needle like, you have an oxidation flame. Increase the amount of propane or reduce the amount of oxygen to make a neutral flame. The life of the torch will be greatly shortened if the flame is too weak. A weak flame is one that doesn't have enough force behind it to make it burn straight. It curves upward. This causes the face of the torch to overheat and erode.

If you find that you need more heat, try working in the flame closer to the torch where the flame is hotter or adjust the gases to make the flame proportionately larger. You will find that a larger flame will give you more overall heat and that further out in the flame you are less likely to boil the glass because the temperature is lower. If the flame becomes very distorted, you probably have it set too high.

If you find that the glass burns or bubbles or has "scum" on it (scum is actually micro bubbles), then you are most likely getting the glass too hot. This can be corrected by one or all of the following: Rotate the glass more to better distribute

the heat throughout the glass, try working in the flame further from the torch where it is cooler or adjust the gases to make the flame proportionately smaller. Also, sharp edges of glass heat up faster, and overheat, than smooth surfaces do because, they cannot dissipate heat as easily. These sharp edges can be a major source of scum. It is always a good idea to remove the end of a cut glass rod by melting it and pulling it off with tweezers.

A reduction flame is cooler than a neutral flame, although it may feel hotter to you, and has a large bushy look to it. It can also be very dirty and may deposit soot on the glass as well as reduce it.

An oxidation flame is also cooler than a neutral flame. The overall flame can be adjusted to very short and needle like. This type of flame is ideal for working with stringers, because it has a jacket of cool, unburned oxygen around it that insulates the part of the stringer not directly in the flame from the heat, thereby giving you better control. Usually, the easiest way to adjust the torch for this type of flame from a neutral flame, is to leave the oxygen setting as is and reduce the fuel setting by about one half. A neutral or reduction flame tends to make the stringer soft some distance from the flame quickly and you will soon lose control of it.

CLEANING

Torches require periodic cleaning. You can usually tell when cleaning is necessary. You will see a carbon build up on the face of the burner head or sometimes the fuel ports on the burner face may look restricted. You may not notice the flame reacting differently until quite a lot of carbon build up has accumulated, but a small amount of build up can affect flame quality and shorten the life of the torch.

Most of the carbon that builds up on the burner face is most often caused or accelerated by using a flame that is too weak. Dirty propane can also be a cause. Different torches build up carbon at different rates. Excessive carbon build up on the burner face works as a heat conduit and will transfer the heat of the flame to the burner face, thereby overheating it. Overheating causes eroding and or swelling of the metals of the burner face. This not only shortens the life of the torch but, creates poor flame quality. Dirty fuel ports, when left unattended, may get so restricted that it may become nearly impossible to get the cleaning tool into them.

ALWAYS turn off the torch and let it cool before cleaning or you might melt the cleaning tool to the burner face. Only use the provided cleaning tool or an approved torch cleaning tool.

Cleaning is very simple and quick. Most of the carbon build up on the burner face can usually just be brushed off with a sideways stroke of the cleaning tool. To clean the fuel ports, insert the wire end of the cleaning tool into the port a short distance. The wire is quite a bit smaller than the hole. Work the wire in and out several times while rotating the wire in a circular or cone shaped motion. This breaks off the build up that accumulates at the very edge of the hole. Repeat on all the fuel ports. Typically the oxygen ports stay clean. You can clean them as necessary.

If you accidentally touch molten glass to the torch and it sticks, immediately turn off the torch. If you try to remove it while it is still molten you will just smear it over the burner face and into the ports. After the torch has cooled, carefully use a hard piece of metal and chip away as much of the glass as you can and then clean as usual. Use caution as not to damage the burner face. Molten glass is corrosive to metal, so be sure to remove as much as possible. If only a very small amount of glass is still on the burner face and all of the ports are not clogged, the glass will burn away within a few minutes.

What Is Annealing? Why Is It Important? and How To Do It.

The following is an excerpt from our annealer manuals...

Annealing is the process of making the entire glass item uniformly hot and holding that temperature steady long enough to remove all stress caused from the manufacturing process. The annealing cycle also includes cooling down slow enough so as to not allow too much stress to build back up.

When glass is held at a steady temperature over a length of time, it is called soaking. Soaking the glass at a higher temperature has the advantage requiring a shorter soaking time for the stress to dissipate, but also runs the danger of being so hot that it may distort under its own weight or of sticking to something. The glass will also need to cool down a through a longer temperature range, and this will take longer than if it were annealed at a lower temperature. Soaking the glass at a lower temperature has the advantage of a shorter cooling time, but requires a longer soaking time to remove the stress, and, if soaked at too low a temperature, will not even remove the stress no matter how long soaked.

After the glass has soaked for the proper length of time, all of the manufacturing stress will dissipate, but stress will reappear during cooling. The faster the glass is cooled, the more the amount of stress the glass will acquire.

The annealing temperature for any glass is actually a range. The higher end of the range is a temperature set to be safely below any possible chance of distortion. The lower end of the range is a temperature high enough for heat soaking to be effective within a reasonable amount of time. The commonly used temperatures for any particular glass is actually just a temperature chosen as a compromise between the higher and lower ends of the range. In other words, a temperature in about the middle of the range. An exact temperature is not what is important. What is important is that you keep the temperature steady for a period of time before slowly cooling the glass to room temperature.

The annealing temperature we recommend for Effetre (Moretti), Bullseye and Lauscha glasses, is around 940º F. Use around 1050º F for borosilicate glass. Around 890º F for Satake. Using a temperature controller can maintain the temperature to within a couple of degrees. Manual control using an infinite control switch can not hold as tight a tolerance, but is adequate. This is one reason that we use annealing temperatures near the middle of the range.

As the glass cools, the outside will always cool faster than the inside. As glass cools it contracts. If the outside of the glass cools much faster than the inside, the outside glass contracts faster than the inside glass. This variance in contraction causes stress in glass. Too much stress and the glass breaks. The slower the glass is cooled, the less the amount of temperature variance throughout the glass and less the amount of stress that will develop.

The cooling of glass is most important between the annealing temperature and the strain point. As explained, glass will develop stress in itself through the cooling process. The strain point is a point in temperature at which any stress that develops below that temperature in the glass through the cooling process is only temporary. Stress that develops in the glass above the strain point is permanent. Once the glass has stabilized to room temperature, temporary stresses will disappear. Because of this fact, you can accelerate the cooling time below the strain point temperature and not worry about this strain causing the glass to break at some time in the future. However, cooling at too fast a cooling rate can still break the glass from thermal shock while still in the annealer. The strain point for glass varies between manufacturers and even between different colors from the same manufacturer. If you use a temperature well below the strain point of all the glasses you use to cool slowly down to before then increasing the cooling rate, you will not need to know the exact strain point temperature of each individual glass. Use 750º F for Satake and 800º F for every thing else.

The process to anneal glass once it is at the annealing temperature is as follows: First soak it for a period long enough to remove its stress. For a small bead, this can be as little as twenty minutes. For large beads, one hour. For a large paperweight, it can take half a day. Very large glass castings weighing hundreds of pounds can even take months. After soaking, cool the glass down past the strain point temperature slow enough so as not to allow too much

damaging stress to develop. For a small bead, this can be as fast as 600º F per hour (10º F per minute). For large beads, one half or one third that rate. A large paperweight, may require a rate as slow as 50º F per hour (less than 1º F per minute). Once the glass temperature has past below the strain point temperature, the cooling rate can be increased without causing permanent stress in the glass. However, cooling the glass too fast below the strain point temperature can still cause the glass to break during cooling due to thermal shock.

The above described procedure is very easily accomplished using a temperature controller that is programmed properly. To do it manually using an infinite control switch and a pyrometer, you first soak the glass as already described above. After the soak time has elapsed, there are several options, depending upon the size of the glass being annealed. For small glass item, such as small beads, simply turn the infinite control switch to Off. Since the annealer has been on for a while, the brick walls will have absorbed a lot of heat. This stored heat keeps the firing chamber from cooling very fast. For medium to large beads, or small hollow sculptures, instead turn the infinite control switch to Low. This setting will make it so that the temperature loss is slowed down. After about fifteen minutes the oven temperature will have dropped to below the strain point temperature. Because as the temperature in an oven gets lower, its heat loss slows, and the glass temperature is below the strain point temperature, you can turn off the oven and let it cool to room temperature for the size of the items described here. You should slowly cool to a lower temperature before turning off the oven for large items. To cool even slower, put the infinite control switch to a setting of 2, then after the temperature drops a to about half way to the strain point temperature, set it to Low.

When soaking and cooling different sizes of glass, use the rate that is best for the larger pieces. You cannot over soak or cool too slowly the smaller items.

You can anneal together borosilicate, Effetre (Moretti), Bullseye and Lauscha glasses. The temperature to use is 1000º F. It is a little high for all but the borosilicate, but at least 30º F below what any of those glasses will distort at. It is a little low for the borosilicate glass, but you can compensate for that by increasing the soaking time.
To find out more about specific soak times and cooling rates and how it relates primarily to glass thickness, consult one of the many excellent books available that cover the subject. Two very good books are: More Than You Ever Wanted To Know About Glass Beadmaking by James Kervin and Contemporary Lampworking - A Practical Guide to Shaping Glass in the Flame by Bandhu Scott Dunham.

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Using SLUDGE™ Mandrel Releases

SLUDGE™ mandrel releases give superior holding strength to the tugging and twisting rigors of even the most aggressive beadmaker, yet the bead easily twists off when it cools. SLUDGE PLUS™ is generally the recommended release because of its balance of superior holding power, ease of use, easy releasing of the bead when cool and smoother coating. Original SLUDGE™ does not have all the additives as SLUDGE PLUS™ and is not quite as strong. SUPER BLUE SLUDGE™ is similar to SLUDGE PLUS™ except without the graphite, thereby making it a little stronger than most beadmakers need. SLUDGE™ mandrel releases come premixed, except original SLUDGE™ concentrate. Here are some hints and techniques to obtain optimal performance.

If left unused too long, SLUDGE™ will separate and will need to be remixed. If it does not reconstitute after shaking, stir it, then shake it again. The consistency can be changed by adding water or by leaving the lid off to evaporate away the water. SLUDGE™ does get old and even if it becomes completely dry. Water will reconstitute it.

To coat the mandrel evenly we recommend the following procedure: Hold the end of the mandrel loosely between your finger and thumb. Quickly dip the mandrel into the release and then quickly pull it out. Holding the mandrel this way insures that it will go straight in and straight out and make a round coating. If the mandrel is withdrawn at an angle, the coating may have a ridge down its length. The action of dipping the mandrel quickly causes the release to coat thicker. To coat the mandrel even thicker, quickly and continuously dip the mandrel in and out several times. The more you repeat, the thicker the coating. This is better than dipping, drying and then dipping again. Dipping the mandrel slowly applies a thinner coat. A mandrel with a very thin coating is harder to remove. Especially if the mandrel is bent. Turn the mandrel around and gently tap the end opposite the dipped end on the table surface. This gives the coating a very smooth surface. Turn the mandrel back around and vertically place it in a holder to dry. A container filled with sand works well. After coating the mandrel it is best to let it air dry. If your in a hurry, SLUDGE™ can be slowly dried in the very back part of the flame.

Very important!
Heat the mandrel until red hot for one full second in the area where the bead will be. The magic about SLUDGE™ is that it holds beads when they are hot and releases them when they are cool. This will happens best if the area of the mandrel release holding the bead has been heated until red hot before glass was applied to it. If a bead is ever difficult to remove form the mandrel, you most likely did not get the coating hot enough. When heated properly, the coating will lose its strength permanently after cooling. For this reason, apply glass to the mandrel while the coating is still very hot. It need not be red hot, but almost. If the bead ever spins off while you are making it, you probably did get the mandrel red hot but, then let it get too cool before applying glass to it. Once glass is on the mandrel, proper beadmaking techniques will assure that the glass will hold enough heat to keep the coating hot. If bubbles appear in the glass near the mandrel release, the mandrel release was probably not dried thoroughly.

Hints: Once the mandrels have become dry enough to handle, you can quickly and thoroughly dry them by placing them on top of a hot annealer.

If you are making a very long bead, perhaps two or three inches long, you may find it difficult to keep the entire bead properly hot. Typically, what happens is that while you are heating one end of the bead in the flame the other end is getting too cool. Of course the mandrel release is also getting too cool. Besides the bead possibly breaking from uneven heat stress, you might find that the mandrel release has also cooled so much and that it may give way while you are still working. To remedy this problem, only heat the mandrel release to red hot where it will be in the central part of the long bead. Near the bead holes where the mandrel release never became red hot, the mandrel release will be strong while hot and stay strong even when cool. This procedure will make the bead only slightly harder to remove from the mandrel but will insure success.

Reduction Frit

Use reduction frits to create a metallic luster similar to a raku like effect.

To use, place frit on a marvering pad. Heat glass enough to pick up the frit and melt it fully into the surface of the glass for best compatibility. Form to its final shape. Allow the glass to stiffen, but still remain hot. Then, quickly heat the surface of the glass until molten. Avoid allowing the inside to become molten or the glass will probably loose its shape during the following steps. Quickly change the flame to a strong reduction flame (excessive fuel gas, lacking in oxygen) and rotate the glass in it. The reduction frit should start changing within two seconds and continue to change for up to ten seconds. You must flame anneal the glass in this reduction flame. If you change the flame to a neutral or oxidation flame, the metallic raku effect will disappear and you will have to repeat the process.

Powder covers the glass with a continuous luster. Large frit makes a broken, mottled pattern. Contains lead and therefore has a wider compatible range than other glasses. Reduction frit does not work with borosilicate (hard) glass, but does work with Effetre (Moretti) Vetrofond, Lauscha, Bullseye, Uroboros, Spectrum and Thompson Enamel.

Note: When you change to a reduction flame, the flame will probably increase in length. Be sure nothing is in its way. Also, the flame will feel hotter to you, but it is actually a cooler flame to the glass. The cooler flame eventually stops the process because, the glass will cool and no longer be molten. The metallic oxides will not be able to get to the surface. This is why you must quickly change the flame to a reduction flame and immediately put the glass in it. Practice is required. Timing is very important. If you are not satisfied with the look, repeat the above procedure.

Pixie Dust

Use Pixie Dust to create a sparkle or pearl luster color inside glass or on its surface.

To use, form glass to its final shape. Allow the glass to harden but, still remain hot. Quickly heat the surface of the glass until molten. Avoid allowing the inside of the glass to become molten or it will probably loose its shape during some of the following application methods. Any of the following methods can be used to apply Pixie Dust powder. Pile Pixie Dust onto a metal or graphite work surface. Dip the glass into the powder and rotate it around until the glass is covered. The powder will only permanently adhere to molten glass. If you find that the powder did not adhere to the glass, it was not hot enough. The glass will coat with a thick layer of powder, but only the layer of powder that is in actual contact with the molten glass will adhere. The rest will be loose. Put the glass back into the flame to flame anneal it. Only use the cool end of the flame or the powder will burn onto the surface of the glass and the item will probably be ruined. Another application method is to place the powder into a small metal bowl or cup. Apply the powder by inserting the glass into the bowl. Because Pixie Dust is made of mica, it is an excellent insulator. While the glass is engulfed in the powder, it performs a pseudo kind of flame annealing. You can also apply the powder by sprinkling or sifting it onto the glass. An enamel sifter works well. Sprinkling or sifting is the best method when you only have a small amount of powder to work with.

To encase glass that has just been coated, wipe off excess layers of powder first. Use a dry cotton cloth and wipe with a quick motion. Be careful with how you handle the cloth and where you put it, because it will get very hot and may catch fire. If you attempt to apply glass on top of the powder without wiping off the excess layers, the glass will just fall off, because it will only have stuck to the outside layer. Pixie Dust that is encased is protected from the flame and will not burn. The color of the glass that the Pixie Dust is applied to affects the final look. You can do a quick color test by simply coating the end of a glass rod. Even if you do not encase the glass after coating it, you can wipe off the excessive layers of powder to see if the application was successful.

You can also make a glass rod with Pixie Dust dispersed throughout it. Heat up a quantity of glass until molten. Mash it flat. In the center of the flattened glass, place a small amount of Pixie Dust. Without spilling the Pixie Dust, heat the opposite side of the glass in the flame until it becomes soft and pliable. Carefully fold the glass, trapping the Pixie Dust and sealing it in and away from possible direct contact with the flame. Do this while forcing out as much air as possible. Using the glass rod that the original flattened glass came from, as a punty, and another glass rod, mix the glass in the flame until well blended. Pull out into a rod.

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Making Glass Core Vessels

Glass core vessels were one of the first glass items ever made, perhaps preceded only by glass beads, small glass sculpture and imitation stones. Originally, glass core vessels were formed over a mixture of sand and clay that was sometimes supported by a metal mandrel. Today the process is similar, except with today's modern materials available to us we can modernize the technique while still keeping the integrity of the process developed thousands of years ago by glass pioneers. This method can be used to not only make vessels, but also large hollow beads.

Take 00 or 000 steel wool and pull it apart to make thin layers. Wrap it around a stainless steel mandrel. An 1/8" or larger mandrel is better than the smaller sizes because the larger size mandrel holds the steel wool better and helps prevent it from spinning loose while working the hot glass. Wrap the steel wool tightly at first, so it won't slip, and then a little looser so as to be able to make the wrapping go into the shape you want. The steel wool wrap can be placed near the end of the mandrel to make an item with a hole at each end like a bead, or at the very tip and even past the tip to make a vessel.

When you are satisfied with the shape, use a small brush to cover it with Sludge Plus mandrel release. Apply several coats, if necessary, allowing them to naturally dry between applications. The final thickness of the coating should be at least 1/16". Make sure that the mandrel release covers all of the steel wool, not just where the glass will be applied. A full coverage coating adds a lot of strength to the steel wool and insulates the steel wool from direct contact with the flame which would otherwise easily burn up. Be certain that the mandrel release covers the steel wool and continues onto the mandrel. This helps in keeping the mandrel from spinning free. You can smooth out the surface with your finger before the mandrel release dries or you can wait until it dries, wet your finger and smooth the surface. The second method gives you more control because it only affects the surface leaving the under coat to hold the shape.

Once the mandrel release has fully air dried, introduce it to the flame to heat it up similar to when making a regular wound bead, but don't let it get too hot or the extra thick coating of mandrel release will crack and the steel wool will burn up. If a little cracking happens or if a little steel wool burns you should have no problem, but the core will be a little more delicate.

Finally, apply the glass where you want it. Work it as you would if making a regular wound bead or sculptured glass. Be very careful to not pull or push too hard or the core will slip from the mandrel. If you use an opaque glass to cover the mandrel release, any of the coating's surface imperfections will not show and you will not have to be so fastidious about cleaning out the inside.

After annealing, remove the steel wool by picking it out. The mandrel release is harder to remove. It can be removed by scraping or you can use a moto tool with a diamond burr.

Making Glass Frit

You can make frit several different ways. In all cases, be sure to wear proper protective eye wear and take all necessary precautions such as using a dust mask and gloves.

1) Heat up glass in a torch or kiln and plunge it into water. The hotter the glass the smaller the frit. You will have to gently crush it to separate the fractured glass.

2) Cut small pieces of glass and break them up in a hand held coffee grinder. Gently shake up and down. The longer you grind, the finer the frit.

3) Wrap the glass in cloth and crush it with a hammer.

4) Place the glass in a metal cylinder that has a bottom and crush it with a metal plunger that fits the cylinder tightly.

5) Run glass through an old garbage disposal that has been removed from the sink and secured to a stout table.

6) Use a ball mill. This is the most expensive tool and least easiest to find, but it gives the finest grind - all the way down to a very fine powder if so desired.

7) Use a mortar and pestle. This tool is best used to make large frit into smaller frit.

Any time you break up glass, the surface of the tool that comes in contact with the glass can abrade and then be mixed in with the frit. A large magnet can remove most of the iron containing contaminants. You do not necessarily need to worry about the small amount of contaminants, as some applications with frit won't show them anyway.

Some of the described methods will produce a variety of frit sizes simultaneously while others tend to produce the same size frit. You can sift the finished frit through different size screens.

Once the coffee grinder or garbage disposal are used on glass they are worthless for their original design, but will last for many hours of frit making.

Stringer Test for Compatibility

Not everybody trusts this test but, if done accurately, can be a very reliable.

Take two glasses that you want to test for compatibility. If they are not the same diameter, make them so. If you use unequal amounts of glass, you will get a distorted reading. The glasses need to be of contrasting colors in order to be able to work with them properly and to read the results of the test.

Heat one end on both rods and then touch them together so that they align down their length. They should overlap about one inch. Now heat the joined area in the flame until they are completely fused together. Marver them round if necessary. It is very important that you do not twist. When the joined area of the glass is uniformly hot, pull it out into a stringer. Keep pulling the stringer, keeping it straight, until the glass hardens. Pull at least an 18” stringer. If you twist as you pull, you will cancel out any tell tale effects that would normally show up in non-compatible glasses. You can pull vertically to avoid the effects of gravity.

When the glass cools, cut it to 12" long from the center of the pull. If the stringer bends by itself, the two glasses are of a different C.O.E and are not exactly compatible. When you heat glass, it expands. When it cools, it contracts. Glass with a high C.O.E. (coefficient of expansion) expands, and then contracts more than glass with a lower C.O.E. Since the two glasses were joined while molten, any differences in the amount of contraction as they cool and stiffen will reveal itself by bending the stringer. The glass that is on the concave side of the bend has the higher C.O.E. because it contracted more. If the curve falls away from a straight line too much, it may not be compatible for your application. Glasses used for beadmaking can have more curve in it than glasses used for fusing, especially large fused pieces. Opinions for the amount of acceptable curve range from about 1/4" to 3/4".

To make this test more significant, you should also do a test to determine how close to the same temperature the two glasses soften, even when the stringer test shows that the glasses are compatible. The glasses are not annealed under ideal conditions and different glasses may cool and stiffen differently in the open.

Make single color stringers from the colors to be tested. They must be identical in diameter and the same length. Place them next to each other but, not touching, in a kiln so that they are held at one end. They should be parallel to the floor and elevated from it. This is easiest to do by pinching them between two kiln bricks. Heat them up slowly and observe the temperature at which each bends. If you heat them too quickly, the results may be distorted. For instance, black glass absorbs heat faster than white glass. If you heat up black and white quickly, the black glass will melt first, even if their melting temperatures are identical. For best compatibility, the bending temperatures should be within 50º F of each other.

Arrow Springs

Connecting Multiple Tanks to a Torch Manifold System

With the following instructions and illustrations, you will be able to set up a single torch or a multiple torch manifold system, using two oxygen tanks and two propane tanks that will automatically switch to the second tank when the first tank is empty. Although this will give you twice as much oxygen and propane to work with, the big advantage of this setup is that when one tank becomes empty, the second tank automatically takes over without any interruption to the operation of the connected torches. While the second tank is continuously supplying the torches, the empty tank can be changed. Even with a lot of large torches running, there will not have to be a panicked hurry to change the empty tank, because you will have as much time to do so as the second tank will last. With the following procedure, all torches connected to a torch manifold can be operated indefinitely without interruption.

SETUP

The following diagrams show two tanks connected by a hose. Both tanks must be of the same gas. In other words, both oxygen or both propane. The diagrams show how only one of the gasses is setup. The other gas is setup identically, but independently from the other. The diagrams show that each tank has a pressure regulator connected. If operating more than six torches, especially large torches, you should use a larger pressure regulator than is industry standard for one or a few torches. A two stage pressure regulator is not necessary or even recommended. Connected to each pressure regulator is a flashback arrestor. The key part that makes this system work, as described above, is the check valve that each flashback arrestor has built within it. You can substitute with quick connects, which also have check valves built in, or with just check valves, but the flashback arrestors give the added safety benefit of stopping a flashback, should one ever occur. Connected to the flashback arrestor on the left tank of the first diagram is a T-Splitter. You can use a Y-Splitter instead. Connected to one of the two open ports of the splitter is a 3/8" diameter hose, appropriate for the gas being used. The other end of the hose is connected to the flashback arrestor on the other pressure regulator shown in the first diagram. A good length for this hose is 6'. Shorter restricts placement of the tanks. Longer is usually in the way. Connected to the one remaining open port of the splitter is a 3/8" diameter hose, appropriate for the gas being used, that leads to a connected manifold. This hose is typically 12½' in length. A 25' hose will allow the tanks to be placed further from the torches. The actual length of both hoses should be what best works with your situation. The torch manifold is usually placed centrally to the location of the connected torches. If the studio layout calls for two manifolds, simply add another T or Y-Splitter to the output side of the flashback arrestor on the tank on the right, as is shown in the second diagram, and connect as before. The second manifold will operate from the same gas source simultaneously. The diagrams show manifolds capable of connecting six torches each, but you can use a manifold with any number of connecting ports, within practical limits. Be sure to apply all safety procedures when setting up this system as you would normally do for a single tank setup. For example, do not remove the cap to an oxygen tank before it is firmly secured in a safe location. Make sure regulators, hoses and all other components are properly connected and tightened. All manifold ports not being used are capped or have quick connects connected. Never allow oil or grease to come in contact with oxygen, which can cause an explosion. Check for leaks.

OPERATION

Follow normal procedures for opening tanks. Make sure that all connections are properly secured. Turn all torch valves off. Back off the pressure setting handle on each pressure regulator. Leaving the pressure set on a regulator when opening the tank's valve will cause damage to the regulator. Open both tank valves slowly for the first turn. Open oxygen tank valves fully and firmly. Check for leaks. Open propane tank valves two full turns. Check for leaks. Set the pressure on either one of the oxygen pressure regulators to 30 to 40 pounds. Do not set the pressure on the other oxygen pressure regulator yet. Set the pressure on either one of the propane pressure regulators to 15 to 20 pounds. Do not set the pressure on the other propane pressure regulator yet. Light at least one torch, using both gasses. Now go to the second pressure regulator of the oxygen. Turn the pressure setting handle slowly, just until you begin to hear the sound of gas going through it. Then back off the setting just enough to stop the sound and therefore the gas flow. The pressure set on this pressure regulator is now set slightly lower than on the other pressure regulator. Repeat this procedure on the second pressure regulator of the propane setup. You are now setup and ready to use all connected torches.

Using these higher pressure settings will buffer out pressure surges to each torch when one torch is turned on or off. Pressure regulators also perform better and have a longer life when they are set to higher pressures. Some propane pressure regulators have a red danger zone on the delivery pressure gauge. This only applies when the pressure regulator is used with acetylene. You can disregard it when using propane. Many torches give suggested pressure settings that are lower than what is stated here. These pressures are actually what the torch works best at, at a minimum. Supplying higher a pressure does not affect your ability to adjust the flame size nor does it increase gas consumption.

The way the system will now work is as follows: The tank with the pressure regulator that has the higher pressure setting will be consumed first. When this tank's pressure drops to what the other tank's pressure regulator is set to, the other tank will then come online and it will then be consumed. Without interrupting the operating torches, the first tank can be disconnected and a full one can then replace it. Do this by first backing off the pressure setting on the pressure regulator connected to the empty tank. Then turn off the empty tank's valve. Disconnect pressure regulator from empty tank and connect it to a full tank. The check valve in the flashback arrestor will not allow gas from the other tank to pass through and out the pressure regulator while it is disconnected. As before, open the tank valve slowly for the first turn, then fully and firmly for the oxygen tank or two full turns for the propane tank. Set the pressure regulator pressure, as described above, to just slightly below the other. If you set the pressure as described here, you will notice that after several tank changes, the pressure setting will be a little lower than when you first stared. This is because each time you change a tank, the new one is set to a lower pressure than the one running. Make adjustments as necessary.

A 20 pound propane tank (often referred to as a 5 gallon tank, but actually holds only 4½ gallons) will last about as long as four to five K (240 cubic feet) or KH (280 cubic feet) size oxygen tanks. Because of this, and because if an emergency occurred where you would need to quickly turn off the propane tank(s), you might consider only turning on one of the propane tanks. Turn on the second one after you notice a change in the flame that indicates the propane is running low. The second tank is already setup. You will be able to quickly turn it on without any significant interruption.

Kits are available for each gas containing two larger pressure regulators, two flashback arrestors, one T-Splitter, one 6' hose, one 12½' hose. Substitutions on hose lengths can be made. Add to the kit the size torch manifold you will need to connect the number of torches you plan on using. If you are an instructor and travel a lot with this setup, consider using a combination flashback arrestor and quick connect at each pressure regulator and quick connects at the torch manifolds.