Northstar Glassworks, Inc.

Northstar® Borocolour®

User's Manual
Colored Borosilicate Glass
Rods, Frits, and Powders

This Version includes information about our newest addition of
NS-100 through NS-128

Table of Contents

Our Company

We at Northstar are a small team of skilled glass artists and technicians who continue the tradition of making hand-pulled color. All of our rods are formed and pulled by hand from small batch furnaces to ensure the highest-level color uniformity and quality. Two operators who must work in sequence to produce good quality glass man each furnace. It is a challenging process that requires much practice and dedication. We are proud that this old tradition lives on in a world with such a high level of automation.

Northstar Glassworks was founded in the early 1980's to offer the first commercially available colored borosilicate palette to the lampworking community. Through the years the color palette has been developed and refined. Under the leadership of Charles Byles between 2001 until his death in 2006, the integrity and quality of our product reached an unprecedented level. Nancy Byles now owns the Company and operates it along with General Manager Abe Fleishman and our team of twenty. Our color palette has grown to be the most comprehensive and highest quality in the industry. We are proud to offer a fully compatible line of colors with many of the favorite opal hues of the soda-lime palette and a whole array of exciting striking colors, unique to the borosilicate palette to explore. Our color palette currently offers more than 100 colors with our R & D department working on the development of new and exciting additions.

What is Borosilicate and how is it unique?

Starting in ancient Egyptian times glass artists worked predominately with soda- lime glass. Soda-lime, also referred to as "soft glass" is comprised of silica (approx 70%), soda (approx 13%), and lime (approx 11%) as denoted by its name. These ingredients render an easily malleable glass that has a long work time and a relatively low melting point. Because of these working properties, this soda-lime type glass was and is commonly referred to as "soft glass." In the late 19th century scientists began

experimenting with different glass compositions. The fruits of their labor yielded a type of glass known as borosilicate. Borosilicate glass as denoted by its name-is comprised mainly of silica (approx 80%) and boron (approx 13%). This type of glass melts at a higher temperature and has a shorter working time. It is an extremely versatile glass that is less dense than soda-lime and because of its molecular structure is also more durable.

Thermal expansion is another property that must be considered when discussing the uniqueness of borosilicate. Thermal expansion is a measurement of linear expansion which denotes how much the glass contracts as it is cooled. Soda-lime glasses are at the highest end of the scale and expand the most as they are heated. This means that as they cool, they contract or shrink at the greatest rate. To prevent cracking, this rate of cooling must be carefully controlled using an annealing oven. Borosilicate glass, however, is on the lower end of the thermal expansion scale. It expands and contracts at a much lower rate than soda-lime glass and is not as susceptible to cracking problems, even when cooled quickly without kilning. This is why borosilicate is used in the scientific industry as well as for cookware. What this means to the artist is when placing borosilicate glass in the flame a rod can be directly inserted into the heat without having to be slowly warmed, as is the case with soda-lime glass. Because of this unique property, borosilicate can be used for large sculptures in which a small section can be worked without the entire piece being hot. It also allows the artist to selectively heat sections of a work or reheat portions without cracking. With soda-lime glass, a large sculptural work can be very challenging, especially when multiple reheats are required.

Factors that Affect Colored Borosilicate

The most unique facet about working borosilicate is the striking color palette. Traditionally, striking colors were those that returned to their original hue after a period of kilning. Borosilicate striking colors on the other hand can produce an entire range of textures and hues, simply from a single rod. The strikes are repeatable and the colors do not burn out, as is the case with certain soda-lime colors. They are extremely versatile, but take careful attention to produce certain effects. In this users manual we will help you tackle these issues and make the process of

creating these alluring colors repeatable and straightforward. In addition to the broad overview of working our colors we will focus in on three of the most interesting and challenging color families to work: the Amber Purples, the Exotics, and the Rubies. First, we will discuss the major factors that affect colored borosilicate:

Flame Settings

One of the most important factors to achieve success in working colored borosilicate is flame setting. In general, the majority of the colored borosilicate palette is affected by reduction. It is critical to know and understand the flame chemistry to be able to control the color. When looking at flame chemistry there are three categories of flames: reducing, neutral, and oxidizing. There is much subjectivity in defining how oxidizing or reducing a flame is, but it can be judged relatively well by flame color, candle length and the sound.

A reducing flame is one in which the gas is not being fully combusted. This means there is not a sufficient amount of oxygen present to burn all the gas. Its long wispy candles and soft bushy character easily identify this type of flame.

A neutral flame is one in which there is an equimolar ratio of propane to oxygen. This means that there is enough oxygen to fully combust all the gas. A neutral flame is the
hottest flame that a torch can put out. In identifying a neutral flame look for the sharpening of the candles and for a bright blue glow. This indicates that the flame is neutral.

An oxidizing flame is any flame that has an excess of oxygen present. A hissing noise, sharp candles, and a paler blue color easily identify the flame. This flame is cooler than a neutral flame because there is an excess of oxygen flowing though the combusting gasses.

Learning and identifying these flames is critical in having good control over the colored borosilicate palette. A good litmus test in learning to dial in these flames is by working a piece of NS-27 Green Exotic. Start by dialing an oxidizing flame in, then place the rod in the flame and gather a small glob of glass. Take it out of the flame and inspect the color. If the rod is still black this indicates that the flame is oxidizing enough. Second, dial in a soft reducing flame and work the rod. A metallic sheen should rapidly develop. If this metal deposit occurs when the oxidizing flame was dialed in, this indicates that there was not a sufficient amount of oxygen present. For those just starting out with borosilicate, this is an excellent exercise to practice and get comfortable with the flame.

Reduction

Once you are comfortable with the flame settings it is important to know what colors should be worked in what flames. Refer to the provided guide for specific flame settings for a particular color. In general, most borosilicate colors should be worked in oxidizing flames. The Cobalt colors, the Rubies, and all other striking colors are susceptible to reduction. If worked in a reducing flame for any great duration these glasses will discolor and lose their appealing hue. With the Cobalt colors, they streak gray, with the copper Rubies they turn a milky red, and with the silver base colors they turn a foggy cream color. This discoloration is due to a chemical reaction that is caused by un-burnt gas in the flame. What happens is the gas particles search for oxygen in order for combustion to take place. In doing so, it robs the surface of the glass of oxygen. This causes the metal oxides that are bonded to these oxygen molecules to change valence state and deposit on the surface in the elemental form of the metal. This deposit causes the discoloration to occur. By increasing the oxygen content in the flame these problems can be eradicated. This is the key in keeping the colors brilliant and true.

Heat Sensitive Colors

The next hurdle to cross when working with colored borosilicate is tackling the more sensitive colors. This group of colors is sensitive to excessive and/or aggressive, quick heat. The reason for this sensitivity is the colorant agent used in these glasses. There are many metals such as copper, cobalt, silver, and chrome that have relatively high boiling point and do not volatilize at low temperatures. These are ideal colorants because once in the glassy state, they take aggressive heat without causing the glass to boil. There are some metal oxides however that have extremely low boiling points that even when in the glassy state they do not take heat well. Here at Northstar we try to chemically minimize these boiling issues, but there is only so much technology can do to curb the nature of particular metal oxides. These colors must be worked in cool, gentle flames and heated up slowly! In order to do so, start by gently heating the rod in the upper extremities of the flame. Pass it back and forth through the flame so it heats up gently and evenly. As it starts to warm it can be brought down closer to the torch head, where the heat is more intense. If you notice the surface start to overheat, move out of the hottest part of the flame. This is the key to preventing surface scarring. The most challenging of the heat sensitive colors are the Intense Opaques: NS-63 Canary, NS-64 Lava, NS-65 Cherry, NS-84 Goldenrod, and NS-85 Poppy. The other major color family that is sensitive to heat is the NS-54 Star White based colors which include: NS-55 Periwinkle, NS-57 Midnight, NS-58 Mint, NS-59 Cranberry, NS-62 Bubblegum, and NS-80 Hyacinth. These colors are far less sensitive than the Intense Opaques, but must be heated up slowly to ensure they do not boil. Once these colors are applied and gently smoothed out they will take more heat without boiling. Refer to the reference guide for additional colors to watch for.

Annealing

Though borosilicate is far less sensitive to thermal shock than soda-lime glasses it is still crucial for the integrity of the work to kiln anneal. With smaller work and less complex vessels flame annealing is a viable option, but with thicker sculptural work or more complex assembled work annealing is crucial. Provided here is an annealing chart that has been compiled to aid you in programming a cycle for your artwork.

Borosilicate Annealing Chart

THICKNESS (INCHES)	0.125	0.25	0.50	0.75	1.00	2.00	3.00	4.00	5.00	6.00
Hrs @ A/T	0.5	1	2	3	4	8	12	16	20	24
Hrs @ A/T – 125 deg	0.2	0.5	1.7	3.2	4.5	10	21	38	60	85
Hrs @ A/T – 200 deg	0.1	0.2	0.5	0.8	1	1.5	3	5	8	11
Hrs @ A/T – 350 deg	0.2	0.3	0.5	0.5	1	1	2	4	7	10
Hrs @ A/T – 550 deg	0.25	0.25	0.3	0.5	0.75	1	2	4	5	10
Total Hrs	1.25	2.25	5.0	8.0	11.25	21.5	40	67	100	140

Anneal Time: 1 hour for every 0.25 inches of piece thickness

Soak Time @ A/T – 125 deg: 50% of the Anneal Time for pieces 0.25 inches thick or less.

anneal time for 100% of the 0.25 inches thick pieces greater the

Soak Time @ A/T – 200 deg: 25% of the Anneal Time

Soak Time @ A/T – 350 deg: 25% of the Anneal Time

Soak Time @ A/T – 550 deg: 25% of the Anneal Time

All temperatures are in degrees F and for 33 expansion borosilicate glass.

A/T = Annealing Temperature.

Critical temperatures for clear:

- Working temperature: 2228 degrees F
- Softening temperature: 1508 degrees F
- Annealing temperature: 1050 degrees F
- Strain temperature: 960 degrees F

For closed forms, assume the wall thickness to be doubled (i.e. 0.125 wall = 0.5 wall for annealing, 0.5 wall = 1.0 wall, etc.).

A piece may also be brought to temperatures 100 to 150 degrees above the A/T for a few minutes to improve the vibrancy of certain colors. This does not improve the annealing process.

As the wall thickness increases, the first soak stage (the soak time at the first temperature drop equal to the A/T minus 125 degrees), becomes more critical in the overall annealing process. This temperature is just below the strain point and allows the thicker, more complex pieces to cool slowly and come to a steady state before continuing with the ramp down in temperature. Additional soak points allow the piece to cool in a controlled fashion and to stabilize before continuing the cooling process.

The times listed for each of the soak periods includes the ramp down time as well as the time at the new temperature. For example, for a one inch thick piece, the time at the A/T is approximately 4 hrs. After 4 hrs, reduce the temperature by 125 degrees and allow the piece to soak for another 4 hrs. Then reduce the temperature again for a 1 hour soak, etc.

The schedule is based on clear and may need to be adjusted for the different colors being used. Specifically, metallic based colors may need a slightly higher A/T (maybe 25 degrees). The magnitude of the temperature decrease may need to be adjusted as well. The soak times can also be a variable that can be adjusted by color in conjunction or separately with the ramp down temperatures.

For non-metallic colors, the soak duration may be able to be reduced and the last one to two ramps eliminated altogether. For pieces that are to be re-worked, it may be necessary to ramp up the temperature of the piece in reverse order to avoid cracking. The thought being that a piece that can crack during the annealing and cooling process might also crack during re-heating.

While having compatible COE's between the different colors and the clear tubing and rod is of primary importance, similar annealing characteristics of the different glass components are also something that needs to be considered. If the annealing temperatures are different enough, and the cycle is set for a component with a lower annealing temperature, the higher end component(s) may not be fully annealed and therefore there may be enough residual stress to cause the piece to check either during cooling or at some later date.

Colors like Forest Green, Moss, and Blue Spruce all have anneal and strain temperatures approximately 100 degree lower than either the clear or the other standard colors. This is by design and is accomplished in the formulation process. The softening point of these colors is still the same (approximately 1508) so there will not be any piece deformity even though annealing is occurring 100 degrees above the A/T. These colors were prone to cracking before the re-formulations about 18 months ago and one of the objectives was to make them more "annealing friendly".

In general, the assumption built into the schedule is that even if the COE's of the clear and different colors are compatible, the annealing temperatures may not be. If this is the case, care must be taken to minimize/eliminate the possibility of cracking by increasing the different soak times and decreasing the temperature drops between each soak. An additional soak period may also be necessary with some colors.

Other factors that can increase or require changes to the annealing cycle include:

- The piece complexity and amount of sharp angles (design induced stresses)
- Thickness variation within the piece
- Thermal gradients in the annealing kiln itself (more pronounced in larger kilns)
- The absorption characteristics of the colors used (variation in the absorption of light in the different spectrums and how this affects radiant cooling/heating rates)
- The amount of re-work and extended heating and cooling

The Amber Purple Family

One of the most elusive and alluring set of colors in the borosilicate color palette is the Amber Purple family. The base formulaic origin of this color family was developed by Suellen Fowler while at Pepperdine University and passed on to the founder of Northstar Glassworks. The Amber Purples are known for the wide array of effects that they produce in many different applications. They truly epitomize the uniqueness of colored borosilicate striking colors. This color set consists of NS-13 Amber Purple, NS-26 Double Amber Purple, NS-48 Light Blue Amber Purple, NS-49 Dark Blue Amber Purple, and NS-69 Green Amber Purple. Each is designed for a particular application and strike characteristic. NS-13 Amber Purple-the original shade-is best suited for thick blown work and sculptural work. This is also the case with the NS-48 Light Blue Amber Purple. The other three shades, (NS-26 Double Amber Purple, NS-49 Dark Blue Amber Purple, and NS-69 Green Amber Purple) are more versatile. The darker shades can be used for sculpture, but they can be stretched much further, making them more suitable for thinner applications. For color tips and suggestions visit our website and call for a complimentary brochure with a step-by-step guide to working the Amber Purples.
The first and most key variable in achieving a purple strike is how the flame is set. Never work the Amber Purples in a reducing flame. Set a sharp oxidizing flame to work these colors. If the flame is not oxidizing enough the color will opacify and turn a milky yellow. When first heating the color you will notice that there is a metallic haze that precipitates on the surface. This is reduced silver metal that leaches out of the body of the glass and deposits on the surface. If the piece is worked before all the haze is heated off, the layer of metal will thicken and turn a matte gray color, thus masking the true color. In order to achieve the purple strike once the Amber Purple is applied it must be heated aggressively with a strong sharp flame in order to remove the initial metal deposit. Turn the work slowly in the flame so the heat scrubs the surface of all the haze. The surface must be heated to the point that it almost boils. Even if the flame scars the color it will melt back in and smooth over. This is *the* crucial step in the whole procedure. Once the initial layer of haze is removed it will re-develop, but not to the extent of the initial buildup. The redevelopment of the haze can be burned off easily without the extreme heat. With the more intense Amber Purples (NS-26 Double Amber Purple and NS-69 Green Amber Purple) more vigilance must be kept because the haze will redevelop more quickly.

When striking the Amber Purples there are two options, flame or kiln striking. To maximize the strike all the haze must be burned off. To flame strike, allow the piece to cool for twenty seconds so that there is no more heat glow. Then, bathe the piece in a soft neutral flame so that the surface barely glows. To darken the color, repeat the heating process. By heating for short increments of time, the color can be struck to the desired hue with a greater degree of accuracy. If the color is heated too aggressively, it will over-strike and perhaps the haze will re-deposit. Flame striking is best suited when a color gradient is desired. To achieve a uniform color all the way through the work, kiln striking is the best option. When kiln striking, place the un-struck (haze free) Amber Purple in the kiln and hold the work at 1125-1150 for approximately sixty minutes or until it reaches the desired level of intensity. Note, some thinner work may slump at these temperatures so be vigilant.

The Exotic Family

The next set of colors that we would like to give you a helping hand in using is the Exotic colors. This family consists of NS-27 Green Exotic, NS-28 Blue Exotic, NS-29 Red Exotic, and NS-47 Aurora. These are the most saturated striking colors on the market and must be worked on a super-oxidizing flame to prevent them from reducing. They are also sensitive to heat, so work them slowly and gently. In general, the way to attain the brilliant mirror-like sheen strike these colors can yield is to work them in an oxidizing flame until the work is complete. Then bathe the piece in an extremely reducing flame for only a few seconds. Another method of working these colors for other interesting effects is reducing the color, then encasing in clear. Dragging the clear over the surface can also produce interesting patterns with these colors. Overall, all but the NS-29 Red Exotic do not strike or change in the kiln and are controlled solely by flame chemistry. The NS-29 Red Exotic darkens and will produce a red hue when kilned. Out of this family, the NS-47 Aurora is the most diverse and produces the most unique shades. It is a lot of fun to experiment with. Note that because these colors are heavily saturated with metal oxides, they must be annealed with care to prevent cracking. In addition, heavy encasement of these colors is not recommended.

The Ruby Family

The final color family that we will discuss is the Ruby family. Northstar's Ruby family is extremely diverse and each of our reds has been carefully formulated for a specific application. At the inception of our company we developed and released three shades of our original formula Ruby: NS-07L Light Ruby, NS-07 Ruby, and NS-08 Dark Ruby. When working these Rubies do so in a neutral to oxidizing flame. When heated, they un-strike to a transparent state. When re-heated, these reds start to return to their original red color. NS-07L is the lightest and will only slightly strike back to its red color in the flame. It is best to kiln strike NS-07L Light Ruby and NS-07 Ruby. This allows the most uniform and even red to be achieved. NS-08 Dark Ruby-because of its intensity-it will strike easily in the flame or in the kiln. You should note that with

these reds over-striking could occur which yields a dull opaque livery red. This can happen by working them too long in the flame or by kilning them too long. When kiln striking these reds, do so by soaking at 1050 deg F until the desired darkness is achieved. In regards to the applications for these Rubies, NS-07-L Light Ruby is best suited for sculptural work, NS-07 Ruby is best suited for blown work, and NS-08 Dark Ruby is best suited for thin applications.

The next generation of Rubies came with the release of NS-82 Ruby K. This red stands out from the rest because of its high optical purity. It can be stretched thin without small bubbles or imperfections causing the surface to pucker. It is designed to be worked long and hot without livering. NS-82 Ruby K is also easier to un-strike back to the clear state, and offers a more uniform strike. This particular Ruby is excellent for sculptural work and blown work. NS-82 Ruby K was designed to be kiln struck. This is done in the same manner as with the original Rubies. The major difference is how NS-82 Ruby K behaves in the kiln. By varying the strike time this Ruby can yield shades ranging from NS-07-L Light Ruby all the way to NS-08 Dark Ruby. It does not over-strike or liver if put into the kiln in a clear state. If the piece is not clear it can liver as severely as the original Rubies. It can, however, be kilned for a far longer duration of time than the standard Rubies.

The most recent addition to our line of Rubies is the self-striking Ruby family. This family is comprised of: NS-86 Garnet, NS-87 Garnet Dark, and NS-88 Pomegranate. When working the self-striking Ruby, work in a hot neutral to oxidizing flame. You will note that as the glass heats up it will turn clear just like a standard Ruby, but as it cools down it will strike to a specific shade that is dependant on its copper concentration.

Thickness also plays a role in how the final color appears, yet even
when thinned they are much cleaner, less bubbly, and a more consistent red.
Repeated striking and cooling should not result in a shade change or browning specifically with the NS-88 Pomegranate. However, with the two darker shades NS-86 Garnet and NS-87 Garnet Dark, a brown hue can develop in certain applications such as I/O work, thin work, or work in which the heat application is uneven or limited. In sculptural applications the two darker self-striking Rubies approach a deep shade of burgundy.

As with the standard Rubies, the self-striking Rubies have been designed for specific applications. The lightest of the three, NS-88 Pomegranate, is best suited for sculptural applications. It is also ideal for mandrel wound beads. This is because it has the lowest tendency to develop a brown hue. Because of its intensity, it will not fully strike on its own and the strike must be finished in the kiln at 1050 deg F. NS-86 Garnet, the medium strength self-striking Ruby is best suited for medium thick blown work and some thin sculptural applications. It will fully strike on its own. NS-87 Garnet Dark is designed for thin blown work, stringers, and lip wraps. It is not necessarily recommended for certain thick sculptural work because it can easily yield a deep burgundy brown color.

Using Northstar® Frits & Powders

The term "frit" refers to granular crushed glass. Soft glass frits have been available to glass artists for a long time in many colors and several different mesh sizes. Furnace working glassblowers and European-style lampworkers use frit regularly as a means of adding color to their work. Frit can also be used in such techniques as Pate De Verre and fusing.

We offer many of our borosilicate colors in powder and frit form. Size Large frit is coarse; approximately .055 inches or 1.397 mm. Size Small frit is finer, approximately .024 inches or .6096 mm. These frits and powders have been formulated for use with Pyrex®, Duran®, Kimax®, Northstar® or any other glass with a similar coefficient of thermal expansion (33). Using frits and powders provide the hot glass artist with a means of adding color and/or texture to a piece quickly and easily.

There is no "right way" or "wrong way" to utilize frit or powder. Experimentation will lead to discovering your own unique effects and subtle refinements of techniques. The basic idea is to get the frit to stick to a target object. In order for this to occur the temperature of the object must be hot enough to be soft (at least on the surface of the glass). The hotter/softer the target object is, the more readily the frit will stick to it. If the object has already been formed and slumping is not desirable it is better to heat the object just enough for the frit/powder to begin sticking (by preheating the frit in your oven, the target object can be slightly cooler and therefore less likely to slump). Successive layers can then be built up if a heavy coating is desired. A light sprinkling of frit may be used as a subtle highlight of brightly colored dots or a substantial layer of color can be built up giving a more uniform or darker look. Frit can be coated on the outside of solid or hollow objects. It can also be coated on the inside of hollow forms. Frit may be fused in completely or left partially raised for a surface texture. A sprinkling of frit may also be mixed into the body of a solid gather of glass, giving the entire gather color. NS-00 Clear frit may be added over a colored object for effect. Different colors may be mixed for a custom look.

Application

After first heating the "target object" hot enough so that frit or powder will stick to it, here are some possibilities.

ROLL METHOD: Put the frit/powder into a bowl or on a plate and then roll or dip the target object into the frit/powder. The piece should be rotated for an even coating. Repeat as many times as necessary to achieve the desired effect.

SPRINKLE METHOD: Frit may be sprinkled over your object either with a spoon or with the fingers. When using this method it is wise to place a clean plate or container under the work area to collect any frit that does not stick (invariably, some frit will not adhere the first time). Remove the object from the flame before sprinkling frit. Sprinkling directly through the flame is not recommended since the flame will blow some of the frit away. This is not only a waste of good frit but can cause a dust problem in your shop (see health precautions below).

TUBE METHOD: Frit or powder can be fused to the inside of a hollow object by sprinkling it into a rotating tube. Using this method the frit/powder may be added either before or after the object has been heated. This method can also be used when applying frit to tubing in a glassblowing lathe.

ROD METHOD: A clear or colored rod may be heated (usually the tip, coated with frit (roll method), and then applied in the usual manner. This is a very quick and easy method of adding color.

Working In the Frit and Powder

Once the desired amount of frit or powder has been deposited onto the object, use a relatively cool flame to fuse it in. Use a cool flame because the glass is in the form of small particles and, until they are mostly fused in, are little bumps on the surface of the glass, easily caught by the flame and super heated to a boil, which could cause a rough texture. A hot flame may be used but the object should be passed quickly through the flame so as to heat the frit more gradually. Working in the tip of the flame can help. While some colors may vary slightly in appearance from rod to frit/powder, most will retain there working characteristics i.e. striking, oxidation/reduction.

CAUTION: AVOID EXPOSURE TO GLASS DUST. ALWAYS USE A DUST MASK AND EXHAUST HOOD WHEN HANDLING FRIT AND POWDER.

These notes are intended as a general guide. Individual results will vary depending upon many factors including type of gas used (i.e. propane or natural gas), type of torch used (surface or internal mix), type of annealing oven used (gas or electric), and the sequence of heating and cooling. Individual batches of color may vary slightly, as all the color is hand made. Northstar® Borocolour® should come to you pre-labeled for easy identification. Please be sure to store your glass colors in a manner that allows you to identify which color you are using and which colors to reorder.

If you should experience a problem with any of our colors please e-mail or call technical support. We want to know what your experience is with our colors. Your feedback will help us to continually improve our products.

Experimentation is the key to diversity as well as the best way to master the use of Northstar® Borocolour® Borosilicate Color Glass.

Health & Safety Guidelines

Like any craft or hobby, glass working has some inherent risk of injury to the artist. As interest in lampworking has increased, it has become clear that general information on potential health and safety risks would be useful. The following information is intended to increase your enjoyment of lampworking, while adding to your awareness and helping you reduce your exposure to potential hazards. These suggestions have been prepared and reviewed by a group of experienced lampworkers.

Eye Protection

Eye protection is very important in lampworking, for two reasons. First, glass can sometimes shatter when placed directly in the flame, and you must protect your eyes from flying glass fragments. Goggles or glasses with side shields are good for this. You must also protect your eyes from potentially damaging Ultraviolet and Infrared rays, which are emitted when you melt glass in a flame. For many years, the standard eye protection for lampworkers has been “didymium” glasses, which have the additional feature of filtering out the distracting yellow glare given off by molten glass. In recent years other types of protective eyewear have become available, some of which are superior to traditional didymium glasses. The type of protective eyewear that is right for you depends on the type of glasswork you will be doing. For instance, making beads would give off less radiation than working a large piece of borosilicate tubing, which in turn gives off less than melting fused quartz. Also, different people may have different sensitivity. Please protect your eyes. Check with your supplier and other reliable sources for more information on choosing eye protection.

Respiratory Hazards

Melting glass in a flame produces a number of gasses and vapors that can affect your health. It is important, therefore, to ventilate your work area. At the very least, you should provide “dilution ventilation”, in which a steady stream of air flows across your work area, drawing any vapors or gasses away from your face and out of the room. Windows at opposite ends of your work area, one of which has an exhaust fan, can be an effective form of dilution ventilation. Some lampworking operations may require “local exhaust ventilation,” such as a fume hood, to eliminate hazardous or irritating vapors and gasses. If you find that you feel slightly short of breath or that you have a headache at the end of a work session, then you can be certain your ventilation is inadequate.

An additional respiratory hazard is posed by glass dust particles you might encounter in your studio or work area. These include powdered “bead release” compounds, the dust stirred up when you work with vermiculite and loose particles of refractory materials such as brick or ceramic-fiber insulation inside your kiln. Take care not to inhale these irritating and potentially harmful dust particles. Wear a respirator if necessary to reduce your exposure. Be aware of hazardous dusts that can be stirred up when you are cleaning your studio. You can also use a wet/dry shop vacuum to pick up glass particles or use a sweeping compound made for fine particulates, in order to keep the glass dust from rising up off the ground. Wet down any questionable areas or spills with a spray bottle before wiping with a wet rag, to reduce the chances of inhaling particles. If you sandblast your finished pieces, follow all safety guidelines appropriate to sandblasting.

Cuts and Burns

These can be avoided with common sense and care. The most common minor burns occur when someone picks up the end of a glass rod or tube, forgetting that it is hot. A simple system, such as always laying the hot end of a rod away from you, can help you remember which end to grab. Arrange your work area so that you never have to reach in front of your torch to get a tool or piece of glass. Choose your work clothes carefully, avoiding synthetic fibers, long loose sleeves, and shirts with open pockets or pants with folded cuffs.

Burns can be treated with ice, aloe vera sap, cold cider vinegar, or a variety of home remedies. Treat your injuries with respect; serious cuts or burns may require professional medical attention.

Tanks and Torch

Potential hazards also exist any time you work with compressed gasses. Carefully follow any manufacturer's instructions that come with your regulators or gas tanks and check with your suppliers for safe operating procedures.

Never move oxygen tanks without their protective cap in place. If the tank falls over, the valve stem can be sheared off by impacting against a table or other object. The pressure inside the tank may then be high enough to send the cylinder flying like a rocket, injuring you and damaging your building. Oxygen tanks should be either laid on their side and secured to prevent rolling, or chained securely to a wall so they don't fall over. Note also that oxygen regulators, hoses and fittings should never come into contact with grease or oil, which can ignite spontaneously in the presence of pure O_2.

Be sure to install check valves and flashback regulators on your fuel, gas and oxygen regulators to prevent backwards flow of gasses-*a major hazard in the event of a fire or torch malfunction.* Make sure that your torch is secured to the work surface so that it doesn't move if a hose is yanked. Keep all flammable and combustible materials well away from your torch. At the end of each work/play day, shut off your oxygen and gas tanks and bleed the pressure out of the lines by opening your torch valves.

Other Hazards

These can include muscle strains or other injuries from maneuvering heavy oxygen tanks or repetitive movements (such as making hundreds of beads). Take frequent breaks and pay attention to your body's signals to minimize these types of injuries. Check for accurate height of table to chair for comfortable work. Dehydration and heat exhaustion are other possible hazards to watch out for. Drink plenty of water, especially if you are working with a large flame. You may also consider applying a sunscreen to your skin to protect it from the radiation given off by the flame.

The following references may be useful in protecting yourself from the common hazards of lampworking:

Artist Beware, by Michael McCann, available from Center for Safety in the Arts, 5 Beekerman St., Ste. 280, New York, NY 10038

Contemporary Lampworking, A Practical Guide to Shaping Glass In the Flame by Bandhu Scott Dunham, available from Salusa Glassworks, P.O. Box 2354, Prescott, AZ 86302

Glassblowing: An Introduction to Solid and Blown Glass Sculpturing by Homer L. Hoyt, Crafts & Arts Publishing Co. Inc, 626 Moss St., Golden, CO 80401

The Artist's Complete Health and Safety Guide by Monona Rossol, available from Allworth Press

Ventilation-A Practical Guide for Artists, Craftspeople and Others in the Arts by Nancy Clark, Thomas Cutter and Jean Ann McGrane, available from Center for Safety in the Arts

"Beads from the Beginning" by Brian Kerkvliet, Glass Art Magazine, November/December 1994, P.O. Box 260377, Highlands Ranch, CO 80126

"F.Y. Eyes" by Lisa M. Malchow, Fusion Journal of the American Scientific Glassblowers Society, May 1993. 1507 Hagley Rd., Toledo, OH 43612

"Glassmaking Health and Safety" by Monona Rossol, Glass Art Society Technical Journal, 1989. Reprint available from Allworth Press

"Optical Radiation Hazards in Glassblowing" by Gary E. Myers, Fusion Journal of the American Scientific Glassblowers Society, August 1976

This information is offered as a starting point for your own safety research, and new information may affect the appropriateness of these recommendations. The suppliers of this information assume no liability for any injury or harm which may result from use or misuse of this information. Be sure to consult with your supplier, physician, or other qualified expert regarding any safety questions you have.

Quick Guide to Flame Settings and Colors

NS-01 Cobalt: Can take a lot of heat and can be worked in a wide range of flame settings. Stay out of reducing flames to prevent dulling or gray streaking to occur.

NS-03 Multi: When worked in an oxidizing flame this color produces smoky blues and sea greens. When reduced, NS-03 Multi yields earthy reds and gold tones.

NS-04 Dark Multi: A more intense version of NS-03 Multi that will yield similar effects, but much more pronounced. When worked in an oxidizing flame Dark Multi produces metallic blues and sea greens. When reduced, NS-04 Dark Multi yields earthy reds and browns.

NS-05 Orange: A bright transparent striking orange that is well suited for sculpture, bead work and moderately thin blown work. Work in an oxidizing flame and kiln strike.

NS-06 Dark Orange: A more saturated version of NS-05 Orange. It is well suited for thin blown work, cane work, or when a deep semi-opaque orange is desired. Work in an oxidizing flame. It can be kiln or flame struck.

NS-07L Light Ruby: A vibrant transparent striking Ruby. Work in a neutral to slightly oxidizing flame. It is designed to be kiln struck.

NS-07 Ruby: A medium intensity-striking Ruby. Work in an oxidizing flame. It can be kiln or flame struck.

NS-08 Dark Ruby: The most saturated of the transparent striking Rubies. Work in an oxidizing flame. Designed primarily for flame striking, but can be kilned as well.

NS-09 Yellow: If worked in an oxidizing environment, NS-09 Yellow will yield a transparent golden yellow. If worked in a neutral to slightly reducing flame NS-09 Yellow will start to darken and opacify. Can be flame or kiln struck.

NS-11 Jade: Slightly heat sensitive. Work gently at first in a cool oxidizing flame.

NS-13 Amber Purple: Work in an oxidizing flame for purples. Reduction yields an opaque milky amber hue. Can be flame or kiln struck. Refer to the Amber Purple section for additional information.

NS-14 Irrid: A nice medium intensity striking color. Oxidize for metallic blues. Reduce for rich opal sea greens.

NS-15 Turquesa: A more saturated version of NS-14 Irrid. Oxidize for smoky blues. Reduce for vibrant greens.

NS-19 Light Cobalt: The lightest of the cobalt blues. It is not sensitive to flame atmosphere.

NS-20: Dark Cobalt: A rich cobalt blue well suited for blown applications. Work in an oxidizing flame to prevent dulling or graying.

NS-23 Pink: A light transparent that is not sensitive to flame atmosphere.

NS-24 Transparent Green: A nice transparent shade for sculpture and blown applications. Work in an oxidizing flame to prevent red streaking.

NS-25 Peach: A light transparent flesh tone well suited for sculpture. It is not sensitive to flame atmosphere.

NS-26 Double Amber/Purple: Work in a hot oxidizing flame. Refer to the amber/purple section for additional information.

NS-27 Green Exotic: A high intensity striking color. Slight reduction will yield bright green metallic hues. Prolonged exposure will yield earth tones. See Exotic section for additional information,

NS-28 Blue Exotic: A high intensity striking color. Slight reduction will yield bright Blue metallic hues. Prolonged exposure will yield earth tones. See Exotic section for additional information.

NS-29 Red Exotic: A high intensity striking color. Oxidize for bright metallic reds. Reduce for earth tones. Kilning will yield a darker red. See Exotic section for additional information.

NS-31 Lavender: A light transparent color. It is not sensitive to flame atmosphere.

NS-32 Violet: A light transparent color. It is not sensitive to flame atmosphere.

NS-33 Turbo Cobalt: The most saturated cobalt blue on the market. Work in a heavily oxidizing flame to prevent graying.

NS-34 Extra Light Yellow: A lighter version of NS-09 yellow. It produces a warm hazy glow when reduced or kilned.

NS-37 Rootbeer: A unique striking color. Oxidize for greens and gold tones. Reduce for reds and earth tones. It will darken in the kiln.

NS-38 Intense Blue/Green: A saturated striking color excellent for encasement. Oxidize for bright opal blues. Reduce for deep smoky greens.

NS-41 Butterscotch: A versatile striking color. Oxidize for creamy hues. Reduce for a slight silvery tone and deeper browns.

NS-42 Cinnamon: A nice medium intensity brown. It is not sensitive to flame atmosphere.

NS-43 Rust: An earthy red color. Work in a neutral to oxidizing flame. The color will strike to a deeper red in the kiln.

NS-44 Caramel: A lush bright silvery color. Oxidize for creamy tan hues. Reduce for a bright mirror-like sheen.

NS-45 Blue Moon: A saturated striking color. Oxidize for brilliant blues and greens. Reduce for sea greens and matte grays.

NS-47 Aurora: An exciting striking color. Oxidize for blues and magenta hues. Reduce for greens and earth tones. For additional information refer to the Exotic section.

NS-48 Light Blue Amber Purple: Oxidize for purples. Reduce for opaque sea greens. Refer to the Amber Purple section for working information.

NS-49 Dark Blue Amber Purple: A more intense version of NS-48 Light Blue Amber/Purple. Oxidize for purples. Reduce for opaque sea greens. Refer to the Amber Purple section for working information.

NS-52 Teal: A bright fully opaque blue/green. Not overly sensitive to atmosphere, but work in a neutral to slightly oxidizing flame.

NS-53 Forest Green: A bright fully opaque green. Work in an oxidizing flame and heat slowly. It can boil if heated aggressively. See the Heat Sensitive color section.

NS-54 Star White: A fully opaque white. It is not sensitive to flame atmosphere, but heat slowly and gently to prevent boiling. See the Heat Sensitive color section.

NS-55 Periwinkle: A bright fully opaque baby blue. Work in an oxidizing flame to prevent graying. Heat slowly and gently to prevent boiling. See the Heat Sensitive color section.

NS-57 Midnight: A dark opaque blue. Work in an oxidizing flame to prevent graying. Heat gently and slowly to prevent boiling. See the Heat Sensitive color section.

NS-58 Mint: A light opaque green. It is not sensitive to flame atmosphere but must be heated slowly to prevent boiling. See the Heat Sensitive color section.

NS-59 Cranberry: An opaque striking red. Work and strike just like NS-07 Ruby, but work gently to prevent boiling. See the Heat Sensitive color section.

NS-62 Bubblegum: A bright opaque pink. It is not sensitive to flame atmosphere but heat gently to prevent boiling. See the Heat Sensitive color section.

NS-63 Canary: A bright Intense Opaque yellow. Work slowly in a cool oxidizing flame to prevent boiling. See the Heat Sensitive color section.

NS-64 Lava: A bright Intense Opaque orange. Work slowly in a cool oxidizing flame to prevent boiling. See the Heat Sensitive color section.

NS-65 Cherry: A bright Intense Opaque red. Work slowly in a cool oxidizing flame to prevent boiling. See the Heat Sensitive color section.

NS-66 Sublime: A bright signal light green. It is not sensitive to atmosphere.

NS-69 Green Amber/Purple: The ultimate amber/purple. Work in a hot oxidizing flame. Refer to the amber/purple section for a working guide.

NS-70 Ice Blue: A cool water blue. Work in an oxidizing flame to keep the clarity. Reduction causes reddish streaking.

NS-72 Glacier Blue: A lush transparent blue/green. Work in an oxidizing flame to keep the clarity. Reduction causes reddish streaking.

NS-73 Millennium Moss: An opaque green aventurine color. It is not overly sensitive to atmosphere, but work in a neutral to slightly oxidizing flame.
NS-75 Indigo Aventurine: A deep blue aventurine color. Work in an oxidizing flame.

NS-76 Onyx: A deep green based black with excellent working properties. Work using a neutral to oxidizing flame.

NS-77 Deep Sea Blue: A smooth, deep opaque blue. Work in a neutral to slightly oxidizing flame.

NS-78 Mystery Aventurine: An exciting color that can be kiln struck to yield a wide array of silvery purples and pinks. Work in a hot oxidizing flame. Flame striking yields amber and gold hues.

NS-79 Blue Spruce: A great opaque blue/green. Work in an oxidizing flame to keep the clarity. Reduce for interesting gray streaks that appear to be growth rings of a tree.

NS-80 Hyacinth: A deep opaque faux purple. Work in a cool oxidizing flame to prevent graying and boiling See the Heat Sensitive color section.

NS-81 Blue Caramel: A rich buttery striking color. Keep it oxidized for hazy blues and greens. Reduce for the most scintillating mirror-like sheen.

NS-82 Ruby K: A versatile red designed for kiln striking. Work in a hot neutral to oxidizing flame.

NS-83 Skyline: A lighter version of NS-55 Periwinkle. Work in a soft neutral to slightly oxidizing flame. Work slowly to prevent boiling. Refer to the Heat Sensitive Color section for additional information.

NS-84 Goldenrod: A bright Intense Opaque gold color. Work slowly in a soft oxidizing flame to prevent boiling. See the Heat Sensitive color section.

NS-85 Poppy: An eye catching opaque orange. Work slowly in a soft oxidizing flame to prevent boiling. See the Heat Sensitive color section.

NS-86 Garnet: A medium intensity self-striking Ruby. Work in a hot neutral to oxidizing flame. It will not liver, but can develop brown hues if overworked. Kilning will not affect the strike. Refer to Ruby section for additional information.

NS-87 Garnet Dark: A high intensity self-striking Ruby. Work in an oxidizing flame. It will not liver, but it can develop a brown hue if overworked. Kilning will not affect the strike. Refer to Ruby section for additional information.

NS-88 Pomegranate: The lightest of the three self-striking Rubies. Work in a neutral flame. Will not liver or develop brown hues. The strike must be completed in the kiln at 1050 deg F. Refer to Ruby section for additional information.

NS-89 Nile: An appealing earth tone. Work in a hot oxidizing flame. Burn off haze and kiln or flame strike. Work like an Amber Purple.

NS-90 Rhapsody: A nice medium-dark intensity shade of purple. It is not sensitive to flame atmosphere.

NS-91 Ninja: A nice opaque blue based black. Work in a heavily oxidizing flame to prevent graying.

NS-92 Amethyst: A nice light-medium intensity shade of purple. It is not sensitive to flame atmosphere.

NS-93 Plum Krazy: Work in a cool oxidizing flame to keep color un-struck. To strike, either kiln at 1050F or bathe in a gentle neutral flame to bring out a smoky blue hue. Prolonged reduction leads to a grayish blue opaque surface.

NS-94 Egyptian White Sand: Not sensitive to atmosphere but must be worked slowly in a soft, unfocused flame to prevent surface scarring and boiling. Once melted in smooth, heat can be soaked in more rapidly.

NS-95 Oregon Gray: An atmospherically stable opal. Work slowly in a soft, unfocused flame to prevent surface scarring. Once melted in smooth, heat can be soaked in more rapidly.

NS-96 Light Oregon Gray: An atmospherically stable opal. Work slowly in a soft, unfocused flame to prevent surface scarring. Once melted in smooth, heat can be soaked in more rapidly.

NS-97 Evergreen: A bright fully opaque green. Work in an oxidizing flame and heat slowly. Color can boil if heated aggressively. See the Heat Sensitive color section.

NS-98 Loch Ness: A dark opaque sparkly green. Best if worked in a neutral to oxidizing flame. Extended annealing tends to bring out a golden hue in this color.

NS-100 Black Lightning is a very dense black with silver. NS-100 Black Lightning can yield a mirror like blue metallic finish or if over-reduced an organic earthy tone. To keep the Black Lightning most vibrant, work in a super oxidizing environment until you are finished with the piece. Then, turn the flame down and bathe the piece in a super reducing flame for several seconds to produce the mirror like sheen. For another great effect, encase NS-100 Black Lightning with clear. This color can be stretched out and is great for blown work. If heavily encased, be sure to anneal thoroughly. This is the bigger brother of NS-111 Alaskan Thunder.

NS-101 Purple Urple is a dark purple that looks like NS-80 Hyacinth but works differently in the flame. This opaque purple uses chrome based technology but does not have cracking problems. It is great for blown work and thin stringer application. It is heat and flame sensitive so it must be heated up slowly to prevent boiling. Once it glows red, NS-101 Purple Urple will take heat well. Because of its intensity it is sensitive to reduction. If the flame is not oxidizing enough, gray and brown streaks will develop on the surface of the glass. Try it with a layer of NS-32 Violet for a deep purple effect.

NS-102 Silver Bullet is a look alike of NS-44 Caramel. It is a rich silvery tan color that can be stretched out thin. It is great for stringer application and blown work. Work in a hot neutral to oxidizing flame for bright tan colors. To bring out the silvery mirror like sheen, bathe the piece in a reducing flame. Try NS-07 Ruby or NS-13 Amber Purple over NS-102 Silver Bullet.

NS-103 Berry Gumbolt is a fully opaque saturated dark blue. It is well suited for stringer application and blown work. It is not susceptible to reduction and is not flame sensitive. For best results keep it in a neutral flame. It is a great backing for such colors as NS-14 Irrid and NS-15 Turquesa, and goes well with NS-63 Canary.

NS-104 Unobtainium is a very dense gun metal blue with lots of sparkle. It is well suited for stringer application and blown work. It is easily worked and can take a lot of heat. To keep the color most vibrant, work in a neutral to slightly oxidizing flame. Try to avoid deep encasement, it may cause cracking. Please use NS-104 Unobtainium with care and test your application before making expensive pieces. Outside work seems to work just great with no problems. Try coating NS-104 Unobtainium with NS-86 Garnet or NS-88 Pomegranate to achieve a brilliant ruby sparkle. Any transparent color coated over NS-104 Unobtainium looks great.

NS-105 Silver Creek is a silver based color which produces the most exciting metallic purples and vermilions as well as silvery greens and blues. It is a very stable color. It behaves similarly in the flame as NS-13 Amber Purple and NS-26 Double Amber Purple, but because of its greater core range, more care has to be taken to prevent reduction and boiling. NS-105 Silver Creek can be stretched and can be blown relatively

thin without losing the vibrant colors. Try using with other colors to achieve multi layered color combinations.

NS-106 Dark Amethyst is a light transparent violet color. This is a “what you see is what you get” color. Use in a slightly neutral to oxidizing flame for best results. NS-106 Dark Amethyst works like butter so do not hesitate to spread it over other colors. The color looks best in solid color blowouts and sculpture work. Stringers tend to lose color and may appear as a clear Violet.

NS-107 Green Tea is a transparent algae green color with no red reduction. Use in a hot oxidizing flame. NS-107 Green Tea is great for color coils and sculpture work. When pulled into stringers, the color fades easily. This is a chrome based color so please use with a little caution to avoid cracking.

NS-108 Blue Velvet is a deep navy blue color with small amounts of sparkle. Use in an oxidizing flame to cut down on any reduction from the heavy cobalt content. This color works great in all applications. Chrome is the ingredient that makes the sparkle so please use with caution.

NS-109 Plum Kush is a black sparkle. It is well suited for sculptural applications and blown work. It is creamy and works easily. When working NS-109 Plum Kush, do so in an oxidizing flame. A reductive environment will cause gray streaks to develop on the surface and will result in a dull matte finish. When applying the color, do so gently. After it is melted in, it can take a lot of heat. This is the first black sparkle introduced to the colored borosilicate palette and is a welcome addition to the palette of blacks from which to choose.

NS-110 Blue Metal is the bigger brother of NS-108 Blue Velvet. It has more sparkle and is more dense in color. Use an oxidizing flame to cut down on any reduction from the heavy cobalt content. This color works great in all applications. Chrome is the ingredient that makes the sparkle so please use with caution.

NS-111 Alaskan Thunder is a black blue silver color. When worked in an oxidizing flame, NS-111 Alaskan Thunder yields bright metallic blues, greens, and purples. When worked in a neutral flame it yields bright hazy green, white, and cream colors. When worked in a heavily reducing flame NS-111 Alaskan Thunder produces a nice ash gray. It is well suited for stringer application, blown work, and sculpture. Try encasing NS-111 Alaskan Thunder with clear or NS-09 Yellow for great effects.

NS-112 Mother of Green Pearl is a mossy green sparkle color. It is a bright semi opaque aventurine color. It is suitable for blown work and some stringer applications. Even when thinned, it will remain sparkly and bright. Work in a neutral to slightly oxidizing flame. If worked in a reducing flame the color will not develop reddish streaks. Be sure to anneal thoroughly when heavily cased. This color is Chrome based so please use caution.

NS-113 Turbo Amethyst is a smooth dark violet. This color is an intensified version of NS-106 Dark Amethyst. This is a “what you see is what you get” color that works like butter. Use in a slightly neutral to oxidizing flame for best results. NS-113 is the violet version of NS-33 Turbo Cobalt.

NS-114 Tan Silver Creek is a yellowish cream color. It can yield rich purplish blue and creamy tan tones. When kept in a more oxidizing environment, you will get more of the blues and purples. If reduced, a silvery haze will appear on the surface. NS-114 Tan Silver Creek is easy to work and can take a lot of heat which makes it a forgiving striking color. It can be stretched out and is good for blown work and sculpture. If you are looking for something even more intense, try NS-44 Caramel or NS-102 Silver Bullet.

NS-115 Silver Sea Weed is a funky green color. It is a wild silver striker that can take a lot of heat and be used in many different applications. Working in an oxidizing flame will yield intense purple hues that are like northern lights. If reduced this color will inherit wispy cream colors with a tint of green.

NS-116 Silver Pearl is a green color with a splash of mossy sheen on the surface. This is just like NS-115 Silver Sea Weed, but with a mossy sheen. Use in a hot oxidizing flame. NS-116 Silver Pearl is great for color coils and sculpture work. When pulled down into stringers the color fades easily. This is a chrome based color so please use little caution. In an oxidizing atmosphere this color will turn purple, green, blue, and even jadish green. If reduced you will get green cream colors and also purple.

NS-117 Millennium Falcon is a transparent green sparkle. It is suitable for blown work and some stringer applications. When thinned, it will remain sparkly and bright. To keep NS-117 Millennium Falcon a pure green, work in a neutral to slightly oxidizing flame. If worked in a reducing flame it will develop reddish streaks. Be sure to anneal thoroughly when heavily encased. This color is a transparent version of NS-73 Millennium Moss. NS-117 Millennium Falcon works great for coating other colors to make a fast sparkle.

NS-118 Obtainium is a blackish to grayish sparkle color. Use a neutral to oxidizing flame for best results. This is a “what you see is what you get” color. To avoid fading, try to avoid overheating. NS-118 Obtainium is a chrome based color so please use caution. You will be amazed at this color. It is one of our favorites.

NS-119 Super Unobtainium is a dark blue sparkle. This color has lots of large crystals of metal on the surface. It is well suited for stringer application and blown work. It is easily worked and can take a lot of heat. To keep the color most vibrant, work in a neutral to slightly oxidizing flame. Try to avoid deep encasement as it may cause cracking. Please use NS-119 Super Unobtainium with care and test before you make any thing that is expensive. Outside work seems to work just great with no problems. Try coating NS-119 Super Unobtainium with NS-86 Garnet or NS-88 Pomegranate to achieve a brilliant ruby sparkle. Any transparent color coated over NS-119 Super Unobtainium looks great. NS-119 Super Unobtainium has lots more sparkle but does not have the Gun Metal surface of NS-104 Unobtainium.

NS-120 Silver Unobtainium is also a dark blue sparkle that has silver in it. It is well suited for stringer application and blown work. It is easily worked and can take a lot of heat. To keep the color most vibrant, work in a neutral to slightly oxidizing flame. Try to avoid deep encasement that may cause cracking. When worked in an oxidizing flame NS-120 Silver Unobtainium stays a dark blue color with wispy hues of silver over it. If reduced the color does not show much sparkle but still has many vivid colors.

NS-121 Blue Nebula is a dark opaque navy blue color. This color is a "what you see is what you get" color. NS-121 Blue Nebula is easily worked in all applications. Use an oxidizing flame to cut down on the reduction of Cobalt in the color. NS-121 Blue Nebula holds up very nicely when thinned.

NS-122 Blue Thunder is a dark cobalt blue color with silver. When worked in an oxidizing flame NS-122 Blue Thunder yields bright metallic blues. When worked in a neutral flame it yields bright hazy greens. When worked in a heavily reducing flame NS-122 Blue Thunder produces a nice ash gray. It is well suited for stringer application, blown work, and sculpture. NS-122 Blue Thunder is a lighter version of NS-45 Blue Moon with the same working values.

NS-123 Crystal Bliss is a light cobalt blue with lots of sparkle. The color is not heat sensitive and works great. NS-123 Crystal Bliss is very light in color and when pulled thin, the color will fade to clear. We created NS-123 Crystal Bliss the artists that like to coat their colors with sparkle. Use an oxidizing flame to cut down on red lines of copper.

NS-124 Silver Amethyst is a dark violet color with silver. Work in a cool oxidizing flame to prevent overheating and striking the color. When ready to strike, either kiln strike at 1050F or bathe the glass in a gentle bushy neutral flame to bring out the soft blue strike. NS-124 Silver Amethyst is best suited for moderately thick coil-potted blown work and sculptural applications. When encased in clear this color produces a vibrant violet with wisps of metallic blue. Prolonged reduction leads to a grayish blue opaque surface. Have fun with this color!

NS-125 Jet Black is a very dense black. It is well suited for sculptural applications and blown work. It is creamy and works easily, making it a welcome addition to the palette of blacks from which to choose. When working NS-125 Jet Black, do so in an oxidizing flame. If worked in a reductive environment it will develop gray streaks on the surface and result in a dull matte finish. When applying the color, do so gently. After it is melted in it can take a lot of heat. NS-125 Jet Black is great in combination with many colors and serves as a background for striking colors.

NS-126 Opaque Aqua is a very nice opal blue green color. It is well suited for stringer application and blown work. NS-126 Opaque Aqua will enhance your art because it has a really nice appearance and color. It is not susceptible to reduction and is not flame sensitive. For best results keep it in a neutral flame.

NS-127 EXP Green #5 is a very nice cobalt emerald green with a very complex color and chemistry. NS-127 EXP Green #5 was created by Draconis Glass. When they stopped making color rod we acquired the formulas. When working NS-127 EXP Green #5 you can achieve many different colors. When used in an oxidizing flame the color will stay a very vivid neon emerald green. Use in a less hot flame to achieve an opaque blue similar to NS-45 Blue Moon. NS-127 EXP Green #5 can also shift to a creamy white and lime green. NS-127 EXP Green #5 needs to be tried as it is hard to explain.

NS-128 Unexplainium is a greenish color. This color is true to its name. It is impossible to explain. NS-128 Unexplainium seems to change all over the board. Use it like a striker and find out the surprises that it holds. Stay tuned for more information soon.

Please visit our website for lots of additional information including our past Newsletters which are full of additional information on Working our Colors.

www.northstarglass.com

Northstar® Glassworks, Inc.
P.O Box 230488
Tigard, OR 97281-0488
(866) 684-6986 toll-free
(503) 670-0978 fax

sales@northstarglass.com
www.northstarglass.com

May 2007