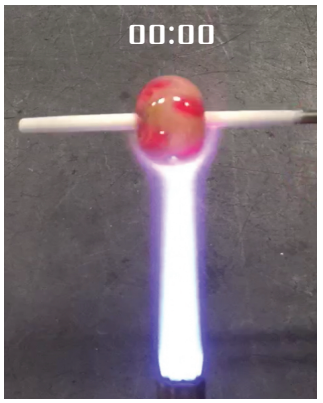
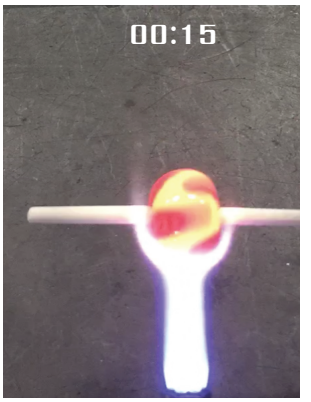
DOUBLE HELIX GLASSWORKS | *Made for the Flame*

Working with Striking Glasses



Resetting 1



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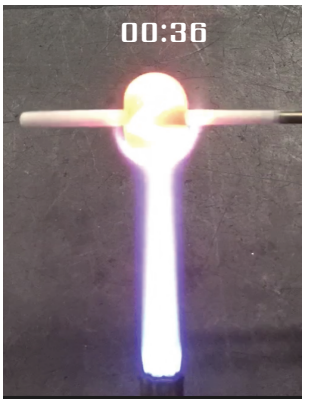

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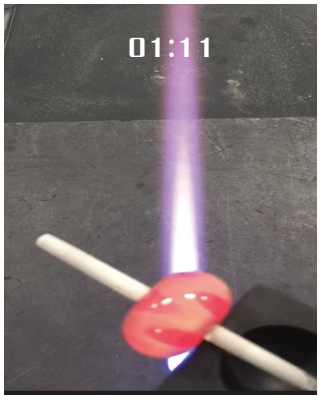
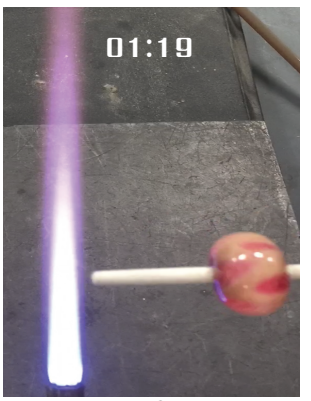


Cooling 1



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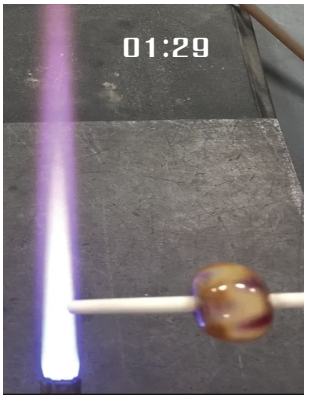

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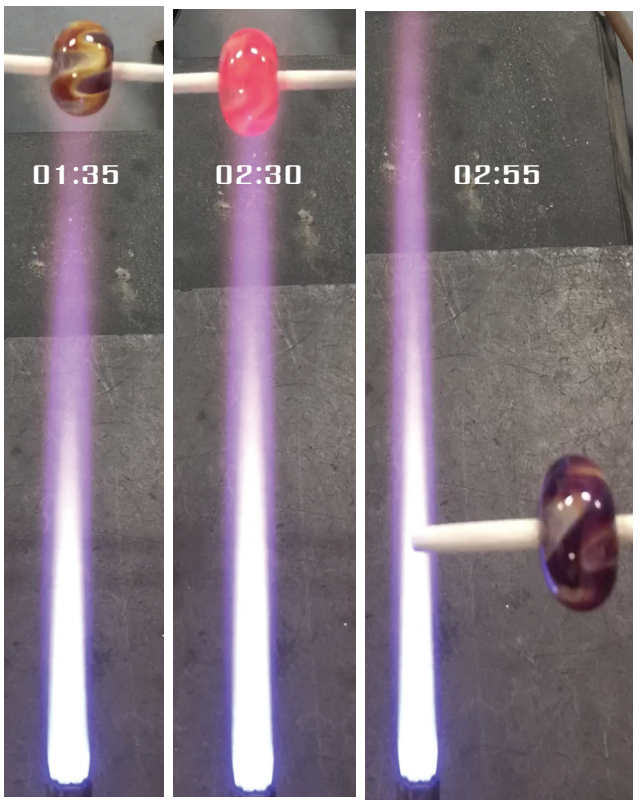
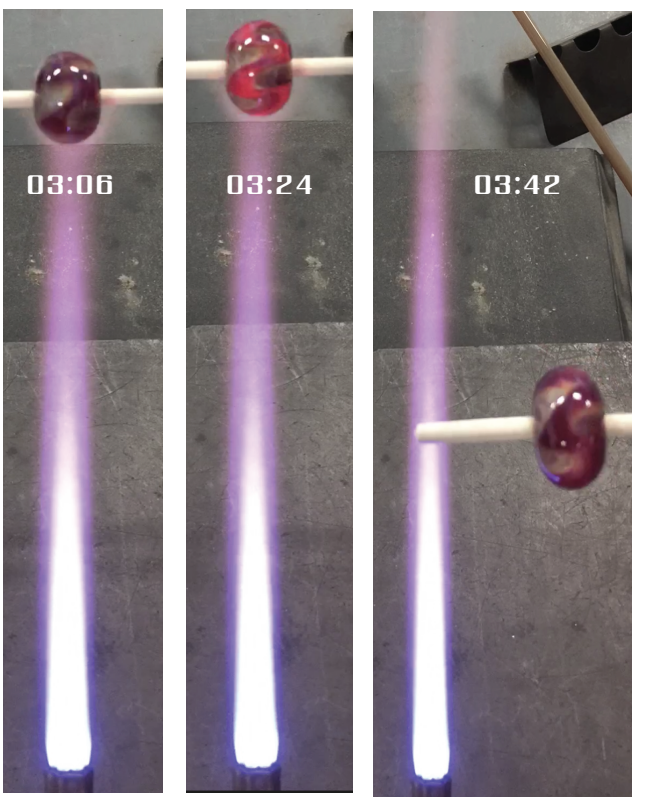


1st Warming



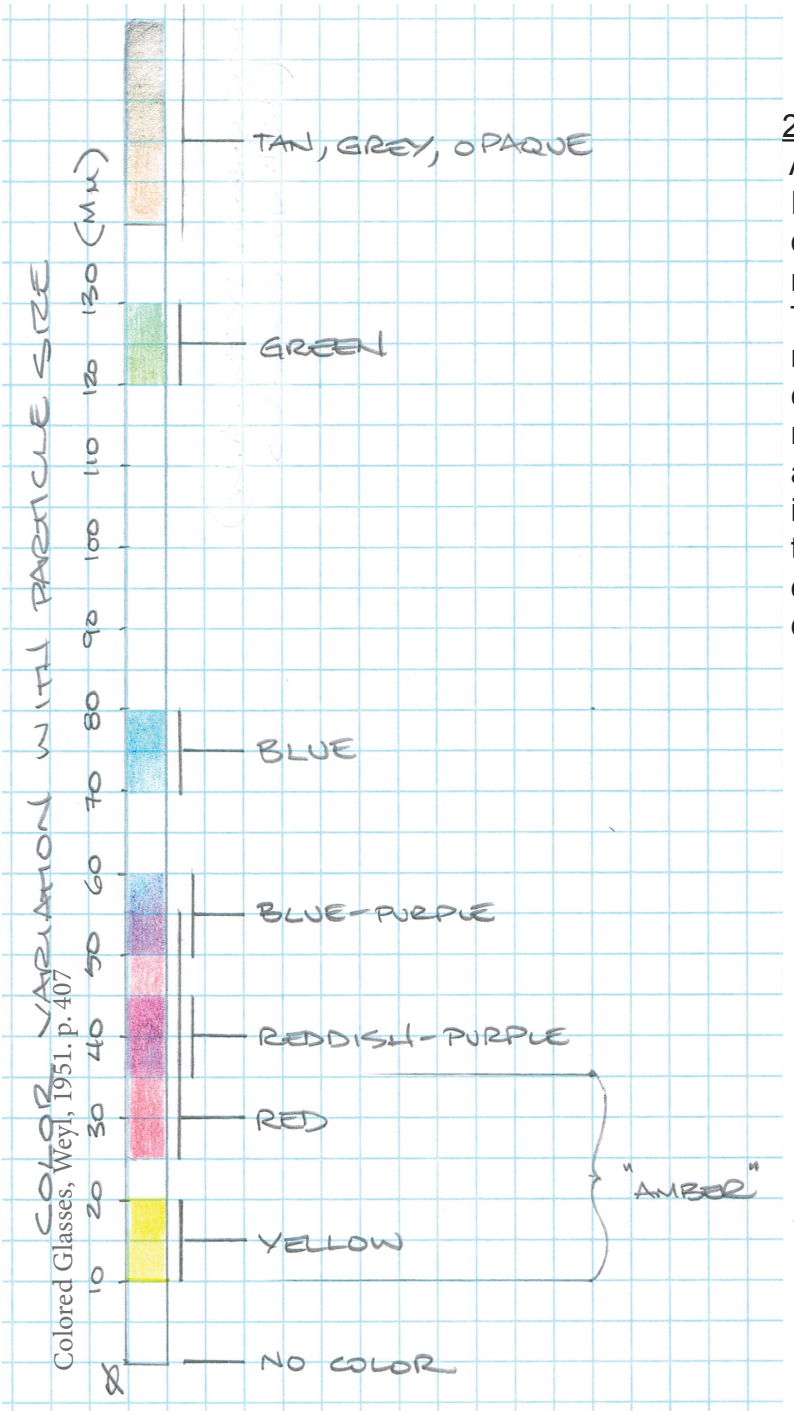
2nd Warming

Striking Color Theory

The theory of striking colors is that the metals, silver, gold and/or copper, are growing crystals (or colloidal chains, depending on which theory you prefer). These metals are dissolved in the glass. When the glass is cooled, then reheated, crystals form inside the glass. As these crystals grow, they cause the glass to transmit and reflect different wavelengths of light.

1. Crystal Growth & Nucleation

Crystal growth begins at a nucleation point. Striking colors can be homogeneously or heterogeneously nucleated. In homogeneously nucleated glasses, the metal itself forms aggregates that act as nucleation centers. In heterorogeneously nucleated glasses, additional materials have been distributed throughout the glass. These materials act as nuclei, (seed locations for cyrstal growth). Our silver striking colors are heterogenously nucleated.



2. Crystal Size and Color Transmission

As the crystals grow, different colors are transmitted. For silver-based striking colors, the color sequence of lengthening crystals is; clear, yellow, red, red-purple, blue-purple, blue, green.
The yellow and red stages usually occur together, resulting in amber or transparent brown. See the chart on this page. Variations in the glasses micro-composition, thermal history and heat application throughout the striking process results in multiple crystals sizes, creating multiple color transmissions. Overstriking, the development of oversized or disorderly metal crystals can produce dull, muddied tones.

Striking Color Process in Words

Striking a glass is a three part process:
Reset, Cool, and Warm (RCW).
Of the three steps, only the warming step should be repeated to continue the color development. We like to use a stopwatch during this process and our elapsed time is shown in the photo version.

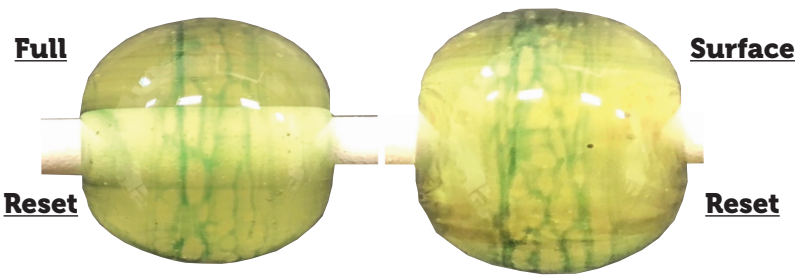
1. Reset

a. Erasing the Thermal History

During production, the glass has been held at striking temperatures for several hours, resulting in crystal growth. The rods are in an overstruck state looking opaque or misty. When the glass is heated above a certain temperature, the metals re-dissolve, yielding a clear glass. We refer to this process as the reset. The reset erases the thermal history of the glass, allowing the controlled intentional growth of the metal crystals. It's best to reset in a separate step. This eliminates variables and provides a more consistent outcome. At the temperatures that silver glasses reset, 104^{coe} glasses are soft enough to move. This does not mean the glass has to be "sloppy hot" to effectively reset the silver. A more judicious application of heat can reset the glass while allowing the viscosity of the glass to remain controllable.

b. Surface or Full Reset

The visual cue for reset is transparency. In some colors this will be crystal clear, in others a clean transparent color, tinted by other metals in the glass. Skylla resets to a transparent light green. In a full reset, the mass of glass would be heated until the entirety of the glass was transparent and the mandrel is visible through the glass. In practice, we often end up with a surface reset, in which the transparent layer only extends to a certain depth, with the core of the bead remaining opaque, swirled, or translucent. For some applications this is adequate.



2.Cool

The cooling cycle is a critical step in achieving repeatable color outcomes. If the reset glass is not allowed to cool before striking, the process does not yield the desired crystal growth. There is a range of cooling times that produce desirable color outcomes. Generally, shorter cooling times will yield lighter pastel colors and longer cooling times will yield darker colors.

a. Determining Cooling Times

I. The earliest appearance of light yellow or amber colors can be a cue that the cooling cycle is complete and the glass is ready to strike.

II. Use known times (gained through experience) to count off the correct cooling time. A clock, stopwatch, metronome, or steady repeatable count can be useful. Keep notes on the times you've tried to adjust in the future or repeat.

Effects on Cooling Time

+ Time	Variable	- Time
bigger	glass mass	smaller
air	cooling method	heat sinks
encased	depth of application	surface
hot	temp of glass at start of cooling	warm

3. Warm

Once the bead has been reset and appropriately cooled, the glass is warmed by gently heating in the furthest reaches of a neutral flame. This reheating temperature needs to be cooler than the reset temperature; warm enough to move under pressure but not hot enough to flow with gravity. If the reset and cooling stages have been sufficient, then the warming process is when you should see the glass striking. Visual cues include, a faint orange glow indicating appropriate temperature, as well as direct observation of the change in glass color. It is ok to take the glass out of the flame for a few seconds and check it's color process. If the color appears too dark, return the glass to the warming flame. Longer warming times tend to produce lighter, more pastel colors. Excessive warming times can develop more opaque, neutral tones.

Trouble Shooting Striking Glasses

Problem	Reset	Cool	Warm	Solution
Failure to strike or stuck in amber phase	none or inadequate	none or inadequate	too hot	Reset again, cool & work further out in the flame when warming
Muddy Colors	none or inadequate		Cooling between warmings or too many warmings.	Reset again, cool & warm without re-cooling between warmings.
Pale colors		none or inadequate	too long or too many	Reset again, + cooling time &/or - warming.
Dark colors		too much	none or inadequate	Reset again, -cooling time &/or + warming.

Skylla Controlled Tests

Nip off 75 mm from a rod of Skylla and flame weld it to a punty. Make a simple bead using all the Skylla on the punty and reset it. Use 45 seconds of air cooling time and 45 seconds of gentle warming. Nip another 75 mm and repeat but use 25 seconds of cooling with a bead rooler and 45 seconds of warming. Continue expirementing with different cooling variables and times while keeping the same mass, shape, and warming time.