

Double Helix Glassworks

Introduction to Reducing Glasses

Jed Hannay

Reduction Color Theory

Reduction colors contain silver dissolved in the glass matrix as Silver Oxide (Ag_2O). Upon exposure to a flame deficient in oxygen, the Ag_2O gives up its oxygen to the flame, leaving behind a thin layer of metallic silver. This metallic layer can be left on the surface or encased in clear glass.

A neutral or slightly oxidizing flame should be used during gathering, working, and shaping to preserve the silver in its oxide form. When the bead is ready to be reduced (after cooling) the flame is adjusted by increasing the fuel or decreasing the oxygen. The glass is then briefly exposed to this reducing flame.

Reduction Color Variables

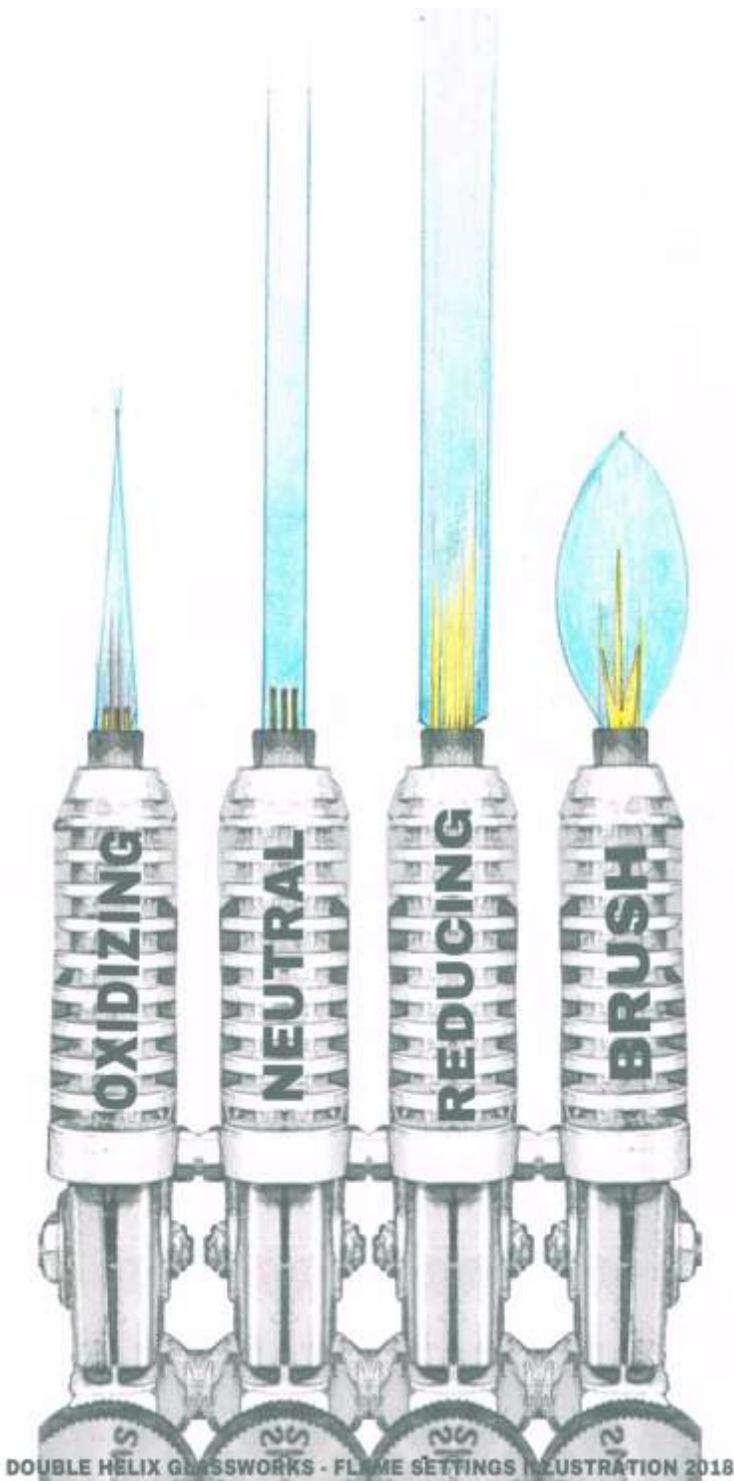
1. Heat

Though reduction is a chemical process, heat plays a role in developing the luster. The glass must be cooled before reducing or the luster can be muddy. Limiting the beads thermal gain during the reduction process will result in a cleaner luster. You can limit the heat by:

- Cooling the bead before reduction
- Using a cool reduction flame or
- Using repeated brief exposures to the reduction flame (5-10 seconds). Allowing the bead to cool for a few seconds between exposures.

2. Flame Chemistry

- An Oxidizing flame will often display “hollow” areas inside the flame, where excess oxygen displaces fuel.
- A Reduction flame will often have “stretched” candles.
- A Neutral flame is somewhere in between the two, when there is an even balance of fuel and oxygen. Though a neutral flame is ideal, it is often simpler to adjust the torch to “slightly oxidizing”.
- A Brush flame is a short, low velocity reduction flame.
- The chemistry of the flame also varies along the length of the flame, with areas closer to the fuel jets being generally more reducing than areas far out near the tip of the flame.



3. Different Torches

Spend some time exploring the various flame settings. Different torches have a range of possible flame settings. See what your particular torch is capable of, and get use to dialing in your preferred flame settings. We do not recommend using a hothead. The more control you can have over your oxygen and your fuel, the better. We are usually using either Nortel's Arrow or GTT's Lynx with an oxygen concentrator and propane.

The Reducing Process

1. Work in a neutral flame.
2. Cool until the glow is gone.
3. Create a reduction flame; increase fuel or decrease oxygen
4. Briefly expose the glass to the reduction flame (5-10) seconds.
5. If more reduction is desired, repeat step 4, allowing the bead to cool again between exposures.

Trouble Shooting Reducing Glasses

1. No Reduction – usually caused by not cooling the glass for long enough before introducing it to the reducing flame. Can also be caused by too weak of a reduction flame.
2. Muddy colors- usually the result of too much reduction or too much heat.
 - a. Test your neutral flame. Hold a rod of reducing glass in it for a few seconds. If it develops a metallic sheen on the surface, then it's not neutral. Adjust by increasing your oxygen or decreasing your fuel.
 - b. Reduce for shorter periods, at the tip of a cool reducing flame.
3. Losing the luster in the kiln – annealing temperature is too high. We anneal at 950⁰. You can also try putting activated charcoal in your kiln.
4. Erasing the luster – you can re-dissolve the metals back into the glass if it isn't muddy yet. Adjust your torch to an oxidizing flame and erase the luster.