

1409-4

Mark Nelson creates a cuff bracelet using an annealing process.

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**Guest:**



**Mark Nelson**

# Stress-Relief Annealing

Cold-working metal (by bending, hammering or forming) makes it harder and stronger, but also less ductile. Ductility is a measure of workability; the more ductile an alloy is, the easier it is to work. Solid-state metal has a crystallized microstructure that metallurgists call 'grains.' Cold-working metal deforms the grains and accumulates residual stresses in the metal that make it unworkable. Annealing is a heat treatment process that relieves stresses in the metal and allows you to continue working it again and again.

**Please Note:** This document includes basic instructions on the annealing process for silver, brass, bronze and yellow gold alloys. White gold and nickel-bearing alloys are different. More information on annealing and metallurgy can be found in *The Complete Metalsmith* by Tim McCreight (#550-108).



## steps:

1. Coat your piece of metal with barrier flux\* and set it on a heat-reflecting solderite high-heat block. Flux acts as an oxygen barrier and will prevent the metal from blackening under heat. **Please Note:** To mix barrier flux, pour an inch of denatured alcohol into a sealable glass jar. Add boric acid powder until you have a 2:3 ratio of powder to alcohol. Mix before using.
2. Apply a small amount of Handy® Flux to the metal. This paste flux turns slightly puffy at 600°F (315°C) and turns clear at 1100°F (593°C). Hold this temperature for a minute to properly anneal. Flux will appear clear and a bright metal surface is visible underneath. Experienced eyes may be able to judge the metal based on its color when viewed in very low light, holding a dull red hue to anneal. A flux coating reduces oxidation and minimizes cleanup. Wearing safety glasses, light your torch and adjust it to a large, bushy (deoxidizing) flame. Move the torch evenly across the surface of the metal from a height of about 3" until the flux turns clear (or the metal turns a dull red). Hold this temperature for 30–60 seconds (depending on the size of the piece) to allow the metal crystals to grow. Remove the flame. Note: When torch annealing, raise the temperature of the metal quickly (do not "stew" the metal).
3. Before the metal cools, use insulated tweezers to quench it in water. Quenching normalizes the grain structure, making it more ductile. Pickle the metal in the pickle pot, turning it over with copper tongs to submerge both sides if the piece is too big to fit. Pickle until the surface of the metal is clean of flux.
4. The metal is now annealed and ready to work. It will be easier to form by hammer or even by hand, allowing you to shape and re-shape your designs. If the metal becomes work-hardened again, it can be annealed over and over until you have just the right shape.

## supplies:

Order #	Description
100-116	6" sterling silver sheet, 16 ga., dead soft
502-063	Solderite high-heat block
704-096	Boric acid (flux)
115-146	Natural brush sticks
504-025	Flux pump dispenser
504-083	Handy® Flux
500-105	Smith® SilverSmith acetylene and air soldering kit
500-060	Acetylene tank
503-048	Automatic torch igniter
115-051	Insulated tweezers
501-017	Copper tongs
501-012	Little Dipper™ pickle pot
501-023/3	Rio Pickle™; 3 lbs.
201-054	Safety glasses
—	Pyrex® dish of water
—	Denatured alcohol



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**⚠ CAUTION!** Always wear eye protection when performing these processes.