Handworking

Annealing

To anneal palladium wires prior to shaping and forming, a high-heat soldering block is used with a natural gas or propane and oxygen torch. The flame should be adjusted to quickly but moderately bring the metal up to annealing temperature. The metal is evenly heated with the flame directed over the top. The torch is moved slowly back and forth covering the metal being annealed. The metal is brought to a bright orange color, briefly held at this temperature, and then quenched in water or allowed to air cool. It is important to reach proper annealing temperatures and to hold them for at least 15 to 30 seconds. Temperatures for annealing range between 1650 to 2010 degrees F (890 to 1098 degrees C) depending upon whether the palladium is pure or alloyed. Essential for palladium is the use of dedicated files, grinding and sanding materials, polishing wheels and storage. This practice keeps dissimilar metals away from palladium minimizing the potential for contamination. It also increases your return when abrasive debris, filings and scrap are submitted for refining.

Contamination

Contamination of palladium can occur through a variety of careless practices. The problem arises when gold, silver or other metals become attached to palladium and when soldered, the lower melting point metals become permanently embedded in the palladium. Since most bench jewelers process multiple metals at their workstation, metal transfer can occur if the bench is not cleaned prior to a palladium project. A dedicated bench is not essential for palladium jewelry making but good cleaning habits are. The workspace must be clean and free of debris when handling palladium.
Forging, Shaping and Forming

The hand fabrication project that follows serves to illustrate the desirable forging, shaping and forming capabilities of palladium.

This project provides an example for procedures used to hand fabricate palladium earrings. Palladium wire materials used in this project include:

- 3x1 rectangular wire
- 14 gauge round wire
- 18 gauge round wire
- 24 gauge sheet
- Easy, medium and hard palladium solder

These custom designed earrings feature cultured Mabé pearls and pink sapphires set into hand formed and fabricated palladium.

Wire pieces were cut to the circumference of the Mabé pearls for the bezels. After cleaning thoroughly, they were placed on a high-heat soldering block for annealing.

Tech Note: Over-annealing can cause excessive grain growth ultimately affecting forming and finishing operations. If the palladium wire is pre-polished, the annealing process will cause it to lose its luster, turning it to a dull white. It is important to remove oxidation that may have formed on the surface of palladium prior to doing further work after annealing. A suitable working surface is easily restored by using light abrasives or re-polishing. Submerging palladium in standard pickling solution has no deoxidizing or brightening affect.

A vented torch tip was selected and the flame adjusted for annealing. The wires were then evenly heated with the flame directed over the top, and the torch moving slowly back and forth along the length of the wires. The pieces were brought to a bright orange color, briefly held at temperature, and then allowed to air cool.

Using forming pliers, the bezel wires were shaped around the circumference of the mabé pearls. The bezels were prepared for soldering by forming and flush-fitting the two flat ends. The individual bezel wires were placed on the soldering block with the joint facing upward. A small piece of palladium hard solder was placed directly over the joint (see the palladium soldering table (page 31) for palladium solder melt and flow temperatures). Then, a hot oxidizing flame was used to directly pre-heat and solder the joint. This is necessary due to the low thermal conductivity of palladium. No flux, firecoating solution or other materials were used in the soldering process. Each of the bezels and lower bezel support wires were soldered in the same manner.

Tech Note: Use Eye Protection - When annealing or soldering palladium, view your work through rated welding lenses. Some suppliers offer welding glasses with protective lenses and visors with magnification and rated lenses.
All the bezel wire components were rounded and trued. The 14 gauge round wire was then fitted to the base of each rectangular wire, forming a seat for the mabé pearl. In preparation, a 45 degree angle was ground on the inner edge of the rectangular bezel wire by using 3M Diamond Flex Band® abrasives.

The pieces were then pre-finished using three grits of abrasive bands - 400, 1200 and 3000 – and then washed in the ultrasonic unit and dried. The rectangular bezel wires were placed face down on a high temperature soldering block. The 14 gauge round wires were positioned into the angled rim. Four small pieces of medium palladium solder (or equivalent) were placed equally around the joint. The pieces were heated from the top in a circular motion and the solder flowed completely around the connection.

Soldering creates a dull white finish on the surface of pieces. It’s simple to remove by using fine abrasives. Here, a 1200 grit abrasive sanding stick is used.

Another product well suited for pre-finishing this alloy is Foredom’s® ceramic impregnated abrasive wheels. They are available in 6 different color coded grits ranging from 120 to 1500.

**Tech Note:** Using a progressive, multiple-step abrasive process with palladium helps to produce the finest finish.

The wires for each side of the bezel assemblies were annealed then hand formed. A ring mandrel provided a suitable forming tool.

To ensure consistent forming, a guide was drawn on graph paper. Each piece was confirmed identical in size and shape.

The wires were formed and pre-finished for soldering. The bare wires were placed on the platinum soldering block and small pieces of easy flowing solder were
placed along the top portion at the joint. The area to be joined was saturated with heat from a pinpoint flame and then soldered. After soldering, the pieces were pre-finished on the top and bottom using a sanding board. This board has 320-grit abrasive paper adhered to it.

The bezels were fitted into the frames and placed face down on the high temperature soldering block. Small pieces of easy palladium solder (or equivalent) were placed along the solder seam on each side of the bezel. The pieces were heated along the top and side and soldered.

To make the small domed shapes for the tops of the earrings, small discs were cut from 24 gauge sheet. Next, they were formed in a dapping block using dapping punches. To get the desired shape, three progressively sized punches were used to form the disc in 5 progressively sized cups in the block. The red arrow indicates the final shaping form.

The bezel wire for the pink sapphires was created by rolling flat a piece of 14 gauge palladium round wire. The resulting thickness was 0.75 millimeters. After rolling, the wire was annealed and cut to length. The bezel wires were formed using round/flat forming pliers, then soldered.

18 gauge round wire was formed to create a support at the base of each dome and soldered using hard palladium solder (or equivalent). A slit cut in the high-heat soldering block supported the wire for soldering. This block has various carved indentations to support or hold a variety of parts for soldering—allowing for hands-free soldering sequences.

After the wire ring was soldered and trued, a 45 degree taper was flat sanded around its circumference (indicated by the red arrow). This flat angle allows for greater metal-to-metal contact with the inside of the dome. They were soldered together using easy palladium solder.
The dome assembly was filed and shaped on one side to accommodate the bezel. The bezel was soldered on with easy palladium solder.

A cross bar to support the earring post was then soldered in place (the quality mark was stamped on prior to soldering).

To complete the top component an earring post was soldered securely to the cross bar.

Holes were marked and drilled in the top portion of each earring unit to allow for free movement on the jump ring. The pieces were pre-finished, polished and set. The earring components were assembled and the jump rings were pulse-arc-welded to secure the assembly. The polishing was quick and efficiently accomplished because the work was pre-finished as it was assembled. No rhodium plating was required because palladium alloys are white and bright.

**Tech Note:** If tweezers or solder pokers are used, they must be made of tungsten carbide to avoid metal transfer contamination.

**Tech Note:** It is important to have metal-to-metal contact for solder joints. Palladium solder does not bridge gaps or irregularly fitting joints.
Cutting and Filing

This file has a build-up of palladium particles and needs cleaning. If not cleaned, the larger particles could create divots or trails in the surface of the piece being filed. Use a standard file cleaner to remove built up debris. To minimize build-up and to increase the life of the file, apply a thin coating of oil of wintergreen on the file surface and use less force when filing.

A jeweler’s saw with standard blades (2/0, 4/0 and 8/0) is used for hand-sawing palladium. Beeswax is used to lubricate the saw blades.

Hand Engraving

While hand engraving is an art unto itself, graver work in some form is used at every level in jewelry making, including:

- Preparation, bead raising, cleaning and bright cutting of pave, threadwork and bead setting.
- Prong setting (leveling seats, adjusting prongs for uneven pavilions, shaping prongs, cleaning).
- Flush, channel and bezel setting.
- Removing metal flashing after burring.
- Adding definition or cleaning after repair work.
- Cleaning castings.

The natural beauty of this palladium ring is enhanced with hand engraving of initials done in relief.

This palladium ring was cast with a heavy gate at the base of the ring shank. The finished rough casting after the gate was removed weighed 13.64 grams. The outside surfaces of the signet ring after finishing are dead flat and have high polish with crisp edges. To prepare the ring for engraving the ring was polished using a flat lap and platinum Tripoli. Then it was cleaned and another flat lap with white Bendick® rouge was used. For the final color and luster and the last step in the polishing process, a stitched muslin buff was used with 8000 grit Platinum white polishing compound – a process which also softened the edges.

Design by Novell

While hand engraving is an art unto itself, graver work in some form is used at every level in jewelry making, including:
A relief engraver designed a layout of the initials to fit the top of the ring and then transferred the design onto it. Next he isolated the letters using a square graver. In the following image, he begins the removal of metal between the lettering by making a set of parallel cuts in one direction and then crossing those with another set of parallel cuts in the opposing direction. He will later finish the metal removal and smooth the recessed area with a narrow flat bottom graver. When completed, the letters will be raised and the recessed background will have a fine stipple finish.

After the engraving was completed, the top was re-finished with 3M’s Imperial Lapping Film® and lightly re-polished. The letters fit the top shape of the ring and the stipple finish provides a nice contrast to the polished monogram.

**Engraver comments:** “Engraving palladium was similar to engraving platinum. One notable difference was that the palladium flaked away and did not clog up my graver tips in the way platinum engraving does. Even though this was a cast ring, the metal was uniform and smooth making metal removal more consistent.”

### Cold Working

Pure or alloyed, palladium is highly ductile and malleable and can be readily cold worked to include rolling, forging, forming, spinning, drawing and other forms of metal manipulation. Palladium work hardens at about the same rate as higher karat yellow gold alloys and must be annealed as this condition develops.

### Cold Working Precautions

When cold working palladium with steel tools, clean or pickle the metal before annealing. This can be done mechanically with abrasives or chemically in hot hydrochloric acid to remove surface traces of iron from the tools. After annealing, the metal can be quenched in water or air cooled. Oxidation can be removed by applying a neutral flame.
Johnson Matthey wishes to acknowledge the following technical experts for their input and contributions:

1 **Lainie Mann & Schuyler Mann**, Mann Design Group, Corvallis, MT: Lainie - Jewelry designs and wax modeling used for example projects, jewelry design annotations, technical research and editing. Schuyler - 3D design layout and wax model making of projects cast and used for research.


3 **Tom McLaughlin**, Lennon’s Jewelers, Syracuse, NY: Jewelry designs, finished projects, stone setting and workmanship annotations.

4 **Stephen Adler**, Automated 3D Modeling, Rye, NH: Rapid prototype model for casting.

5 **Teresa Frye**, TechForm Advanced Casting, Portland, OR: Allowing on-site photography of casting facility, casting research and production of cast pieces for manufacturing research.

6 **Steece Hermanson**, Heirloom Hand Engraving, Sumter, SC: Hand engraving project and hand engraving annotations.

7 **Brenda Warburton**, Austin & Warburton, Ann Arbor, MI: Laser Welding research, jewelry design and palladium working characteristic annotations. Provision of images by Craig Warburton.

8 **Vidi Beccera**, Holman Design Group, Dallas, TX: Stone setting annotations.

9 **William Holman**, Holman Design Group, Dallas, TX: Stone setting, engraving and workmanship annotations.

10 **Barney Jette & Rod Smith**, Barney Jette Jewelry Design, Missoula, MT: Channel setting project and setting annotations.


**Stewart Grice & Fred Klotz**, Hoover and Strong, Richmond, VA: Loan provision of palladium mountings and mill products used for examples research and ongoing technical metallurgical annotations.


**Thomas Dailing Designs**: Provision of palladium jewelry design and manufacturing annotations and for supplying images for award winning palladium jewelry designs and workmanship. Dailing jewelry images taken by “Azad Photo”.

Johnson Matthey extruded and machining experts, Pennsylvania for sharing expertise with related content.

Some images or content from this manual was first published in Jewelers Circular Keystone (JCK).

All technical content produced by Mark B. Mann, President of Mann Design Group.

Content and images, copyright Johnson Matthey Public limited Company.

Photographs by Mark B. Mann, Mann Design Group except where noted.

This information is provided without warranty, either expressed or implied. The procedures can be harmful if not executed properly and are undertaken at the reader’s own risk. The author and publisher are not responsible for injuries, losses or other damages that may result form use of this information.