Bench Tricks for the Platinum Smith

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Platinum's popularity in the United States is on the rise, and so is the desire of jewelers to be able to master this precious metal. One of the most common misconceptions is that platinum is "hard to work with." Working with platinum is not difficult. It requires a different approach with respect to most traditional goldsmithing techniques, and it will force you to break some of your habits around the work bench.

The properties of platinum are unique and so are some of the techniques it requires. So lets first take a look at some of the basic principles and note what's different and what's important. This observation will inevitably lead us to discuss the use of techniques and tools and consequently move forward to the finer points and treasured tricks of working with platinum at the work bench.

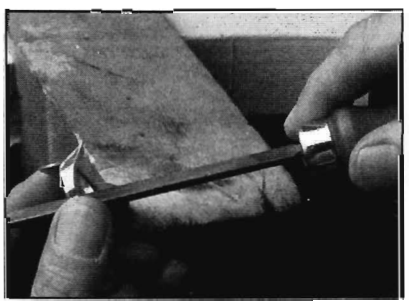
THE BASICS:

Bench cleanliness

It can't be stressed enough that cleanliness is the law and foremost rule to live by when processing platinum. Platinum is easily contaminated with almost anything that you use around your work bench and jewelry shop. Once contaminated, platinum can only be reclaimed through costly refining.

Think of it as a royal metal that requires white glove treatment. Understanding the platinum etiquette will reward you with quick turn-around-time, happy customers and impressive profit margins. Violating these rules guarantees lost time, high refining cost and frustration beyond belief.

If the limitation of space in your work shop doesn't permit separate platinum-only benches, clean your work bench and drawer thoroughly before starting your work on the platinum piece. Remove all tools that you use on gold and silver from the surface of the bench and replace them with your set of platinum-only tools. This procedure eliminates the possibility of accidental contamination. Switch to a platinum-only bench-pin and attach your (platinum-only) bee's-wax to it. Line your drawer with a sheet of paper so that your filings and sweeps are easy to move to your individually-labeled platinum scrap bins.



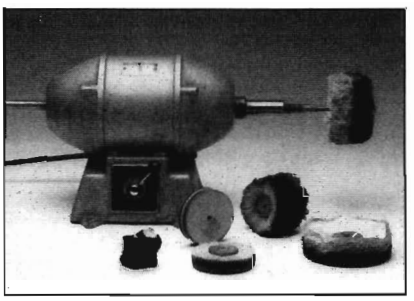
Cleanliness of workshop tools

Be cautious when using shop tools like draw plates, rolling mill or polishing motor, as each of these work stations represent a potential risk of contamination,

Drawing:

Be sure that the draw plate is free of residue from previous operations and has a polished surface. Steel plates are not recommended. Tungsten-carbide, corundum or diamond tools are called for to ensure a precise cross-section of your wire or tubing.

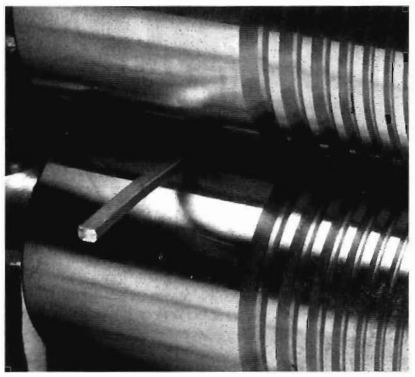
Polishing:



Cross-contamination from gold and silver particles can be avoided by using specially marked wheels and attachments. Therefore, one set of brushes, felts, buffing wheels and emery wheels should be dedicated for platinum use. Mark your platinum polishing tools distinctively in a bright color for example, and keep them in zip bags or plastic containers with lids. Store the polishing compounds with the wheels to reduce the risk of mix-ups. Clean the polishing station before and after you polish platinum. This way you eliminate the risk of cross-contamination through polishing dust. Change emery papers and dress buffing wheels often, since platinum will charge papers and buff, causing scratches that interfere with your polishing efforts.

Rolling:

Prior to any platinum rolling operation, clean the rollers with alcohol. After each rolling step and before annealing, the platinum piece should always be treated in a



10% nitric acid solution to prevent any possible damage by non-ferrous impurities. A bath of sodium sulfide acid before heating and melting, followed by pickling, will remove any ferrous metal contaminants from the surface.

The right alloy

There are a variety of platinum alloy combinations that find use around the world. Each particular one has been composed by metallurgists and metal experts because it has certain properties that make it particularly suitable when being used to perform a specific task. Some alloys are great for castings, others are ideal for wrought materials, and some have desirable characteristics to be applied for settings or chain making (see chart, Figure 1). So, before you get started, take some time to analyze which production steps your design will require and based on those findings, choose the alloy that will accommodate your needs best. The alloy you choose for your design will impact your manufacturing process and the wear on your tools. Sometimes, deciding for one alloy alone is not an option. Depending on the complexity of your piece, it might be necessary to produce individual components from different alloys, and then assemble them to one jewelry piece.

Platinum's unique properties offer design opportunities that other precious metals can't provide. Use these special characteristics to your advantage and create distinctive platinum designs. Platinum will maintain its structural strength in thin sections and cross-sections, and its resistance to shearing and buckling makes it the metal of choice for filigree jewelry and for prong settings.

Finally, in choosing which alloy to use, consider if you want to export your platinum design to foreign countries. If so, familiarize yourself with the Hallmarking Regulations in those countries. In Europe, for instance, there is an uniform standard of a 950 platinum content. If you produce 900/100 platinum jewelry for the domestic market, you need to increase the platinum content in order to be able to export your products to Europe. Also be aware of the different marking requirements (e.g. PT versus PLAT) which differ from country to country.

Plan your design

Instead of working with one large platinum casting, try to break the piece down to smaller individual components, as it is much easier to get good casting results for small pieces. Wall thickness is an important factor when working with platinum castings; try to stay under 2mm cross sections. Plan your brazing seams and joining sections such that they are hidden, and not subject to the most attention. When combining gold and platinum, use interlocking joining segments to avoid trouble during assembly. Assemble and finish the platinum components completely before joining them with karat gold segments. Determine where to expect stress/tension, and remember to stress relief the piece, or the stress can tear your piece apart. Know the specific properties of the metals that you are working with, in-

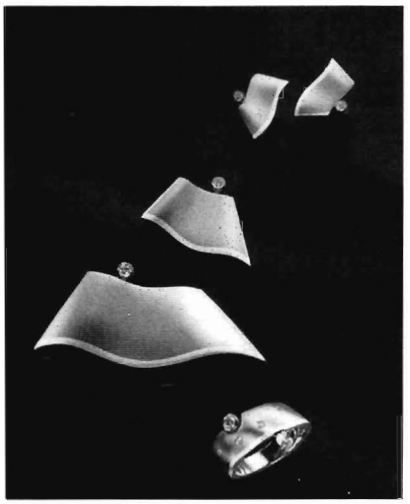
The Basics:

	Casting	Brazing	Welding	Die Stamping	Setting	Chasing
Pt-Co	☺	☹	☹	☹	☹	☹
Pt-Ir	😐	☺	☺	😐	☹	☹
Pt-Cu	😐	☺	☺	☺	😐	😐
Pt-Ru	☹	☹	😐	😐	☹	😐

Table 1: Suitability of Platinum Alloys for Jewelry Applications

☺	Good
😐	Ok
☹	Not Good

❑ Choosing the right alloy



cluding the melting ranges of your solders.
Keep the specific gravity of platinum in mind! Don't design pieces that are too large, too heavy or too expensive to ever be sold.

Use welding techniques over brazing whenever the piece allows. Work with the highest melting range solder (brazing filler) that you are comfortable with, and work from high temperature to low temperature solders. If a piece is very complex, make a 1,2,3-list of the steps involved. Chances are that you can catch an error on paper before you actually commit it in 3-D. (Time spent = money saved).
Choose wire prongs over cast prongs as these are less likely to be brittle and have a better surface quality. Polish the settings completely before you set stones, and only start setting after all high temperature work has taken place.

Switching gears

If your workshop space allows it, have one bench strictly designated for work with platinum. This sacrifice in space will reward you with time-savings when changing between metals. If you have your platinum-only tools at your platinum-only work station, there is little to 110 risk of accidentally grabbing the wrong file or emery paper.

Switching physically from the "gold bench" to the "platinum bench" will also help you focus on switching gears between the different manufacturing techniques that the properties of the metals dictate. Some of the most striking differences are: the need to wear welding glasses when welding or brazing; the use of highly polished, clean cutting tools in combination with generous lubrication; and the reduced cutting angle when sawing, drilling or engraving.

Appropriate Tools

Every piece of platinum jewelry is only as good as the worst tool that was used to produce it. If the wrong torch, crucible, soldering pad or polishing wheel is used, failure is certain.

Utilizing the right tool is important since this metal requires special tools which can withstand the higher brazing and welding temperatures. As a rule of thumb, it's safe to say that a steel-tool should not be used within half an inch of a torch flame (in the red-heat stage). This includes tweezers, soldering picks, and binding wires. The use of tungsten tools instead is recommended. You can make your own tungsten tools by using tungsten wire (available at welding supply stores) which you can attach to wooden handles for soldering picks, or which you can solder to other tool components for a variety of applications. Also, during all high temperature procedures, welding glasses must be worn to protect the eyes from the intense glare that would otherwise cause permanent eye damage. Depending on the intensity of the heat, welding lenses #6-#12 will be necessary.

During all cutting and shearing applications it is important that all cutting edges are clean, polished and sharp. Although cutting platinum is not significantly different from cutting other precious metals, the high surface resistance will lead to a much higher wear on the tools. Clogging of machine tips, saw blades, drills and files is a common experience when working with platinum and the overall impression is that platinum is somewhat "sticky."

Generally speaking, tungsten tools or diamond-tipped tools are superior to steel, as they produce faster and more accurate results. Depending on the size of the angle between the platinum surface and the tool's cutting edge, the dragging friction will be high or low. A shallow cutting angle will keep the smearing minimal. For all cutting and grinding processes generous lubrication is highly recommended.

Be Creative

Sometimes you might have "a vision" for a new jewelry design, but you can't think of an immediate solution for the challenges the manufacturing process entails. Maybe the process is multi-layered, maybe the design is based on a technique you are not particularly familiar with. In any event, don't drop the idea because "it's too difficult!" Keep the thought in the back of your mind, juggle it around and be open for a different approach. If you do not want to weld or braze for reasons the piece dictates, there are numerous other (mechanical) bonding techniques out there offering an alternative. Consider them even if (or because of the fact) they

are not "traditional." You can apply screws, links or rivets or experiment with expansion fitting or diffusion bonding (metallurgical bond). The point is, if you are hatching the idea long enough you will eventually find a solution. Perseverance and patience are virtues required for successful platinum designs. If Edison had followed the path that everybody else was walking, we would have a candle light presentation today!

No Shortcuts

The same perseverance that is part of the innovative design process is also called for when finishing platinum. Bright mirror polished surfaces are visually appealing. They are an excellent way to take advantage of platinum's high surface resistance since the metal will retain its polish much longer than other precious metals. Unfortunately, achieving this high goal has its price because the steps that lead to it are very labor intensive (about three times higher than silver and gold) and require disciplined, progressive use of increasingly finer abrasive paper and polishing compounds. Following these systematic steps will result in the desired surface qualifies; cutting corners will find you spending overtime at the bench pin.

A final consideration discussing the "platinum basics" is striving for knowledge. Education is a key factor for your success. Platinum is a rapidly growing market in the jewelry arena and new suppliers and competitors are joining the circus every day. In order to stay atop of all the innovations and developments, use the resources that industry associations offer. There might be a new tool out there that could save you time and money, but you will only learn about it if you keep looking for it.
Surf the Internet, subscribe to professional magazines, participate in local Jewelers' Association Meetings and stay in touch with your colleagues. Participate in trade shows and seminars, since there is always something new and worthwhile to learn. Time spent will reward you with valuable information and knowledge.

The Tricks:

Wedge angle principles

Now that we have covered the fundamentals of platinum processing, lets move on to the finer points. Some of the most common tools for daily jewelry applications will require some modifications to work equally well for work on platinum. This holds particular truth with cutting tools. We'll start by taking a brief look at the underlying theoretical principles in metal-cutting technology and move on to some real-life applications: The two side planes of the wedge

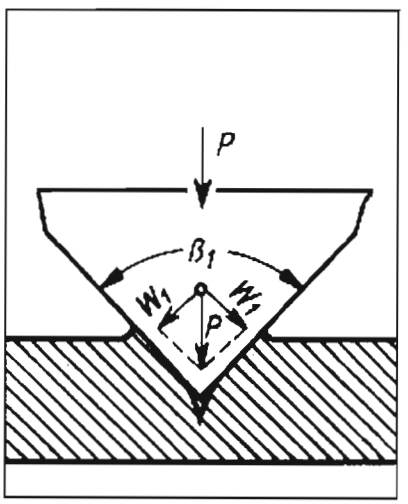


Figure 2. Large Wedge Angle
ß1 = wedge angle;
W1 side plane force;
P = force

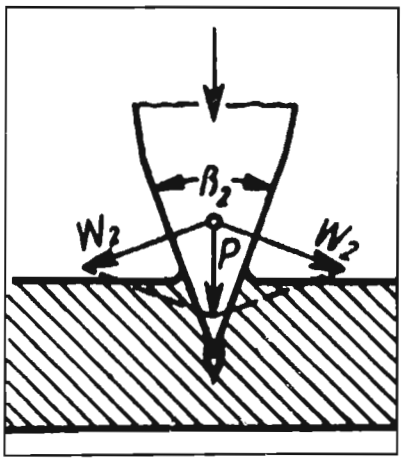


Figure 3. Small Wedge Angle
ß2 = wedge angle
W2 = side plane force
P = force

form the wedge angle (β). The cutting action is largely dependent on the size of the wedge angle. Figure 2 shows a large wedge angle: When entering the metal surface, a large amount of metal has to be pushed away, so the transformation resistance is high and requires a large amount of physical force (energy). Figure 3 shows a small wedge angle: Only a small amount of metal needs to be moved. Because of minimal transformation resistance, it is easy (low energy) to push the wedge into the metal. A knife edge (skinny) wedge has a tendency to glide-off easily and requires frequent re-sharpening.
The comparison of the two shapes also demonstrates the force relation. The applied force (P) is the same for both examples. P translates into W1 and W2. Wedge angle β1 shows a relatively small side plane force, whereas wedge angle β2 demonstrates a high side plane force.

Conclusion:

A high surface resistance metal (platinum) will require an ex-

tremely high energy level when working with a wide wedge angle. A small angle will wear out the tool soon and is more difficult to guide.

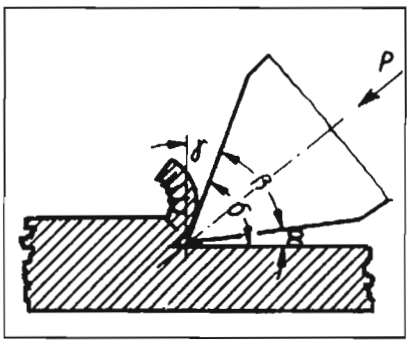


Figure 4. Cutting Angle
α = clearance angle
γ = rake angle
ß = wedge angle
σ = point angle

Cutting angle principles

Figure four shows engraving:

α = **Clearance angle:**
Is formed by the side edge of the cutting tool that is facing the cut portion of the metal and the already cut surface of the metal piece. In order to avoid unwanted friction between the cutting tool and the surface, it is advisable to keep this clearance angle small, using only the point of the tool.

β = **Wedge angle:**
Is formed by the angle between the two side edges of the wedge. In essence, the wedge angle is defined by the cross-section of the tool, for instance, a graver, which we'll get to in a moment.

γ = **Rake angle:**
Is formed by the angle between the side edge of the tool (that is facing the metal curl) and the vertical line. The steeper this area (the bigger γ is), the easier it will be to perform a cutting action.

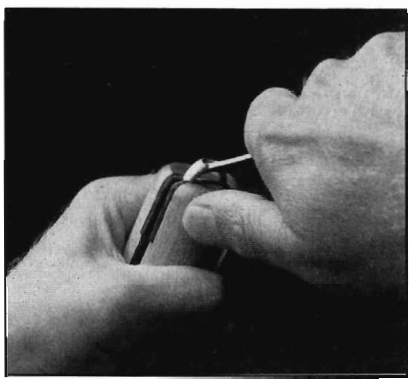
σ = **Point angle:**
Is formed by α + β. The smaller the point angle, the longer are the cut metal curls. If the point angle is small, the cutting performance and the tool wear are high. Conclusion: In order to achieve a small point angle for best cutting efficiency, reduce the wedge angle of the cutting tool and keep the clearance angle shallow.

Change the angle of your gravers

Now then, let's move on to the real-life applications. Let's say you need to cut a groove into a ring. Often times, it is faster to use a graver instead of a milling cutter. Most gravers from your tool suppliers come in sharpening angles for traditional gold and silver applications (commonly 35°-40°). Due to platinum's toughness, though, it is necessary to reduce the sharpening angle to 15°. Make sure that the graver surface is clean and high polished. Increased surface density and a final finish will be achieved by rubbing the graver on diamond-powdered leather. Unparalleled smooth cutting and a high glossy shine will be your reward.

15° α-angle for platinum

Not only the cutting edge of the tool, but also the angle in which you should introduce the tool to the metal surface (rake angle) is different from traditional gold- and silver cutting. A large rake angle will allow you to achieve a fine cut with moderate force. Using a shallow rake angle requires a considerably higher physical effort, with the bulging of platinum particles and quick dulling of the tool as the result. Common gravers such as Florentine gravers can be used for textured finishes on platinum. Frequent cleaning of the cutting edges as well as generous application of cutting oils or Teflon® powder will extend the tool's life.



Modify your drill bits

Depending on the amount of drilling that is performed in your jewelry shop, you can either take the time to modify your regular drill bits, or you can reach deeper into your pockets and buy those specialty platinum drill bits. For all important precision cutting operations with no tolerance for off-center fixing, it is recommended to use diamond-tipped drills.

Also, it is advisable to work with pilot holes, ideally in combination with a modified drill bit (as Michael Bondanza describes it in the

Platinum Tech-Book, Volume IV, Pages 31 and 32.) at a cutting angle of about 15°.

You should not work with high rotational speed when drilling platinum. Since platinum is a high surface resistance metal, excessive speed will increase your chances of getting the drill bit stuck or wearing it out too soon. So, generous lubrication and a lower rotational speed will allow the drill to transport the drill grindings away from the drill bit shaft.

Note:

Make it a habit to perform your drilling operations on a small piece of wood and not on the bench pin. Pits filled with dust and grindings in bench pins are a source of contamination.

Bendable files

Sometimes it is the "little helper tools" that make your life a lot easier. Some special needle files have a flexible core under the hardened surface which allows them to bend into the shape ii ceded for hard-to -reach spots. This permits filing at a relative quick rate without worrying about marring surrounding prongs, or other components.

Frequent saw blade changes

The basic principle of a saw is based on the fact that the lined-up teeth of a saw blade are cutting small metal particles from the metal's surface. These particles are stored in the voids in between the teeth (clearance angle) until the saw blade is leaving the metal piece and the metal particles can fall out of the room in between the cutting teeth. By clearing the voids between the cutting wedges the saw moves forward. Every single tooth works like a cutting wedge described in the previous slide. Depending on the hardness of the metal that you are cutting, you have to choose the appropriate saw blade. A hard metal requires a large wedge angle to prevent the teeth from breaking. A soft alloy calls for a blade with a larger clearance angle to allow all particles that were cut during the last stroke of the saw to be accommodated in the voids. If the voids are not big enough the particles get stuck and the saw blade is jammed. Bee's wax lubrication supports the transport of the cut particles from the voids and reduces the dragging friction. When cutting thin cross-sections of sheet or tubing, it is necessary to work with a fine-toothed saw blade, because large teeth get hooked on the sheet or tubing and cause the piece to bend. For all normal cutting operations that work on pull (teeth facing down), you will find that depending on the angle in which you introduce the saw teeth to the metal piece, it will be easier or more difficult to cut the piece. Experiment and find out which angle works best for the particular alloy you are working with. Due to platinum's "stickiness" that I described before, the saw blades dull much faster compared to other metals. Change the blades often to avoid breakage. Keep in mind that only one undetected saw tooth stuck in the work piece when the piece gets heated is enough contaminate the whole piece permanently.

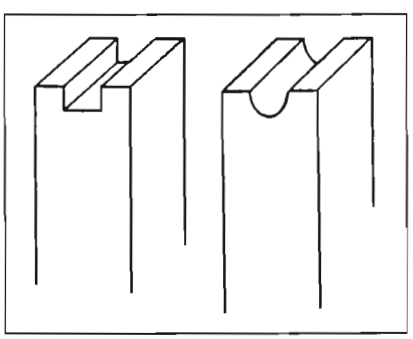
Re-tipping prongs

Don't repair a setting, or re-tip a prong with a gem stone in place. Even diamonds will be damaged or destroyed by the temperatures required for brazing platinum. Make it a rule of thumb to remove all gemstones that will be closer than half an inch to the heat source.
If removing a gem is not an option due to the risk of breaking the stone when removing it from the setting (e.g. large size emeralds and opals) you might want to consider repairing it with laser welding technology. Paying a contractor for laser welding your piece will be cheaper than replacing an expensive customer-owned stone.

If you are re-tipping platinum prongs with gold-technique (using white gold solder and platinum wire), make sure the stone is not fracture filled, chipped or otherwise likely to be troublesome during heating.

Groove the pusher

Platinum is a setting-friendly metal, as it easily bends. Once a prong is pushed on a stone it stays there, not showing the springiness you know from gold. Since the finish on your platinum piece is already completed when you are starting the setting process, avoid leaving tool marks on the settings. Cut or file a groove into your prong pusher that can accommodate the width of the prong. Shape a negative cylindrical shape for round wire prongs, or a squarish groove for flat wire prongs. Keep your pushers clean and high-polished.



Magnetic platinum-cobalt

When working with platinum cobalt, keep in mind that this platinum alloy is slightly magnetic. If you use a magnet to separate broken saw blades from filings in the working tray, you will catch the platinum saw dust too. Therefore, hand pick the ferrous parts and then collect your dust by regular sweeping. Another way is to loosely wrap a sheet of tissue paper around the magnet. The magnet will attract the platinum dust and all you have to do is to fold the paper around the filings and dispose your catch into your platinum cobalt collecting bin.

Annealing

During common cold working operations, platinum will work-harden to a point that increasing dislocation density makes it necessary to re-crystallize the grain structure. Also, whenever the direction of definition is changed by ≥ 90° (for instance when cross-rolling a sheet of platinum), an intermediate annealing step is necessary to allow the reorientation of the grains. The re-crystallized metal will then allow further rolling-or pulling steps. Although the need for annealing is undisputed, it seems that the determination of the right temperature seems to be a lesser-known fact. The trick is, to heat-up the piece hot enough and to hold that temperature long enough to achieve a proper re-crystallization. For most jewelry alloys, the required annealing temperature is 1000°C to 1200°C (for approximately one minute, per mm thickness). The color relating to this temperature range translates to a mid-yellow; for pure platinum the annealing temperature is 700°C to 800°C, which is considerably

lower and relates to a bright orange color. Annealing can be done on a welding pad, although you will get more predictable and accurate results using a furnace.

Note of caution:

Although it is necessary to reach a high annealing temperature, don't overheat the platinum and don't hold the temperature for too long. Once a piece is over-annealed it will be virtually impossible to achieve a clean mirror polish, since the large grains (and the voids in between them) will give the surface a pitted look (also known as orange peel). Refer to the refiner's alloy properties chart to determine the temperature and time combination that work best for your specific alloy.

Stress relief

When joining platinum to gold components, use cadmium-free gold solders. Cadmium will cause brittleness because it moves into the grain boundaries. Also, protect the gold portion(s) of the jewelry piece from oxidation during brazing by dabbing a powdered mix (50/50 ratio) of denatured alcohol and boric acid on the gold and let it dry. During brazing, this coating will produce an anti-oxidizing glaze on the gold. When in need of a parting agent for platinum-to-gold or platinum-to-platinum joining, zircon oxide paint (ZrO) is a great brazing-filler-stopper. It will not contaminate the platinum, since it is designed to withstand the heat of high temperature operations.

Note:

Zircon oxide paint is commonly used for treatment of crucibles. Polish the platinum component prior to joining it with the gold segment. By applying this technique you will only have to polish the gold portion of the jewelry after brazing. Due to the fact that gold polishes much faster than platinum there is a risk of over-polishing the piece when polishing both components simultaneously.

After the joining process, it will be necessary to stress-relief the assembled piece, especially if it has been extensively locally cold-worked. Because the two metals have very dissimilar shrinkage and expansion properties, cracking will result unless the stress is relieved. Heating the assembled piece in a furnace at 750°C for about 20 minutes with cooling time in the furnace afterwards will achieve the desired effect. During this process it will be necessary to protect the gold portion of the piece from oxidation through the process described previously.

If a furnace is not available in your shop, you can stress-relief the piece with a standard bench torch. This method is less accurate, as its

parameters are less controlled, but it will still support your effort to reduce cracking or tearing. Use a soft, broad flame of your bench torch to heat the assembled piece to a dull red, just below the melting temperature of the solder material used in the joining process. Hold this color (temperature) for about 30 seconds and then let the piece air-cool. Especially when joining larger sections of platinum and gold this less predictable process is still much more promising than no stress-relief at all.

Conclusion:

Platinum is an exciting precious metal that can do wonderful things for you if you take it for what it is. When approached with the proper work ethics and with the right tools, it will allow you to create distinctive jewelry designs that take advantage of its unique attributes.

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