Beginning Platinum

by Jurgen J. Maerz

Today, platinum casting for the small shop is easier than ever - as long as you're sufficiently prepared.

In 1986, when Ricardo Basta Eichberg decided to begin casting platinum, he tried to learn all he could about the white metal and its properties-and quickly came up empty.

"When I started, no one knew how to cast platinum, not even the supply houses," recalls Eichberg, a contract manufacturer in Beverly Hills, California, with less than two dozen employees. "I didn't even know you had to use insulated gloves so you wouldn't bum your arms - I'd put wet rags around my arms and cheeks to protect myself I just wasn't equipped."

He began learning through trial and error, and his first castings showed his inexperience. "I had so many problems: bad surfaces, cracks in the metal, porosity - if there was a problem, I had it," he says. "I

had to try different things until I got a perfect casting -- it took me about six years."

Today, Eichberg says, it would be a very different story: If he had started working with platinum in 1999 rather than 1986, he could be "casting perfectly in a week."

"You have so many resources available - Platinum Guild International, literature, platinum manufacturers-as well as new equipment and technology," he explains. "Casting platinum is , not as impossible as it was 10 years ago."

The learning curve with platinum has decreased because the metal's popularity is at an all-time high: Worldwide demand last year rose to a record 5.35 million ounces, according to Johnson Matthey's Platinum 1999 report. And as demand skyrockets, more manufacturers have begun to contemplate platinum casting & including many small shops. If you're among them, take heart: As Eichberg testifies, casting platinum today is not as difficult as it once was.

But platinum casting is different from gold or silver casting, and insufficient preparation and understanding of the process can still lead to many hours of frustration. Success depends on having good, functional equipment and process control, and learning all you can about the process before you cast your first flask.

A preparation primer

Let's begin with the basics: To cast platinum, you need a casting machine, a torch, appropriate fuel, a burnout oven, the right investment, a suitable casting alloy, eye protection, and devesting solution. We'll consider each of these elements in turn, then begin looking at the actual process of casting platinum.

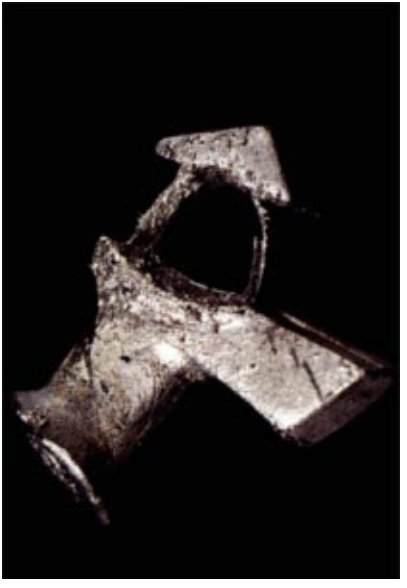
The casting machine.
Medium frequency induction casting machines are usually preferred for casting platinum, since these machines permit atmosphere control and rapid, safe melting. However, most small shops do not have the money for such equipment, so they must rely on the other-and perfectly viable-option: torch casting.

For torch casting, a vertical centrifugal casting machine is the safest, most efficient, and most reliable way to cast platinum. Vertical machines have high torque, produce a rapid centrifugal force, and require very little maintenance. They are also safer than horizontal centrifuges-which, if a spill occurs, can fling molten metal in a waist-high circle around the shop. A vertical machine has a straight centrifuge; major spills are very rare, and if one does occur, the flying metal is confined to a narrow vertical area.

The vertical casting machine should be mounted on a sturdy base so that one person can load the flask from the back while another person melts the metal at the front. This two-person approach is important, since with the eye protection required to melt platinum, the operator sees virtually nothing but the glow of melting metal. A machine that's freestanding and bolted to the floor offers the best access.

Finally, be sure the crucible used for melting the metal is specifically designed for the higher temperatures required by platinum. Use crucibles made from fused crystalline quartz or silica Si02+2. Avoid graphite crucibles, since the carbon can contaminate the platinum.

The torch.
For platinum melting, your torch should have a Multiport or rosebud tip that's screwed on rather than soldered. Solder could melt in the platinum's reflected heat, causing the tip to fall into the molten metal



Far left: Platinum investment comes in two basic types, phosphate-bonded %and acid bonded. Typically, acid-bonded investments give better reproduction, but they have much longer mixing and burnout cycles. Middle: When torch casting, a hydrogen/oxygen mix works most efficiently. Left: A platinum casting.

and splash platinum.

In addition, your torch must have a built-in flashback arrestor, to prevent gas from flowing back into the tank in case of a pressure change. This is an important safety feature.

The fuel.

Selecting the proper fuel to cast platinum is of utmost importance. Do not use acetylene, since it has a very high carbon content and expels carbon in the flame. The platinum will absorb the carbon, leading to contamination and brittle castings.

Although propane, or LPG, is also a carbon-based fuel, it does not have the high carbon content that acetylene does, and therefore can be used for platinum casting. Be aware, though, that even when mixed with oxygen, propane does not burn as hot as hydrogen and thus requires more time to melt the platinum. This longer melting time can lead to porosity caused by gas absorption or debris - a direct result of keeping the metal in the melting crucible too long. If you do use propane, pay particular attention to the flame: It should be no larger than 6 inches with a high oxygen setting. A sample regulator setting would be 5 lbs. of propane with 40 lbs. of oxygen.

The most efficient way to melt platinum is with hydrogen combined with oxygen. This fuel is carbon-free, and the high heat created by a proper hydrogen/oxygen mix melts platinum in seconds. But even with hydrogen, a proper flame is crucial: If it's too big, the flame will heat the surrounding crucible, adding to the melt time-and creating the same problems as those with propane. Use as much oxygen as necessary to make a relatively small but oxidizing flame. A sample regulator setting here would be 50 lbs. of hydrogen and 50 lbs. of oxygen.

All fuel gases are dangerous, and you should have a professional install your torch systems and fuel tanks. In addition, the regulator on the fuel tank should have a directional flow restrictor, which allows gases to leave the tank but not re-enter. For safety, use only regulators designed for the fuel you're using.

It's good practice to install hard pipes near the casting machine, so you don't have gas tanks close to the heat of the flame. You can then attach rubber gas hoses from the hard pipe to the torch. These hoses should be inspected regularly for leaks and wear. Also, always turn off your regulator and bleed your hoses after use.

This is especially true if you're using hydrogen; the molecules are small enough to seep through even a new hose, causing a fire hazard. Also, when using propane, remember that it weighs more than air and can accumulate on the ground if it leaks.

The burnout oven.
Since wax must be completely burnt out to ensure a clean and trouble-free casting, the burnout oven (or kiln) is a crucial part of the process. The kiln must be able to reach the high temperatures required for platinum casting, hold the temperature it is set to achieve, and do heat ramps as programmed to eliminate the wax from invested flasks.

One factor to consider is that steam dewaxing often used in gold casting, cannot be used in platinum casting because it will cause most platinum investments to break down. That means all wax must be eliminated in the kiln, making it crucial to have adequate air flow through the heating chamber so the wax vapor can be carried out the exhaust.

Because of this need for good air flow, gas kilns have some advantages. Gas jets distribute the heat more evenly and, unlike electric coils, require a great deal of oxygen to bum; consequently, good air flow is always part of a gas kiln's design. For a small shop, however, a good electric kiln will work fine. There are even electric kilns made especially for platinum casting that offer excellent air flow. (If your kiln does not have adequate air flow, you might be able to drill a few holes in its top or bottom. Check with the kiln's manufacturer.) In addition, be sure to place the flasks at the center of the kiln, leaving enough space around each one so the temperature is as evenly distributed as possible. (This will also help you avoid hot spots caused by having the flasks too close to the heating spiral.)

The investment.

Using the right investment is especially critical when casting platinum. Imagine a metal entering your flask with 20 to 40 Gs of force, at temperatures exceeding 3,500 F into a material that is expected to give you an exact replica of the wax model without problems or flaws. You can see why choosing the right investment is a key to successful platinum casting.

Platinum investment, which is much stronger and can take higher heat and pressure than gypsum investment, comes in two basic types: phosphate-bonded and acid-bonded. Typically, acid-bonded investments give you better reproduction, but they have much longer mixing and burnout cycles.

Some of the acid-bonded investments contain acid powder (usually silicic acid or organic acids such as oxalic, malaeic, or lactic), which activates when mixed with water. Others require the addition of liquid phosphoric acid to work. Usually the acid is mixed with distilled water at a specific ratio, with the powder then added to the mixture. The acid powder formulations are easier to prepare because you only add water, but powder particles can settle to the bottom of the investment in the drum, requiring careful mixing of the investment before use to ensure a homogenous mix. Whichever one you choose, mixing should take about I to 2 hours.

Either type of acid-bonded investment will provide excellent reproduction, but both take a long time to set and bum out. For that reason, many smaller casters are turning to phosphate-bonded investments. Widely used in the dental industry, these investments set quickly. Unfortunately, they are also expensive and, because of the very short setting time,cannot be mixed in large quantities for high volume production. They are well suited for the small shop, however. While their reproduction quality is not as good as those of

other investments, they will serve for most general designs.

The choice of investment is really a personal decision. Try several brands under comparable conditions before deciding on one; most manufacturers will be happy to provide a small quantity of their brands for you to sample at no charge.

Platinum casting alloys.
For torch casting, the most commonly used platinum casting alloy is platinum 900/iridium 100. This alloy, also referred to as 90/10 iridium, has good working characteristics, casts well, can be welded, and does not oxidize. It also offers a bright white color and has sufficient hardness at 120 Vickers (HV). It was the universal platinum alloy in the United States for many years.

In recent years, many casters have begun using a platinum 950/iridium 50 alloy, known as 95/5 iridium, to comply with the 950 standard. (Many countries, including the United States, require any item stamped “platinum” to be at least 95 percent pure platinum.) Unfortunately, this alloy is not a good choice for casting. While it has great characteristics for fabricating, including rapid work-hardening, as cast it has a hardness of only 80 HV-far too soft for jewelry. (A minimum hardness of 120 HV is recommended.) With wear, rings bend and scratch, and stones come loose.

One of the finest 950 platinum casting alloys is platinum 950/cobalt 50, also known as 95/5 cobalt. This alloy has a very fine grain, high liquidity, and the ability to fill intricate detail. With a hardness of 135 HV and the ability to cast well and take a good polish, it is one of the most popular casting alloys in Europe and the United States. Platinum 950/cobalt 50 is also slightly ferro-magnetic, making identification easy (you can simply use a

magnet to detect attraction).

This alloy does oxidize, however. Because of this tendency, propane and other fuels do not work well with it. Instead, torch melting should be done with a hydrogen/ oxygen fuel mix, which does not permit much oxidation. This alloy is most successfully cast with induction heating in a controlled atmosphere.

Another alternative is platinum 950/copper/ cobalt, which is similar to the platinum/ cobalt alloy, except it is not magnetic. However, it still needs to be cast with hydrogen/ oxygen or by induction to prevent oxidation.

If a spill occurs in a vertical casting machine, the flying metal is confined to a narrow vertical area. A spill in a horizontal machine could throw molten metal in a waist-high circle around a shop.

Eye protection.
Proper eye protection is important when melting platinum, since the ultraviolet light emitted by the glowing melt can damage your eyes. Use only lenses that are approved by the federal Occupational Safety and Health Administration and comply with American National Safety Institute standards. A #10 welding goggle is the absolute minimum protection for the caster, and we generally recommend a # 11 or # 12 lens to be safe. Do not, under any circumstances, use regular sunglasses or other dark lenses! Any jewelry tool supplier or welding supply house can provide

you with the proper eye protection, as well as gloves and a leather apron-two other important safety items.

Devesting.
Removing the castings from the investment can be a challenge. The investment, which is baked at very high temperatures, turns into a glass-like substance that can be difficult to separate from the cast pieces.

Most manufacturers use hydrofluoric acid, which is extremely dangerous and must be handled with utmost caution. Always use rubber gloves, a rubber apron, and a respirator that filters small particles from the air.

A small shop may wish to consider a safer devesting agent for platinum investment as a substitute for hydrofluoric acid. Ask your tool supplier; there are many brand names. You can also mix your own substitute using the following formula (percentages are given by weight): 25 percent sodium hydroxide, 25 percent potassium hydroxide, and 50 percent deionized or distilled water. (The sodium hydroxide and the potassium hydroxide should be in pearl or flake form.) Combine all three solutions in a stainless steel container, and heat (do not boil) for 25 to 40 minutes. Be careful mixing, since the three ingredients will naturally heat up when combined.

The casting process

Now that you have the tools in place, you're ready to begin-and the place to start is process control. This is one of the basic-and most frequently overlooked requirements for successful platinum casting in a small shop. Good process control requires a total understanding of the process and the ability to repeat functions over and over again. You must eliminate as many variables as you can.

Start with a dean table for investing and

create a checklist that describes the investing process in detail. Write down the water/acid ratio, the humidity, and the water temperature. Determine your average size casting and prepare the flasks based on this size. In other words, if you usually cast 50 dwt, always cast 50 dwt. That way, your flask will weigh the same, the machine can be balanced to that weight, and the flame setting will never have to change.

Wash your waxes to be sure they contain no mold release or talcum powder residue. Also, be sure that the wax of your casting cone has a lower melting point than the wax being used for the actual jewelry piece; if it doesn't, liquid wax will be trapped inside the flask until the cone melts.

Once you have assembled the casting tree, place it under a vacuum bell and pull a vacuum. This will pop any small air bubbles in the wax, which can then be fixed before the tree is invested.

Wax your flask onto the investment paper, line it, and invest. (Some investments do not require flasks to be lined, while others need a lining to soak up water from the binder. Follow the investment manufacturer's directions to the letter) When mixing the investment, always wear an OSHA-approved dust mask. Also, most types of platinum investments will lump up

Platinum casting requires a complete understanding of the process and the ability to repeat functions consistently.

as they are mixed, making them took too dry and just wrong to casters more familiar with gypsum investment Do not be tempted to add liquid! The investment will self liquefy after a few minutes.

Be aware that platinum investment may not rise the way gypsum investment does under the vacuum bell. instead, it pours like RTV rubber, almost folding into your flask. It may appear to be set, but it will liquefy if you move it. Again, make sure you precisely follow the investment manufacturer's directions, since platinum investments vary from brand to brand. Some are designed to set completely and need to be totally dry before being placed into the kiln. Others will have the consistency of yogurt and be placed into the kiln on the paper they were waxed to. Also, some investments will be placed into a room-temperature kiln, while others most notably the high speed investments - go directly into a hot kiln for burnout. Whichever investment you use, remember: There are no shortcuts.

When burnout is complete, bring the kiln to the proper casting temperature, which can range from 850*F to 2,000 F depending on the investment and on the complexity and weight of the item being cast. For example, high speed dental investments seem to give better reproduction at lower temperatures, whereas regular platinum investments perform better in higher heat. Also, items that are thin or have filigree will usually require a higher temperature than larger items, such as a heavy man's ring. Here, too, it is important to create a chart to keep records.

Once you're ready to cast, wind the machine one turn and lock it in place. The vertical machine has three settings, and each setting will give you a little more speed. I usually use the fastest setting, especially if I am casting a large amount of metal. You may want to use the lower settings when the spring is new.

Set your regulators to an appropriate setting: For hydrogen/oxygen torches, a 50/50 psi setting works well. Light the torch and open the hydrogen side until the flame starts to hiss, and then add oxygen. The flame should be about 6 to 8 inches long. Put on your protective lenses, add the metal to the crucible, and start melting. It should take less than a minute to melt 50 dwt of platinum using a hydrogen torch.

This is where you'll need help from another person. As soon as the metal is liquid, have your assistant get the flask from the kiln and place it into the casting machine. You can then pull back the spring that locks the flask in place.

As soon as you are sure the flask is in place and the metal is liquid, pull back the torch (do not lift, as with a horizontal casting machine), and release the mechanism to cast the platinum. Turn off the torch and let the flask spin until it stops. Remove the flask from the machine and set it down to cool until the platinum is no longer glowing and has become white.

Finally, remove the investment from the flask and place the cast pieces in investment remover to dissolve any remaining bits. Then give yourself a little pat on the back: You have joined the growing group of small shop owners who have successfully cast platinum. Try it, and you'll realize it isn't as difficult as you've heard-as long as you familiarize yourself with the available literature, set up your process controls, and experiment a little. Given that, you could be casting in no time.

Just ask Ricardo Basta Eichberg.

Jurgen J Maerz is director of technical education for Platinum Guild International USA.

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