



Getting Started with PMC

Concept In the 1990s scientists in Japan developed a combination of binders and metal particles to create a material with the working properties of modeling clay, known as precious metal clay, or PMC. This water-soluble product is available from several manufacturers in the form of lump, sheets, slip, and ready-to-use syringes.

An organic binder provides elasticity while holding very tiny grains of metal in suspension. After the water is driven off, the object is heated to the fusing temperature of the constituent metal. During heating, the binding material burns away, which causes the object to shrink to a degree equal to the volume originally occupied by the binder.

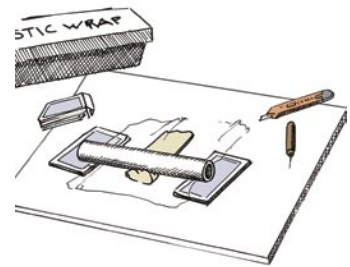
The process is easiest with pure silver and pure gold because these noble metals resist the formation of oxides and fuse at easily attainable temperatures. Platinum (the other noble metal) can be made into a clay but requires temperatures beyond the reach of most kilns.

Working with PMC

The working properties of metal clays are related to moisture content. Avoid working in a draft or using materials that will absorb water (like paper and cardboard). Take only the amount to be used at the moment, sealing the rest in plastic wrap to keep it moist. Put a few drops of olive oil or an organic skin lotion in your palms and roll the metal clay to apply a thin layer of oil. This will help seal in moisture.

To make sheets of metal clay, roll it out like cookie dough, using a convenient length of plastic pipe as a rolling pin. To ensure uniform thickness, set matching spacers on each side of the clay. Tongue depressors, pieces of mat board or stacks of playing cards make good spacers.

Cut metal clay by dragging a needle through the material or with a knife, (which leaves a neater edge). A long, razorlike medical industry tool, called a tissue blade, is a useful (though dangerous) cutting tool. Plastic picnic knives make a nice alternative when children are involved, and the edge of a playing card works too.



Crystal Structure

Metals are made up of small clusters of molecules called grains that arrange themselves according to several external conditions including heat, stress, and time. Metal clays are, by their nature, loose-packed compared to traditional metals, which are compressed into rods and sheets under great pressure. Because pure metals are almost always more malleable than their alloys, these two factors explain why basic sintered metal clay is more malleable than wrought metals. Metal clays with shorter firing times (e.g., PMC+) use several sizes of particles to yield a more dense and tough material.

PMC



slow firing;
less dense

PMC+



quicker firing;
more dense

PMC3



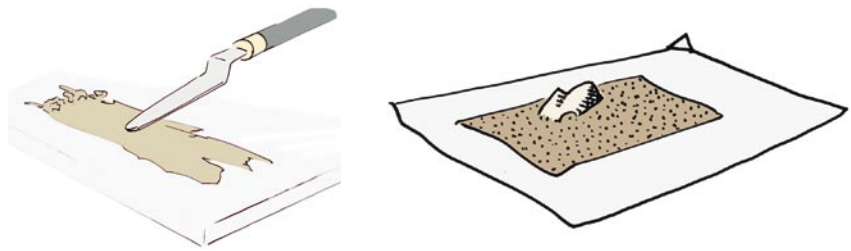
fast firing;
most dense



Slip

Metal clays can be thinned with water to make a paste (called slip or slurry) that is useful to join elements, repair cracks, and as a surface texture. Because the material is very dense, simply stirring is not sufficient to blend additional water into the mix. Instead, use a palette knife or similar flexible blade to blend clean water into a small piece of PMC. Seal the mix in an airtight container and allow it to rest for a few hours, after which it will be ready to use. The water and binder will separate if it is left unused for several days, but at this point they can be stirred together easily and used immediately. Some people find it useful to have several consistencies of slip available—just change the proportion of water to make these.

To make slip, either smear water into metal clay with a palette knife, or rub a dried piece of clay on coarse paper to reduce it to dust, and mix this with water. To retard the rate of drying, add a drop of glycerine, but be careful not to add too much or the clay will never harden properly.



Textures

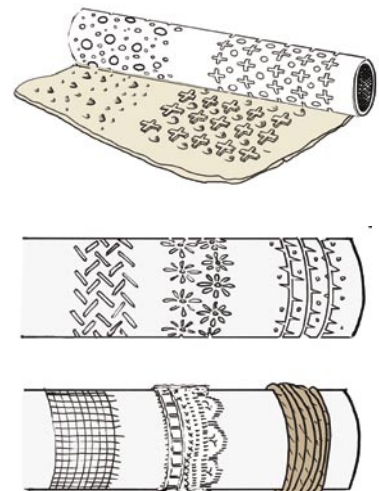
Metal clays are great at capturing textures. Textures without undercuts can be collected by simply pressing the metal clay against an object. If a release agent is needed, use cooking spray (e.g., Pam) or roll the clay between oiled palms to create a film on its surface.

When working with delicate objects that are also combustible, it is usually easier to leave the textured object in place and simply allow it to burn away during the firing step. Examples include leaves, flower petals, fine fabric, lace, feathers, and thread.



Patterned Rollers

To make a patterned roller, carve a pattern into a length of PVC pipe with linoleum cutters, wood carving tools, or gravers. You can also make a patterned roller by gluing a sample of a textured material onto a piece of pipe. For instance, cover a clean length of PVC with glue and press a piece of lace into place, securing it with rubber bands until the glue dries. If a specific repeat length is desired, use a cylinder with a diameter of one-third the intended repeat. A mark on a 1" pipe will reappear about every three inches when rolled.





Carving Some people prefer to work with PMC when it is dry. Make a starting form and set it aside to dry, then work it with files, sandpaper, and carving tools.

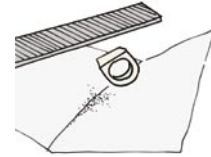
1. Make the form, sometimes to final shape and sometimes in a general way.



2. To allow the work to dry, lay it on foam rubber or a crumbled wad of paper (to increase air flow). You can also dry it in an oven, on a warming tray, or with a hair dryer. Do not set it on aluminum, including foil.



3. Shape with knives, files, and sanding sticks. Catch the dust on a piece of paper and add it to your slip jar with a little additional water.



4. To engrave lines, use a V-gouge such as those for linoleum engraving. Use the small bits for surface decoration or rehydrate with water. High-quality miniature gouges are available from craft supply and woodworking suppliers.

Embedding

Materials that can withstand firing temperatures can be pressed into clay. Allow for shrinkage by leaving a gap around the implant. One way to achieve this is to wrap the piece with tape or coat it with wax equivalent to the shrinkage. Sometimes it is enough to wiggle the element to enlarge its socket. Don't quench after firing—allow the work to air cool. Remember that metal clay shrinks from all sides in all directions. Material beneath the implant will often push it upward as it contracts.



Acceptable materials include:

- ▶ brass & copper
- ▶ some glasses
- ▶ fine silver
- ▶ high-karat gold
- ▶ laboratory-grown gems
- ▶ titanium and niobium
- ▶ stainless steel
- ▶ ceramic elements

Hollow Forms

PMC can be shaped over a burnable core to create beads and other hollow forms. Core materials include paper clay, Styrofoam, bread, and some snack foods, such as cheese balls. In general, the more porous the material, the better, since this means there is less material to burn away.

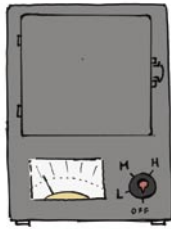
Shape the core by molding, pressing, or carving, depending on the material. If it is wet, like paper clay, allow it to dry completely. While not necessary, some people coat the core with a white glue—this helps the PMC stick to the core.

Work any version of PMC over the core, perhaps by rolling out sheets and laying these over the core, or by ornamenting with a syringe. It is not usually necessary to make a hole in the bead, because fumes from the core can escape through the pores in the PMC before it fuses.

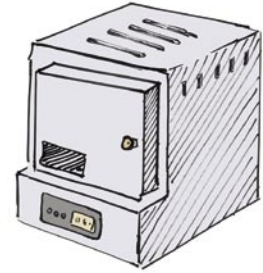
Burn out as usual, except perhaps allowing greater ventilation if the core you're using makes smoke or annoying fumes. Hollow forms can be enameled, plated, and finished like any other use of PMC.



Firing Equipment



The ideal tool for firing is an electric programmable kiln. These kilns combine the benefits of accurate control with freedom since they do not require monitoring. Several kilns have been developed just for metal clay and can be purchased through jewelry supply companies.

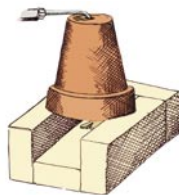


Next best is a manual kiln with an accurate pyrometer. As the kiln approaches the desired temperature, regulate the heat by adjusting the knob or cracking the door open. Kilns appropriate for this method include enameling kilns, burnout ovens, test (glaze) kilns, and many kilns used to fuse or anneal glass. Large ceramic kilns are not recommended because the internal temperature varies throughout the chamber.

Some metal clays have been created to have relatively short firing times. These open the possibility of alternate firing techniques using a torch, campstove, or alcohol-based fuel. Because technology is changing rapidly, consult the Web or contact a supplier of metal clay for the latest information.



Firing with a Torch



Some versions of metal clay are made of such tiny particles that they can be fused quickly enough to make torch firing practical. A few minutes at fusing temperature (indicated by a glowing red color) is enough to make the metal solid. Simply set the dried object on a soldering or firing surface and heat it evenly with a torch.



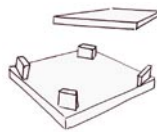
An alternate approach is to juryrig a furnace from a flower pot. Line the terra cotta pot with aluminum foil to reflect the heat, and find a way to prop a jeweler's torch so that its flame is directed into the chamber. This method reaches around 1500° F (815° C), which is good for several versions of metal clay. It is practical for 10-minute firings; something that isn't comfortable when you're holding the torch the whole time.

Firing Surfaces

To make it easy to set objects into the kiln and remove them after firing, place your work on shelves or trays. These can be soldering blocks, bisque tiles (ceramic supply), most floor tiles, terracotta saucers, and slabs of kiln bricks. If in doubt, run a test firing. All these materials will eventually break from use, but their lifespan can be extended by reducing exposure to thermal shock. When a shelf has been unloaded it should be put back in the warm kiln to cool slowly.



These materials can be stacked using pieces of soldering block as supports between layers. Shelf materials are brittle so use common sense in providing support and avoiding stressful situations.



Solderite boards cut into one-inch blocks make handy stilts to stack trays.

Setting a heavy dish like this on an elevated shelf is tempting fate. Better to put the saucer on a low shelf. The single blocks make it easier to lift the tray with a spatula.



Setting Gems

Natural and synthetic stones are likely to break and discolor under prolonged heat. The exception to this is a specific category of gemstones created at very high temperatures. These are always translucent and may be cut either as cabs or as faceted gems. They will be clearly identified as “lab-grown” by reputable vendors.

1. Make the object, creating a thickness equal to the height of the stone where the gem will go.



2. With a pencil point, sharpened dowel, or similar tool, poke a conical hole roughly the same size as the stone.

3. Use a needle (wiggled in a circle) or a small straw to remove clay from the bottom of this hole. While not mandatory, this both conserves material and makes a more elegant setting.

4. Lay the stone in position and press it down securely into the clay. Be certain the stone is level and seated below the surface of the metal clay.



Shrinkage Around Stones

The natural shrinkage of the process will curl metal over the top of the stone, which is what we want. But it will also push the stone upward from below. For this reason, press the gem down far enough into the clay that the table is below the level of the PMC.



Setting Heat-Sensitive Stones

For stones that cannot withstand the firing temperature of PMC you'll need to make a socket into which the stone is set conventionally. While the clay is soft, press the gem into position to create a starter hole. Because the clay shrinks, you'll need to enlarge this socket by either 12% or 28% depending on which clay you are using. This is often nothing more than wiggling the stone in all directions.

In the case of a round stone, the math is easy and because there are hundreds of cylinders in our lives, it's easy to come up with a tool. Imagine a 10 mm round cabochon set into PMC+, which has a 12% shrinkage rate. Locate a dowel, pen, nail head, or similar tool that is 12–13 mm in diameter and press it into the clay to make the proper socket. After firing and finishing you can put the stone into place and press the fine silver over it with a burnisher.



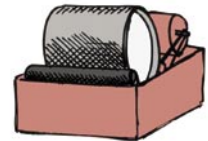


Finishing

After firing, all versions of PMC are 100% metal and can be soldered, filed, sanded, oxidized, patinaed, and polished like any other metal—almost. Because of their porous nature, high-shrinkage materials like original PMC should be burnished or tumbled to compact the structure before finishing. This is especially important before soldering and machine buffing, procedures that will otherwise soak up solder or compounds.



Tumbling is a mechanical process that burnishes the surface with cascading steel shapes. It is especially useful for production situations, since dozens, even thousands of pieces can be polished at a time. Most small studios use a barrel tumbler with stainless steel shot of mixed shapes. Use a proprietary solution to lubricate the action,



and clean the shot after each batch. Tumbling time depends on several factors, but is generally between two and six hours.

Frequently Asked Questions

What alloys are being used?

> All versions of PMC are 100% silver or gold.

Is it possible to fire PMC too long?

> All versions can be heated for as long as you want, as long as you don't go above 1650° F (900° C). The firing schedules always refer to minimum times and temperatures. For instance, PMC3 can be fired for "as little as 2 minutes" and at a temperature "as low as 1110° F (600° C)." Longer and higher, up to 1650° F, is okay.

Should I quench PMC?

> The cooling time does not affect PMC. You can quench it or allow it to cool very slowly—no difference.

Can I reuse PMC before it has been fired?

> Yes, dry pieces of PMC can be recycled. Chop, grind, or sand the dry work into fine granules or a powder and mix it with water. Allow at least a day for the moisture to penetrate, kneading occasionally. Be patient, and add water only a few drops at a time until you achieve a workable consistency.

Can I refire already solid pieces?

> Yes, it's possible to join elements, either by joining two pieces that are already fired, or by adding fresh PMC to a fired piece. In either case, extend the firing time to at least an hour, even if using PMC+ and PMC3. This is necessary to allow the diffusion to penetrate into the solid metal.

