

Focus On: Bronzes

Bronze art sculpture is hard, durable and corrosion-resistant and some has survived for millennia. Most people who have an affinity for bronze art sculpture hope to be able to look beyond the physical shapes and surfaces of a particular work and see its soul. In early times, the creation process was often spiritually linked, with the ultimate outcome of a pour considered dependent on their gods. Bronze sculptors and foundrymen were held in high esteem, and technical and metallurgical secrets were carefully guarded. Modern bronzes, of course, lack such intimate spiritual linkage, but they still require an intimate mix of technology with art. Whether modern or ancient work is being observed, at least a modest knowledge of the history and technology of bronze and bronze-casting is recommended for understanding.



A Brief History of Bronze

The Bronze Age (approximately 3300BC – 1000BC) was characterized by the first serious use of metals by mankind. The earliest part of the Bronze Age brought pure copper and stone tools into use. By the second millennium, around 3000BC, metallurgists in Mesopotamia had discovered bronze (an alloy of copper and tin). They learned that adding a small amount of tin ore to the copper ore during smelting produced a metal that was harder and more functional than either tin or copper alone. Adding tinstone reduced the temperature required to melt the metal and, once melted, the bronze became more fluid and easier to cast.

Initially, bronze art sculpture was associated with statues of gods, but eventually artistic style moved beyond mythical and religious boundaries to likenesses of mortals in a variety of forms. The Greek and Romans for example, made “portrait statues” of men who were deemed deserving of lasting commemoration, such as Olympian winners. As trade increased along the Mediterranean basin and beyond, bronze technology spread; archaeologists have discovered bronze artifacts and art bronze masterpieces from ancient cultures in all corners of the earth.

Bronze-Casting Technology

The Direct Method

By the 6th century BC, the technology of bronze casting had become very sophisticated. Initially, small bronze objects and tools were solid-cast in two-piece clay molds. From 1500BC forward, larger items were hollow-cast in bronze using the lost-wax method. For this type of casting, a clay core was formed in the basic shape of an object. This core was then covered with wax into which fine details of the statue or object were sculpted and carved. Wax sprues and gates were attached to the model to provide pathways for the wax to exit the mold and for the molten metal to enter. Vents were added to allow hot gases to rise while the liquid bronze was being poured. The wax model with its vents and gates was first painted with very thin clay to reproduce the finely sculpted and carved details. Then it was completely covered with coarser clay mantle. The mantle was attached to the inner core by iron or bronze pins. The clay mold was first baked slowly so the wax would melt out (hence the term “lost-wax method”), and then it was fired at a higher temperature so it would harden. The space left by the wax was filled with molten bronze. When the bronze had cooled, the clay mantle was broken open and the bronze object was removed. The pins, vents, and gates, now in bronze, were removed, and the surface of the statue was finished by various cold-working techniques. The inside core was chipped out from the opening in the bottom.



This method was used almost exclusively during the Archaic Greek and Early Classical (480 – 450BC) periods to make small objects or statues. However, it presented a limitation with serious practical implications. A

mold could only be used once because it was destroyed in the production process. Thus, every bronze casting represented a significant amount of unique artistic and production work. Even in ancient times, this limitation drove commercial interest toward the development of the indirect method.

The Indirect Method

The majority of the large-scale bronze statues produced by the Greek and Romans were made using the indirect method of hollow-casting. This method preserved the original master model (mold) so it could be reused. Therefore, it was possible to easily and more economically make exact copies of the same statue and to make large-scale cast statuary. In this process, the clay core was finished more completely and a direct cast model was made from it. A mold of clay was then made around the model to replicate its form. This mold was made in as few sections as could be taken off without damaging any undercutting on the model. When dry, the individual pieces of the mold were removed, reassembled, and secured together. Each mold segment was then lined with a thin layer of wax. After the wax cooled, the mold was removed and corrections and other details could be made on the wax model. This working model was then cast using the same techniques as the direct method.

The Patina

Patina is the surface coloration and texture on copper or copper-based alloys which is created by natural oxidation and other chemical reactions associated with aging and exposure to the natural elements. Although commonly some shade of green and relatively smooth, patinas can vary in color and consistency; they may be red, brown, black, blue, or gray, and they may be smooth, glossy, or crusty. Three water-soluble compounds form the basis for most patinas; Ferric Nitrate produces reds and browns, Cupric Nitrate creates the greens and blues, and Sulphurated Potash produces blacks. Ancient or antique art bronzes that have been exposed to natural elements and possibly multiple environments over many years develop cumulative patinas that become unique, irreproducible signatures. While a patina on a utilitarian item such as a copper pot may detract from its appearance and be considered undesirable, a patina is a very desirable feature of art bronzes, which enhances value.



The Collas Machine

Invented in 1836 by a French engineer named Achille Collas, this machine signified a huge technological leap in the reproduction of sculpture and statuary in varying sizes. The Collas Machine uses a pantograph system to make proportionately larger or smaller duplications of a model. The concept can be traced to ancient Greek and Roman artists, who wanted to reproduce the perfect proportions of the human figure in their sculpture. Their method was called pointing, which meant that measurements of the desired figure were taken, then proportionally increased or decreased on a model.

Collas Machines often look like lathes: on one turntable sits the model and on a second turntable, connected to the first, sits a clay or plaster blank that has been roughly shaped to resemble the model but on a larger or smaller scale. The Collas Machine keeps the model and the blank in the same orientation as the technician uses a tracing needle, linked to a sharp cutting instrument, or stylus, to transfer a succession of profiles from the model onto the blank. Gradually the blank is worked, by the artist and/or trusted assistants, so that it becomes a larger or smaller duplicate of the model.