

Button Materials: Enamel



Vitreous Enamel: Is a material made by fusing powdered glass to a substrate by firing, usually between 750 and 850 °C (1380 and 1560 °F). The powder melts, flows, and then hardens to a smooth, durable vitreous coating on metal, and also glass or ceramics, although the use of the term "enamel" is often restricted to work on metal, enameled glass is also called "painted". The fired enameled ware is a fully laminated composite of glass and metal. The word *enamel* comes from the High German word *smelzan* (to smelt) via the Old French *esmail*. Used as a noun, "an enamel" is a usually small decorative object, coated with enamel coating. Enameling is an old and widely-adopted technology, for most of its history mainly used in jewelry and decorative art, but since the 19th century applied to many industrial uses and in everyday day consumer objects, especially cooking vessels.

The key ingredient of vitreous enamel is a highly friable form of glass called frit. Frit is typically an alkali borosilicate chemistry with a thermal expansion and glass temperature suitable for coating steel. Raw materials are smelted together between 2100 and 2650 °F (1150 and 1450 °C) into a liquid glass that is directed out of the furnace and thermal shocked with either water or steel rollers into frit.

Color in enamel is obtained by the addition of various minerals, often metal oxides cobalt, praseodymium, iron, or neodymium. The last creates delicate shades ranging from pure violet through wine-red and warm gray. Enamel can be either transparent, opaque or opalescent (translucent), which is a variety that gains a milky opacity the longer it is fired. Different enamel colors cannot be mixed to make a new color, in the manner of paint. This produces tiny specks of both colors; although the eye can be tricked by grinding colors together to an extremely fine, flour-like, powder.



A fine example of a **Champlevé Enamel button**



A fine example of a **cloisonné enamel button**

The History of Enamel:

The ancient Egyptians applied enamels to pottery and stone objects, and sometimes jewellery, though the last less often than other ancient Middle Eastern cultures. The ancient Greeks, Celts, Georgians, and Chinese also used enamel on metal objects.

Enamel was also used to decorate glass vessels during the Roman period. There is evidence of this as early as the late Republican and early Imperial periods in the Levantine, Egypt, Britain and the Black Sea.

Enamel was at its height in European art history in the Middle Ages, beginning with the Late Romans and then the Byzantines who began to use cloisonné enamel in imitation of cloisonné inlays of precious stones. This style was widely adopted by the "barbarian" peoples of Migration Period northern Europe. The Byzantines then began to use cloisonné more freely to create images, which was also copied in Western Europe. The champlevé technique was considerably easier and very widely practiced in the Romanesque period. In Gothic art the finest work is in basse-taille and ronde-bosse techniques, but cheaper champlevé works continued to be produced in large numbers for a wider market.

From more recent history, the bright, jewel-like colors have made enamel a favored choice for designers of jewelry and bibelots, such as the fantastic eggs of Peter Carl Fabergé, enameled copper boxes of Battersea enamellers, and artists such as George Stubbs and other painters of portrait miniatures. Enameling was a favorite technique of the Art Nouveau jewelers.

Enamel was first applied commercially to sheet iron and steel in Austria and Germany in about 1850. Industrialization increased as the purity of raw materials increased and costs decreased. The wet application process started with the discovery of the use of clay to suspend frit in water. Developments that followed during the twentieth century include enameling-grade steel, cleaned-only surface preparation, automation, and ongoing improvements in efficiency, performance, and quality.

Properties of Enamel

Enamel may be transparent or opaque when fired; vitreous enamel can be applied to most metals. The great majority of modern industrial enamel is applied to steel in which the carbon is controlled to prevent reactions at the firing temperatures. Enamel can also be applied to copper, aluminum, stainless steel, cast iron or hot rolled steel, as well as gold and silver.

Vitreous enamel has many excellent properties: it is smooth, hard, chemically resistant, durable, scratch resistant (5-6 on the Mohs scale), long-lasting color fastness, easy-to-clean, and cannot burn. Enamel is glass, not paint, so it does not fade with UV light. Its disadvantages are its tendency to crack or shatter when the substrate is stressed or bent, but modern enamels are chip and impact resistant because of good thickness control and thermal expansions well-match to the metal.

Techniques of Artistic Enameling



The Royal Gold Cup, 23.6 cm high, 17.8 cm across at its widest point; weight 1.935 kg, British Museum. Saint Agnes appears to her friends in a vision.



Stavelot Triptych, Mosan, Belgium, c. 1156–58. 48×66 cm with wings open, The Morgan Library & Museum, New York City

Basse-taille, from the French word meaning "low-cut". The surface of the metal is decorated with a low relief design which can be seen through translucent and transparent enamels. The 14th century Royal Gold Cup is an outstanding example.

Champlevé, French for "raised field", where the surface is carved out to form pits in which enamel is fired, leaving the original metal exposed; the Romanesque Stavelot Triptych is an example.



Ming Dynasty cloisonné enamel bowl, using nine colors of enamel



Student copy in grisaille after Jacques-Louis David

Cloisonné, French for "cell", where thin wires are applied to form raised barriers, which contain different areas of (subsequently applied) enamel. Widely practiced in Europe, the Middle East and East Asia.

Grisaille, French term meaning "in grey", where a dark, often blue or black background is applied, then a palescent (translucent) enamel is painted on top, building up designs in a monochrome gradient, paler as the thickness of the layer of light color increases.



Limoges enameled copper plate, attributed to Noël II Laudin, circa 1700



The Mérode Cup, about 1400 (V&A Museum no. 403-1872)

Limoges enamel, made at Limoges, France, the most famous European center of vitreous enamel production. Limoges became famous for *champlevé* enamels from the 12th century onwards, producing on a large scale, and then from the 15th century retained its lead by switching to painted enamel on flat metal plaques.

Painted enamel, a design in enamel is painted onto a smooth metal surface. Grisaille and later Limoges enamel are types of painted enamel. Most traditional painting on glass, and some on ceramics, uses what is technically enamel, but is often described by terms such as "painted in enamels", reserving "painted enamel" and "enamel" as a term for the whole object for works with a metal base.

Plique-à-jour, French for "open to daylight" where the enamel is applied in cells, similar to cloisonné, but with no backing, so light can shine through the transparent or translucent enamel. It has a stained-glass like appearance; the Mérode Cup is the surviving medieval example.



The Holy Thorn Reliquary



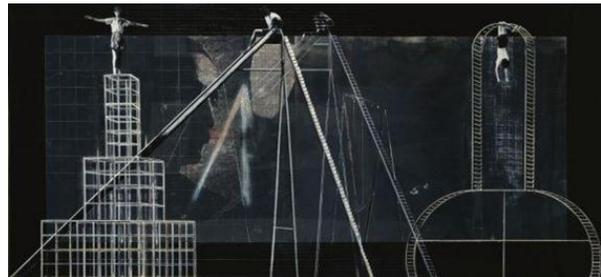
A stenciled enamel pot

Ronde bosse, French for "in the round", also known as "encrusted enamel". A 3D type of enameling where a sculptural form or wire framework is completely or partly enameled, as in the 15th century Holy Thorn Reliquary.

Stenciling, where a stencil is placed over the work and the powdered enamel is sifted over the top. The stencil is removed before firing, the enamel staying in a pattern, slightly raised.



A Sgraffito print



Serigraph Enamel and acrylic

Sgraffito, where an unfired layer of enamel is applied over a previously fired layer of enamel of a contrasting color, and then partly removed with a tool to create the design.

Serigraph, where a silkscreen is used with 60-70in grade mesh.



COUNTER-ENAMEL: This is the enamel covering the interior surface of a piece of cloisonné

Counter enameling, not strictly a technique, but a necessary step in many techniques, is to apply enamel to the back of a piece as well - sandwiching the metal - to create less tension on the glass so it does not crack.