

General Champleve Enamel Procedure

Medieval vs. Modern - Edgar Refskegg

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Overview

The procedure for creating the enamel pieces I present is multi-tiered with several distinct steps. This document will separate them out into easy to digest steps. The intent here is to provide a general overview of both the period method of preparing metal and subsequent enameling, the modern steps, and an explanation on why the differences exist. Additionally, I intend to add other information as necessary to provide amplifying information and otherwise.

Of great use here is Theophilus 12th century book, *On Divers Arts*.¹ It's a substantial book describing the methods that painting, glassmaking, and metalworking used in his time period. It is an invaluable resource for enameling and metalworking with a medieval flair, as I do. Further, the *Enamels of Limoges* book provided by the Met is incredible and has endless resources on how Champleve enamel was done in France.

For greater amplification of the steps, differences, or historical background, either look for other documentation I've written or simply ask me! I enjoy helping others learn. Reach me at edgar@refskeggbrewing.com

Medieval Method

Most of the early period enamels that can be found (including as described by Theophilus) were done using the Cloisenne method. That is, the shapes and patterns were created using carefully bent wires soldered to the metal to create the *cloisens* for enameling. The Champleve method², by contrast, was done by engraving (using gravers - also in Theophilus' book) the shapes into the metal. For the Champleve method, the depressions could have been done by casting, etching, or die struck as well.

Further, the enameling was done on copper plates (sometimes gold and silver) measuring anywhere between 3-5mm thick. The tools used (described by Theophilus) to pack the enamel were goose quills and fine pointed copper tools. The quills were used to pick up the wet enamel and move toward the surface, and the fine copper tools were used to distribute the enamel onto the metal.

The enameled piece was fired in a charcoal furnace built into the workshop. Theophilus has several plates in his book that depict the goldsmith's workshop that include some artwork of the furnace. He advocates firing the enameled piece for around half an hour to ensure the glass is fully melted. This process was performed several times to ensure the engraved areas were sufficiently filled with enamel. After the piece was enameled sufficiently, it was ground down and polished using stones of varying smoothness (wet and dry) until it shined brilliantly.

Gilding in this time period was done using the fire gilding method. The gold or silver was dissolved in mercury to create an amalgamation with consistency similar to butter. This amalgamation was rubbed onto the metal and then heated in a furnace, which boiled off the mercury, leaving the precious metal behind. Mercury vapor is incredibly hazardous.

Step by step - generalized (medieval)

1. Clean metal to prepare for engraving
2. Scribe desired picture onto the surface
3. Using hand gravers or hammers and chisels, engrave surfaces deep enough for enamel to be packed (0.5mm - 0.8mm)
4. Prepare enamel for packing

¹J. G. Hawthorne and C. S. Smith, *On Divers Arts: The Foremost Medieval Treatise on Painting, Glassmaking, and Metalwork*, Dover Art Instruction (Dover Publications, 1979), <https://books.google.com/books?id=MMiLTJqvYnYC>.

²J. P. O'Neill, Musée du Louvre, and N. Y. Metropolitan Museum of Art New York, *Enamels of Limoges: 1100-1350* (Metropolitan Museum of Art, 1996), <https://books.google.com/books?id=i4okAQAAAJ>.



- This was done using lump enamel (large chunks of glass) that was ground in a pestle and mortar to the appropriate grain size.
5. Moisten enamel and pack into the cloisens on the surface of the metal
 6. When sufficiently packed, fire enamel in furnace
 7. After cooling, re-pack and re-fire enamel as necessary to completely fill the metal
 8. Polish metal
 9. Finished!

Modern (My) Method

The process I use is largely similar to the medieval method except for a few key differences which mainly involves the use of a few electronic, and chemical procedures. The core process is effectively similar, though overall requires more steps to ensure the best work.

The art is done electronically (Illustrator, usually) and then printed onto press-n-peel transfer paper (typically used for home circuit board etching). The appropriate shapes are cut and then taped to the copper and placed into a hot t-shirt transfer press for approximately five minutes. After transfer is complete, sparse areas or areas that didn't transfer well are painted with resist to ensure proper etching is done. The backs are tapes and painted (to seal) and when dry, are submerged face down into the ferric chloride etchant bath.

I have started using foam insulation (some pink board from Home Depot. It comes in 2x2' squares) with double-sided tape to hold and float the copper in the bath. It seems to work the best. In the future I intend to experiment with different techniques for this.

When the pieces have etched to about the thickness of a manilla folder (0.5-0.8mm), they are removed, neutralized, and then cleaned. The copper is then packed with enamel, fired, and repeated as necessary. When enamel is sufficiently packed, it is then ground down with stones, flash fired, and then sanded to a polish.

For enamel packing, I do not use a quill, but instead use fine paintbrushes, dowel rods with darning needles (fulfills similar purpose as quill) embedded, and long fine pointed metal tools. 150 and 220 grit alundum stones are used for the initial grinding to smooth down all of the glass to be level with the metal. 400+ grit sandpaper (I go up to 1000, but more is certainly fine) is used to do the final polishing steps.

Also, I do not gild (fire gilding, very hazardous). Fire gilding is not a safe process and should be avoided. At some point I'm going to consider building my own electroplating set or most economical would be to find a local electroplating shop that can gild copper.

Step by step - generalized (modern)

1. Determine art desired and draw electronically. Print onto transfer paper
2. Clean metal (steel wool, light abrasives, soap and water) to ensure transfer is successful
3. Cut transfer paper to size and apply to metal, place onto heated t-shirt press for ~5 minutes
4. Remove transfer paper and paint un-resisted areas. Tape back of metal and paint the seam to seal
5. When paint is dry, apply metal to a float and submerge into a ferric chloride bath for a few hours
 - The amount of time this takes varies depending on many factors (heat of solution, age, purity, etc.), so it's best to keep checking
6. When the etch is deep enough, remove, rinse, and place into sodium carbonate solution for a few minutes to neutralize (this will also dissolve some of the resist)
7. Scrub off the resist and clean metal with Penny Brite
 - This is also a good time to dome medallions if it is desired
8. Pack copper with wet enamel



9. Dry the enamel (I do it on top of the kiln) and then fire for approx. 2 min.
10. Re-pack and re-fire as necessary
11. Stone the piece flat and polish
12. If gilding... electroplate it now (or do fire gilding, if you hate your health and the law).
13. Use some kind of spray polyurethane to seal the item and limit tarnishing
14. Finished!

Explanation of Differences

Engraving vs. Etching

This is really the largest difference between medieval and modern Champleve enameling. Engraving is an incredibly time consuming process that requires years of practice and really careful craftsmanship. Etching on the other hand is much faster and allows better fidelity for a fraction of the effort. The art can also be done electronically to make the process easily repeatable. The art can also be adjusted much easier prior to printing, which further enhances this process.

Overall, etching and the associated steps produces quicker repeatable results with much better quality. Engraving and scratching the design is the period way to execute this, but is simply not practical for the type of work that is desired.

Electric Kiln vs. Charcoal Furnace

Simply, the electric kiln is much more portable and has a far superior temperature control than a charcoal furnace. The charcoal furnace is not portable, requires substantial maintenance, and again is simply not practical for the goals I have.

Polishing and Gilding

Interestingly, the grinding and polishing process that I use is very similar to medieval smiths as far as the general process is concerned. I can use consistent and standardized stones and sandpaper, both wet and dry. I also finish mine with spray polyurethane to resist tarnishing (because mine usually aren't gilded!). By contrast, Theophilus³ uses the following: sandstone, a smooth hone, potsherd from ancient pots, flat smooth lead plate, goatskin fastened to a wooden board. All of his are done wet and dry in various combinations.

Miscellaneous

A lot of the tools I use are likewise different than what is described in period manuals and artwork. However, unless otherwise described they are functionally similar. Something to note is that in medieval workshops these tasks all would be divided amongst a team of metal workers. By contrast, the work is done mostly by me and Rajan (she controls the artwork!). We're able to accomplish a lot with only a few people with the methods we use to enamel.

Also, the enamel powder we use is likely more consistent as well, and possibly uses different additives to create the various colors. I typically use 80 mesh enamel and don't have to worry about sifting any myself. Medieval enameling was done, as mentioned above, using lump enamel. This has to be broken up and sifted to the proper size.

³Theophilus, book III chapter 55, pg. 128



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