

10th Century Norse Brass Belt Buckle

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[Summary *](#)

[Historical Documentation *](#)

[Norse Belt Buckles *](#)

[Brass Casting *](#)

[Metal Working *](#)

[Finishing *](#)

[Materials and Tools *](#)

[Method of Construction *](#)

[Making the Model *](#)

[Preparing the Mold *](#)

[Melting and Pouring *](#)

[Forming and Finishing *](#)



[Lessons Learned *](#)

[Bibliography *](#)

Summary

Belts have long been a basic accessory of clothing and armor, and the various forms of belt buckle have changed little from the Viking Age to the present day. Buckles ranged from uninteresting iron to highly decorated silver or gilded bronze, with enamel or gemstones. The Norse culture enjoyed decorated metalwork, as did the cultures in close contact with it, and highly decorated belt buckles were favored by those who could afford them.

When my Laurel bestowed my apprenticeship belt at Pennsic XXXI, after taking me as an apprentice at Pennsic XXIX, I decided to design and create a belt buckle that would be worthy of this belt and appropriate to my persona. After cutting the belt down to a more period width of one inch, I designed this buckle for it.

This was my second project casting brass, and I learned a lot in making it.

Historical Documentation

Norse Belt Buckles

This belt buckle (WOV 3100) is a lead-alloy buckle found in Viking Age York, which was under Danelaw at the time. It is made of lead alloy, has an unusual shape, and displays decoration along the buckle and the pin. The pin is attached by being formed, or bent, around the base of the buckle. It is inherently very strong, because the stress is on solid metal, not the joint.



This example of a decorated pin, attached by forming it around the base, was the inspiration for my pin design.

This belt set (WOV 3006) dates to Viking Age Norway and was found at Borre. It consists of a buckle, strap retainers, strap ends, and many decorative mounts. Some of the leather is preserved, proving that some of these items were attached to a strap or belt.



This set is an example of how a wealthy Norseman could afford highly decorated buckles and related gear.

Shown to the near right is a belt set from the Gokstad ship burial in Norway (WOV 3022). To the far right is another view of the same buckle and some strap mounts that were found with it (WOV 3020). This buckle set also shows exquisite decoration, done in the Borre style that was prevalent in the 8th to 9th Century.



This buckle is designed such that the pin (now lost) is cast as part of the buckle back, which fits into holes on each side of the buckle. This sort of construction is inherently weaker than the York example above, because the stress is placed on the joints between the back and sides of the buckle.

Brass Casting

The archeological evidence for metal casting in 10th Century Denmark is extensive. However, some question remains as to whether the Norse craftsmen employed sand casting, or exclusively used fired clay molds.

Evidence of casting in fired clay molds is widespread. At the museum in Ribe, Denmark, I saw hundreds of clay molds that had been pieced back together, some of which are shown in the photo to the right. These reassembled mold fragments showed that the craftsmen of Ribe could cast metal into many types of tools and jewelry, including buckles. Traces of metal in clay crucibles found there show traces of bronze, brass, lead, silver, and gold (Jensen 31). Furthermore, the mold fragments found in any one location show that individual craftsmen routinely cast the entire variety of objects, rather than specializing in keys, brooches, and so on (Jensen 33).



The archeological digs at the Coppergate site in York, England, dated to Viking Age, also provide information about clay casting. These included many crucibles, ingot molds, and cupels (Bayley, 799). The crucibles show evidence of being used to melt all manner of copper alloys (Bayley 803), including brass and bronze, as well as silver (Bayley 799). Likewise, a wide variety of copper-

alloy items were found in York, including strap-ends, buckles, brooches, and finger-rings (Hall 103-105).

photo by Isabel Ulfsdottir

The process of clay casting is, in theory, simple. A "master," or original, is carved from wax, including a wax sprue or gate to pour the metal. This master is carefully packed in clay, which is fired to pour out the melted wax and harden the clay. While the molds are hot, the metal can be melted and poured in. Finally, when the casting has cooled, the clay mold can be broken apart to free the metal item for finishing (Theophilus, 106). Clay mold casting can create nearly any shape including intricate shapes with undercuts, but requires one wax master for each item cast.

The use of the sand casting technique is more difficult to prove, because a mixture of fine sand and clay is not recognizable in an archeological dig as a casting component. However, sand casting produces a rougher surface on an unfinished piece than clay mold casting. A sand-cast piece has tiny pits and bumps which, in my own experiments with clay versus sand casting, do not occur with a fired clay mold. Some artifacts show this type of bumpy surface and could, therefore, have been cast in sand. Sand casting is documented by Biringuccio in the 16th Century (324-328), but Theophilus in the 12th Century makes no mention of it. Thus, it is possible that it was available to 10th Century Danish metalsmiths, but I have not been able to prove it.

Sand casting is different from clay casting, in that the mold is made from two halves of packed sand, mounted in frames that fit together. One half of the mold is packed and dusted with powder to prevent it from sticking to the master or the other half of the mold. The original is pressed into the mold and dusted again. Then, the second frame is set in place and the second half of the mold is covered with sifted sand and then packed down around the master. Finally, the two halves are pulled apart to extract the master and cut the sprue and vents. Sand casting can create any shape that does not have undercuts, can make many castings from the same master model, and usually requires more finishing work because of the parting line left between the mold halves. However, the effort of packing the sand can gradually damage the master.

In either case, it is believed that the mold masters were usually made from wax originals, because beeswax was readily available, easy to carve, and has an advantage over wood or bone in that its lack of grain makes detailed carving easier. A copy of the wax master, of clay, lead alloy, or other durable material, was usually made as a basis for future castings (Jensen 33). Such a lead master could be used with clay to mold wax masters for clay molds, or directly in sand-casting.

Metal Working

Forming, or bending, is an important step in many types of jewelry, including attaching the pin to the buckle for a design like this. The craftsmen had various types of pliers to accomplish this. At the Danish National Museum, I saw an assortment of tongs, pliers, hammers, chisels, files, gravers, and other tools that were likely to have been used in carpentry but some of which could also be used in metal working. The museum display did not provide any information as to where these tools were found, but the display was in the Viking Age wing of the museum. The Mästermyr find, from Sweden, also has similar tools (Arwidsson 12-17).

Works from later time periods such as the writings of Theophilus and Biringuccio can fill the gaps in our knowledge. The technology of metalworking is believed to have changed little during the Middle Ages. The main advances during that time were in the use of chemicals for parting, assaying, and pigments (Agricola 354), so it is likely that most tools and techniques from later periods could be applied to the Viking Age.

Metal, when hammered or bent, gradually becomes hard and brittle. To restore malleability and ductility to the metal, it is necessary to conduct a process called annealing. Theophilus mentions annealing as being done at each stage of working silver (102, 138). His failure to define or describe the annealing process in a work that is otherwise very detailed is evidence that the concept of annealing was commonly known to metal workers in the 12th Century. Biringuccio describes the process of annealing copper-silver alloy using a charcoal fire (362), and reiterates the importance of annealing after hammering (367). Annealing consists of heating the metal and then quenching it to cool quickly, which softens the metal.

Finishing

Finishing jewelry consists of shaping, smoothing, and polishing. There were many abrasives available in period, chosen by their availability and effectiveness on the material being worked. Theophilus describes the process of shaping with a flat hone (102) or flat sandstone (189). He describes a variety of files (93) and wire brushes (86) for shaping and smoothing harder metals such as brass and bronze. He describes smoothing as done with a piece of oak covered in ground charcoal (102) or fine sand and cloth (152). He describes polishing with a cloth covered in chalk (102) or powdered clay tiles and water (128), or saliva-moistened shale followed by ear wax (115). Biringuccio describes shaping as done with files, smoothing with cane dipped in powdered pumice (366) or sand and water (390), and polishing using tripoli powder (366, 374), or a wheel of copper or lead covered with powdered gems (122), emery (123), or lime (372).

Materials and Tools

I used brass for this project, because it is affordable, has a beautiful appearance, and casts at a high temperature that makes it just as challenging as silver. I purchased the brass from a jewelry supply outlet, because I lack the necessary experience to safely alloy my own metals. I carved the original buckle master from beeswax, which is cheaper than modern formulated carving wax and is likely to be the wax used in period. I made a pewter master from the wax original and made the entry by casting from the pewter master, as was done in period.

The tools needed are:

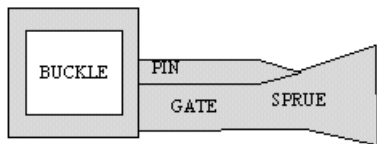
- Carving tools to carve the original or "master" model (I made some from 10-gauge wire)
- Casting sand, talcum powder, mold frame, and palette knife, to make the molds
- Miscellaneous small dowels, wires, or nails to make gates and vents in the mold
- Crucible with tongs and a heat source that can heat the crucible to 2000° F
- Fire extinguisher, fire-resistant apron, and safety glasses
- Brass, bronze, pewter, or silver raw material, and flux (boric acid crystals)
- Spoon and/or graphite rod for stirring molten metal in the crucible
- Oven or kiln with controllable temperature capable of 300° F
- Wire cutters or jeweler's saw to remove the sprue and vents
- Files, sanding equipment, & polishing equipment, to file and polish the cast piece
- Dust filter mask for polishing
- Heavy welding-type insulated gloves for handling crucible tongs, hot molds, and metal
- Light leather gloves for holding items while grinding and polishing

Method of Construction

Making the Model

The design for the buckle is one of the first free-form designs I have made. That is, I drew it on paper once and then proceeded to carve it without the need for tracing or transfer. The design is based on dogs and a snake in the Jelling style. The small size of the animals means that they are not very detailed, however. I also had to give them only one leg each, which is not immediately noticeable because of how the design is formed. Each side of the buckle shows two intertwined dogs, meeting at a tiny snake curled up in the center. The pin, which is not very visible when the buckle is worn, shows a simple interlace design that complements the buckle's artwork.

I made a thin slab of beeswax by pouring melted wax onto a tin plate, from which the wax easily separates after it hardens. I then carved an original model of the buckle. I decided to cast the buckle and pin in one piece, with a gate running along the pin up to the sprue, as shown here. This design allows one casting to obtain the buckle and pin, but requires a lot of work to saw the pin from the gate. In retrospect, casting the pin separately would have given a better result. With the high-temperature metals such as brass, a longer sprue helps avoid bubbles and loss of detail.



The final step in making a wax original is to fire-polish it. This is done over a small heat source, such as an alcohol lamp, and requires great care. Hold the model over the flame, always moving it to keep the temperature under control. To do this properly, it helps to be able to see the underside where the heat is acting on the wax. The idea is to melt the wax enough that its surface becomes smooth, and gravity pulls it into a nice rounded form. Fire-polishing takes a great deal of practice, because overheating the wax or holding it at the wrong angle can ruin the design. Beeswax in particular is difficult to fire-polish, because it goes from solid to liquid in an instant, and is thus much less forgiving of fire-polishing errors than the modern carving waxes. If the fire-polishing goes poorly, however, you can get out your carving tools, solder on more wax, and repair the design.

Preparing the Mold

Put the flat side of the mold frame on the bench, fill it with sand, and pack it down firmly. Then, turn the frame over, powder it with talc, and press the master, non-detailed side down, into the sand. Powder the master a bit, and sift the sand over it. Once the buckle is covered with a layer of finely crumbled sand half an inch thick, fill the frame with sand and pack it down hard.

Separate the halves and carefully remove the original. With a palette knife carve a sprue channel into the sand, and use a thin wire to make vents at the bottom corners of the buckle. Gently tip any loose sand out of the mold. Put the mold halves together and set the mold up to pour.

Melting and Pouring

Heat the metal in the crucible, using a kiln, oven, or torch. Silver, brass, or bronze should be heated to about 2000° F. It will have a "sheen" on the top and glow bright orange when the metal is above its "flow" point. Pewter can be heated to about 600° F. Most metals develop an oxide crust on top, which you should scrape away. With any metal, it is ready to pour when it reaches "flow" temperature, that is it should be as liquid as water or mercury. If the temperature is too low, the metal will not flow properly and may not enter all the recesses of the mold. If the metal is too hot, it may oxidize or implode by cooling unevenly. When the metal is at or slightly above flow temperature, pour it into the mold. Pour it all in one smooth motion, taking about one second to do so. This takes practice to do well.

After the visible top of the sprue cools to a darker color, carefully separate the mold halves, take out the casting (it will still be very hot), and tap the sprue on the bench to remove the burned sand. Then, polish the casting a bit to see if the pattern came out well. If it did not, you can melt it down and try again. If it came out well, cut off the sprue and gate with the jeweler's saw and the vents with wire cutters. When sawing, stay away from the buckle and pin, because you can always file them down later if you leave part of the gate on them, but cannot add metal if you cut too deeply.

Forming and Finishing

I used primarily modern methods for finishing because it saves time and, unlike the Norse craftsmen, I have another job and have no apprentices to assist me.

Rough shaping is required to remove the flash, the bits of metal where the mold halves met. This design was particularly prone to flash on the inside edges of the buckle. I used hand files and a Dremel-size coarse sandpaper drum, held in a drill press, for this process. Certain detailed and interior areas had to be done by hand. I shaped the easy-to-reach areas, such as the flat sides of the pin, with a 600-grit belt sander.

After rough shaping is done, cut the pin from the buckle and file the indentation on the buckle base where the pin will attach. With round-nose pliers, bend the pin's base to a $\frac{3}{4}$ circle that bends away from the decorated side. Slip it over the buckle base, and gently crimp the pin shut with pliers, so it is permanently attached to the buckle. The process of forming will harden one end of the pin, but my experiments have shown that even pewter is hard enough for a functional buckle. In normal use, the open portion of the joint should not be subject to any stress.

Brass is somewhat hard, so I was able to polish it reasonably well with a fine wire brush wheel followed by a medium buffing wheel with black polishing compound. I got a better result using a succession of the white, black, blue, and green polishing wheels. It took much longer that the wire brush and buffing wheels, but these high-tech polishers do give better results. While such polishing wheels are designed for a handpiece or Dremel tool, I use them in my drill press at a slow speed (1100 rpm) with very good results.

If desired, you can accent the design by filling the recesses with niello or enamel, use acid to darken it and surface-polish the buckle. I did none of these with this buckle, because the depth of the decoration is such that no additional enhancement is needed.

Lessons Learned

This buckle turned out well with the pewter master, and worked with brass, but this particular design is not well-suited to bronze. Getting the bronze to flow the bottom of the buckle with its thin sections is a challenge, and making a deeper sprue and heating the mold would be required to cast this buckle from bronze. Since my personal color scheme prefers silver metals to gold, I wear a pewter copy of this buckle for everyday use. Eventually, I intend to design and cast some belt mounts and possibly strap ends to match this buckle.

It took me 1 hour to design the buckle, 2 hours to carve it, half an hour to cast and smooth the pewter master, one hour to cast and assemble the brass buckle, and two hours to finish it.

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Various museums in Denmark. In the summer of 2000, my lady and I traveled to Denmark and visited the National Museum in Copenhagen, the Viking Ship Museum in Roskilde, the Viking Museum in Ribe, and the research/reconstruction sites at Fyrkat, Trelleborg, Jelling, and Lehre. We

took many photos, saw many artifacts, and spoke to an archeologist or two. What we saw on this trip gave us ideas and research for years of arts and sciences projects. Our only complaint is that we had to take our own photos, which did not always come out well when taken through the glass that protected the artifacts. None of the museums sold information or photos of individual artifacts.

York Archaeological Trust and the National Museum of Denmark, [The World of the Vikings](#) (CD-ROM), Past Forward Limited, undated. This CD contains thousands of photos of artifacts, but the photos are described only as the item, the place it was found, the museum where it is located, and sometimes the date the item was originally buried.



[Back to Danr's A&S page.](#)