3.A04 Modern Blacksmithing and Physical Metallurgy
Fall 2008

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Casting Methods & Practice
Casting Methods

- Lost-Wax (Investment casting)
- Sand Casting
- Lost-Foam Casting
- Casting Principles
Cast Objects Around MIT

• The following 6 slides show cast sculptures at MIT
  – All are investment cast
  – All are silicon bronze
  – All are artificially patinated
  – Some are cast in multiple parts and welded
  – Others cast in a single pour
The most crucial part of lost-wax casting is producing a quality wax model. The metal you cast will be a very close replica of your original wax. Even fingerprint-level detail can be transferred from wax to metal. This wax is a wall-mount bottle opener.
One method to produce a wax is to rubber mold an existing object. You can also sculpt or machine wax into shape.
Here is a rubber mold made around the previous bottle opener. Once the rubber hardens, you remove the object and are left with a cavity that is an exact copy of the molded object. Molten wax is then poured into the cavity to produce wax copies.
The inside of the bottle-opener rubber mold, showing the cavity left by the molded object.
A finished wax, as removed from the rubber mold
Waxes >>> "plumbing" >>> mold (investment)

Multiple waxes created from a single rubber mold
The Anatomy of Casting

- **Gates**
- **Vent/Riser**
- **Runner**
- **Heat cost**
- **Hot inward flow to casting**
- **Cool outward flow from casting**

Figure by MIT OpenCourseWare.
Casting Pitfalls

• Even fill from bottom to top
• Fill thin sections first
• Avoid air entrapment
  – Pay special attention to venting small detail
Casting Pitfalls

Open Mould Cavity

Closed Mould Cavity

Figure by MIT OpenCourseWare.
Attaching gates to wax objects using “sticky wax” as adhesive
Attaching gated objects to central sprue to make wax “tree”
A partially finished wax tree of bottle openers
Adding vents to objects to allow air to escape during casting
MIT Ceramic Mold Material  
(Investment)

• Crystalline silica
• Ethyl silicate binder (TEOS)
• Ethanol diluent
• 3% ammonium carbonate catalyst

NEW MATERIAL:  
Ransom & Randolph GlassCast 810  
    Water-based  
    Plaster/Flint/Fiberclass mixture
Pouring ceramic slurry over a wax tree, contained in a Carboard mailing tube
Removing cardboard tube in preparation for wax burnout
Finished mold with wax sprue evident
Burning ethanol-based binder to de-wax mold
De-waxed ceramic mold ready for pouring
Once wax is removed, molds are fired/sintered in a furnace
Pouring molten silicon bronze into a ceramic mold
Allowing the metal to cool -- still visibly hot
Removing ceramic investment from cast bottle opener trees
SAND CASTING METHODS

Above is a sand casting pattern. This is a model of what is cast
Sand casting flasks -- cope & drag -- that form the sand molds
The pattern is placed between the flasks, and foundry sand is rammed into the cope and drag, around the pattern form.
The pattern is removed from the sand flasks, leaving a cavity in the shape of the pattern mug. Metal can then be poured into this cavity.
Since the mug needs to be hollow, a core must be inserted into the mug-shaped cavity, to displace volume. Above is a “core box,” used as a mold to make cores.
A finished core.
THE FOLLOWING SIX SLIDES SHOW VARIOUS PATINAS (NATURAL & ARTIFICIAL) ON BRONZE/BRASS OBJECTS AROUND MIT