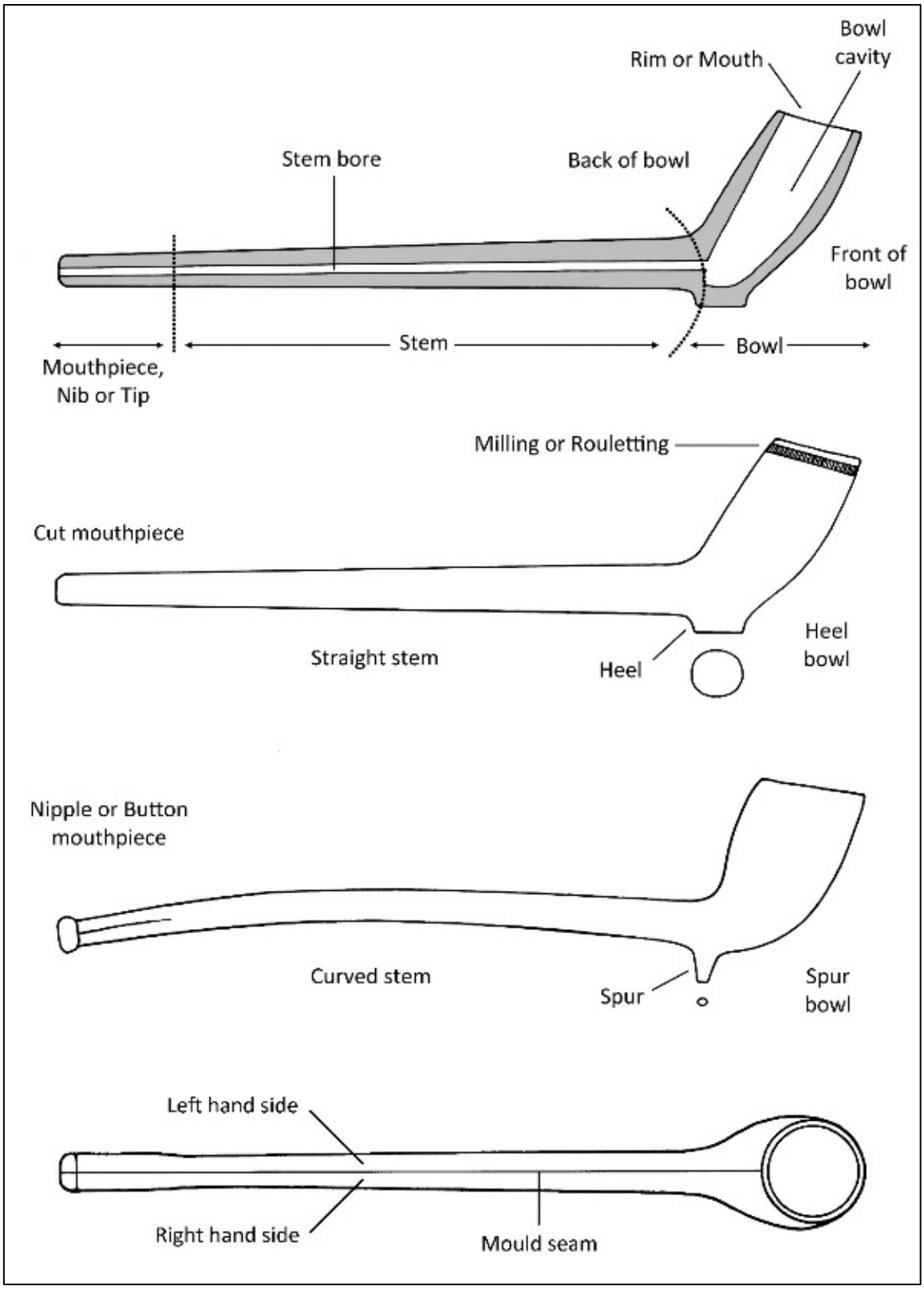
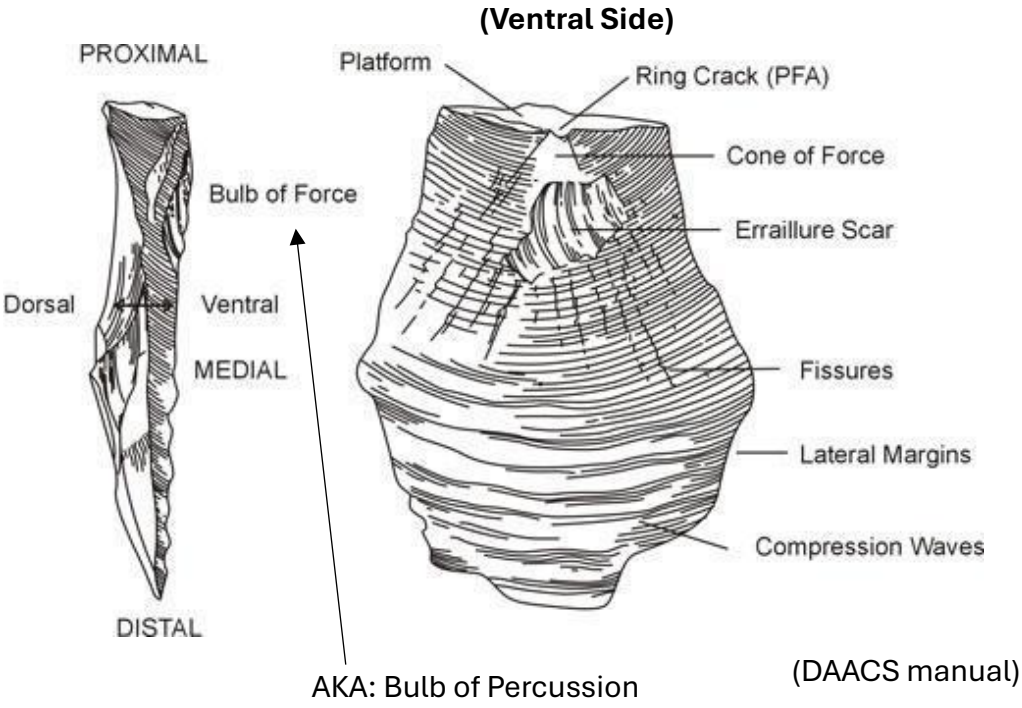
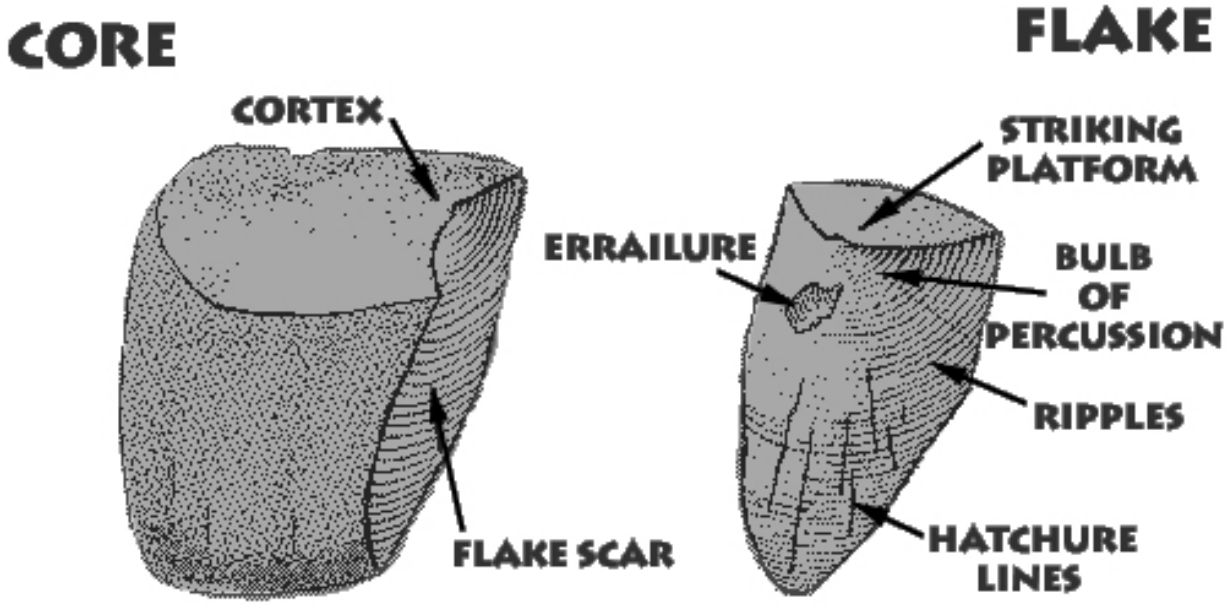
Parts of a Kaolin Tobacco Pipe



Parts of a Lithic Flake and Core



(DAACS manual)



Historic Glass Tutorial

Monticello Field School 2025

Material/Composition

- Basic components are **silica + flux + stabilizer**
  - Silica: i.e., sand
  - Flux: material added to lower the melting point of the silica and facilitate fusion to form the glass
    - Most common fluxes are soda ash (or sodium carbonate) and potash (or potassium carbonate)
  - Stabilizer: material added to replace the natural impurities in the material and make the glass stronger and less brittle
    - Most common stabilizers are lime (calcium oxide) and lead (lead oxide)
- Most commonly encountered historic glass types are **soda lime** and **potash lead**
  - Soda Lime Glass = silica + soda ash + lime
  - Potash Lead Glass = silica + potash + lead
    - *Can identify lead content in material by ice-blue color of fluorescence under short wave UV light*

Manufacturing Technique

- **Free Blown**
  - Refers to vessels that are produced entirely by hand, without the use of molds
  - Key attributes
    - Asymmetry
    - No evidence for mold seams, molded decoration or lettering
    - Surfaces generally smooth and glossy
    - Curvature of body typically more curvilinear, flowing, with no sharp angles
      - Globular and elongated cylinders most common
    - Glass more evenly distributed throughout various parts of the vessel when compared with mold blown examples
    - The base of the vessel will have a pontil mark or scar where the pontil rod was removed after shaping the finish (unless base was ground down or polished afterwards—this additional step typically reserved for tablewares)
- **Mold Blown**
  - Refers to vessels shaped by forcing molten glass into the outline of a mold through air pressure applied by mouth through a blow pipe

        - Vessel shoulders, neck and base may also be formed in the mold, or may be finished by hand and tooled
        - Mold may have one or multiple constituent parts
        - After vessel is removed from mold, the **finish must always still be hand-manipulated or tooled in some way**
        - *Note: Technically, molds are also used for machine-made glass, and for this reason, some material culture researchers consider "machine-made" as a sub-category of "mold blown." At Monticello, however, we distinguish between machine-molded and hand-molded glass for dating purposes. We use the term "mold blown" only in reference to historic, non-machine-made vessels that have been formed in a mold.*
    - <u>Key attributes</u>
        - Presence of mold seams* *(=raised lines on vessel surface caused by hot glass forced into the edges of a hinged mold)*
        - Presence of molded lettering and/or decoration
        - Vessel shape more regular and symmetrical relative to free blown examples
        - Body shape may have sharp angles and can be multi-sided or paneled (e.g. square, octagonal, etc.)
        - May or may not have a pontil scar at the base
        - Textured surface
            - Mold interior often imparts an "orange peel" like texture to exterior surface of vessel
        - **Location of mold seams is most important diagnostic**
            - Mold seams do **not** run all the way up the vessel, and **never** extend onto or over the lip
            - Seams usually disappear at the shoulders, along the neck, or at the base of the finish
            - → This is because the top of the vessel is reheated when the glass maker forms the finish, and this process typically erases any mold lines in this area
        - **Unfortunate caveat is that molded vessels do not always have visible mold seams. 1-part "dip" molds, for example, typically do not have mold seams because the mold has no hinges and therefore no gaps where seams can form. Seams can also be removed via other processes, such as marvering and fire polishing.*
- **Mouth Blown**
    - Generalized term referring to glass vessels formed by air pressure that is applied through a blowpipe by the mouth (i.e., not by a machine).
        - Applies to fragments that lack any clear indicators of free blown or mold blown manufacture—but which are clearly not machine made
    - Most often applied to historic wine bottle glass or dark green bottle glass (DGBG)

- **Machine-Made**
  - Similar process to mold blowing, except that the air pressure or power that forces the glass into the shape of the mold is now supplied by machine, or by a mechanized plunger (in the case of machine press molding)
  - Semi-automatic and fully automatic machines appear late 19th/early 20th century

  - Basic process
    - First, a quantity of molten glass enters a combination of two molds: (1) a "ring" or finish mold and (2) a part-sized or parison mold
    - Ring mold shapes the finish to full size, while the body is partially formed in the part-sized mold
    - Part-sized mold is removed from the bottom and the partially formed vessel (still attached to the ring mold at the top) is placed in a second, full-sized mold where it is blown to full size

  - Key attributes
    - *Note that while many attributes of machine-made glass (e.g., mold seams, symmetry) overlap with mold blown examples, the following diagnostics are exclusively found on machine-made vessels*
    - Again, **location of mold seams is important diagnostic**
      - Mold seams should go over the finish and up to or over the lip of the vessel (*caveat is that mold seams are sometimes removed via fire-polishing*)
    - Ghost Seams: Faint, irregular or "wandering" seam lines that appear parallel to the main, more prominent mold seam on some machine-made bottles
    - Owen's Suction Scar: Circular mark on base of vessel with "feathering" edges, often off-center
    - Valve Marks: Regular circular mark or indentation on base of vessel, typically around ½ inch in diameter
    - Stippling/Knurling: Textured surface seen on the base of many machine-made bottles (post-1940)

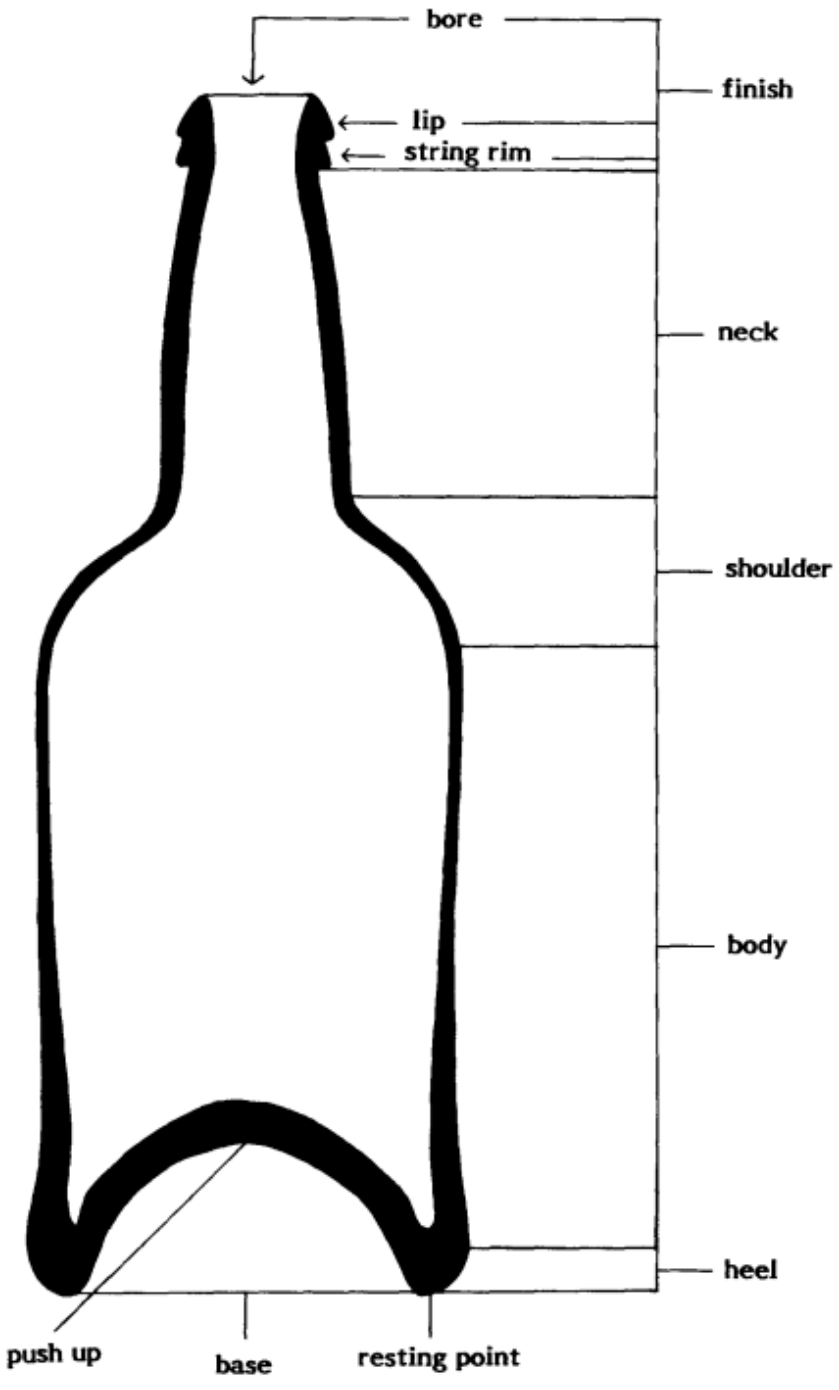
Form

- **Bottle/Container**
  - Wine-Style Bottle
    - Generalized term used to describe globular or cylindrical shaped bottles manufactured from dark green or olive-green glass
    - Vessel shape can be used as approximate dating mechanism

        - → In general, vessels become less globular, taller and more cylindrical over the course of the 17th and 18th centuries (*see Noel Hume pp. 60-71 for detailed typology)*
    - Other common bottle forms include case, pharmaceutical, mineral/soda, beer/liquor, condiment/food, cosmetic, ink, etc.
    - Jars
        - Mason Jar patented 1858
        - Very common on archaeological sites from the late 19th century onward
- **Tableware**
    - Drinking glasses such as tumblers and stemware most common forms
    - Additional forms include decanters, salvers, salts, desert glasses, cruets/castors, bowls, plates and cups
    - Often manufactured of leaded (potash-lead) glass, but important to look for additional attributes like vessel shape and decoration to ID
    - Often has engraved, molded, cut, or other decoration
    - Tracking changes in vessel form/shape over time can be used as approximate dating mechanism (e.g., stem and bowl shape on stemware)
    - Manutech often difficult to pin down for tablewares
        - Multiple different manufacturing techniques often used on the same vessel
        - Finishing techniques frequently used to erase diagnostic mold lines and smooth out pontil scars

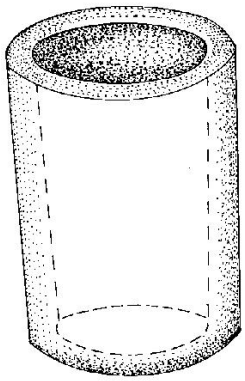
Other Glass (Non-Vessel) Forms

- Window Glass
- Plate Glass
    - Refers to larger category of thick, cast, flat glass used for a variety of purposes, including mirrors and furniture inlay
- Lamp chimney
- Other forms of lighting glass proliferate in the 19th century (e.g., lamp globes and shades, oil lamps, lantern glass, etc.)

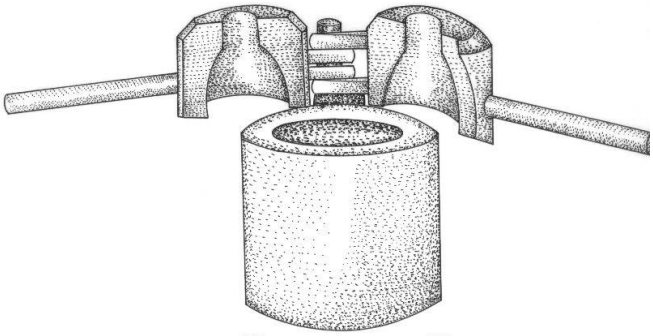


Bottle Anatomy
Source: Jones 1985, 77

FIG. 2. The manufacture of free-blown bottles. From left to right: the glassworker inflates the parison (note the simple one-piece or dip mould at his feet), the kick or pushed in base is formed, the string rim is applied, and the neck finished (from Diderot's *Encyclopaedia*).



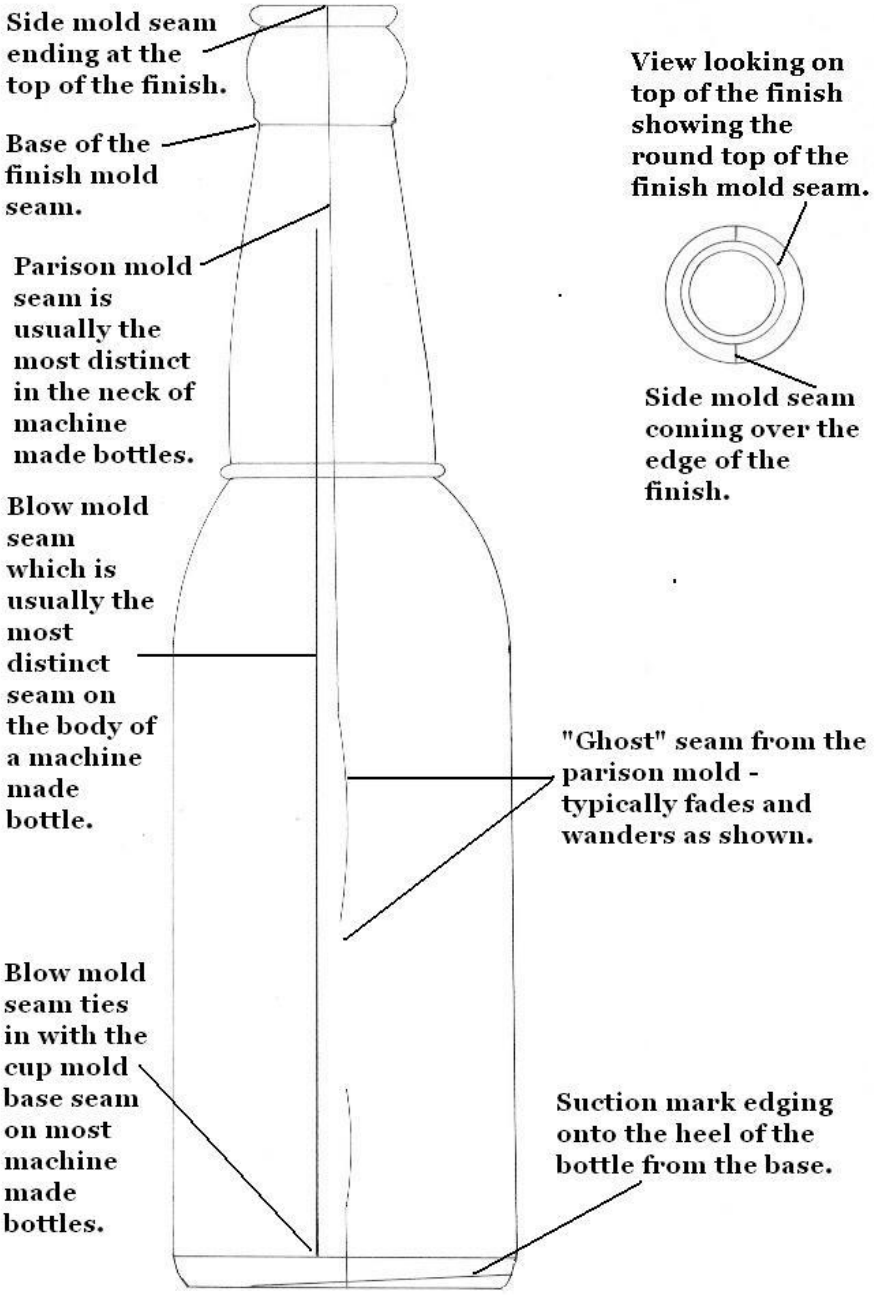
Dip Mold



Three-piece mold

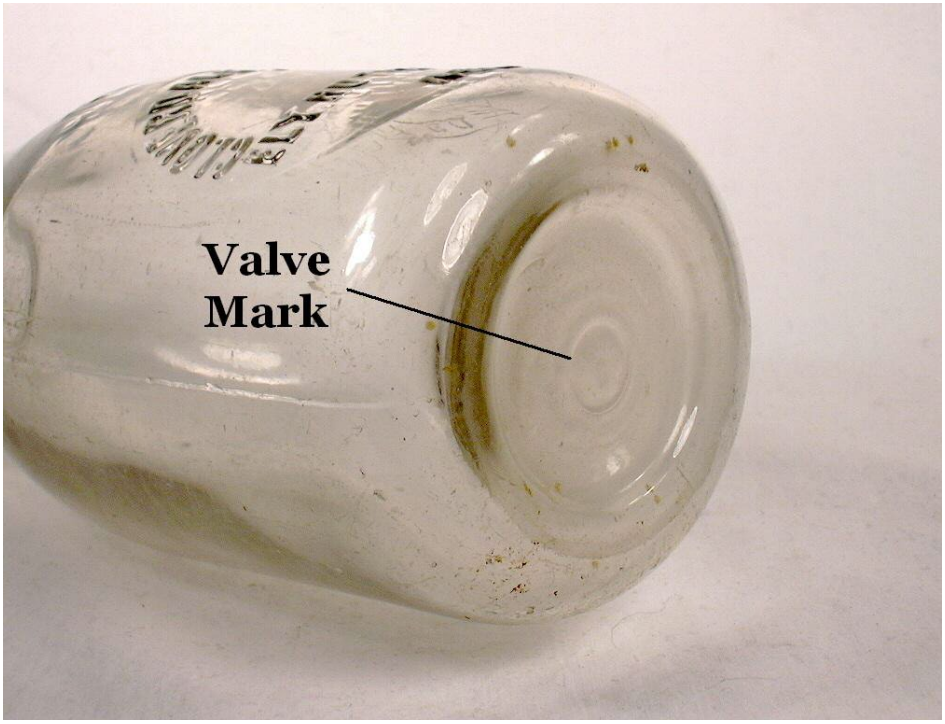
Mold Examples

Source: https://sha.org/bottle/body.htm#Molded%20shape%20related%20features



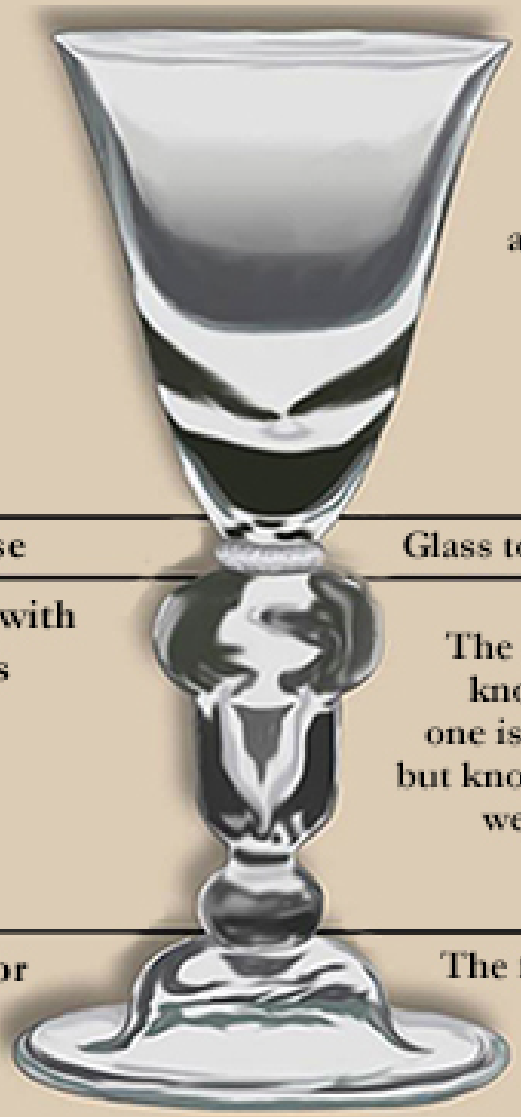
Machine-Made Bottle Diagnostics

Source: https://sha.org/bottle/body.htm#Molded%20shape%20related%20features



Source: https://sha.org/bottle/valvemark.jpg

Parts of an 18th-Century Wine Glass



Bowl

This is an example of a conical bowl with a slightly curved botton, also known as a "rounded funnel." Other glasses of the era had bell-shaped bowls or "trumpet" bowls that flared at the top.

Merese — Glass to connect the bowl and stem

Stem with Knops

The stem is made up of bulbous knops of different widths. This one is known as an "acorn" knop, but knops of many different shapes were used on wine glass stems of the 18th century.

Base or Foot

The foot was typically wider than the bowl, and reinforced by an extra glass layer. This helped prevent chipping.

Credit: Sara Rivers Cofield of the Maryland Archaeological Conservation Laboratory.

Supplementary Materials

(fear not – you shall not be tested on this)

- **Manufacturing Techniques for Mold Blown Vessels, cont.**

    - Molding Techniques
        - (1) *Contact Molding:* Molten glass is blown into a full-sized mold to produce a full-sized vessel
            - Full-sized mold can be one-piece or multi-part
            - Key attribute here is that the interior and exterior surfaces of a contact molded vessel have a concave-convex relationship—that is, if the curvature of one surface is convex, the opposite surface will have a corresponding concavity in the same place
            - Most common type of mold, esp. for bottle/container glass, both historically and into modern era
        - (2) *Pattern Molding:* Glass is first blown into a part-sized mold with a decorative pattern imprinted on the surface, then vessel is removed from the smaller mold and free blown to full size
            - Key attribute here is that interior and exterior surfaces mirror one another in terms of their curvature—that is, a ridge on the outside will always be paired with a corresponding ridge on the inside of the vessel
            - Typically only found on tablewares and flasks, but occasionally used for other container types
            - Technology exists since Roman times, but pattern-molded vessels become increasingly rare from the mid-19th century onward
        - (3) *Optic Molding:* Glass is first blown into a part-sized mold with a pattern imprinted on the surface, then transferred to a full-sized mold and blown to full size
            - Essentially a combination of pattern and contact molding
            - The two-part process transfers the patterned design of the first, part-sized mold onto the *interior* surface of the full-sized vessel
            - The *exterior* surface of the finished vessel takes on the configurations of the second, full-sized mold (typically undecorated)
            - Relatively uncommon—generally only found on tablewares dating from the 18th century or later
        - (4) *Press Molding:* Pressure is applied with a plunger to force molten glass to conform to the outlines of a mold

- Because interior surface is shaped by the plunger, it is smooth and does not necessarily follow the curvature of the vessel exterior
- Exterior surface is shaped by the mold, and is often decorated with a pattern
- Typically only used for open-mouthed vessels such as tablewares (particularly tumblers) and jars because process requires a wide enough opening at the top of vessel to remove the plunger
- Most common in archaeological contexts from the early 19th onward (although technology exists earlier)
- Technically, the glass is not literally "blown" into a press mold, in that the pressure is supplied by plunger (not air pressure) – but archaeologists generally still consider press molding a subcategory of "mold blown" glassware

  - Note: *With the exception of pattern molding, all of the above molding techniques were eventually translated to the machine manufacturing process*

- **Important 19th Century Advances in Molded Glassware**

  - Snap case (1857)
    - Case or clamp device that replaces role of pontil rod for holding bottles while neck/lip are finished
    - Technology eliminates pontil mark on vessel bases
    - This another reason why the absence of pontil mark doesn't necessarily mean a vessel is machine-made—vessels produced with snap case lack pontil mark, but finish still must be hand tooled
  - Lipping tool (c. early-mid 19th century)
    - Handheld tool that clamps onto bottle neck and forms a cleaner, more regular finish on mold blown vessels (almost looks machine-made)
    - Process removes all extant mold seams around area of finish

- **20th Century Tips**
  - Applied color labels: production of baked-on enamel labels begins 1934
  - "FEDERAL LAW PROHIBITS SALE OR REUSE OF THIS BOTTLE" → Bottles with this mark date from 1935-1964

- **Glass Color**

    - Glass color can sometimes be useful as a dating tool and in identifying vessel form (albeit with caveats)

    - <u>Colorless/Clear</u>
        - Colorless glass requires adding a decolorizing agent to counteract impurities in glass that naturally impart color to the material
        - Most common decolorizing agents historically are manganese and lead oxide
        - Because the technology for colorless glass is complex and historically challenging to manufacture, it was largely restricted to more expensive tableware forms
        - Venetians mastered recipe for colorless soda lime glass by at least the 15th century, which they achieved by adding small amount of manganese oxide, but this technology was not widely distributed
        - English don't master technology for colorless glass until invention of potash-lead glass in late 17th century
        - Following invention of leaded glass, soda lime glass is largely replaced by potash-lead glass for most tableware forms between the late 17th through 19th centuries
        - By the end of the 19th century, however, more advanced recipes for colorless soda lime glass are marketed and begin to appear again on tableware forms
        - Soda lime eventually replaces potash lead as most common type of glass used for tablewares in the 20th century
        - Manganese dioxide was commonly used in early 20th century as decolorizing agent on many container forms
            - Manganese turns glass a light purple when exposed to sunlight (i.e., "solarized" glass)

- <u>Dark Green/Olive Green</u>
    - Although there are always exceptions, dark green/olive green colored glass is almost always associated with bottle glass, especially wine-style or case bottle

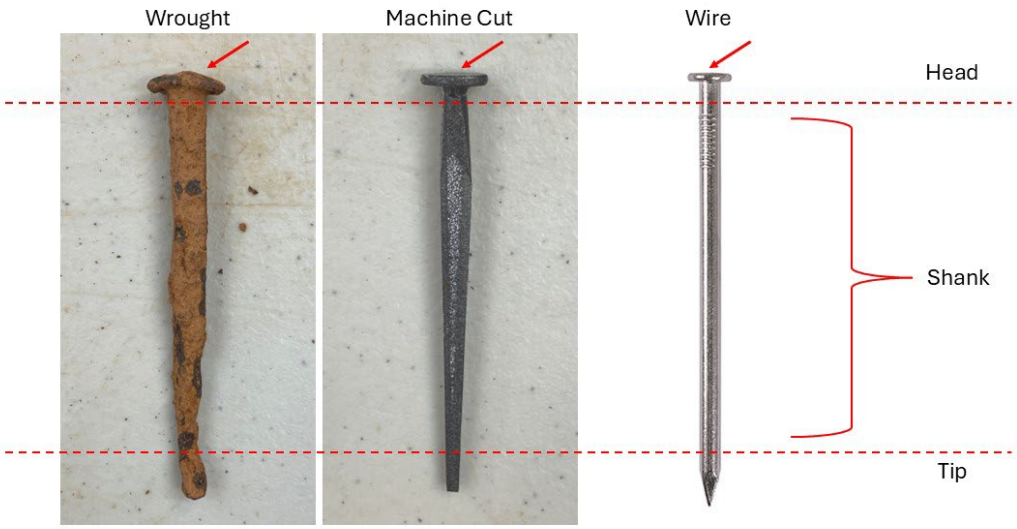
- <u>Amber/Brown</u>
    - As a general rule of thumb, lighter colored amber glass typically dates to the 19th century, while darker amber or brown ("beer bottle brown") bottle glass is often machine-made
        - *However, it is often difficult to distinguish nuanced colors at the fragment level, and vessel thickness plays a significant role in how light or dark the glass color appears*

- "Sprite Green"
    - Very light, neon green color most closely associated with modern Sprite bottles
    - This color occurs almost exclusively on machine-made bottles

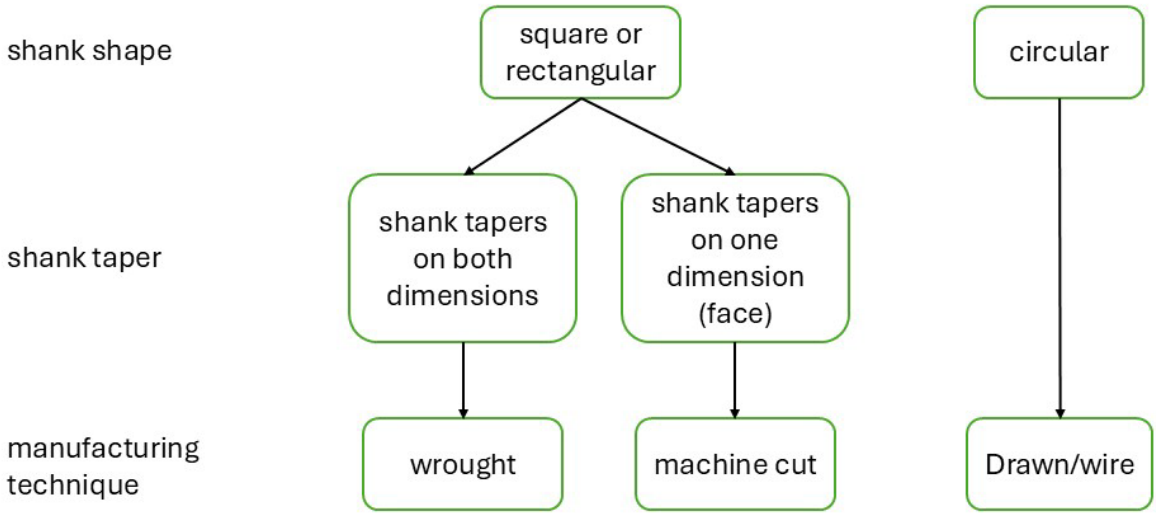
Recommended Resources

- Jones, O. (Olive R.)., Sullivan, C., Parks Canada. National Historic Parks and Sites Branch. (1985). *The Parks Canada glass glossary for the description of containers, tableware, flat glass, and closures.* Ottawa, Ont.: National Historic Parks and Sites Branch, Parks Canada, Environment Canada
    - *Digital copy here* → https://sha.org/bottle/pdffiles/GlassGlossary.pdf
- https://apps.jefpat.maryland.gov/diagnostic/TableGlass/index-TableGlass.html
- https://sha.org/bottle/
- *Window glass manufacture demo*: https://www.youtube.com/watch?v=kzBXU2ovfGo
- *Anything from the Corning Museum*: https://allaboutglass.cmog.org/

Nail Anatomy

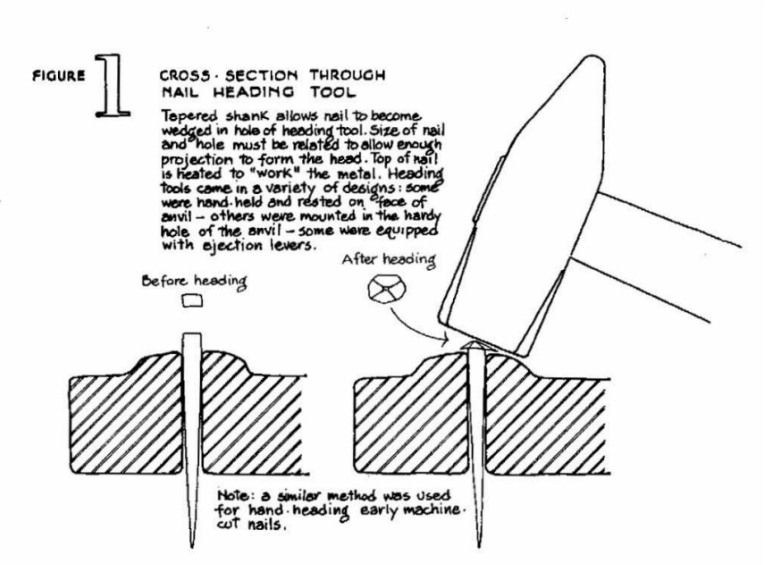


Nail Shank Shape and Identification



Wrought Nails

a. Oldest nail manufacturing type; used for thousands of years. Completely hand wrought by blacksmiths.
    a. Although the technology to manufacture machine cut nails emerged in 1780s/1790s, it wasn't until the 1820s where machine cut nails proliferated markets and usurped handwrought nails.
    b. Handwrought nails continue to be used into the present day due to preference, superior holding ability, and flexibility.
b. Material
    a. Made of wrought iron: composed of iron and a flux (lowers melting point of iron). Wrought iron is soft and more malleable.
        i. As iron is worked, flux may leave voids in the iron resulting in a grain. Ability to see the grain is highly dependent on preservation of nail. Likely not possible to see on archaeological nails at Monticello.
    b. Nail rod shipped from England and costal cities. Philadelphia was main supplier to Monticello.
        i. Nail rod are long square rods of wrought iron. Held in bundles by nail rod binder.
c. Manufacturing Process
    a. Nail rod heated over fire; end is hammered by a blacksmith to form nail tip.
    b. Worked nail rod placed over a hardy and snapped off to create shank.
    c. Placed in a nail header, a tool with hole in it slightly smaller than widest part of the nail shank (the top is the widest).
    d. Blacksmith strikes top of exposed shank to form nail head.



(Nelson, 1968)

d. Characteristics
    a. Shank tapers on all four sides.
    b. Head is formed right on top of the shoulder (no pinching).
    c. Shank is square or rectangular.

Handwrought Nails

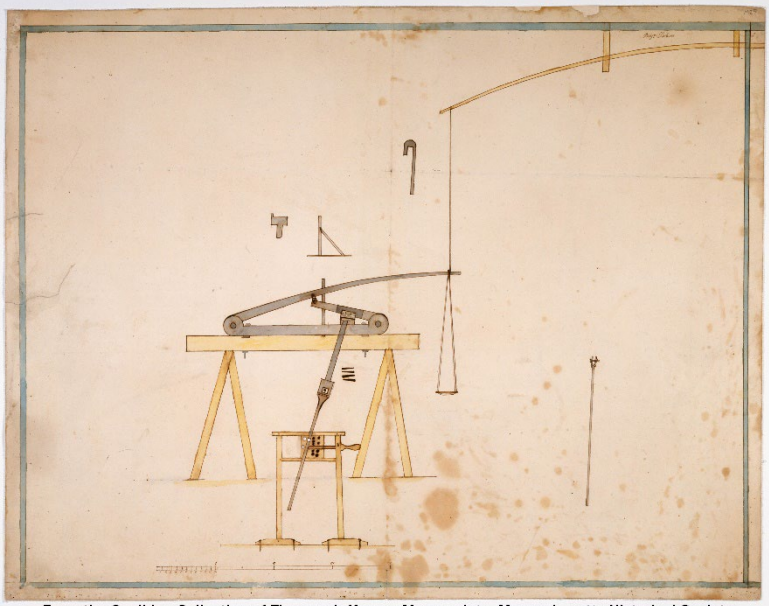
front view side view

Diagnostic characteristic: shank tapers in both dimensions

Taper – thickness of shank decreases on all sides from top of shank to tip

Machine Cut Nails

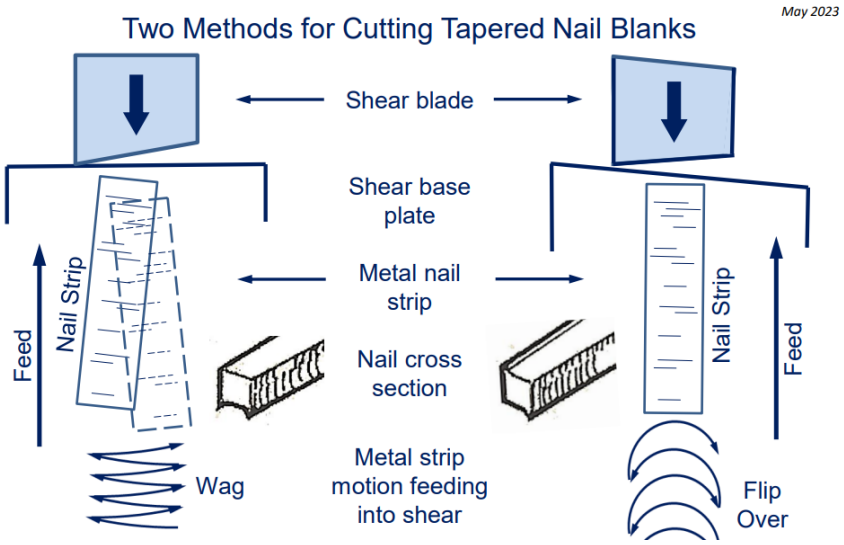
a. Early machine cut nail technology developed in 1780s/1790s
    a. 88 patents filed between 1791-1815.
    b. Thomas Jefferson purchased a manual nail cutting machine in 1796.
    c. First machines only cut nail shanks, called “blanks”, which were left either headless or hand headed. Later machines cut and headed the nail.
b. Material
    a. Iron nail plate (later nails may be steel).
    b. Hoop iron from barrels (this was the case for cut nails at Monticello).



From the Coolidge Collection of Thomas Jefferson Manuscripts, Massachusetts Historical Society

Objects: nail cutting machine, 1801, by Benjamin Perkins. M29 [electronic edition]. Thomas Jefferson Papers: An Electronic Archive. Boston, Mass. : Massachusetts Historical Society, 2003. http://www.thomasjeffersonpapers.org/

c. Process
    a. Nail plate fed into machine where a blade slices through to create a triangular nail blank.
        i. Triangular shape of nail shank achieved by wiggling the nail plate side to side or flipping 180˚. This action can be done manually (earlier technology) or automatically by machine (later technology).
    b. Heading
        i. Headless nail (1790s-onward)
        ii. Hand headed (approx. 1790-1830)
            1. No pinch or side pinch
        iii. Machine headed (approx. 1810s-1890s)
            1. Side pinch or face pinch



Visual from Amesbury Carriage Museum

(https://amesburycarriagemuseum.org/news/2023/7/11/high-tech-in-the-1700s-nail-manufacturing-in-amesbury)

b. Characteristics
    a. Nail has a “face” and a “side.” Only tapers in one dimension.
        i. Face is the dimension of the shank that tapers. This is the surface of the nail plate.
        ii. Side is the dimension of the shank with uniform and consistent width. This is where the cut occurred.

Machine Cut Nails

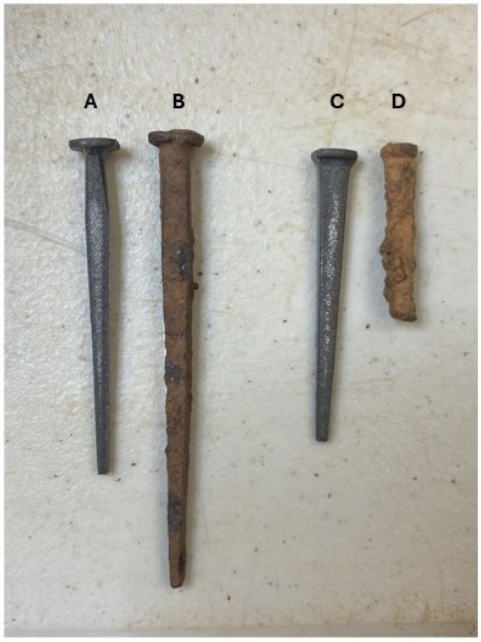
face

Taper - width of shank decreases from top of shank to tip

side

Width of shank is consistent from top of shank to tip

b. Shank is square or rectangular.
c. Blunt tip either straight across or rounded from face to face, the result of the finished edge of the nail plate being the finished tip of the nail.
d. Pinching beneath the head as a result of being placed in a vice-like header.



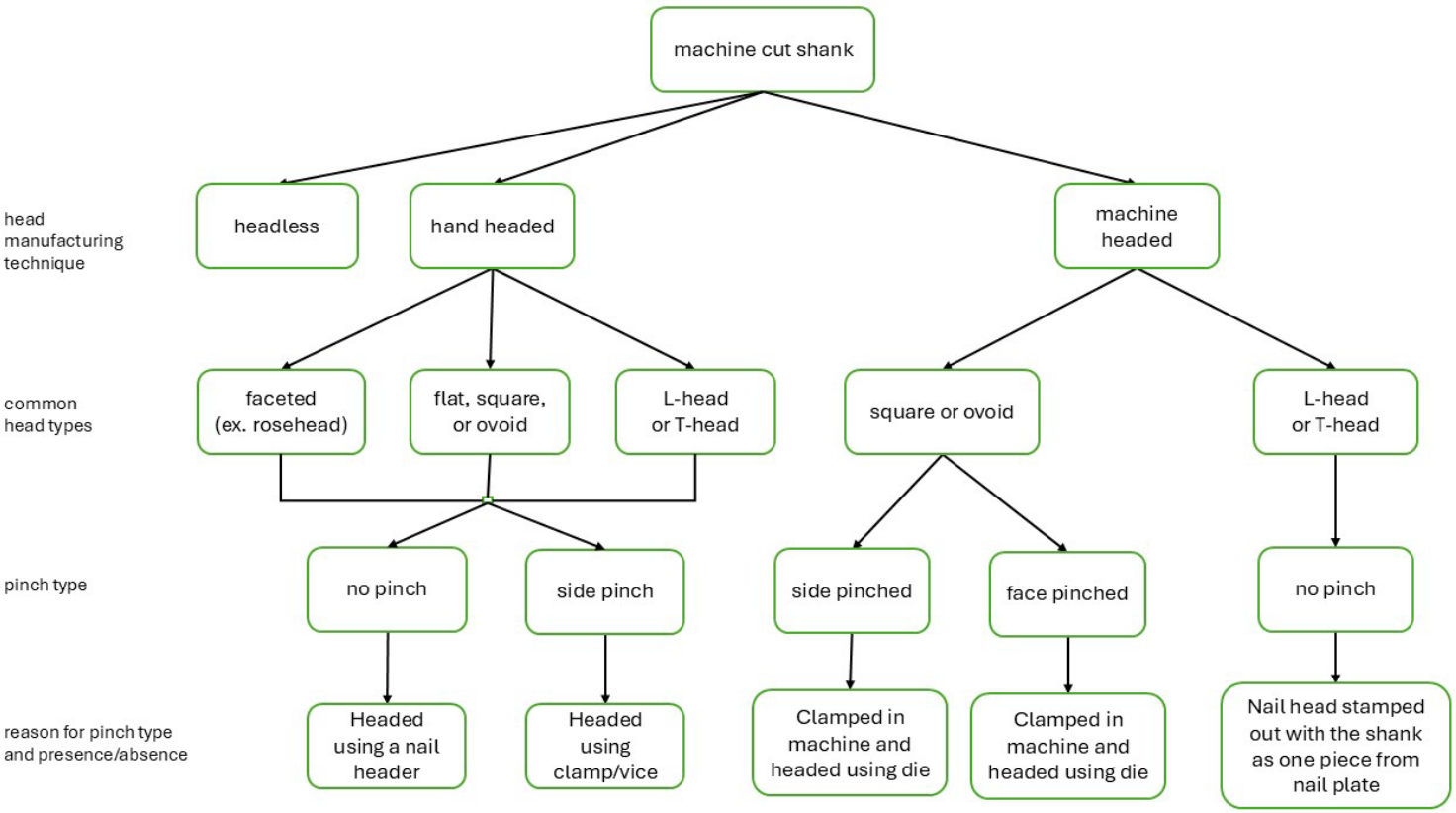
Side pinched
- Hand headed (c. 1790s onward)
- Crude machine stamped heads (c. 1810s-1830s)

Face pinched (c. 1815-1900s)
- Not mass produced until 1890s

A: reproduction nail with side pinch
B: archaeological nail with side pinch

C: reproduction nail with face pinch
D: archaeological nail with face pinch

Head Manufacturing Techniques for Machine Cut Nails



Wire Nails

a. First factories in NY in 1850s. First nails were small, not perfected for building constructing into 1870s. Initially wire nails were used for boxes.
    a. Very gradual transition from cut to wire nails.
    b. Wire started to be widely manufactured and used in late 1890s. Wire nails were cheaper but more brittle than wrought iron and had poorer adhesion to wood than cut or wrought.
b. Material: wire, iron or iron-carbon alloy (steel)
c. Process
    a. Wire fed into machine which clamps on the shank. Clamp teeth score the upper shaft.
    b. Head is machine stamped.
    c. Die squeezes end of shaft to create pointed tip. This tip can be conical or have facets (often four) from a die cutter.
d. Characteristics
    a. Round in cross section.
    b. Scoring on shank beneath head.

c. Modern - wire nails are what is mass produced and sold today.

e. Head types
    a. Flat/round

f. Tip types
    a. Point

Heads

a. Rosehead: hammer strikes creating "petals" meeting at a central apex, most often four strikes. Common and multipurpose.
b. T-head: T shape. Often brads used for finishing and flooring. The head can be hammered in flush to the wood and in line with the wood grain (less splitting).
    a. On handwrought nails, may be a rosehead with parallel sides hammered in.
    b. On machine cut nails, head is stamped out of nail plate with shank.
c. L-head: Often brads used for finishing and flooring. The head can be hammered in flush to the wood and in line with the wood grain (less splitting of wood).

Machine cut flooring brad (reproduction)

Machine cut L-head

Head is same thickness as nail shank, may be able to see a bur from shearing. Reproduction image from Tremont Nail Company.

Handwrought L-head

One "arm"/protrusion from head

Handwrought T-head

Two "arms"/protrusions from parallel sides

Head is created by a hammer strikes, may have distortion or unevenness

d. Machine cut square head: square or rectangular head machine stamped on machine cut nails.
e. Round head: circular head stamped on wire nails.

* See Nelson, 1968 and study collection for visuals of head types without images

Bonus: Machine cut nail with handwrought head. What to look for: head is eccentric to shank, doublestruck (has two opposing facets that meet in peak). No pinch, headed in a header instead of clamped.

Tips

a. Chisel/shovel: tip is flared out. Also known as spatula/spatulate. Chisel tip is useful for getting into grain of wood.
b. Rounded: tip is rounded, not flared as a spatula tip would be.
c. Pointed: all sides of nail come to a point
d. Blunt: most often machine cut, tip is straight across.

Left to right: chisel/shovel (HW), rounded (HW), point (HW), blunt (MC)

		Tip Type			
		Chisel/shovel	Rounded	Pointed	Blunt
Manu Tech	Wrought	**X**	**X**	**X**	
	Machine cut			*	**X**
	Wire			**X**	

*rare, only on very early machine cut nails

Nail Modifications

a. Clinched
    a. When nail is hammered through both thicknesses of the wood. AKA after being hammered through the front, the portion of the nail shank and tip sticking of from back is turned and hammered back through.
    b. Handwrought nails are superior for flexibility and clinching and remained in use for this purpose even after the invention and mass production of machine cut and wire nails.

"Clinched"


Tip is U-shaped or L-shaped


Tip is J-shaped


Tip is a Curlicue

b. Pulled: result of removing nail from object it was once hammered into

"Pulled"


Overall nail is J-shaped


Overall nail is C-shaped

c. Bent


Any other modification to the shank (not straight)

d. Wasters
    a. Unfinished handwrought nails that were flawed and discarded at hardy or heading stage. See study collection.

Nailmaking at Monticello

a. Nailery on Mulberry Row began operations in 1794. Enslaved boys aged 10 to 21 worked 10-14 hour days. By 1795, each produced 8 to 10 thousand nails per day.
b. Thomas Jefferson received orders and sold these nails to fulfill local and regional needs (operations dependent on supply chain, ex. War of 1812)
c. Nail cutting machine installed in 1796.
d. Hired smiths: William Stewart, 1801–07
e. Enslaved smiths: George Granger, Jr. (1759-1799), 1794–1799, Isaac Granger Jefferson (1775–1846), 1795, Moses Hern (1779–after 1832), 1799–1819, Joseph Fossett (1780–1858), 1800–1827
f. Due to fires, Mulberry Row smith's "shop and nailery demolished c. 1803. Moved to "junction of the second roundabout and the road leading from the East Front of the house."
g. Nailery closes in 1823

Resources and Further Learning

Nail Chronology and Typologies

- Nelson, 1968: https://npshistory.com/publications/nail-chronology.pdf
- Wells, 1998: https://daacsrc.org/doc/Wells_1998.pdf

Handwrought Nails

- Eric Slaone, *A Museum of Early American Tools*, page 92.
- https://youtu.be/qF6mXGrV4tM?si=ECkFkDgQdgdpG1dI

Machine Cut Nails

- Tremont Nail Company
  - https://youtu.be/mmTL2e_3fRs?si=I3LeZo2mABP8sT26
  - https://youtu.be/xL9HSmIzWIs?si=X637xkvSNTgdSdJ7
- La Belle Cur Nail Plant (nail machines at 3:39)
  - https://youtu.be/HI_lRTbEkIc?si=0Oy2lx50gzuaEJOC