

Desirable Mold Properties and Characteristics

- **Strength** - to maintain shape and resist erosion
- **Permeability** - to allow hot air and gases to pass through voids in sand
- **Thermal stability** - to resist cracking on contact with molten metal
- **Collapsibility** - ability to give way and allow casting to shrink without cracking the casting
- **Reusability** - can sand from broken mold be reused to make other molds?



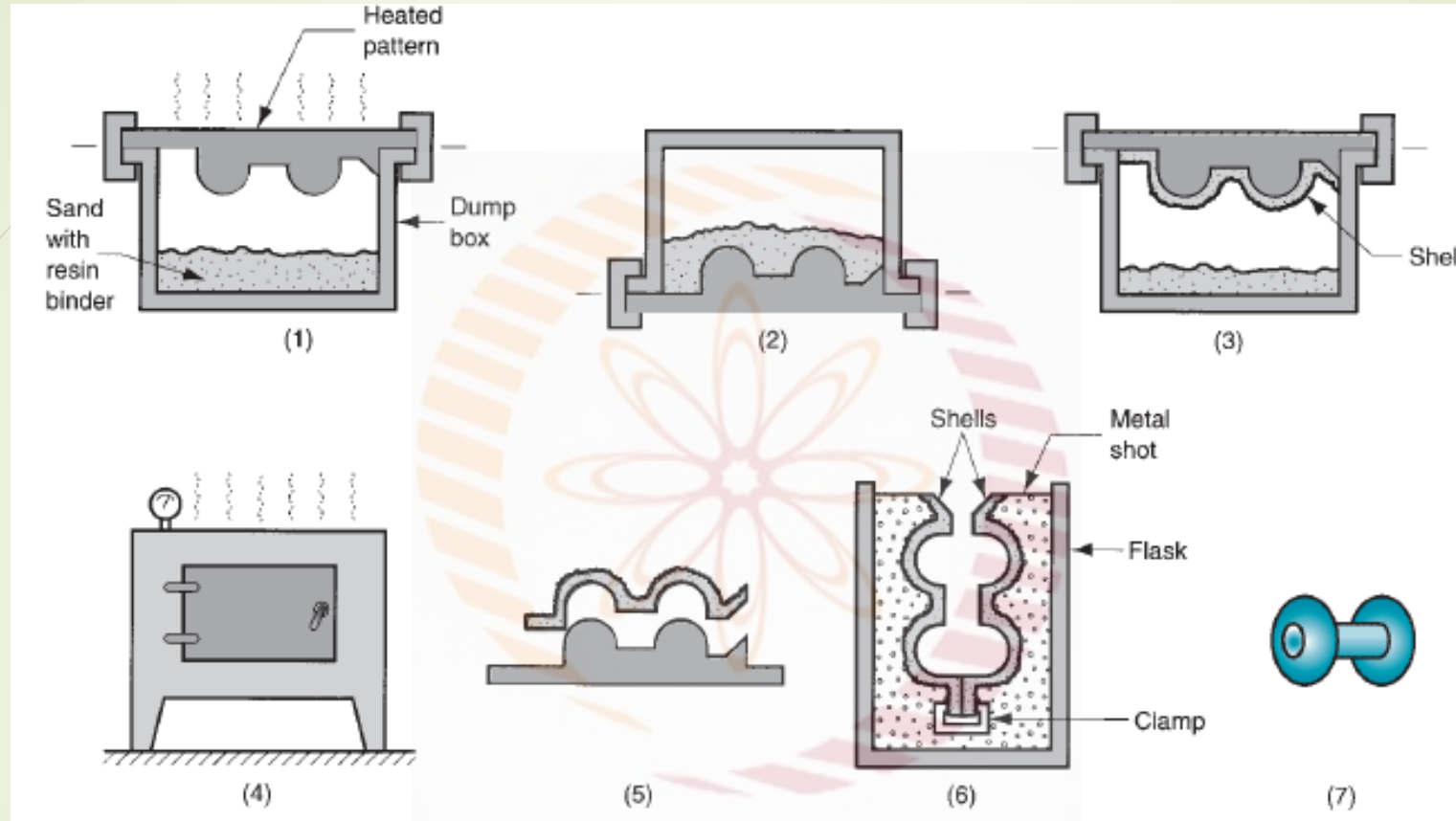
Other Expendable Mold Casting Processes

- Shell Molding
- Vacuum Molding
- Expanded Polystyrene Process
- Investment Casting
- Plaster Mold and Ceramic Mold Casting



SHELL MOLDING

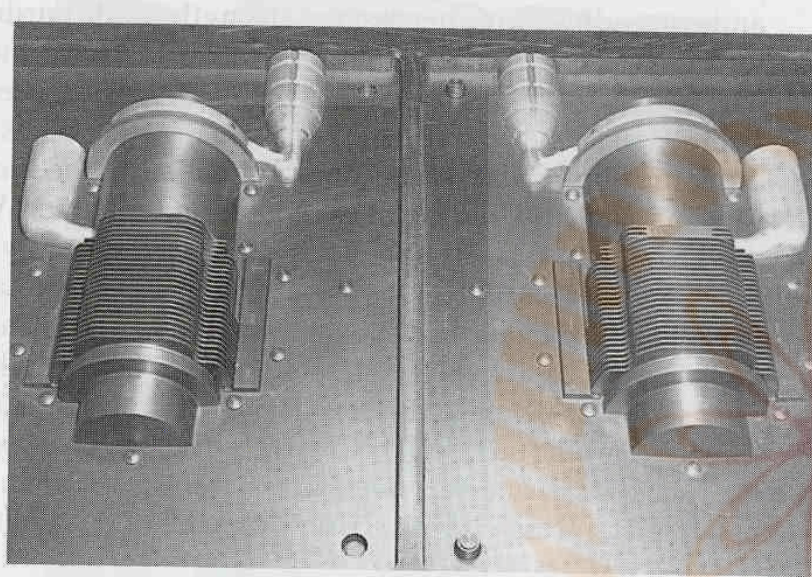
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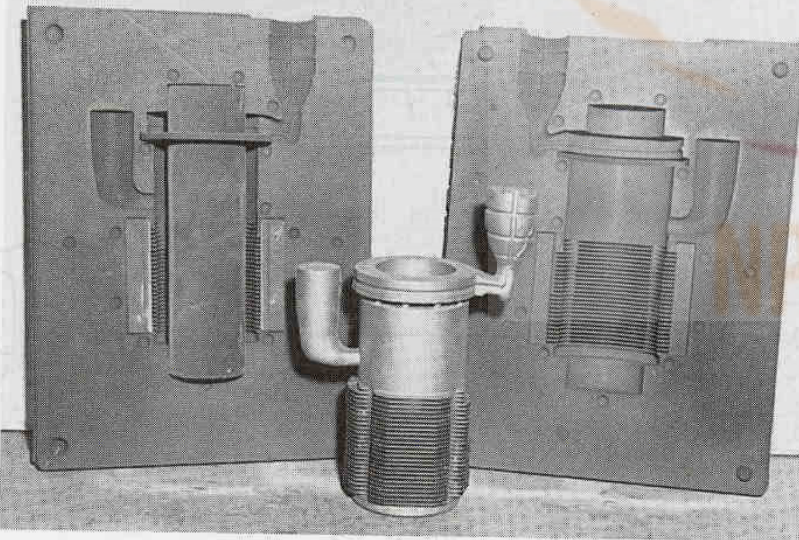
Steps in shell molding: (1) a match-plate or cope-and-drag metal pattern is heated and placed over a box containing sand mixed with thermosetting resin; (2) box is inverted so that sand and resin fall onto the hot pattern, causing a layer of the mixture to partially cure on the surface to form a hard shell; (3) box is repositioned so that loose, uncured particles drop away; (4) sand shell is heated in oven for several minutes to complete curing; (5) shell mold is stripped from the pattern; (6) two halves of the shell mold are assembled, supported by sand or metal shot in a box, and pouring is accomplished. The finished casting with sprue removed is shown in (7).

SHELL-MOLD PATTERN

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Two halves of a
shell mold pattern



Two shells before
clamping

Final casting with attached
pouring basin, runner and
riser

SHELL MOLDING CHARACTERISTICS

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- Shell is light and thin (5 mm – 10 mm)
- Thermal conductivity different from sand

ADVANTAGES

- Complex shapes can be produced with less labour
- Better dimensional accuracy (0.008 – 0.01 cm)
- Better surface finish (fine sand used for shell)



- **Significant reduction in cleaning, machining, finishing**

DISADVANTAGE

- **Lower permeability than sand molds.**
- **Decomposition of shell-sand binder produces high volume of gas. Need good venting system.**

PRODUCTS

- **Gear housings, cylinder heads, connecting rods**

Investment Casting (Lost Wax Process)

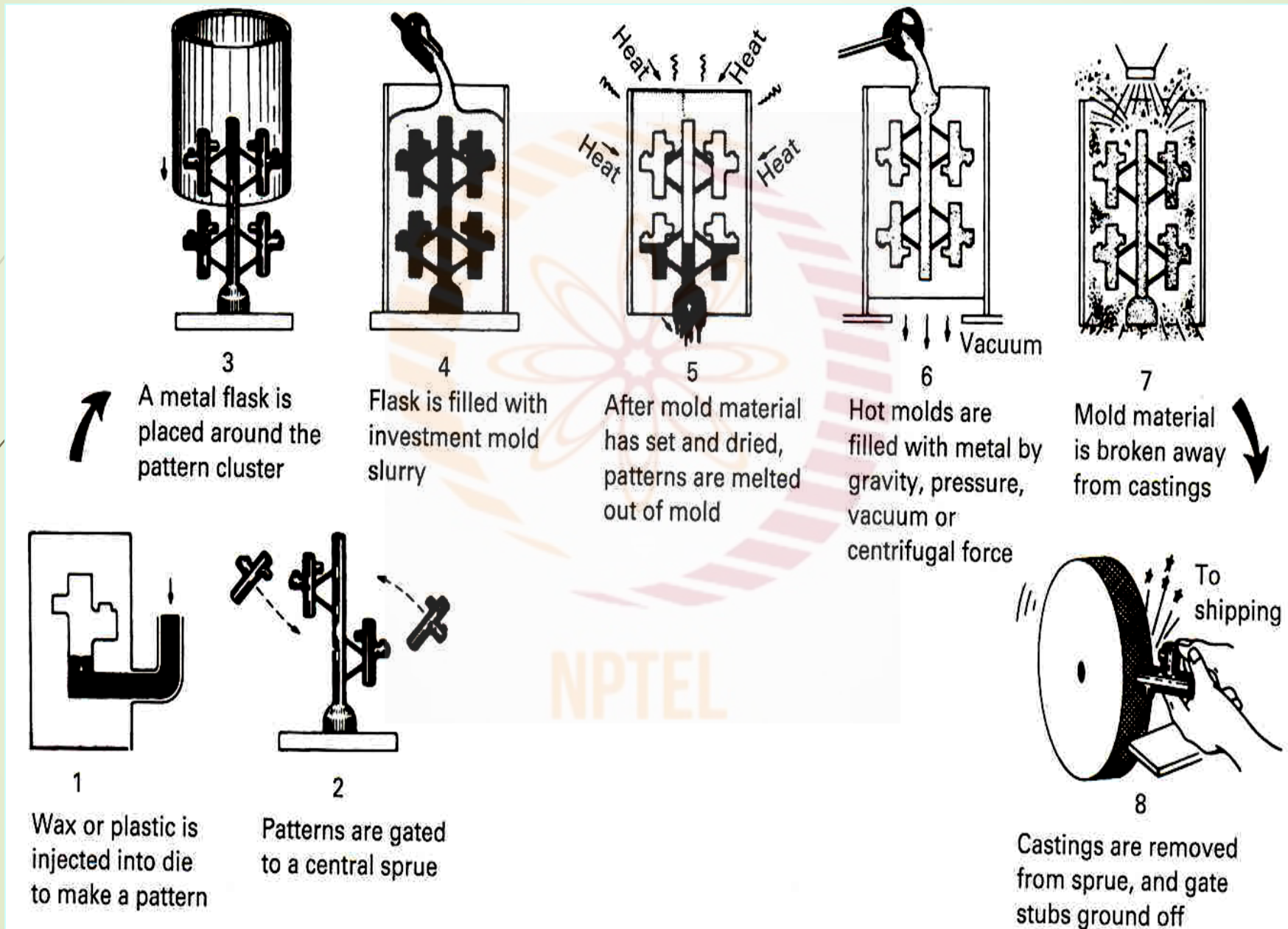
A pattern made of wax is coated with a refractory material to make mold, after which wax is melted away prior to pouring molten metal

- "Investment" comes from one of the less familiar definitions of "invest" - "to cover completely," which refers to coating of refractory material around wax pattern
- It is a precision casting process - capable of castings of high accuracy and intricate detail



Steps of Investment Casting

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Advantages and Disadvantages of Investment Casting

INVESTMENT CASTING

➤ Advantages:

- Parts of great complexity and intricacy can be cast
- Close dimensional control and good surface finish
- Wax can usually be recovered for reuse
- Additional machining is not normally required - this is a net shape process

➤ Disadvantages:

- Many processing steps are required
- Relatively expensive process

