Permanent Molds

Characteristics

- superior mechanical properties because the metal molds can be chilled
- excellent surface finish
- excellent dimensional tolerances
- uniform castings

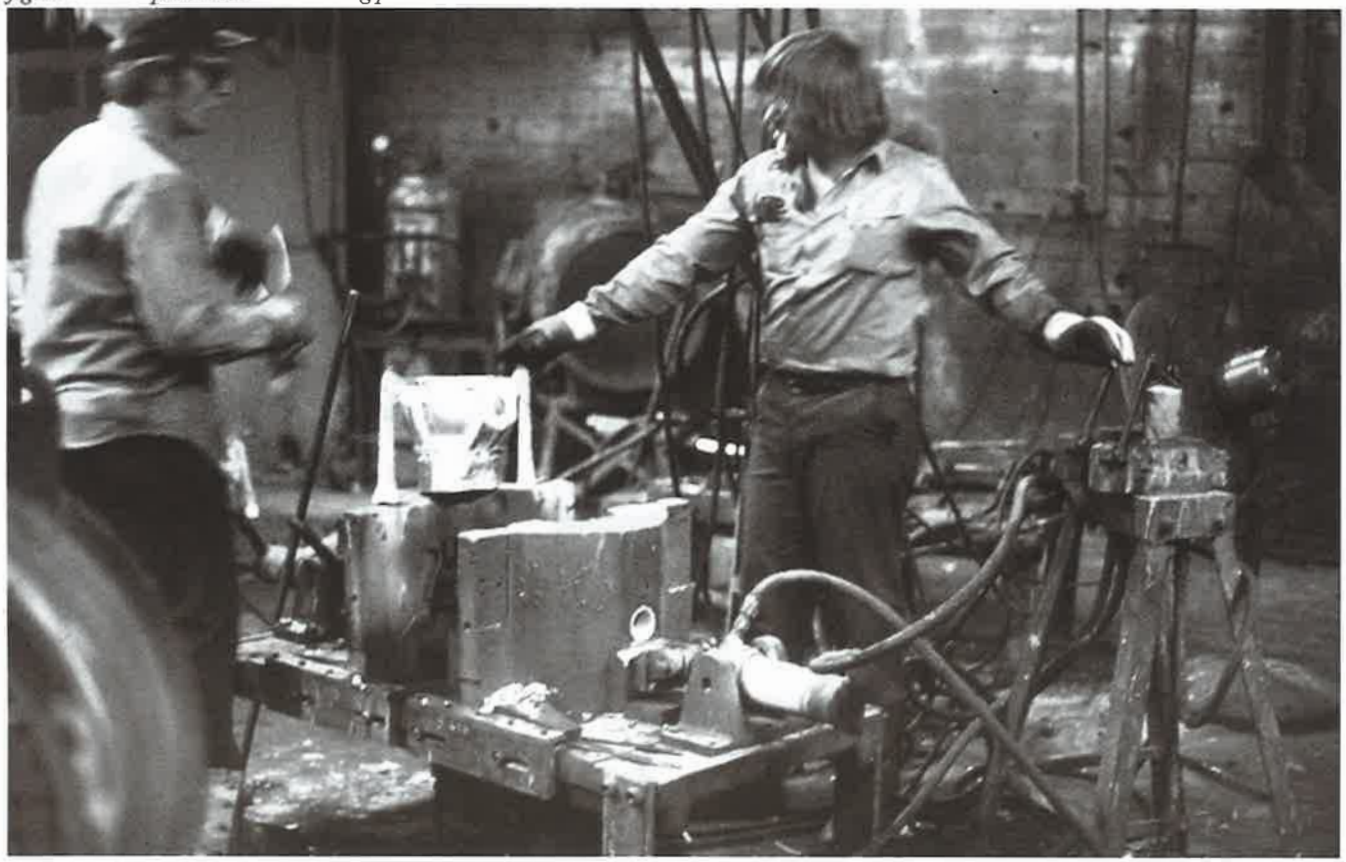
figure 4-27. permanent mold casting

Permanent Molds

Permanent molds can be cast in iron, but they are now primarily machined in tool steel. Cores can be metal, sand, or sand shell. Castings are limited to aluminum, zinc, some brass, bronze, and lead. The molds are usually coated with a ceramic wash prior to being gravity filled. Permanent molds must be made of metals that have a higher melt temperature than the metal to be cast. Permanent molds can have a horizontal or vertical parting line. Cores for permanent molds can be metal that may be operated mechanically in the mold or they can be made of sand, which are placed by hand in the mold.

Permanent molds are gravity filled in a vertical position (static pour) or they can be filled as the mold is tilted from a horizontal position to a vertical position (tilt pour). In this case, the molten metal is poured into a cup attached to the mold at the sprue. Next, the mold is tilted up to a vertical position, thereby allowing the metal to flow out of the cup into the mold cavity. Tilting the mold as it is filled enables the molten metal to flow into the mold cavity with less turbulence. The ability to selectively insulate or cool sections of the metal mold helps to control the solidification, improving the overall casting properties.

figure 4-28abc. permanent mold casting process



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Low Pressure Casting

In ***low pressure casting,*** molten metal is forced by 5 to 15 pounds of air pressure from a heated crucible through a feed tube into the mold. Bottom fill eliminates much of the turbulence typical in gravity-fill casting. After the cast part solidifies, pressure is reduced and excess metal returns to the crucible. The advantages of low pressure casting include increased density and uniform grain structure, which ensures good casting repeatability and good tolerances. When required, internal passageways can be made by mechanically activated metal cores or by using sand cores placed in the mold by hand.

figure 4-29a. low pressure casting

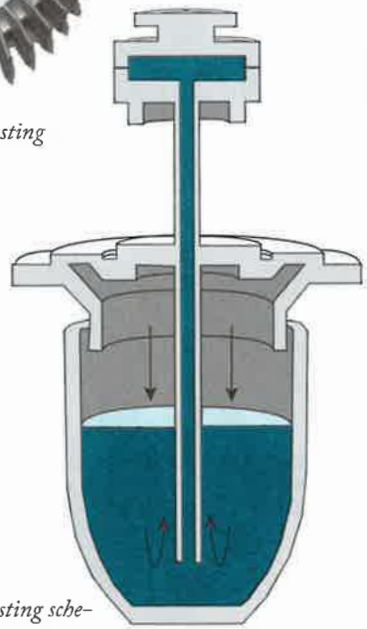
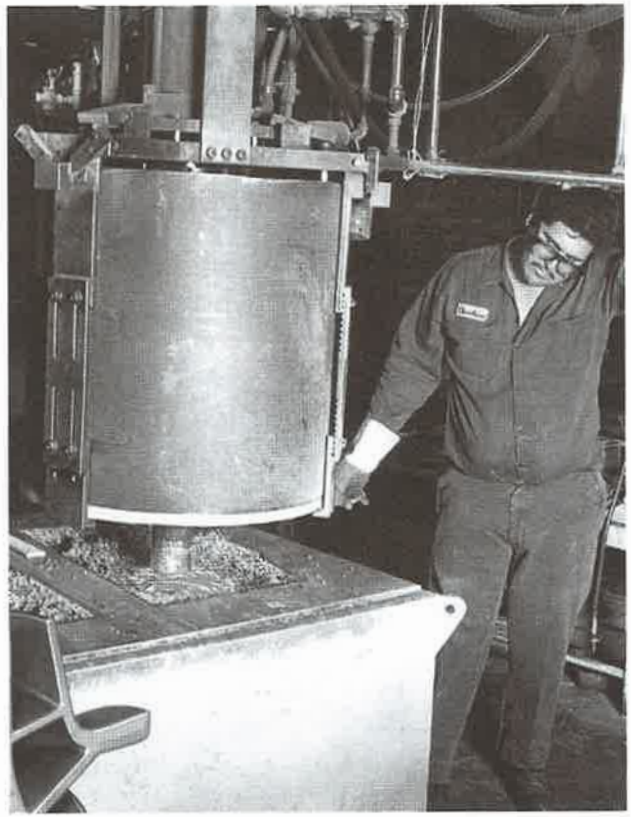


figure 4-29b. low pressure casting schematic

Vacuum Low Pressure Casting

Vacuum low pressure casting, originated, developed, and patented by Aurora Metals, is used to produce castings that require precision and strength. In this process, a steel die is enclosed in an airtight bell and submerged into the molten metal. A vacuum is drawn within the chamber, causing the metal to flow up the sprue and into the cavity. After the mold is filled, the vacuum is released and the metal in the sprue flows back down into the reservoir. Symmetrical parts are particularly well suited for this process.



Low Pressure Casting

Characteristics

- excellent surface finish
- thin wall
- excellent surface finish
- excellent dimensional tolerances
- uniform castings
- limited to low melt temperature alloys
- casting size limited

Vacuum Low Pressure Casting

Characteristics

- metallurgically superior
- excellent surface finish
- thin wall
- excellent dimensional tolerances
- uniform castings
- limited to low melt temperature alloys
- casting size limited

figure 4-30ab. vacuum casting process and section of a complex pump impeller vacuum cast in one piece (courtesy Aurora Metals Div. L.L.C.)

Die Casting

Characteristics

- high production
- good tolerances
- low part price
- excellent surface finish
- thin walls
- limited to aluminum, magnesium, and zinc
- tools are expensive with a long lead time for tooling and casting
- required draft angles 0.3°–3°
- small to medium casting sizes
- ounces to 30 lbs.
- quantities: medium to very large

Die-casting is used to produce small to fairly large-sized castings at high production rates. Nearly all die-castings are produced in low-melt temperature nonferrous alloys and some very limited amounts of small, thin iron parts. The "P" type tool steel water-cooled molds are coated with a mold surface coating and preheated before being filled with molten low melt temperature alloys.

In cold chamber die casting, premeasured amounts of metal are forced from a shot chamber into the tool or die under extreme pressure (>15,000 psi). Hot chamber die casting yields superior castings and can be automated.

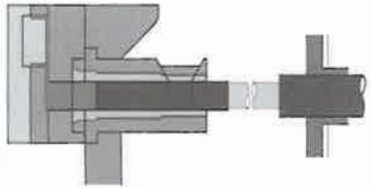


figure 4-31. cold chamber die casting schematic

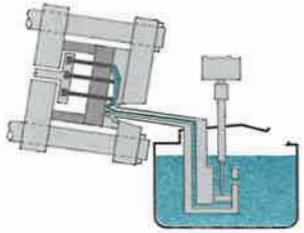


figure 4-32. hot chamber die casting schematic

figure 4-33. exploded view of Equa chair by Chadwick/Stumpf that uses eight die castings (courtesy Herman Miller)

figure 4-34ab. sketch and final product that utilizes a zinc die-cast neck to support and cradle the Motorola Ojo video phone handset. The casting is painted to match the ABS handset. (courtesy Bressler-group, Inc. and WorldGate Communications)

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