

Different Types of Casting

Casting manufacturing is a process in which liquefied material, such as molten metal, is poured into the cavity of a specially designed mold and allowed to harden. After solidification, the workpiece is removed from the die to undergo various finishing treatments or for use as a final product. Casting methods are typically used to create intricate solid shapes, and cast products are found in a wide range of applications, including automotive components, aerospace parts, electronics, mechanical devices, and construction supplies.

Different Types of Casting and the Casting Process

Although casting is one of the oldest known manufacturing techniques, modern advances in casting technology have led to a broad array of specialized casting methods. Hot forming processes, such as die casting, investment casting, plaster casting, and sand casting, each provide their own unique fabrication benefits. Comparing both the advantages and disadvantages of the common types of casting processes can help in selecting the method best-suited for a given production run.

Sand Casting

Sand casting typically relies on silica-based materials, such as synthetic or naturally-bonded sand. Casting sand generally consists of finely ground, spherical grains that can be tightly packed together into a smooth molding surface. The casting is designed to reduce the potential for tearing, cracking, or other flaws by allowing a moderate degree of flexibility and shrinkage during the cooling phase of the process. The sand can also be strengthened with the addition of clay, which helps the particles bond more closely. Many automotive products, such as engine blocks and housings, are manufactured through sand casting.

- Advantages of Sand Casting

Sand casting's main advantages as a casting process include:

- Relatively inexpensive production costs, especially in low-volume runs.
- The ability to fabricate large components.
- A capacity for casting both ferrous and non-ferrous materials.
- A low cost for post-casting tooling.

- Disadvantages of Sand Casting

Despite its benefits, sand casting yields a lower degree of accuracy than do alternate methods and it can be difficult to sand cast components with predetermined size and weight

specifications. Furthermore, this process has a tendency to yield products with a comparatively rough surface finish.

Investment Casting

Investment casting uses a disposable wax pattern for each cast part. The wax is either injected directly into the mold or pre-coated with a liquid refractory material before injection. Molten forming material is then poured into the mold and allowed to harden and set into the shape of the wax pattern. The component is then ejected, while the wax pattern is melted out of the casting and made available for reuse. Investment casting is often used to manufacture parts for the aerospace and automotive industries, as well the military. Some of the central advantages and disadvantages of investment casting include:

- A high degree of accuracy and precise dimensional results.
- The ability to create thin-walled parts with complex geometries.
- The capacity for casting both ferrous and non-ferrous materials.
- Relatively high-quality surface finish and detail in final components.

Although it is highly precise, investment casting is usually more expensive than other comparable casting techniques, and is typically only cost-efficient when sand or plaster castings cannot be used. However, the expense can sometimes be compensated for with reduced machining and tooling costs due to investment castings' quality surface results.

Plaster Casting

Plaster casting is similar to the sand casting process, using a mixture of gypsum, strengthening compound, and water in place of the sand. The plaster pattern is typically coated with an anti-adhesive compound to prevent it from becoming stuck against the mold, and the plaster is capable of filling in any gaps around the mold. Once the plaster material has been used to cast a part, it usually cracks or forms defects, requiring it to be replaced with fresh material. The advantages offered by plaster casting include:

- A very smooth surface finish.
- The ability to cast complex shapes with thin walls.
- The capacity for forming large parts with less expense than other processes, such as investment casting.
- A higher degree of dimensional accuracy than that of sand casting. This process tends to be more expensive than most sand casting operations, and may require frequent replacements of plaster molding material. It is usually more effective and cost-efficient when the quality of the surface finish is an important requirement.

Die Casting (Metal Casting Process)

Die casting is a method of molding materials under high pressure and usually involves non-ferrous metals and alloys, such as zinc, tin, copper, and aluminum. The mold is coated with lubricant to help regulate the die's temperature and to assist with component ejection. Molten metal is then injected into the die under high pressure, which remains continuous until the workpiece solidifies. This pressurized insertion is rapid, preventing any segment of the material from hardening before being cast. After the process is completed, the component is taken out of the die and any scrap material is removed. A few of the major advantages provided by die casting include:

- Close size and shape tolerances.
- High component dimensional consistency and uniform design.
- A reduced need for post-casting machining.

Despite its advantages, die casting has relatively high tool costs, making it more cost-efficient in high-volume product runs. It can also be difficult to ensure the mechanical properties of a die cast component, meaning these products usually do not function as structural parts.

Different Types of Casting in a Table

Types	The Process	Advantages	Limitations
Investment Casting	Refractory slurry is cast around (or dipped on) a pattern formed from wax or plastic; when slurry hardens, pattern is melted out and mold is baked. When poured metal solidifies, mold is	High dimensional accuracy Excellent surface finish Almost unlimited intricacy	Size of part limited; Requires expensive patterns and molds; High labor costs.

	broken away from casting.	<p>Almost any metal can be used</p> <p>No flash to remove</p> <p>No parting line tolerances.</p>	
Sand Casting	<p>Green sand. Moist, bonded sand is packed around a wood or metal patterns, the pattern removed, and molten metal poured into the cavity; when metal solidifies, mold is broken and casting removed</p> <p>Dry sand. Same as above except; core boxes used instead of patterns, sand bonded with a setting binder, and core baked in an oven</p>	<p>Almost any metal can be used</p> <p>Almost no limit on size and shape of part</p> <p>Extreme complexity possible</p> <p>Low tool cost</p> <p>Most direct route from pattern to casting.</p>	<p>Some machining always necessary;</p> <p>Large castings have rough surface finish;</p> <p>Close tolerances difficult to achieve;</p> <p>Long, thin projections not practical;</p> <p>Some alloys develop defects;</p> <p>Usually limited to smaller parts than possible with green sand</p>
Die Casting	Molten metal is poured into closed steel die under pressures varying from 1500 to 25,000 psi; when the metal solidifies, the die is opened and the casting ejected.	<p>Extremely smooth surfaces</p> <p>Excellent dimensional accuracy</p> <p>Rapid production rate</p>	<p>High initial die costs;</p> <p>Limited to nonferrous metals;</p> <p>Size of part limited</p>