

Sand Casting Applications

Skill Level  Time  Cost 

Overview

Sand casting is an economical process for creating rough metal parts. Raw castings are then machined to produce finished products or components. Sand casting is the least expensive of all casting processes, including die and investment casting. Sand casting may require a longer lead time for production at high output rates (1–20 pieces/hour/mold), but is unsurpassed for large-part production. Sand has almost no upper limit on part weight and minimum part weight ranges from 0.075–0.1 kg. The sand is bonded together using clays or chemical binders. In most operations, the sand can be recycled many times, requiring the addition of only small amounts of sand each time.

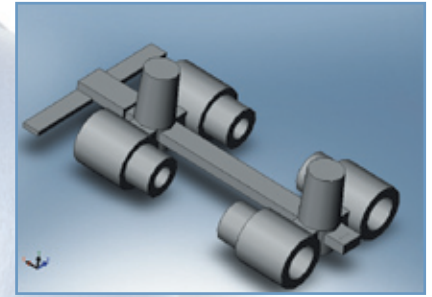
Preparation of the sand mold is fast but requires a pattern that can “stamp” out the casting template. Typically, sand casting is used for processing low-temperature metals, such as iron, copper, aluminum, magnesium, and nickel alloys. It can also be used for high-temperature metals where other means would be impractical. Sand casting is by far the oldest and best understood of all techniques. As such, automation can easily be adapted to the production process, although somewhat less easily to the design and preparation of forms.

The Sand Casting Process

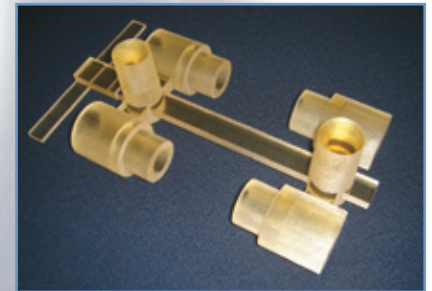
In the sand casting process, a pattern is made in the shape of the desired part. The pattern can easily be made using PolyJet™ models. A single piece or solid pattern is used for simple designs. Patterns that are more complex are made in two parts, and are called split patterns. This can also be designed in the CAD level, and printed by Objet systems. The upper part of a split pattern is called a cope, while the bottom section is called a drag. Where the cope and drag separate is known as the parting line. Both solid and split patterns can have cores inserted to complete the final part shape. When making a pattern, it is necessary to taper the edges so the pattern can be removed without breaking the mold.

Forming the Cavity

The pattern is housed in a box called the flask, and then packed with sand. A binder helps harden the sand into a semi-permanent shape. Once the



Picture 1. CAD design for a pattern.



Picture 2. Printing the pattern.

Application Tip: Sand castings generally have a rough surface, sometimes with surface impurities and surface variations.

A machining finish allowance is made for correcting these kinds of imperfections.

sand mold is cured, the pattern is removed. This leaves a hollow space in the sand in the shape of the desired part. The pattern is made larger than the cast to allow for shrinkage during cooling. Sand cores can then be inserted in the mold to create holes and improve the casting's overall shape. Simple patterns are usually open on top, allowing molten metal to be poured into them. Two-piece molds are clamped together. Molten metal is poured into a pouring cup from where it travels down a sprue and into the gating system. Vent holes are created to allow hot gases to escape during the pour. Ideally, the pouring temperature of the molten metal should be a few hundred degrees higher than the melting point, assuring good fluidity. The temperature difference also prevents premature cooling and the resulting voids and porosity. After the metal cools, the sand mold is removed and the metal part is ready for additional operations, such as cutoff and grinding.

Sprues and Runners

The molten material is poured into the pouring cup, which is part of the gating system that supplies the molten material to the mold cavity. The vertical part of the gating system that is connected to the pouring cup is the sprue, and the horizontal portions are called the runners. The multiple points where the material is introduced to the mold cavity are called the gates. Additionally there are extensions to the gating system, called vents, that provide the path for the built-up gases and the displaced air to vent to the atmosphere.

The cavity is usually made oversized to allow for metal contraction as it cools down to room temperature. This is achieved by making the pattern oversized. To allow for shrinking, the pattern must be oversized according to certain averaged factors. There are linear factors that apply in each direction. These shrinkage allowances are only approximate because the exact allowance is determined by the shape and size of the casting. In addition, different parts of the casting might require a different shrinkage allowance.



Picture 3. The sand casting mold – forming the cavity.



Picture 4. The pattern is removed from the flask.



Picture 5. The desired bronze cast model.

Disclaimer

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Reference: Erie Bronze & Aluminum Company. www.eriebronze.com

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