

| CASTING PROCESS | DESCRIPTION | METALS | SIZE RANGE | TOLERANCES | AVERAGE TOOLING COST | RELATIVE COST FOR HIGH QTY | RELATIVE COST FOR LOW QTY | SURFACE FINISH | MINIMUM DRAFT REQUIRED | MINIMUM SECTION THICKNESS | EASE OF CASTING COMPLEX DESIGNS | EASE OF CHANGING DESIGN | COMMENTS |
|-------------------------|--|--|---|---|----------------------|----------------------------|---------------------------|---|---|--|---------------------------------|-------------------------|--|
| GREEN SAND | Process that mixes raw sand, clay and water, which is then compacted around a pattern to create a mold. Most common type of molding, suitable for any production volume, and typically a low-cost option. | Most Castable Metals | All sizes per foundry capabilities | 0-3" = 0.03" per in. + 0.005" per in. for each additional in. Across parting line add 0.020" to small castings, 0.090" to large castings | Low | Low | Low | Ferrous: 420-900 RMS Aluminum: 175-350 RMS Copper Base: 300-560 RMS | 1-5 degrees | Ferrous: 0.250-0.375" Non-Ferrous: 0.125-0.250" | Fair to Good | Best | Most widely used casting process for both small and large production runs. |
| NO BAKE / AIRSET | Molding method utilizing raw sand combined with resins and binder to create a hard mold capable of improved surface finishes. Excellent for lower-volume parts where superior dimensional stability is required. | Most Castable Metals | All sizes per foundry capabilities | 0-3" = 0.03" per in. + 0.005" per in. for each additional in. Across parting line add 0.020" to small castings, 0.090" to large castings | Low | Low | Low | Ferrous: 420-900 RMS Aluminum: 175-350 RMS Copper Base: 300-560 RMS | 3-5 degrees | Ferrous: 0.250-0.375" Non-Ferrous: 0.125-0.250" | Fair to Good | Best | Widely used casting process for both small and large production runs. |
| SHELL | Resin-coated sand, typically of a smaller grain size than green sand, which is applied to a heated pattern that activates the resin to create a hard-shell mold. Exceptional surface finishes can be achieved with reduced machine stock and/or draft. | Most Castable Metals | Typical max mold area = 3000 in ² | Ferrous: +/-0.008" per in. up to 3" add 0.003" per in. over 3" Non-Ferrous: Add 0.005-0.010" per in. across parting lines, under 1" = +/-0.004" 1-3" = +/-0.010" 3-6" = +/-0.013" 6-12" = +/-0.016" 12-20" = +/-0.020" | Medium | Medium | Medium | Ferrous: 200-350 RMS Aluminum: 75-150 RMS Copper Base: 150-200 RMS | 0.5-2 degrees | Ferrous: 0.125" Non-Ferrous: 0.080" | Good | Fair | Used for production of fairly small parts for which closer tolerances and improved surface finishes are required than are obtainable from sand castings. Widely used in core production. |
| INVESTMENT | Casting process in which wax replicas are coated with a slurry mix of ceramic refractory and sand, allowed to dry, and then heated to extract the wax, leaving behind a near-net-shape cavity. Capable of creating shapes that are not possible by any other molding method, particularly for small or intricate components. Widely used to eliminate additional machining expense. | Most Castable Metals | 0.1 to 100 lbs | +/-0.005" per in. up to 3" add 0.002" per in. over 3" | Medium | High | Medium | 60-120 RMS | 0-1 degrees | Carbon Steel: 0.090" Stainless Steel: 0.125" Aluminum: 0.030" Copper Base: 0.030" | Best | Fair | Used for precision castings, particularly for complex designs. |
| LOST FOAM | Can be utilized in two different methods; The first method is similar to investment, in which a polystyrene replica is coated with ceramic refractory and then molded in sand. The second method consists of foam patterns that are molded into a media similar to no bake or airset. In either method, molten metal is poured directly into the sand mold and evaporates the foam during the casting process, creating a part with no draft or parting lines. | Most Castable Metals | Up to several hundred pounds | 0-3" = 0.03" per in. + 0.005" per in. for each additional in. Across parting line add 0.020" to small castings, 0.090" to large castings | Low | High | Low | Per type of foam used | None | Ferrous: 0.250-0.375" Non-Ferrous: 0.125-0.250" | Good | Good | Widely used for prototypes and low usage parts. In some cases patterns can be used more than once. |
| PERMANENT MOLD | Reusable metal tooling that can be used to create repeatable dimensional accuracy, typically used for decorative or ornamental products made from nonferrous materials. | Aluminum & Copper Base | All sizes per foundry capabilities; Aluminum = 0.5 to 100 lbs. | Aluminum: +/-0.015" per in. up to 1" add 0.002" per in. over 1" Across parting line add 0.010" to small castings, 0.030" to large castings | Medium | Medium | High | Aluminum: 125-200 RMS Copper Base: 175-225 RMS | Ferrous: 3-5 degrees Aluminum: 2-4 degrees Copper Base: 3-5 degrees | Ferrous: 0.187-0.250" Aluminum: 0.100-0.150" Copper Base: 0.100-0.150" | Fair | Poor | Used for moderate quantities of semi-precision castings. Normally less expensive than sand casting for 100's - 1000's of parts. Limited applicability for ferrous metals. |
| DIE CAST | Method in which molten metal is forced into a metal die under pressure. This process is suitable for repeatability of medium- to high-volume, intricate or close-tolerance parts. | Aluminum, Zinc, Magnesium, & Copper Base | Typical max mold area = 3 ft ² | 0.0015" per in. Not less than 0.002" on any one dimension. Across parting line add 0.010" | High | Low | High | 20-90 RMS | Aluminum: 1-3 degrees Zinc & Mag: 0.5-2 degrees | Aluminum: 0.050" Small 0.080" Med Zinc & Mag.: 0.025" Small 0.040" Med | Good | Poorest | Very widely used for high production of aluminum and zinc castings. An inexpensive way of obtaining precision parts. |
| CENTRIFUGAL | Process utilizing permanent tooling that is rotated horizontally or vertically while molten metal is introduced, typically used to manufacture pipe or other cylindrical products. | Most Castable Metals | OD 2 to 50 in; Length & wall thickness per foundry capabilities | OD = 0.1" Small Dia ID = 0.03-0.06" | None | Low | Medium | 250-500 RMS | None | Per foundry capabilities | Not Practical | Good | Used for round tubular or cylindrical castings. ID will likely require machining due to impurities. Excellent casting soundness. |
| V-PROCESS | Dry sand molding method that uses a vacuum to hold a membrane on the surface of the pattern, which is then backfilled with sand. Advantages are exceptional surface finish and tighter dimensional control than most conventional sand casting processes. | Most Castable Metals | All sizes per foundry capabilities | +/-0.010" per in. up to 1" add 0.002" per in. over 1" Across parting line add 0.020" max | Medium | Medium | High | 125-250 RMS | None | 0.090-0.125" | Good | Good | Unlimited pattern life. Used for medium to high volumes. |