CASTINGS & FORGINGS

ALUMINUM, BRASS & STAINLESS STEEL FORGINGS
ALUMINUM, BRONZE & ZINC DIE CASTINGS
BRONZE ALLOY, DUCTILE & GREY IRON SAND CASTINGS
STAINLESS STEEL & STEEL INVESTMENT CASTINGS

DEECO is one of the largest suppliers of raw material and semi-finish and finish machined metals in the industry. Our commitment to excellence is evident in the customers we serve, including Boeing, Disney, the world's largest automobile manufacturers, the U.S. Government and the business next door. Our Castings and Forgings are used all over the world by some very demanding companies. We look forward to adding your company to our list of satisfied customers.

Investment Castings

Very fine surface finishes and excellent reproduction of detail are characteristic of the investment casting, or lost wax process. The process was practiced by several ancient cultures and has survived virtually without modification for the production of artwork, statuary and fine jewelry. Today, the process's most important commercial application is in the casting of complex, net shape precision industrial products such as impellers and gas turbine blades.

The process first requires the manufacture of an intricate metal die with a cavity in the shape of the finished product (or parts of it, if the product is to be assembled from several castings). Special wax, plastic or a low melting alloy is cast into the die, then removed and carefully finished using heated tools. Clusters of wax patterns are dipped into a refractory/plaster slurry, which is allowed to harden as a shell or as a monolithic mold.

The mold is first heated to melt the wax (or volatilize the plastic), then fired at a high temperature to vitrify the refractory. Metal is introduced into the mold cavity and allowed to cool at a controlled rate. The sequence of steps involved in the investment method are illustrated in Figure A.

Investment casting is capable of maintaining very high dimensional accuracy in small castings, although tolerances increase somewhat with casting size. Dimensional consistency ranks about average among the casting methods; however, surface finishes can be very fine and the process is unsurpassed in its ability to reproduce intricate detail.

Investment casting is better suited to castings under 100 lbs (45 kg) in weight. Because of its relatively high tooling costs and higher than average total costs, the process is normally reserved for relatively large production runs of precision products, and is not often applied to copper alloys.

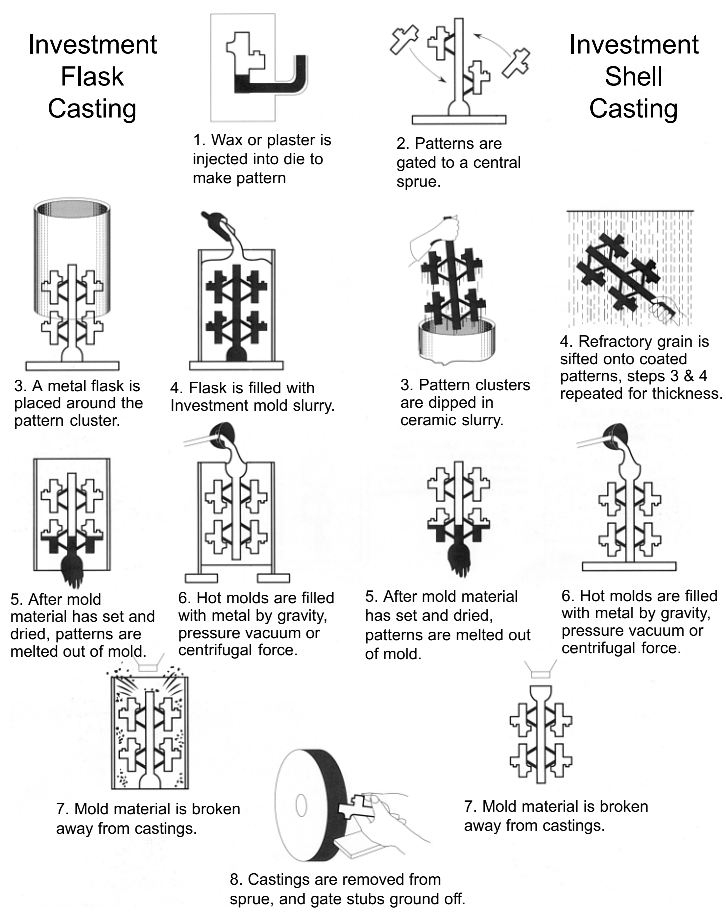


Figure A

Permanent Mold or Gravity Die Castings

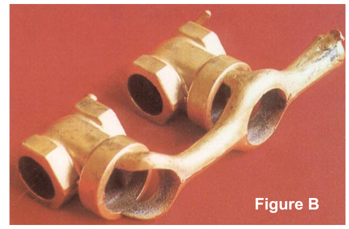


Figure B

Reusable or metal-mold processes are used more extensively for copper alloys in Europe and England than in North America; however, they are gaining recognition here as equipment and technology become increasingly available. Permanent mold casting in North America is identified as gravity die casting or simply die casting in Europe and the U.K. The process called die casting in North America is known as pressure die casting abroad.

Permanent Mold casting utilizes a metallic mold. The mold is constructed such that it can be opened along a conveniently located parting line. Hot metal is poured through a sprue to a system of gates arranged so as to provide even, low-turbulence flow to all parts of the cavity. Baked sand cores can be provided just as they would be with conventional sand castings. Chills are unnecessary since the metal mold provides very good heat transfer. The nature of the process necessitates adequate draft angles along planar surfaces oriented perpendicular to the parting line. Traces of the parting line may be visible in the finished casting and there may be some adherent flashing, but both are easily removed during finishing.

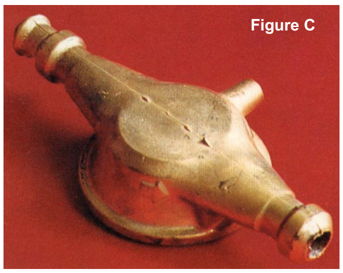


Figure C

Permanent mold castings are characterized by good part-to-part dimensional consistency and excellent surface finishes. Any traces of metal flow lines on the casting surface are cosmetic rather than functional defects. Permanent mold castings exhibit good soundness. There may be some microshrinkage, but mechanical properties are favorably influenced by the castings' characteristically fine grain size. The ability to reproduce intricate detail is only moderate, however, and for products in which very high dimensional accuracy is required, plaster mold or investment processes should be considered instead.

Permanent mold casting is more suitable for simple shapes in mid-size castings than it is for very small or very large products. Die costs are relatively high, but the absence of molding costs makes the overall cost of the process quite favorable for medium to large production volumes. Figures B and C show typical permanent mold castings.

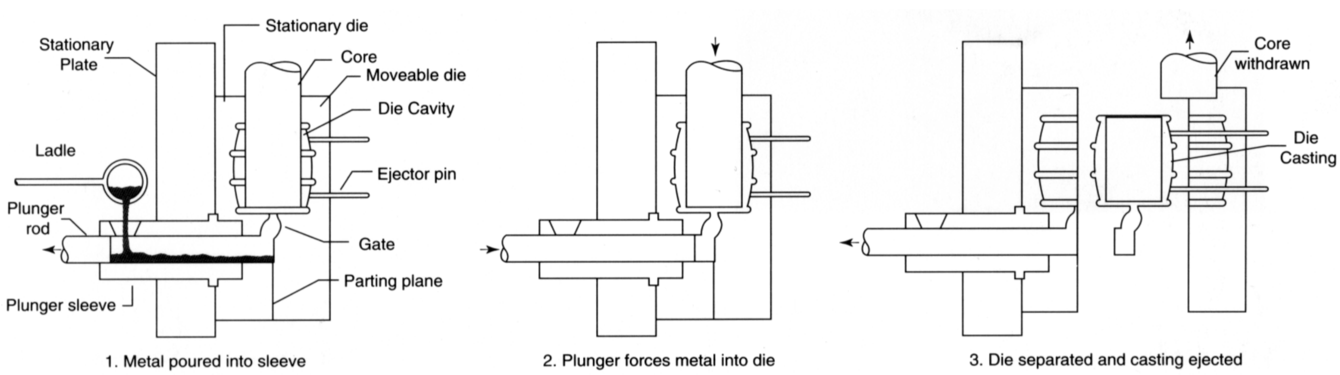
Die Castings

Die casting involves the injection of liquid metal into a multipart die under high pressure. Pneumatically actuated dies make the process almost completely automated. Die casting is best known for its ability to produce high quality products at very low unit costs. Very high production rates offset the cost of the complex heat-resisting tooling required; and with low labor costs, overall casting costs are quite attractive.

The process can be used with various metals and alloys, including yellow brass, C85800, manganese bronzes, C86200 and C86500, silicon brass, C87800, the special die casting alloys C99700 and C99750, DZR (Dezincification and Low Lead alloys), Aluminum alloys, Titanium and Magnesium alloys, and a few proprietary compositions. These alloys can be die cast because they exhibit narrow freezing ranges and high beta phase contents. Rapid freezing is needed to complement the process's fast cycle times. Rapid freezing also avoids hot shortness associated with prolonged mushy solidification. Beta phase contributes the hot ductility needed to avoid hot cracking as the casting shrinks in the mold.

Highly intricate copper alloy products can be made by die casting (investment casting is even better in this regard). Dimensional accuracy and part-to-part consistency are unsurpassed in both small (<1 in, 25 mm) and large castings. The attainable surface finish is better than any other casting process. Die casting is ideally suited to the mass production of small parts. The process is illustrated in the figure below.

Rapid cooling rates (dies are normally water cooled) results in very fine grain sizes and good mechanical properties. Leaded alloys C85800 and C99750 can yield castings that are pressure tight, although lead is incorporated in these alloys more for its favorable effect on machinability than for its ability to seal porosity.

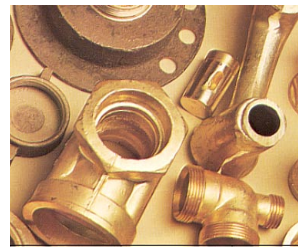


Sand Castings

Sand casting currently accounts for about 75% of U.S. copper alloy foundry production. The process is relatively inexpensive, acceptably precise, and above all, highly versatile. It can be utilized for castings ranging in size from a few ounces to many tons. Further, it can be applied to simple shapes as well as castings of considerable complexity, and it can be used with all of the Copper, Stainless Steel, Cast Iron and Aluminum casting alloys, among others.

Sand casting imposes few restrictions on product shape. The only significant exceptions are the draft angles that are always needed on flat surfaces oriented perpendicular to the parting line. Dimensional control and consistency in sand castings ranges from about +/- 0.030 to +/- 0.125 in (+/- 0.8 to 3.2 mm). Within this range, the more generous tolerances apply across the parting line. With proper choice of molding sands and careful foundry practice, surprisingly intricate details can be reproduced. There are a number of variations on the sand casting process.

Other Casting Processes



Recent years have seen the introduction of a number of new casting processes, often aimed at specific applications. While these techniques are still to some extent under development and while they are certainly not available at all job shop foundries, their inherent advantages make them valuable additions to the designer's list of options.

Squeeze Casting. This interesting process aims to improve product quality by solidifying the casting under a metallostatic pressure head sufficient to (a) prevent the formation of shrinkage defects and (b) retain dissolved gases in solution until freezing is complete. This method was originally developed in Russia and has undergone considerable improvement in the U.S. It is carried out in metal molds resembling the punch and die sets used in sheet metal forming.

After introducing a carefully metered charge of molten metal, the upper die assembly is lowered into place, forming a tight seal. The "punch" portion of the upper die is then forced into the cavity, displacing the molten metal under pressure until it fills the annular space between the die halves.

Proponents of squeeze casting claim that it produces very low gas entrapment and that castings exhibit shrinkage volumes approximately one half those seen in sand castings. Very high production rates, comparable to die casting but with considerably lower die costs, are also claimed. The process produces the high quality surfaces typical of metal mold casting, with good reproduction of detail. Rapid solidification results in a fine grain size, which in turn improves mechanical properties. It is claimed that squeeze casting can be applied to many of the copper and aluminum alloys, although die and permanent mold casting alloys should be favored.

IMPRESSION DIE FORGING

ADVANTAGES OF THE FORGING PROCESS

Deeco can provide your company with substantial savings without sacrificing product characteristics or quality. In fact, *the integrity of your product can actually be enhanced while your costs are reduced*.

One of the best-kept secrets in metal technology is the Forging process. Metal Forging has tremendous advantages over other manufacturing methods such as extrusions, castings, and machining from bar stock. If your company is not benefiting from these advantages, they should be - here's why!

- *Extensive Cost Savings*
- *Across the Board Time Savings*
- *Significant Product Improvements*
- *Innovative Manufacturing Enhancements*

Cost Savings

One of the most important benefits of forging technology is the *added productivity* gain due to fewer secondary operations. Fewer secondary operations (such as machining and waterjet cutting) result in a much lower cost per piece, especially when compared to extrusions, castings, or solid blocks. The bottom line is more parts manufactured in less time.

In addition to increased productivity, there are *material and quality advantages* as well. For example, unlike casting, a forging is not subject to "blow holes". Blow holes can wreak havoc on a parts cosmetic appearance and material quality. Forging technology also provides excellent natural surface finishes. These preferred finishes result in less time spent on preparing parts for polishing, anodizing or coating. It also improves the material structure leading to improved product integrity.

Forging technology also produces significantly less machine shavings, saving you machine time, money, and room on your shop floor. Additional savings are achieved by designing cavities or pockets into the part. These designs can be added to flat surfaces, potentially increasing the overall appeal and making the product more desireable. It also adds to the practicality of machining and reduces the overall weight of the part providing even more savings in shipping and handling.

Further cost recovery starts at the beginning of the forging process with the die tool. This is because the technology used in producing this tool provides the die with longer life, especially when compared to a die from an extrusion. In addition, any repair or replacement for a forging tool would be at our expense.

No doubt, one of the most substantial advantages of forging technology comes from the ability to use one blank for *multiple designs* if required. Imagine the possibilities and innovation this can bring to your manufacturing process. Furthermore, buying smaller quantities of forged parts will not affect the price as significantly as it would for smaller quantities of extruded parts.

Time Savings

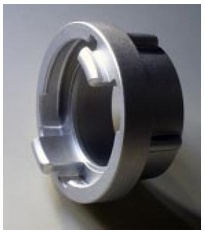
In general, forgings offer tremendous productivity gains which ultimately result in real time savings. The previously mentioned reduction in initial and secondary operations is one of the most significant assets forgings can offer. When examined closely, *the realization of what is involved in your initial and secondary operations can be an astonishing revelation*.

When you think about timesaving, consider your machining. Machining can eat you alive in time and money if you are not careful (and sometimes even when you are careful). Forgings provide you with a part that is "near net shape" with better surface finishes. *These advantages can slash your machining expenses by over 50%!* They also allow you to increase machine capacity and free up labor to concentrate on other jobs.

Did you know that forging technology can also speed up your material purchases? It's true! Once a tool has been completed, it takes less time to manufacture a forged part then it does an extrusion or casting. In addition, forging dies are more flexible when it comes to design changes or revisions.

In summary, forging related timesaving ultimately translates to better service through reductions in rejects and returns, and faster deliveries to your customers. Remember, speed kills! *(Your competition.)*

Product Improvements & Manufacturing Enhancements



Forgings are generally *stronger* than bar stock or extrusions because of their superior grain structure. This grain structure provides higher integrity and absence of defects, which results in improved economical use of material.

Additionally, forgings provide *lower scrap yield*; the ability to add pilot marks or dimples for machining or drilling; and the ability to add webs or ribs to thin parts for increased strength or rigidity. When compared to extrusions, forgings will not twist or warp during machining because the inherent stresses in extrusions do not exist in forgings. Also, a forging can be cored for less machining and greater material savings.

Design flexibility is another important advantage. Forgings offer the ability to create shapes that are more complex with increased efficiencies, many times altering the overall attractiveness of the part. A forging can also allow for longer lengths and wider widths and can be created using three dimensional thinking and designs. Better blending and radiuses can be added to improve the overall look of the product. We can even use your existing CAD drawings for providing semi finish or finish machined parts.

The key to our success has been the devleopment of a close working relationship with our clients to meet and exceed their expectations. With over 75 years of combined technical experience, we have developed a highly competent sales and service organization.

CALL DEECO TODAY. FIND OUT WHICH PROCESS IS RIGHT FOR YOU AND GET THE BEST PRICES IN THE INDUSTRY. ***CALL TOLL FREE 1-800-BRASS-84***

TEL. 908-688-0333
FAX 908-686-0936

600 Bloy Street, Bldg. 5
Hillside, New Jersey 07205 USA

E-MAIL: info@deeco.net
INTERNET: www.deeco.net