# Dr. Die Cast

## An "Element"-ary Guide to Die Casting Alloys

**(Choosing the casting material that best suits your (customer's) project)**

High Pressure Die Casting, HPDC (die casting) is the fastest way to produce a near-net-shape or net-shape casting. How do we as an industry assist our customers to choose both the process of die casting and the alloy best suited for their application? One is by recognizing who or what processes are our competitors. And it is not the die caster in the next city, state or country. My late mentor George Spalding used to tour potential customer's assembly plants and pick up parts or assemblies produced by other processes and methods and volunteer to quote them as a die casting. The parts he was proposing to replace could have been steel or iron sand castings, screw machine parts, welded-fabrications or stampings. The point is, he was proposing to provide a die cast solution at lower cost, higher quality and with higher volume capabilities than the existing product. The new material and process required engineering design & testing. Once completed, many of the new die cast products became the new "normal."

**Selecting the "ideal" material:** I have observed that sometimes when engineers who are unfamiliar with die casting will "cherry pick" materials from all the available listed alloys. For example, if the new product must conduct electricity, the designer may select an alloy based on the highest conductivity. However, with the higher conductivity may come a significantly higher cost, both for raw material and operating costs.

Ductility is another attribute that is often placed as top priority. There are several available alloys that have excellent ductility. However, several are not "plug and play." Some alloys require occasional spectral analysis checks of the melting and holding furnaces and must be "sweetened" to maintain the chemistry within a very tight specification.

With aluminum die casting, tool life can vary greatly depending on the product design and wall sections. High purity tool steel alloys and state of the art heat treatment processes and die surface coatings can greatly improve tool life. These may be essential when using some of the more exotic alloys just to achieve a tool life that would be considered normal when using the more popular alloys like 380.

Remember, 380 is usually the most economical choice for aluminum die casting.

**Lead:** We do not often hear of lead die casters but they exist for the battery industry and battery cables. The plungers, gooseneck components, holding pots and dies seemingly last forever as there is simply no measurable wear. Personnel in lead plants were self-disciplined at washing their hands long before COVID-19 mandated frequent hand washing.

**Magnesium:** Magnesium is the lightest of the die casting alloys. It is one third lighter than aluminum. It was popularized for military use when aluminum was in short supply. It can be die cast using hot-chamber, cold-chamber or Thixo-molding machines. AZ-91D is the most popular alloy with AM-60 close behind. The number one safety practice in a magnesium die cast shop is stringent housekeeping. I have visited magnesium die casting shops where the shop floor was just as clean as an office floor.

**Pewter:** Dr. Sam Ramrattan and his students die cast pewter to demonstrate their "Die Casting in a Box" miniature die casting machine to produce Western Michigan University medallions. Pewter has long been a popular material for collectibles and memorabilia. Since its melting point is lower than lead, tooling and melting equipment lasts much longer than with higher temperature materials such as lead and zinc.

**Zinc:** If thin walls and high finish such as plating or other decorative surface finishes are your requirement, then zinc die casting is your choice. If the casting is subject to "load bearing" then be sure to investigate some of the "low creep" alloys that are available. There are ZA alloys that contain high percentages of aluminum that provide extra strength.

Due to its lower operating temperature, zinc tooling generally requires less maintenance than it does for aluminum die castings. For high volume jobs this can be a major long term cost saving.

While current zinc prices in recent years are higher per pound than aluminum, the ability to reduce the wall section can reduce the casting weight to the point that it is competitive. Especially if you factor in tool repair and replacement.

If you need to go super thin wall, there is a "high fluidity" zinc alloy for that.

In North America, Number 3 zinc is the most popular alloy.

**Who's Dr. Die Cast?**
**Robert P. McClintic**
*Die Casting Consultant*

**Bob McClintic & Associates**
523 Lincoln Lawns Dr. NW
Walker, MI 49534

RMcClintic@ameritech.net
www.drdiecast.com
616.292.0454