What is high pressure die casting?

High pressure die casting is a process in which molten metal is forced under pressure into a sealed mold cavity. It is held in place by a powerful compressive force (a real mold installed in a hydraulic press) until the metal solidifies.

After solidification, the mold is released, opened and the metal released.

After removal, the mold cavity is resealed for the next cycle.

Molten metal is injected into the mold cavity in fractions of a second (usually less than 100 milliseconds). Filling the mold cavity once, applying extremely high pressure (often in excess of 1000 bar) into a true injection plunger of molten metal. This stage is called reinforcement.

This pressure compresses any gas in the metal (during the extremely fast and turbulent cavity filling process) and sends more metal into the mold, partially compensating for the metal's shrinkage as it solidifies.

In addition to the traditional high pressure die casting method, there have been many improvements to the process in recent years. E.g:

Vacuum die casting

semi-solid casting

squeeze casting

High Pressure Die Casting: Hot and Cold Chamber Systems

To inject molten metal into a mold, two different systems are available:

Hot cell system

cold room system

Let's learn more about these two processes.

Hot cell system

Hot cell systems are used for metals such as zinc, magnesium and lead.

The injection system of the hot cell machine is immersed in the molten metal from the blast furnace. As the piston pumps, it forces the metal along the nozzle into the mold.

cold room system
Cold chamber systems are used for metals that melt at high temperatures, such as aluminum, copper, and magnesium.

Magnesium parts can be produced using either system, although generally small parts are made in hot chamber systems and large parts are made in cold chamber systems due to the limited size of hot chamber machines.

In this system, higher pressures are used compared to the hot cell system. Hot chamber machines are more productive than cold chamber machines because less time is required for the pouring process.

The cold room system also uses two injection systems in this process:

horizontal jet
vertical injection
In this system, molten metal is poured manually or automatically into openings leading to channels feeding the cold chamber.

A hydraulically driven piston moves down the steel channel, blocking the light and pushing the metal into the mold at high speed and pressure.

After the fluid solidifies, the piston is pulled back, the mold opens, the fluid is expelled, and the system is ready to start again.

Advantages of high pressure die casting
Advantages of high pressure die casting include higher production speeds compared to flow casting under gravity.

Additionally, the ability to generate streams of specific sizes significantly reduces processing operations.

The fusion has a good surface finish, which is a basic requirement for electroplating, and the thickness of the board wall can be reduced by reducing the overall weight of the fusion.

Molds are durable, which reduces unit cost price and allows for the

manufacture of more complex parts, reducing the number of components required each time.

High Pressure Die Casting at FAIST
For some time now, FAIST has focused on providing a high level of high pressure die casting processes, backed by a knowledgeable team, especially leading edge technology.

The initial steps in this process are analysis, especially fluid dynamics, thermal analysis, and finite element analysis, which are critical to optimizing the process and ensuring the high quality of the products produced. The simulation and virtualisation of the mould development phase are also very important steps and they are created directly by the FAIST dedicated department.

This high-quality production is made possible thanks to the advantages of a highly hygienic alloy process with central and local degassing systems, global process thermal control, and DC tool sensors for temperature and pressure. About the device FAIST also has:

Low oxide dosing system
Fondarex Vacuum Systems
High vacuum tools
Thermal control, unit oil, pressurized water, water-air, jet cooling
Additive Manufacturing of High Thermal Control Tool Inserts
special nozzle
Semi-solid metal GISS device
semi-solid metal casting
Semi-solid metal casting (SSM) is an extremely high level process that can achieve excellent results and is suitable for very special production lines; a prerequisite for only a few top companies.

This process (SMM) is actually a variant of high pressure die casting and is based on non-ferrous metals (magnesium, copper and aluminium). It effectively unifies the advantages of casting and forging. It's named after a fluid property called thixotropy, the effect that allows the process to work. In a simple way, the molten metal is stirred and partially solidified (in varying

percentages of solids) by obtaining a spherical microstructure (true aluminum dendrites break up). The spherical structure increases the kinematic viscosity, which in turn improves the flow of the metal. This pre-cured formulation, called a slurry, is then injected into the mold cavity as in the usual HPDC process. Due to the thixotropic slurry properties, small part thicknesses can be filled, with better quality in certain conditions, due to less air entrapment and less shrinkage porosity (partial solidification of metal) during cavity filling. The result of previous improvements has been to improve the electrical conductivity, mechanical properties, weldability, heat treatability of the alloy.