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Research Article

Die Design and Analysis of High Pressure Die Casting Die for Oil Pan

Anuj Chaudhary and Pardeep Rana

Department of Mechanical Engineering, Seth Jai Parkash Mukand Lal Institute of Engineering and Technology, Radaur,Yamunanagar, Haryana, India

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Abstract

Pressure die casting is about 150 years old and one of the widely used processes for the mass production of components required in many applications like automobiles, electrical equipment, motors, telecommunications equipment, building hardware, home appliances, etc. The design of die casting die requires considerable skill and expertise. Designer purposes designs of dies employed to cast parts from various alloys and perform a variety of other operations. Every new job requires original thought in its design and the solving of individual problems in its manufacture. Each die cast component, currently in production, presents a challenge for the improvement of its output and quality. The objective here is to design dies to be fit for the purpose, operate at optimum shot rate and is of reasonably simple construction. The main purpose of this report is to present the systematic design procedure for pressure die casting dies. Die casting dies like any other type of tooling can be very simple and very complex. How difficult is to design and build depends entirely on the parts to produce. They can be as simple as a single cavity die with no side cores or they can be complicated dies, which represent split dies along with moving cores actuated by either finger cams or hydraulic cylinders depending on the feasibility. This project involves design of die casting die for the Cover Cylinder Head-1 for two wheeler. The scope of the project involves: Component Study, Design Calculations, Designing the tool.

Keywords: *Die Design, High Pressure Die Casting Die etc.*

1. Introduction

Aim: Aim of this project is to design a High Pressure Die Casting die for OIL PAN, for 4W ENGINE by taking into account of the manufacturing resources and capability of the company within minimum possible time and economic cost of manufacturing to meet all the customer requirements and to produce the component with low rate of rejection.

Background of the project: The project is carried out at Endurance Technologies Pvt Limited. The project involves the designing and development of the Die Casting Die Tool used for the mass production of the component Oil Pan for a four Wheeler engine. The material of the component is Cast Alloy ADC-12.

Scope of the project: The scope of the project involves,

- Component Study
- Design Calculation
- Layout Design
- Designing the tool
- Preparation of detailed drawings of the parts involved.

*Corresponding author's ORCID ID: 0000-0001-8938-5127

2. Literature survey

2.1 Die Casting

Die casting is a versatile process for producing engineered metal parts by forcing molten metal under high pressure in to reusable steel moulds. These moulds, called dies, can be designed to produce complex shapes with a high degree of accuracy and repeatability. Parts can be sharply defined, with smooth or textured surfaces, and are suitable for a wide variety of attractive and serviceable finishes.

This process involves the use of a furnace, metal, die casting machine and die. The metal, typically a non ferrous alloy such as aluminum or zinc, etc is melted in the furnace and then injected into the dies in the die casting machine. There are two main types of die casting machines are hot chamber machines (used for alloys with low melting temperatures, such as zinc) and cold chamber machines (used for alloys with high melting temperatures, such as aluminum). The difference between these machines will be detailed in the sections on the equipment and tooling. However, in both machines, after the molten metal is injected in to the dies, it rapidly cools and solidifies into the final part, called the casting.

Die castings are among the highest volume, mass produced items manufactured by the metal working industry, and they can be found in thousands of consumers, commercial and industrial products. Die cast parts are important components of products ranging from automobiles to toys. Parts can be as simple as a sink faucet or as complex as a connector housing.

All die casting process types are designed with the same goal in mind-cast a mould using injected molten metal. Depending on the type of melted metal, part geometry and part size, different die casting processes can deliver superior results over alternative methods. Depending on the rate by how much clamping force they can apply, typical ratings are between 400 and 4000 short tons.

3. Company profile

3.1 Profile

Endurance was established in 1985 as Anurang Engineering Co. Pvt. Ltd. to manufacture Aluminum Die Casting products at Aurangabad, Maharashtra (India). The Endurance Group is a global force in Aluminum Casting (including Alloy Wheels), Suspension, Transmission and Braking products with annual sale revenue of US$ 564 Million from domestic operations and approx. US$ 165 Million from overseas operations for the year 2010-2011. Endurance Group has 19 Plants across India, Italy & Germany.

Endurance is a name that spells strength and the will to perform. Our Core business is focused on becoming the component partner of choice for leading Automobile Manufacturers. Assisted by a strict quality regime, interaction with customers and an eye on emerging needs, we have carved a niche to cater to some of the world's leading Automotive Manufacturers.

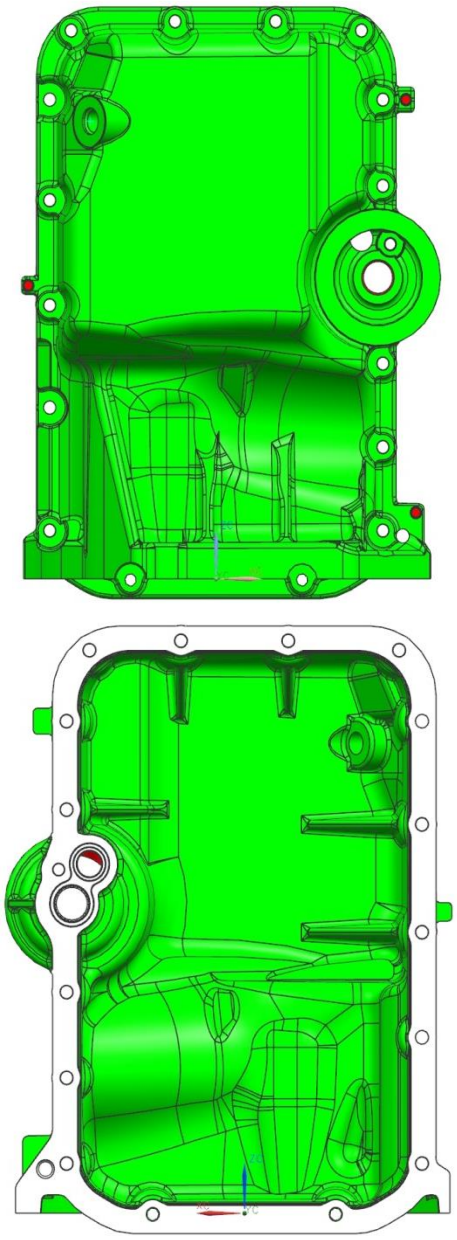
On the strength of our experience and the depth of our Technological Expertise, we have now geared up to launch ourselves on the high growth global circuit.

4. Methodology

4.1 process flow

- Check the 3D Model and 2D Drawing given by the customer
- Ensure that 3D Model matches with the 2D drawing and make model inspection report
- Identify critical and major dimensions
- Check for design feasibility and decide parting line
- Get customer approval for the selected parting line
- Add drafts to the model considering tolerances for MMC
- Add shrinkage to the model
- Generate surface as per the decided parting line
- Split core and cavity considering the manufacturing aspects
- Check for draft analysis and clearance analysis
- Optimize feed system as per the filling pattern shown by MAGMA
- Create model base
- Provide ejector positions in the component and inserts
- Create cooling holes
- Conduct concept design review meeting
- Change the model or layout based on the review output
- Freeze the layout
- Prepare detail drawings of inserts and mold base elements
- Checking of the detail drawing
- Release drawings to manufacturing
- Check for any design non-conformity with the assembly division.

4.2 Product study



Component name=Oil Pan
Application= 4W Engine
Material= ADC-12
Volume of component= 893.497cm^3
Density of component= 2.56 gm/cm^3
Projected area of component= 734.31 cm^2
Side Core Projected area=174.10 cm^2
Weight of component= 2412.4 gm (2.4 kg)
Radius of gyration= 131.966 mm
Factor of safety= 15 %
Average Wall Thickness=4±0.5 mm
Maximum thickness =20mm

Conclusion

In this project the following learning's were made:

- Systematic approach leads to better understanding and yields a better result.
- Usage of technology helped in achieving the targets
- Team work yields the best result
- Able to reach the customer expectations within the limit
- Launched the product at the least rejection levels
- Design reviews will help in identifying the problems and solving the same with team work

Component "OIL PAN" was given as my project to analyze, design and to develop the tool. The die design was completed successfully and sent for manufacturing.

Apart from the above mentioned project, I have done the data management, detailing and product designing for other castings.

Acknowledgement

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