

METAL CASTING

Project Fact Sheet



INTEGRATING RSP TOOLING AND RAPID PROTOTYPING IN DIE CASTING

RAPID SOLIDIFICATION PROCESS CAN REDUCE LEAD TIME AND IMPROVE PRODUCTIVITY IN DIE CASTING

BENEFITS

- RSP Tooling can reduce the cost of making die casting dies by reducing machining operations and capital equipment and by using less expensive starting materials (cast vs. forged H13 tool steel) to produce the dies.
- RSP Tooling reduces the delivery time to market.
- RSP Tooling can achieve huge energy by eliminating tool steel unit operations, reducing machining operations, heat treating at low temperatures, and increasing die life.

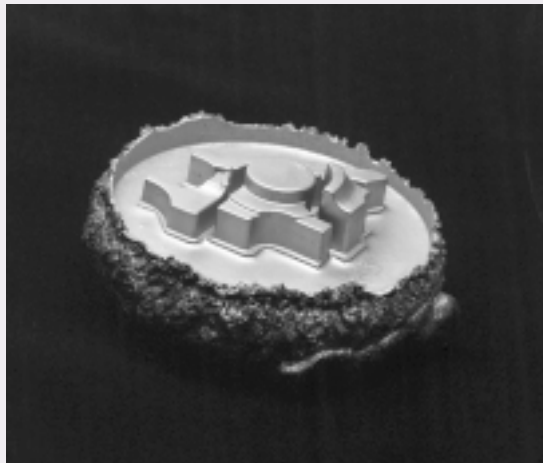
Die casting can quickly produce intricate, high quality metal components in high volume. However, die casting dies continue to be manufactured through the use of machining practices, materials, and heat treatment practices developed many years ago. The need for innovation in die casting is reflected in recent R&D projects. These projects seek to improve the turnaround time of tooling for making prototypes, and to develop a better understanding of the microstructure, chemistry, and heat treatment of hot forming die steels that lead to die life extension. In this project, a new and unique Rapid Solidification Process (RSP) technology will be introduced to the die casting industry that will reduce lead time for prototyping and producing die casting tooling. In addition to productivity increase, use of RSP Tooling technology will also result in a substantial reduction in energy use and scrap than conventional machining practices.

RSP Tooling is a spray forming technology tailored for producing molds and dies. The approach combines rapid solidification processing and net-shape materials processing in a single step. The concept involves converting a mold design described by a CAD file to a tooling master using a suitable rapid prototyping technology such as stereolithography. This is followed by spray forming a thick deposit of tool steel on the pattern to capture the desired shape, surface texture and detail. The resultant metal block is cooled to room temperature, separated from the pattern, and squared up to fit a standard holding block. The turnaround time for die casting tooling is significantly less than traditional tooling.

APPLICATIONS

This project addresses the need for developing a low-cost, rapid tooling technology for die casting applications. In addition to achieving industry goals in lead-time reduction and productivity, the project will also develop technologies that can quickly convert design concepts into actual designs for manufacturing die casting tooling.

H13 SPRAYED GEOMETRY



As-deposited H13 tool steel die for die casting applications.



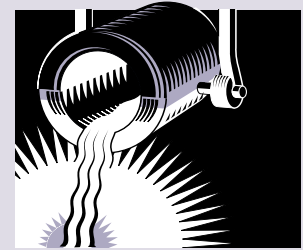
Showcase Description

Goal: The goal of this project is to develop a rapid tooling technology that can reduce lead time for production of die castings. The rapid solidification (via spray forming) based tooling approach should also increase productivity in die life cycle times and reduce energy consumption associated with producing dies.

Progress and Milestones

This three year project was awarded in August 2000. Planned project activities include:

- **Model Geometry, Pattern and RP/CNC** – Die cast part geometry will be selected for use in RSP. Unigraphics will be the primary design software. Researchers will review and select RP and CNC processes to fabricate model pattern.
- **Ceramic Tool Pattern for Casting** – This step will establish and translate requirements into quality factors for ceramic tool pattern. Vacuum mixing, de-airing and casting equipment will be designed to improve process during ceramic casting. Ceramic patterns will be produced using implemented equipment and an evaluation on the new process will be conducted.
- **Modification of RSP Tooling for H-13 Steel Dies** – H-13 tool steel will be sprayed to verify modification of the tooling technology. Dies will be produced using a bench scale system.
- **Analysis of H-13 Dies** - Various analyses will be conducted on the fabricated H-13 dies, including optical microscopy, scanning electron microscopy (SEM), x-ray diffraction, etc.
- **Optimization of Aging Heat Treatment** – The structure and properties leading to die life extension will be evaluated. Researchers will optimize aging heat treatment and produce extended-life dies.
- **RSP Tooling Inserts** – Applied research in the first two years will focus on using RSP tools produced with the modified RSP tooling technology. In the third year, it will focus on using RSP tools produced with the scaled (4x) tooling technology.



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