

# METAL CASTING

## Project Fact Sheet



## CREEP RESISTANT ZINC ALLOY DEVELOPMENT

### BENEFITS

Due to the lower melting temperature of zinc significantly less energy is required to produce zinc die castings than other light weight alloys. In addition, most zinc castings are made via the more efficient hot chamber die casting process. By improving the creep resistance of zinc-based alloys produced using the hot chamber process, and thereby increasing the range of applications for these alloys, this project can result in significant energy savings and emission reductions.

### APPLICATIONS

The results of this research can be applied throughout the zinc die casting community and should increase the range of zinc-based cast components. Zinc-based cast components can be used in high temperature applications. They can respond to needs for high strength, light weight castings in automobiles as well as components in hardware, plumbing and electronic appliances that are used in high temperature environments.

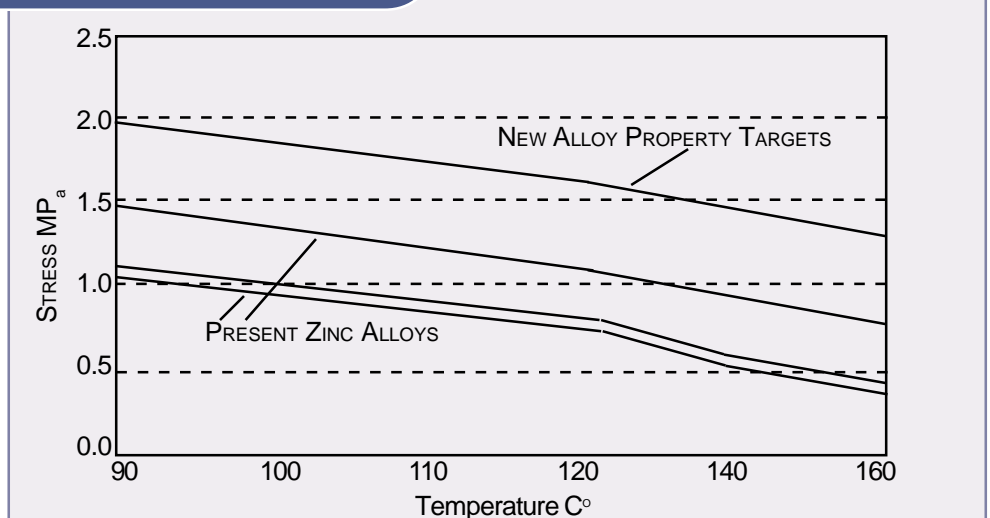
## DEVELOPING HIGHER STRENGTH ZINC-BASED ALLOYS SUITABLE FOR HOT CHAMBER DIE CASTING

The hot chamber die casting process, by which almost all zinc alloys are cast, is known to be a more efficient casting process than the cold chamber technique. Moreover, because zinc has a lower melting point than other lightweight alloys, considerably less energy is used in melting. However, applications for zinc alloys have been limited due to low creep resistance -- a slow deformation that limits the ability to sustain loads for long periods of time at elevated temperatures. Although creep is common in all metal alloys, light metal alloys with a higher creep resistance are often selected over zinc. These alternatives typically have a higher melting temperature and are cast using the cold chamber process.

The objective of this project is to develop zinc-based die casting alloys, suitable for processing by the hot chamber die casting process, that have higher creep resistance. This responds to the need for improved energy efficiency in melting as well as the demand for castings that exhibit improved properties, lighter weight and higher strength. Both are important targets in the *Metal Casting Industry Technology Roadmap*.

In this project, researchers will develop a more complete empirically based prediction model of the effect of zinc alloy composition and phases on creep strength. Based on the results from this model, they will die cast several compositions to produce samples suitable for creep testing. Plant trials and casting campaigns will be run to aid in testing. Results will be transferred to industry.

### IMPROVING ZINC ALLOY STRENGTH



New alloy targets high temperature strength improvements.



## Project Description

**Goal:** The goal of this research is to develop higher creep strength hot chamber die castable zinc alloys. Specific objectives include:

- expanding the database on creep behavior of zinc alloys that are hot chamber die castable, allowing better analytic prediction of promising compositions of future alloys.
- using the above data to develop at least one hot chamber die castable zinc alloy that has the target properties identified in a previous market survey, including: temperature capability of 140°C to 160°C; creep stress of 4500 psi; exposure time of 1,000 hours; and maximum creep elongation under the above conditions, of one percent or less.

## Progress and Milestones

This three-year project began in 2000. Specific tasks include:

### Task One: Data Generation and Modeling

- Experimental Design - Completed in March 2000, 96 alloys were identified for investigation. After screening, 36 alloys were selected for casting experiments. As wide a range as practical for each element will be studied. The analysis will use the Response Surface Modeling (RSM) method.
- Alloy Preparation and Characterization - Heats of experimental alloys, suitable for hot chamber die casting, will be made by induction air melting.

### Task Two: Refinement and Optimization

- Experimental Design - Task One results will be used to design a small series of alloys with optimized property combinations in terms of creep, castability, and die attack.
- Alloy Preparation and Characterization - Selected alloys will be prepared for creep testing. A detailed assessment will be made of appropriate melting and casting practices.

**Task Three: Creep Testing and Technology Transfer** - In conjunction with the Cast Metals Coalition and the Industry Monitoring Team for the project, technical results will be disseminated by the research team to the die casting industry.



### PROJECT PARTNERS

International Lead Zinc Research Organization  
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