# METALCASTING

**Project Fact Sheet**

# Titanium Matrix Composite Tooling Material for Enhanced Manufacture of Aluminum Die Castings

## Benefits

- Reduces energy consumption by 4 to 8 percent by reducing heat loss associated with aluminum shot preheating at the sleeve
- Extends sleeve life by at least 4 times over H-13 steel
- Reduces downtime in die-casting
- Improves product quality through longer continuous operations and a more uniform liquid metal flow
- Potentially eliminates die lubricant and subsequent emissions since molten aluminum does not adhere to the lining surface

## Applications

This new technology will have immediate applications in the die-casting industry, where significant research efforts focus on improving the service life of H-13 tool steel. The technology can be used with any die-cast application currently using the H-13 steel shot sleeve. Additional industrial applications may include other die-casting components, such as plungers, plunger tips, core pins, die inserts, etc.

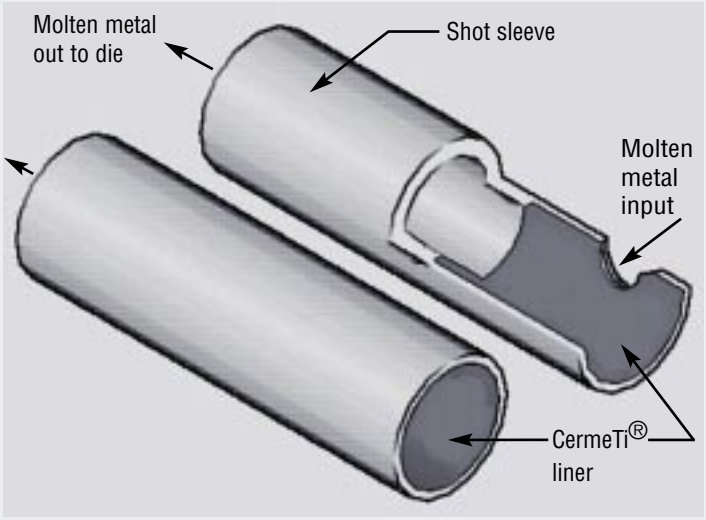
## Innovative Material for Use in Aluminum Die-Casting Components Saves Energy and Extends Product Life

In the aluminum die-casting process, shot sleeves force molten aluminum into a die for casting. The shot sleeve is filled with molten aluminum either by a manual or an automated ladle. The material is then forced into the die by a plunger or piston. The conventional material of choice for fabrication of shot sleeves and other aluminum die-casting components is H-13 steel.

However, the conventional H-13 shot sleeve technology wears out after 20,000 to 40,000 casting cycles, due primarily to hot corrosion which washes out the bottom of the sleeve. Additionally, the conventional technology requires a die lubricant, a major source of environmental waste.

A new technology, CermeTi®, is a titanium-alloy composite material. This material can be implemented in the form of an entire shot sleeve or a partial liner inserted into an existing H-13 shot sleeve. This new technology has demonstrated significant advantages over the conventional technology in preliminary testing, especially in its resistance to thermal loading and hot corrosion. The result is an extended useful life for the shot sleeve, reducing downtime and improving product quality.

### Shot Sleeves with CermeTi® Liner Material




**A new shot sleeve liner material being developed by Dynamet Technology saves energy and waste in the die casting process.**

## Project Description

**Goal:** Validate initial prototype testing of the technology as a liner material for aluminum die-casting shot sleeves.

The newly developed metal-matrix composite is expected to reduce energy consumption during the die-casting process, while increasing the service life of shot sleeves. In particular, the reduced thermal conductivity of the titanium liner reduces heat loss during the injection phase of the casting process. This slower cooling permits either cooler shot temperatures (less preheat energy) or slower plunger-tip speeds (less turbulence or surface impingement problems within the die). In addition, improved erosion resistance decreases sleeve wear and increases sleeve life. Furthermore, CermeTi® shows significant resistance to molten aluminum attack, greatly reducing soldering effects when in contact with molten aluminum.

CermeTi® also offers environmental advantages over conventional H-13 tool steel. During the aluminum die-casting process, aluminum adheres to steel, requiring the use of die lubricants. CermeTi® may not require a die lubricant, thereby eliminating a source of environmental waste.

Dynamet Technology is developing this new technology with the help of a grant funded by the Inventions and Innovation Program in the Department of Energy's Office of Industrial Technologies.

## Progress and Milestones

- Manufactured CermeTi® test bars and distributed for testing and evaluation.
- Conducted independent laboratory testing and evaluated materials produced at Oak Ridge National Laboratory and Worcester Polytechnic Institute.
- Select specific shot sleeves and/or alternative casting tool components.
- Manufacture prototype CermeTi® liners for end-user shot sleeve sizes.
- Assess machinability and machine and install CermeTi® liners into H-13 sleeves.
- Operate and evaluate shot sleeve assemblies in production environment.

## Economics and Commercial Potential

The die-casting industry is receptive to new technologies that improve efficiency and extend shot-sleeve durability. The considerable increase in tool life coupled with additional benefits such as reduced downtime, improved product quality, impressive energy savings, and the elimination of a die lubricant make CermeTi® an attractive alternative to current industry practice. Projected annual U.S. energy productivity and waste savings from this innovative new technology ranges between $80 and $120 million.

The use of die-cast parts reached a record 2.1 billion pounds in 1999, and forecasts predict consumption will reach 2.2 billion pounds in 2000. Custom aluminum die-cast shipments rose 15 percent last year to 1.7 billion pounds. The automotive industry is responsible for the majority of this growth. The North American aluminum content in passenger cars and light trucks has increased from less than 100 pounds per vehicle in the late 1970s to approximately 250 pounds per vehicle in 1999.

## *Industry of the Future—Metalcasting*

*The metalcasting industry – represented by the American Foundrymen's Society (AFS), North American Die Casting Association (NADCA), and the Steel Founder's Society of America (SFSA), has prepared a document,* ***"Beyond 2000,"*** *to define the industry's vision for the year 2020. OIT's Metalcasting Vision Team partners with metalcasters, national laboratories, universities, and trade/environmental/technical organizations to develop and implement energy efficiency technologies that benefit both the industry and the United States. Recently, the Metalcasting Team facilitated the development of the Metalcasting Technology Roadmap, which outlines industry's near-, mid-, and long-term R&D goals.*

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The Inventions and Innovation Program works with inventors of energy-related technologies to establish technical performance and conduct early development. Ideas that have significant energy savings impact and market potential are chosen for financial assistance through a competitive solicitation process. Technical guidance and commercialization support are also extended to successful applicants.

### Project partners

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