

# METAL CASTING

Project Fact Sheet



## IMPROVED DESIGN, OPERATION AND DURABILITY OF SHOT SLEEVES

### ELIMINATING THE DIFFICULTIES EXPERIENCED WITH SHOT SLEEVE OPERATION

#### BENEFITS

- Results will produce higher quality die castings due to elimination of premature solidified metal.
- Lower scrap rate due to production of sound castings.
- An energy saving of 80 billion Btu per year by 2030 due to lower heat loss allowing for furnaces to operate at lower temperatures, and a reduction in re-melting due to reduction in scrap.
- Annual cost saving of \$160 million due to the extension of shot sleeve life, reduction in repair costs, savings of down time and scrap reduction.

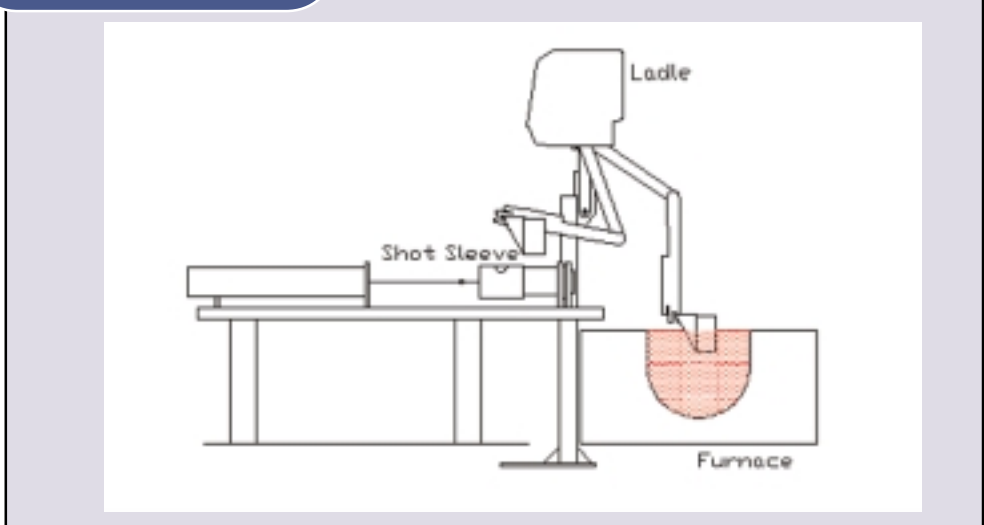
#### APPLICATIONS

The results from this project can be used by die casters throughout the U.S. Results are also pertinent to heat treaters and machine shop personnel involved in the fabrication of dies.

At the present time, shot sleeves exhibit relatively early failure in their operation. Failure occurs due to variations in dimensions resulting from uneven heating, excessive wear, and dimensional instability. In addition, the aluminum metal added to the pouring hole can and does dissolve the steel which results in large weld repair areas in the shot sleeve under the pouring hole. These conditions produce relatively early failure of the shot sleeve and increase the cost and energy losses associated with die casting operations.

Research being performed at Case Western Reserve University will improve the design, operating conditions and longevity of shot sleeves for use in aluminum die casting. This research will make improvements in the die casting machine that will eliminate or significantly reduce the need for repair or replacement of shot sleeves thus facilitating a smoother operation of the die casting machine than feasible at present. This project does not target a specific shot sleeve, but rather a generic improvement in shot sleeve design and operation by the application of advanced materials. This research program will examine ways of correcting the dimensional changes that produce warping of the shot sleeve. The team of researchers will examine the addition of high melting point, stable inserts or weldments in the shot sleeve directly under the pour hole. Tests will be conducted on a material with a very high stability and small amount of thermal expansion for use in the area under the pour hole. Finally, researchers will examine the use of a low thermal conductivity liner inside the shot sleeve, to retain the heat in molten aluminum and prevent premature solidification.

#### Experimental Setup



Case Western Reserve University experimental setup for evaluation of shot-sleeve performance



## Project Description

**Goals:** The goals of this research program are as follows:

- Improve the operation and performance of high-pressure die casting machines.
- Eliminate or significantly reduce the need to repair or replace the shot sleeve.
- Reduce the heat loss in the shot sleeve and prevent premature solidification.
- Improve the uniformity of the temperature distribution in the shot sleeve.

## Progress and Milestones

This R&D project began in January 2002. Planned tasks include:

- **Task 1:** Reducing the heat losses in the shot sleeve and preventing premature metal solidification. Researchers will reduce heat loss by utilizing low thermal conductivity liners inside the shot sleeve.
- **Task 2:** Develop methods to improve the dimensional stability of the shot sleeve. In this task two methods will be evaluated. First, by introducing appropriate cooling lines in the areas of the shot sleeve that are likely to overheat. Second, by improving the uniformity of the temperature distortion in the shot sleeve by utilizing high thermal conductivity materials.
- **Task 3:** Reduce or eliminate wear and washout that occur under the shot sleeve hole. Researchers intend to alleviate this situation by placing refractory metal inserts in this area. The inserts will be produced from alloys that will not be affected by the high temperature.
- **Task 4:** In-Plant evaluation of the enhanced shot sleeve.



### PROJECT PARTNERS

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