



AMC

AMERICAN METALCASTING CONSORTIUM

Lube-Free Die Casting



Overview: Die casting, a low-cost, near-net-shape manufacturing process, requires that a liquid organic-based lubricant be applied to the reusable steel die before each shot to prevent the liquid metal from sticking to the die. Under the AMC Casting Solutions for Readiness program, Colorado School of Mines (CSM) has been evaluating permanent and semi-permanent coatings for die casting dies so they do not require lubrication.

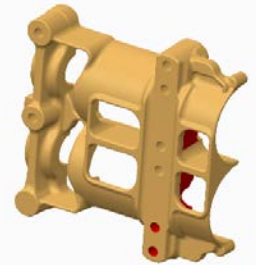
SUCCESS STORY

Problem: In the die casting process, the application of lubricant can reduce the quality of castings, increase processing time and costs, reduce die life, and create environmental issues.

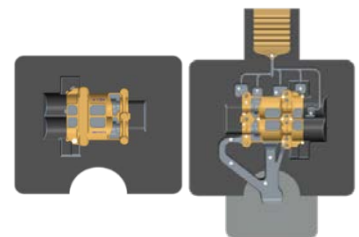
Solution: CSM conducted an in-plant trial at Mercury Marine, a manufacturer of outboard and inboard engines located in Fond du Lac, WI, to evaluate the potential of using an AlCrN coating for lube-free die casting. This AlCrN physical vapor deposition coating was identified as being the best candidate via laboratory testing performed at CSM. The casting produced during the plant trial was a Balance Shaft Housing, weighing about 1.75 lbs. The entire surface of the die was treated with the AlCrN coating. This trial was an initial Production Part Approval Process run for the die, and involved that castings met dimensional and performance producing sufficient castings so that Mercury could prove to their customer requirements.

Benefits: In the initial trial, 70 cast parts were successfully produced using only 2 seconds of spraying. This was in contrast to 12 seconds of spraying normally required per shot for an uncoated version of the die. This equates to a decrease of 83% in the spray. No evidence of alloy sticking was observed for these 70 shots. The spray time was further decreased to 1 second per shot, or a 92% reduction in spray, and another 30 castings were produced with no evidence of sticking.

This dramatic reduction in the amount of lubrication required to produce quality castings is of great interest to Mercury Marine and the die casting industry as the potential exists for significant improvements to the die casting process, including reducing residual porosity and entrapped gasses in the castings, lowering production costs, reducing housekeeping issues, and extending die life.



Balance Shaft Housing



Cover Half

Ejector Half

"Light weighting of transportation applications increases the fuel economy, and reduces the environmental emissions. Lubrication free die casting is critical to enabling technology for light weighting. By avoiding trapped lubricant, we can now T6 heat treat die castings thereby doubling their yield strength. This allows us to use less, but higher strength materials. This saves weight in numerous applications allowing higher power density and more robustness to the end consumer." Kevin Anderson, Brunswick Senior Fellow, Materials Engineering