



Introduction: "Rapid Creation of Tooling with Conformal Cooling" is an AMC project sponsored by the Defense Logistics Agency. It is a collaboration between AMC, the North American Die Casting Association (NADCA), and the University of California - Irvine (UCI). This project is developing a process using Additive Manufacturing (AM) and powdered steel to 3D print die cast die inserts with unique cooling systems to reduce scrap and improve the quality of die cast parts.

SUCCESS STORY

Problem: In the traditional method of tool building in die casting, internal cooling lines are put in the steel die using straight holes made by drilling and intersecting cooling lines to achieve thermal balance. A tool at Ryobi Die Cast, Shelbyville, Indiana was performing poorly in production and the castings did not consistently meet the quality requirements. The traditionally built die tool resulted in cooling that was not adequate to achieve thermal balance. Soldering during the die cast process caused production to be shut down to remove the solder and polish the die tool every shift. The tool life was reduced, and the die tool had to be replaced every 10,000 shots and new inserts put into the mold.

Solution: Using the information learned from the Conformal Cooling project at UCI, two designs were finalized using different conformal cooling line configurations (Figures 1 and 2). Six inserts were produced from H13 printed powder and six from maraging steel powder (see two of them in Figure 3). The cooling lines were printed into the steel using the guidelines of a 3 mm channel size, 2 mm minimum curvature, and a minimum wall thickness of 3 mm.

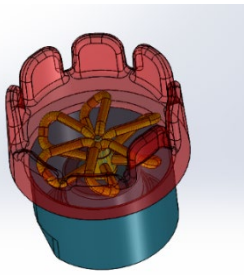


Figure 1

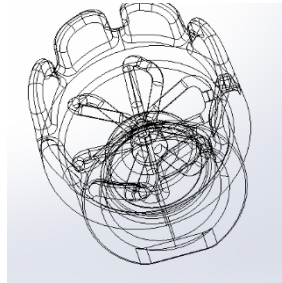
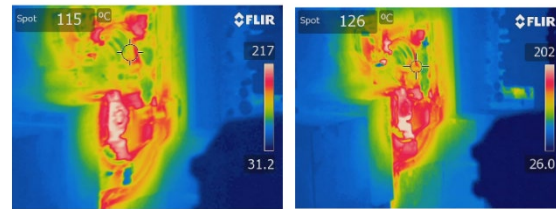


Figure 2



Figure 3

Benefits: The new crown inserts were put into production. The thermal effects before and after using printed inserts and adjustments to achieve thermal balance in the die cast die are shown on the right. Using the printed crown inserts caused the soldering to completely stop and eliminated additional down time for polishing. The crown inserts are now lasting over 90,000 shots, providing nine times more die life versus traditional inserts. In addition, rejects due to porosity dropped from 0.5% to 0.1% after using the conformally cooled inserts.



Before

After



This insert made from two different powder materials has outperformed the traditional H13 in scrap and solder reduction and resulted in great improvement in die life. - Dr. Yeou-Li Chu, Ryobi Die Cast

For more information about AMC go to: amc.ati.org

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