# Injection Molding Reshapes Cooling Components

**By David Morrison**, Editor, *Power Electronics Technology*

An advanced metal injection-molding technology makes it possible to build heatsinks and liquid-cooled cold plates in any shape and with features not obtainable in machined components. Amulaire Thermal Technology originally developed this injection-molding technology to address thermal management challenges in the computing industry. However, the company has found that the same technology can be applied to cooling high-power IGBTs, high-brightness LEDs, laser diodes and other devices.

Amulaire uses two processes to fabricate thermal components. First, it applies its Advanced Molding Technology (AMT) process, which uses plastic injection-molding equipment to mold a mixture of metal and polymer binders into the desired shape. After parts are injection molded, the part is removed from the mold and sintered at high temperature to remove the polymer binders, so no extraneous material remains in the final product.

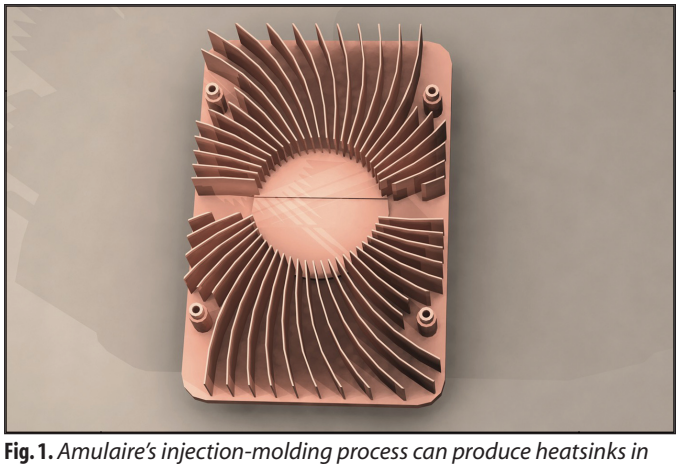

**Fig. 1.** *Amulaire's injection-molding process can produce heatsinks in unusual shapes and with unique features like curved fins.*

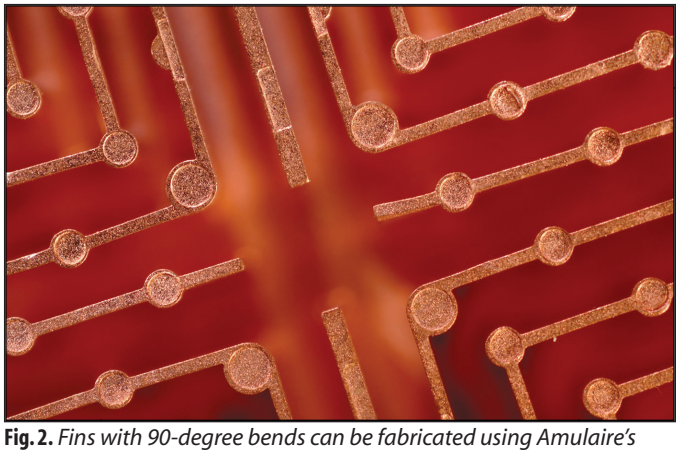

**Fig. 2.** *Fins with 90-degree bends can be fabricated using Amulaire's injection-molding technology.*

The AMT process allows multiple metals to be combined in any proportion. This broad choice of materials can be exploited to reduce component weight, increase performance, achieve a better CTE match and optimize cost.

During sintering, the parts shrink in a uniform and controlled manner. After the base is molded, fully sintered components can be added to the base, such as aluminum or copper fins to a copper base. Pressure is applied to the sides of the base to squeeze in the fins, creating a solid bond between the two. The result is an efficient assembly process with excellent mechanical and thermal fin-to-base connections.

Unlike conventional methods of building heat dissipation components, the Amulaire process requires no machining and no plating of fins. Nor does the process require any crimping or soldering of fins. Consequently, heatsinks automatically comply with the Restriction of Hazardous Substances directive.

Using metal, mixed metal and metal/nonmetal material combinations, Amulaire can produce any shape that can be created in plastic. Parts can have curves and complex shapes (**Fig. 1**). They can have fins of varying thickness and heights oriented in many directions. The technology allows for greater fin density than would be possible with most extruded or machined heatsinks, because Amulaire's injection-molded heatsinks can readily achieve aspect ratios of 50-to-1.

Besides molding straight fins, Amulaire's process can produce pin fins, elliptical fins and fins with 90-degree bends (**Fig. 2**). The process also allows for mounting features to be integrated into the components.

The AMT process also can be used to manufacture cold plates with microchannels for precise liquid cooling. Fins can be as small as 0.1 mm wide and 0.7 mm high with 0.1-mm spacing. Amulaire's cold plates can have more pin fins, to increase the surface area of the cold plate, or they can have complex fin patterns. One recently developed IGBT cold plate contained 5000 pin fins in a 5-in. × 5-in. area.

Thermal products can be tailored quickly and cost-effectively to meet customers' requirements, and then manufactured in high volume. For more information, see www.amulaire.com. **PETech**