diecast solutions no. 31

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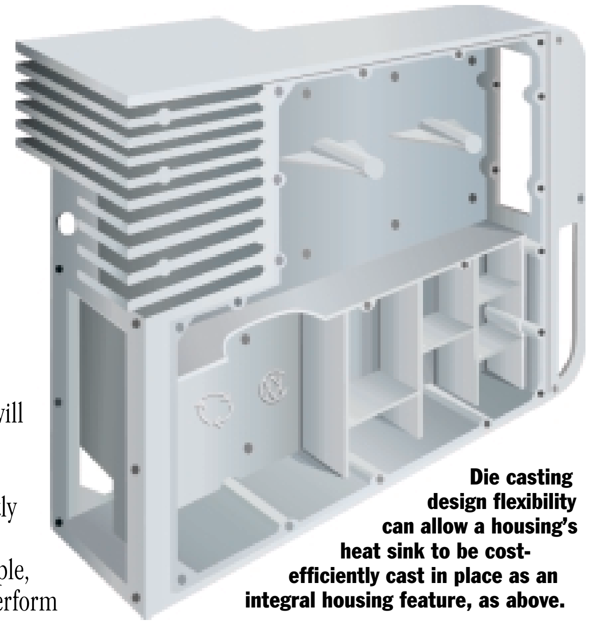
Optimum Heat Sink Performance Offered by Die Castings

Die Cast Heat Sink Design and Production Can Be a Cost-Effective OEM Choice



Die casting design flexibility can allow a housing's heat sink to be cost-efficiently cast in place as an integral housing feature, as above.

Heat sinks are widely used in a range of commercial and industrial applications for cooling electronic components. With products incorporating today's semiconductor devices, minimizing temperatures in such units is critical to product reliability.

Designers of heat sinks strive to maximize the amount of heat dissipated while keeping the temperature of internal heat generators low. The optimum design, material, and production process selected for a customized heat sink solution are key decisions.

The Heat Sink Material Choice

Aluminum, magnesium and zinc are all potential material alternatives currently being used for customized heat sink designs.

Shown above is an example of a heat sink set in a design optimized for heat transfer, produced as high-tech aluminum die castings.

Aluminum is used in many heat sink applications based on its low density, high thermal conductivity and high thermal diffusivity. Where potential field corrosion is a concern, corrosion-resistant aluminum alloys, such as die cast Al 360, can be specified—offering above-average thermal conductivity as well.

While magnesium has lower thermal conductivity than aluminum alloys, the fact that it is 35% lighter than aluminum makes it very attractive for weight-sensitive applications, especially for heat sinks in electronic products. Further, magnesium has comparable thermal diffusivity to aluminum, and thus it has been demonstrated that heat will diffuse through it at a comparable rate to aluminum under transient conditions.[1] Due to its significantly lower density, magnesium designs can often be configured, for example, with longer fins to thermally outperform aluminum while still maintaining a mag heat sink's weight advantage.

With zinc's very high thermal conductivity, this material can yield a high-efficiency heat sink and be an ideal heat sink choice for many applications. However, with its high specific weight, zinc alloy is often ruled out for portable electronics or other weight-sensitive applications.

The Heat Sink Process Choice

Stamped heat sinks can be produced from light-gauge aluminum. As a metal stamping, such sinks have low fin density, and, thus, low efficiency, and are usually not suited to higher-performance applications.

Extruded heat sinks are widely used for heat dissipation, but usually with omnidirectional straight fin designs. Bidirectional sinks, which allow air to flow either way along the extrusion direction, are produced by saw crosscutting across the extruded fins. This arrangement can result in a higher temperature rise, but at higher production costs.

Table 1: Die Cast Material Properties[2]

	Al 380	Al 360	Mg AZ91D	Zn No. 3
Thermal Conductivity (BTU/ft hr °F)	55.6	65.3	41.8	65.3
Density (lb/in³)	0.099	0.095	0.066	0.24

The Die Cast High-Tech Heat Sink

High-technology die casting offers the opportunity for optimized heat sink configurations combined, when required, with lowest weight and often integrally cast as part of a housing (above). Uniquely efficient designs, such as shown in the photo at left, could not be economically produced by any other process.

Where weight is not a product consideration, zinc die castings can be produced as highly optimized sink designs at low cost.

Aluminum die cast heat sinks can meet most weight, efficiency and cost specifications.

Die cast magnesium heat sinks offer lowest weight, with optimized designs that can achieve dissipation efficiencies comparable to aluminum die cast heat sinks.

(1) Brown, J. F., Jr., Riopelle, L., Shirazi, S. A., Magnesium Heat Sink Evaluations, SAE, 1993.
(2) NADCA Product Specification Standards for Die Casting, 2000

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