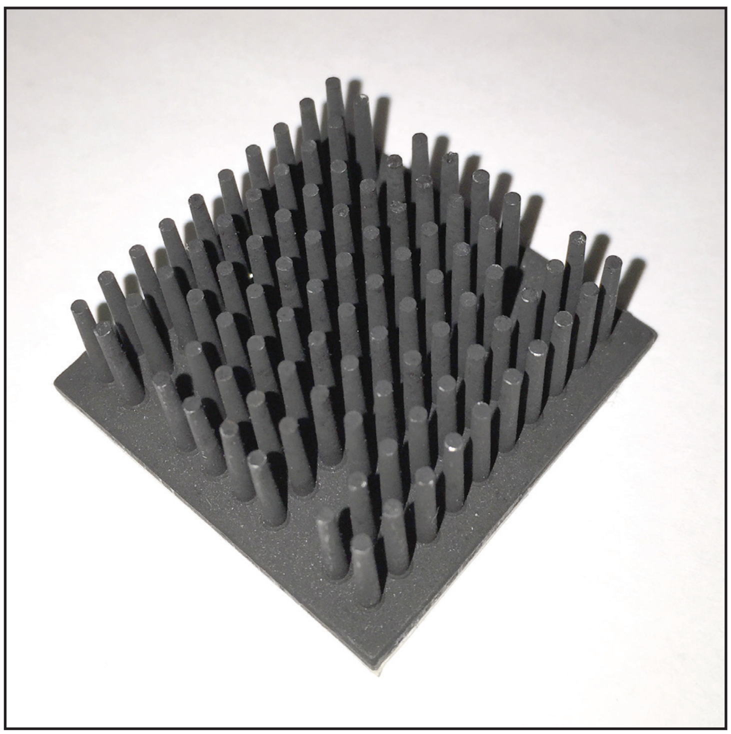
White Paper:

Die Cast Heatsinks

March, 2015



Abstract:

This paper helps define basic characteristics of Die Cast Heatsinks.

What is Die Casting

Die casting is the process of forcing molten metal under high pressure into a molded cavity. The molded cavity is created using a hardened tool steel die which is carefully machined into a pre-designed shape. The casting equipment and the metal dies represent large capital cost which tend to limit the process to high volume production applications.

Radian Die-Cast Heatsinks utilize a hot-chamber die casting process which rely upon a pool of molten metal to feed the die. A pneumatic or hydraulic powered piston forces molten metal into the die. The advantages of this system include fast cycle times (approximately 15 cycles a minute). Radian die-cast heatsinks are primarily manufactured using aluminum based alloys (356.0, A380).

Two halves of a die are required in the die casting process. One half is called the “cover die half” and the other is called the “ejector die half”. A parting line is created on the part where the two die halves meet. The die is designed so that the finished casting will slide off the cover half of the die and remain in the ejector half as the die is opened. The ejector half contains ejector pins to push the casting out of the ejector die half. In order to prevent damage to the casting, an ejector pin plate accurately drives all of the pins out of the ejector die at the same time and with the same force. The ejector pin plate also retracts the pins after ejecting the casting to prepare for the next shot.

Excess material such as metal extension can be removed from the ejected die cast heatsink through a secondary machining operation. Casting metal extension removal cost can be reduced if the amount of metal extension to be removed and the removal method to be employed are considered in the early stages of the design.

The following are the typical steps in Radian’s die casting proces:

- Die / Mold Design and Manufacture
- Die Preparation (lubrication)
- Filling the die with molten metal
- Ejection from the cover die half
- Shakeout from the ejector die half
- Trimming / Grinding excess materials
- Paint / Anodize

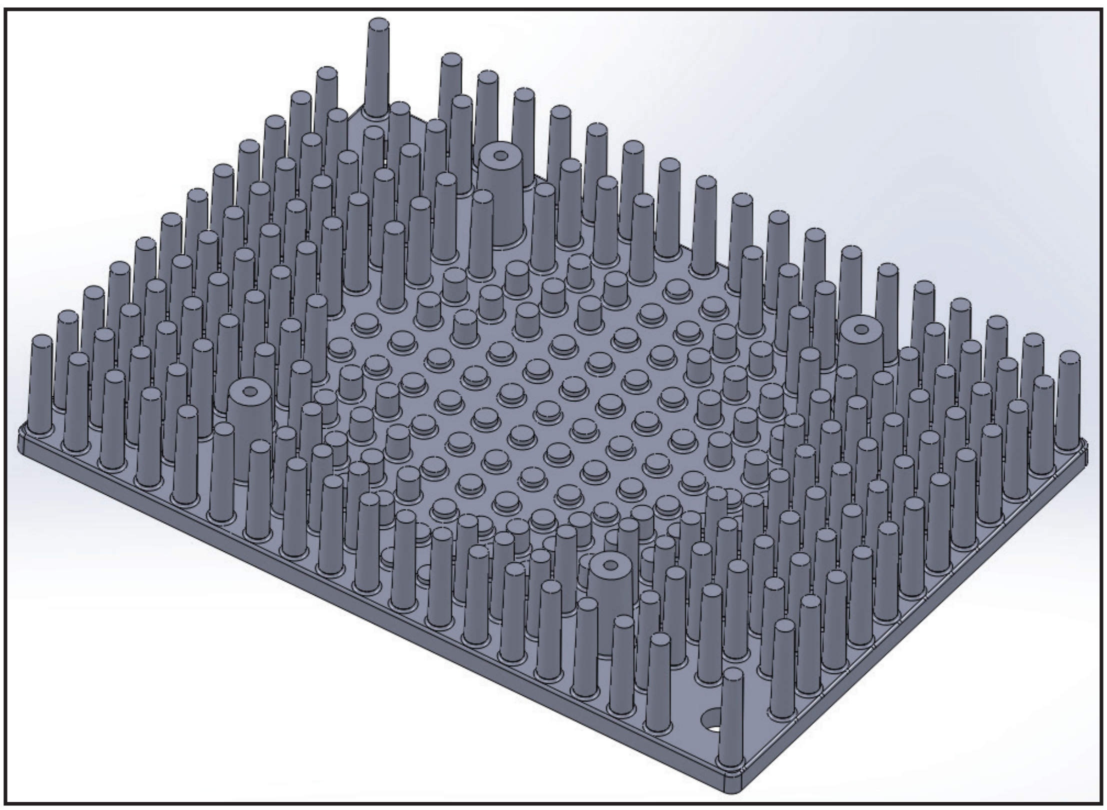
Heatsink Material

Aluminum with high purity is a good heatsink material for removing heat from electronic components. However, the die casting process adds impurity to the metal, which affects the thermal performance of the metal due to reduced thermal conductivity.

The thermal conductivity of aluminum used in extruded or machined heatsinks is 160-200 W/m-K. However, aluminum can be difficult to die cast, so impurities are often added to aid in the die casting process. Most aluminum casts (non-thermal applications) are done in A380 for structural purposes. Radian uses 356.0 for the improved thermal properties.

Heatsink Material Comparison Table

	A380	356.0
Tensile Strength (Ultimate MPa)	≥ 324	≥ 207
Density (g/cc)	2.76	2.68
Melting Point	538 - 593	557.2 - 612.8
Conductivity (w/m-k)	109	151



In Summary

THE ADVANTAGES:

Die casting is ideal for high volume applications that can support initial tool / die cost, typically at least 5,000 pieces. The piece price of die casting is generally cheaper than other manufacturing processes. The short processing time saves money when manufacturing the heatsinks in high volumes. The dies can support complex geometries that can be challenging to produce by other processes. Furthermore, the parts that are produced through die casting have near net shape of the final product and require less machining operations, which add extra cost, compared to other manufacturing processes.

THE DISADVANTAGES:

Tool / Die set-up cost of $12-15k may be too expensive of a start-up cost. Each Die / Tool has a typical life of 10k - 100k shots (depending on the injected metal and temperature). Other disadvantages include draft angles required and ejector pin marks left on the parts due to the die casting process. Further more, porosity is the most common defect of the parts made from die casting. Quality assurance needs to ensure that the strength and surface finish of the product meet the requirement.