

A REVOLUTIONARY DESIGN IN LED HEAT SINKS

Experience the next-generation in cooling technology for LED lighting. The Singapore Institute of Manufacturing Technology (SIMTech) has developed revolutionary heat sinks made from a process known as Liquid Forging – that delivers improved designs far superior than conventional heat sinks. With better thermal efficiency, liquid forged heat sinks enhance LED brightness and reliability.

Why well-designed heat sinks are important?

As the need for high-powered LED lighting (which generates significant amount of heat) gains traction, existing light fixtures cannot effectively dissipate heat away from the LED lighting. Hence one of the key challenges of lighting manufacturers today is – thermal management.

When the LED temperature continues to rise, the optical wavelength can shift. A thermally stressed LED light will also quickly lose efficiency and have diminished lumens-per-watt output, affecting its brightness. If LED thermal management is unable to meet the temperature specifications of the LED, a breakdown may also occur. Other effects of thermally stressed LEDs may include internal solder detachment, damage to die-bond epoxy, lens yellowing, and so on.

This effectively increases the warranty and replacement costs for the LED lighting company and end-users.

Thus, the LED lighting industry needs to develop innovative, low-cost conductive and convection cooling to deliver peak LED lighting performance with improved longevity. And this is made possible with a revolutionary heat sink design – one that hinges on breakthrough manufacturing processes, in order to realise the vision of new, cutting-edge thermal performance.

BENEFITS OF LIQUID FORGED HEAT SINKS

Improved thermal performance

Rapid heat transfer delivers more lumens/watt and enhances the LED lifespan.

- Aluminium wrought alloys conduct heat faster than cast alloys used in die casting. Also by incorporating a copper base, the heat sink achieves 4 times better thermal conductivity.
- Intricate fins and pins deliver a higher aspect ratio, increasing the surface area for ambient heat transfer. With no centre core, heat removal by convection is also improved.
- Porous-free microstructure eliminates air pockets for rapid, continuous heat transfer through the heat sink to the surroundings.

Flexible design

The key to an effective LED heat sink design is to be able to balance both maximisation of heat sink surface area and form factor constraint of light fixtures. Each custom LED lighting design involves the concept of efficiently transferring as much heat as possible away from the LED chip. SIMTech's liquid forging manufacturing revolutionises the way aluminium heat sinks can be designed and optimises the total surface area of the heat sink.

With a high aspect ratio and the ability to create 3D designs as a single piece, liquid forging is a highly scalable manufacturing process, allowing the creation of intricate heat sinks made of composite materials such as copper and aluminium in a single step. The fins of the heat sink can be combined with a copper base to create a radial heat sink with improved design and better thermal conductivity. The process allows heat sinks and light fixtures to be formed as a single piece, minimising assembly costs, and improving thermal efficiency.

Enhanced finishing

The heat sink can be anodised for a better finishing, which further improves thermal performance by an additional 10 – 15%.

“We can now deliver more brightness on the same board. Our users especially appreciate the smaller form factor that produces so much illumination. Additionally, with a flexible manufacturing process, we can create a wider range of products without incurring extra tooling or materials costs.”

Mr Simun Wong, Director, Redd Innolit Pte Ltd

COMPARISON WITH TRADITIONAL HEAT SINKS

Liquid forged heat sinks perform better than current heat sink designs. Some advantages include

Features	Liquid forged	Die Cast	Extruded
High-aspect ratio	✓	✗	✗
Enhanced heat dissipation	✓	✗	✗
Flexible design (E.g. 3D)	✓	✗	✗
One-step manufacturing with light fixture	✓	✓	✗
Minimum porosity	✓	✗	✓
Anodised finishing	✓	✗	✓
Enhanced aluminium alloy conductivity	✓	✗	✓

Benchmark tests results:

Liquid forged heat sinks deliver better cooling with its unique design. Tests performed using the same heat source on three different types of heat sinks show that a radial fin design – formed by liquid forging – achieves the lowest base temperatures; the lowest temperature difference between the fin base and tip, and the lightest weight. This indicates highly-efficient heat dissipation and much lower thermal resistance than conventional heat sinks.

Heat sink	Fin base	Fin tip	Temperature difference	Weight
Radial	97°C	92°C	5°C	62g
Sunflower	102°C	95°C	7°C	119g
Plate	172°C	158°C	14°C	101g

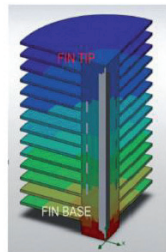
Test performed based on the same form factor of diameter 50mm, height 40mm and 20W power.



RADIAL




SUNFLOWER

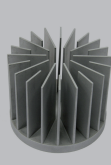


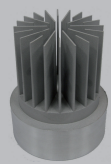
PLATE


FULL SUITE OF DESIGNS

1. Target LED power: 10W – 12W

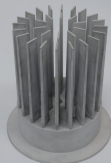
Radial – D46				
	Material	Number of Fins	Weight (G)	Fin Height
	Wrought Aluminium	24	70	≤70mm

Radial – D50				
	Material	Number of Fins	Weight (G)	Fin Height
	Wrought Aluminium	20	62	≤40mm

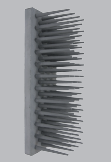
Radial – D50 – D60				
	Material	Number of Fins	Weight (G)	Fin Height
	Wrought Aluminium	20	130	≤40mm

Pin – D46				
	Material	Number of Fins	Weight (G)	Fin Height
	Wrought Aluminium	37	70	≤70mm

2. Target LED power: 12W – 20W

Radial – D70 – D90				
	Material	Number of Fins	Weight (G)	Fin Height
	Wrought Aluminium	30	280	≤70mm

3. Target LED power: 20W – 30W

Pin – 225 x 80				
	Material	Number of Fins	Weight (G)	Fin Height
	Wrought Aluminium	81	440	≤70mm

For More Information

To find out more about our heat sink solutions for LED lighting, contact:

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