Benefits of a Forged Heat Sink - China

Posted on Nov 14, Posted by P&A International Category General Talk

Aluminium extruded and die cast heat sinks dominate the industry. As devises that require cooling becoming smaller and heat generation increases, companies are forced to look for a more efficient cooling solutions. One of them is FORGED heat sinks.

Comparing extruded heat sink design to bonded fins type assembly, extrusions will outperform by large margin due to bonded assembly thermal transfer is somewhat reduced by the bonding agent added thermal resistance. There are four common techniques that are used to manufacture heat sinks: Die Casting, Machining, Extrusion and Forging.

Let’s discuss performance of each of those types of heat sinks, excluding Machined parts. This is due to high CNC machining costs of machined heat sinks making it economically feasible only for prototyping and special low volume and high cost products.

Thermal Conductivity

Diecasting is a method for manufacturing complex shapes in high volumes and low cost. Initial tooling cost outlay is high, but the parts cost during the production run is relatively low. Drawback is porous structure as the molten aluminium alloy cools in the die-set it expands creating voids. The porous structure weakens the part and adds to thermal resistance to the heat sink.

Extruded aluminium alloy heat sinks are most cost effective way for manufacturing linear shapes. The drawback is the limitation in the freedom in design, but this method requires low cost tooling. During the extrusion, alloy is heated below melting point and force-feed thru the forming die-set. However the grain structure cannot be controlled evenly and shape of the heatsink cannot be optimized completely thus somewhat reduce thermal performance.

Forging is the effective method to produce complex shapes in high quantity and also offers interesting thermal advantages due to processing alloys at room temperature. Due to the nature of the forging process, part is formed at high pressure and low temperature, process that allow better control of the grain structure. Making heat sinks stronger and better conductors of heat.

Below chart compares die casted, formed and extruded heatsink performance.

Manuacturin Method
Die Cast
Extrusion
Forge
Extrusion
Forge

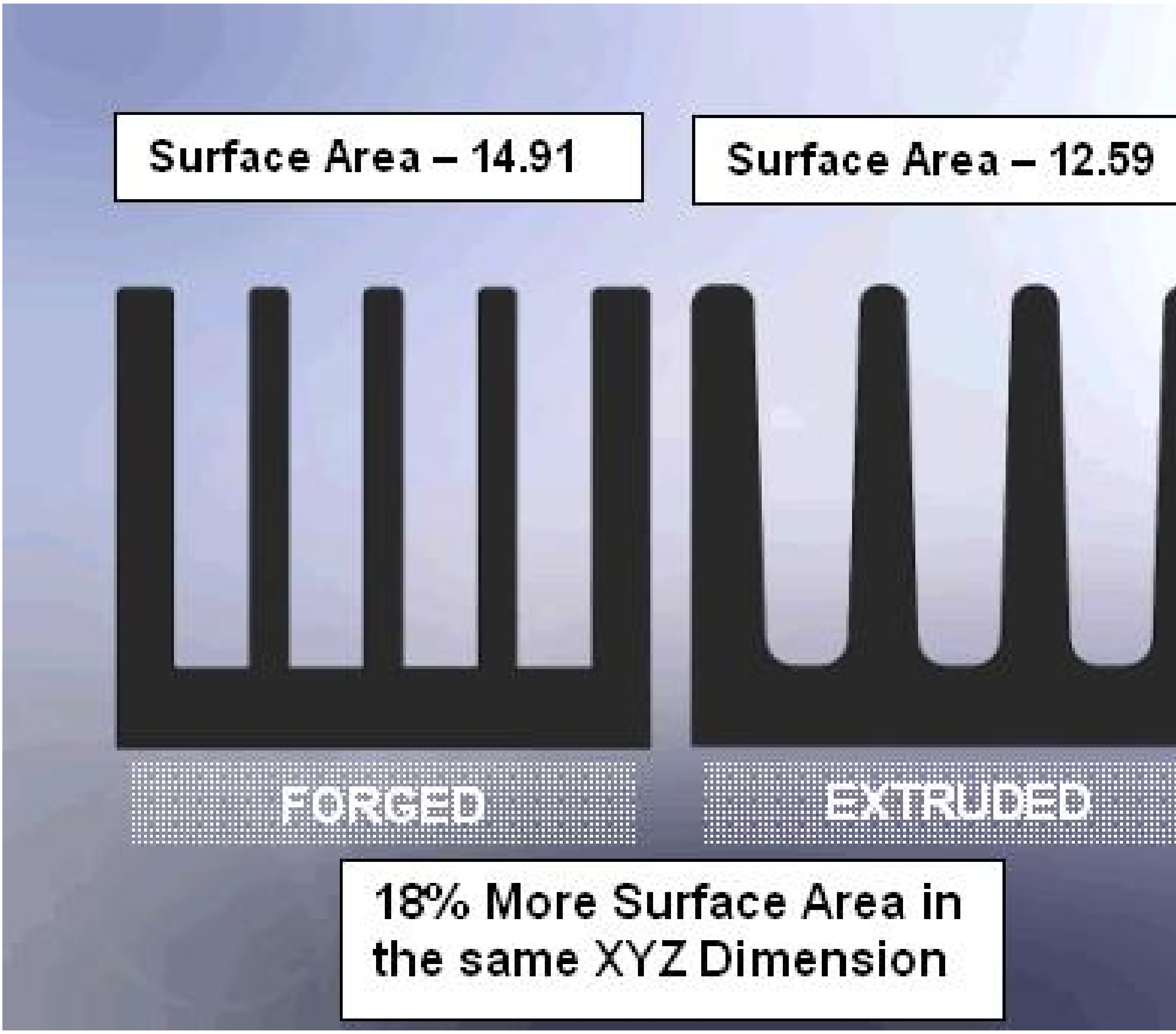
The cold forging process produces heat sink with 13% better thermal conductivity over extruded and 60% over die-cast part. Note that in this test average samples been tested. Best examples of each heat sink likely to produce better results somewhat dampening large outperformance by forged part.

Heatsink Surface Area

Increased surface area of the heat sink will yield lower thermal resistance and better component cooling, but only if boundary layer is not formed and fins close proximity do not prohibit flow of air.

When designing extruded part, fins must be tapered so that the aluminium alloy will pass through the tool without breaking it. The number of fins in an extrusion limited by strength of the die set and the size of the extrusion. These restrictions will have impact on the surface area.

Forged fins require lesser taper for extraction from the tool, allowing for more fins per given heat sink size. Heat sink fins can also be formed in to elliptical shape if required.



The forged heat sink increases the surface area by 15% without increasing the size. The result is improved thermal performance.

Reduced Cost

Depending on design, forged heat sink process can simplify manufacturing process. In cases when secondary operation required when working with extruded or die-cast heat sinks in forging process this can be part of a single operation. That can greatly influence cost of the finished product.

The forging process has fewer limitations to forming heatsink shapes and fin designs. A forged part is formed in two dimensions within the stamping tool creating complex shapes without the need for secondary operations. Holes, chamfers, pins, elliptical fins and steps are created in the one tool in a single operation.

SECONDARY OPERATIONS
Required to Manufacture the Part Pictured Above

Extruded	Forged
1. Straighten	Machine Top for Flatness
2. Cut to Length	Machine Bottom for Flatness
3. Machine Top for Flatness	Drill Screw Holes
4. Cross Cut	Insert Stand-offs
5. Machine Cavities for Screw Holes	
6. Drill Screw Holes	
7. Machine Cavity for Copper Spreader Plate	
8. Cut Spreader Plate to Size	
9. Solder Spreader Plate in Cavity	
10. Machine Bottom for Flatness	
11. Insert Stand-offs	

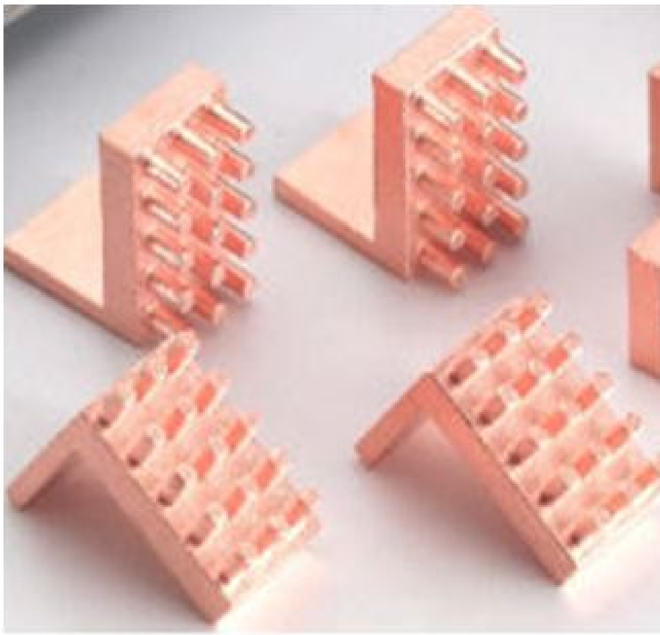
Conclusion

Forged heat sinks offer advantages over machined, die cast and extruded processes. The improved thermal performance due to aluminium grain structure coupled with the increased surface area without increasing the size of the heat sink and low process cost are main advantages.

Cold forging can also produce heat sinks of the complex shapes such as elliptical fins, staggered fins, round pin arrays, steps, all within the tool. Finally, precision forged heat sinks can often be manufactured at a lower cost because most operations can be performed in the tool and secondary operations are reduced.

Forging is also the most effective method for forming copper. Copper is difficult to extrude because it must be heated to high temperatures to soften the metal, making it challenging. Forging is a cold process, and copper heat sinks can be formed with minimal waste.

Highly Compact Curved Fins Maximize Surface Area



Material can be formed in multiple di

Round Pins, holes and standoffs formed in the tool in a single operation

Round Shapes (ideally suited for LED

For you by P&A International your [Heat Sink Specialist](#)

Tags: [copper forged heat sink](#) , [die cast heatsink](#) , [extruded heat sink](#) , [forged heat sink](#)