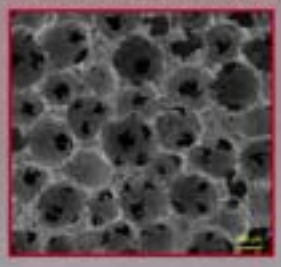
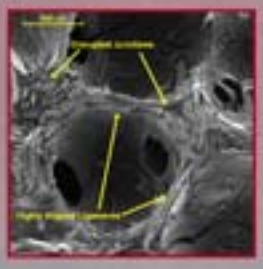
Graphite Foam for Ultra-Efficient Radiators

Unique, high-conductivity, high-surface-area graphite foam is ideal for heat transfer





Superior alignment along carbon foam ligaments results in higher thermal conductivity

High-Conductivity Carbon Fiber

Carbon Foam Ligament

Material	Density (g/cm³)	Thermal Conductivity (W/m·K)
Aluminum 6061	2.7	180
Copper	8.9	400
Carbon Fiber	2.2	1000
Synthetic Diamond	3.5	1200
Graphite Foam Ligament	2.25	1700
Perfect Diamond	3.5	2000

Flow-By Design

Compact, lightweight radiators that dissipate 6 kW of heat have been developed for the racing industry

C&R Aluminum Core

Advanced Radiator Used by Racing Industry

Dissipates at 6 kW

Louvered Aluminum Fins
Core size = 30.5 x 7.6 x 3.8 cm
Overall Fin Surface Area = 0.71 m²

A similar design made using graphite foam dissipates > 30% more heat

Carbon Foam Core

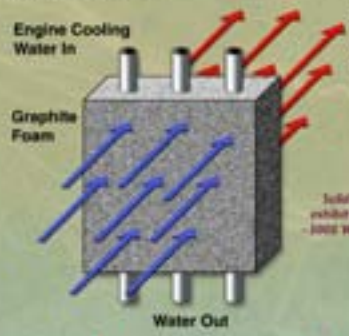
Machined Carbon Foam Fins
Core size = 30.5 x 7.6 x 3.8 cm
Overall Fin Surface Area = 0.42 m²

Dissipates at 8 kW

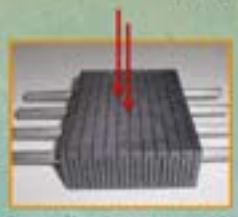
Simple manufacturing process identified

Flow-Through Design

Significantly better heat transfer can be achieved by forcing cooling air through the foam



Solid foam heat exchangers exhibit heat transfer coefficients ~ 5000 W/m²·K at a ΔP of 3 psi/in.



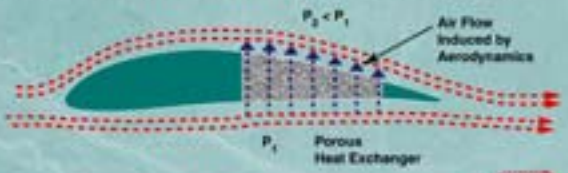
Corrugated foam heat exchangers exhibit heat transfer coefficients ~ 3000 W/m²·K at a ΔP of 0.3 psi/in.

Corrugated form significantly reduces pressure drop

Optimized Design

By incorporating the heat exchanger into an airfoil, the system can be very efficient (Georgia Tech Research Institute)

- Eliminate large drag induced by flat radiator in front of vehicle
- Pressure difference across airfoil induces airflow through heat exchanger
- Supplemental air flow or heat dissipation required at low speeds only



- Airfoil heat exchanger reduces drag induced by radiator
- Airfoil design exhibits similar heat transfer to standard radiator concepts

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Conclusions

- High-conductivity graphite foam is ideal for heat transfer
- The use of ultra-efficient graphite foam reduces the size and weight of conventional radiators
- Novel airfoil heat exchangers drastically reduce aerodynamic drag without sacrificing heat exchange capability

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