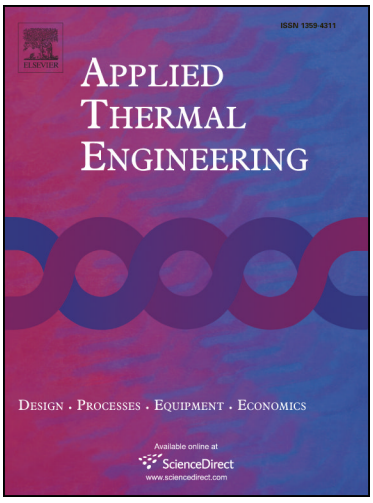

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Comparison of pin-fin and finned shape heat sink for power electronics in future aircraft

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Highlights

- Heat transfer performance comparison between finned and pin-fin heat sink
- Laminar and turbulent flow with air and fuel coolants are considered
- Pin-fin double reduce the heat sink weight
- Pin-fins heat sink is almost double overcomes the thermal performance of finned shape

Abstract

This study investigates the heat transfer performance of finned and pin-fin heat sinks for high power density converter more-electric aircraft of the future. There is a lack of studies evaluating the cooling performance of pin-fin as compared to that of the finned-type heat sink configuration. The influence of various design aspects such as type of fluid flow (laminar or turbulent), type of working fluid (fuel or air) and geometry configuration (pin-fin or finned shaped heat sink) on heat transfer performance is compared. Circular, cone and hydrofoil pin fin arrays have been considered. It is concluded that the thermal performance of pin-fin heat sink is superior to the finned configuration by 1.6-2 times in all cases except when fuel coolant is employed at turbulent type of flow. As weight of heat sink is concerned, the use of pin-fin shape can reduce up to half of the weight of conventional finned heat sink. The results of this paper can provide the guidance to be applied when designing the heat sink for power electronics in future more-electric aircrafts.

Nomenclature

A	area (m^2)
c_p	specific heat (J/kg·K)
D_h	hydraulic diameter (m)
h	heat transfer coefficient (W/Km^2)
H	height (m)
k	thermal conductivity (W/Km)
L	length (m)
N	number of channels
Nu	Nusselt number
Δp	pressure drop (Pa)
P_{pump}	pumping power (W)
q	heat flux (W/cm^2)
Re	Reynolds number
T	temperature (K)
U	velocity vector (m/s)
u, v, w	flow velocity (m/s)
W	width (m)
x, y, z	Cartesian coordinates

Greek symbols

μ	viscosity ($N·s/m^2$)
ρ	density (kg/m^3)

Subscripts

j	junction
in	inlet