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Computational Investigation of Energy Efficient Pin Fin Cross Section for a Compact Heat Exchanger

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Abstract

This paper presents the computational investigation of compact heat exchangers that are primarily used in dissipating heat generated by electrical and/or electronic components and assemblies. In order to assess the effect of pin cross-section on the pressure drop and heat transfer capabilities, six different types of pin cross sections, namely, elliptical, straight circular, 2º tapered circular, 4º tapered circular, drop and hexagonal, were computationally investigated. The heat exchanger channel is characterized by the presence of the fins mounted vertically on a horizontal base plate in a staggered arrangement along the flow direction. Aluminum was considered to be the material of pin fins. The fluid flow inside the heat exchanger channels is assumed to be three-dimensional, incompressible and steady. Pressure, temperature and velocity profiles at different locations within the computational domain are considered for different Reynolds number. The thermal and fluid dynamic characteristics of six pin fin heat exchangers along the computational domain are discussed in detail. We have shown that a small amount of tapering significantly improves the performance of heat exchanger. The results show that the overall performance of elliptical pin fins is better than other pin cross sections considered. This makes the elliptical fin arrays a promising cooling device for high thermal loaded electronic components.