Closure to "Discussion of 'Effect of Tip Clearance on the Thermal and Hydrodynamic Performance of a Shrouded Pin Fin Array' " (2006, ASME J. Heat Transfer, 128, pp. 855–856)

Kevin A. Moores
CALCE Electronics Products and Systems Center,
Mechanical Engineering Dept.,
University of Maryland,
College Park, MD 20742

Yogendra K. Joshi
George W. Woodruff School of Mechanical Engineering,
Georgia Institute of Technology,
Atlanta, GA 30332-0405

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The authors would like to express their appreciation to Dr. Razelos for his interest and thoughtful comments regarding their work. The arguments that he presents in Ref. [2] for the use of dimensionless parameters u and $\mathrm{Bi}^{1/2}$ to represent the dimensional geometry of the pins are compelling and will be closely considered in future studies. However, the authors believe that the form of their experimental results as originally presented is reasonable, given that their intent was to investigate the little considered effect of tip clearance and to put those results into the context of other pin fin array studies. As noted by Dr. Razelos, the use of H/D in the authors' work is consistent with that used in a preponderance of fin array analysis and characterization studies in the literature.

The contention that a simpler model of the pin efficiency and temperature profile may have sufficed is well taken. While more rigorous, the treatment of Kraus and Bar-Cohen [20] most likely did not produce a substantially different result compared with that, which would have been obtained using the simpler expressions of cylindrical fins and assuming averaged dimensions. While the coordinate system of Ref. [20] was applied correctly in our work, the authors regret that the definition of the variable b, as Dr. Razelos properly points out, is misleading as defined in the nomenclature, particularly if the reader is not acquainted with the coordinate system employed by Kraus and Bar-Cohen. In future work, the authors will revisit the use of simpler treatments as well as that for tapered fins described in Ref. [4] with the intent of putting the results into a more accessible form.

With respect to the comments concerning the equations used to define fin efficiency and thermal profile, Eq. (10) is equivalent to a one-dimensional form defined by Gardener [6] in which the surface area of the fin is replaced with its height. As a result, heat transfer from the tip of the pins was not explicitly considered in the calculation of fin efficiency. It may be possible to include this in the form of a modified height.

Equations (11), (12a), and (12b), as correctly noted, were derived assuming a specified pin base heat flow ($Q_{x=b}$) and dimensionless base temperature ($\theta_{x=b}$). However, contrary to the assertion that $\theta_{x=b}$ is not specified, it was in fact considered to be known based on the use of average endwall temperature measurements, which were taken to represent an effective value for the entire array, just as $Q_{x=b}$ and h were assumed to be uniform across the plate. The authors would also dispute the recommendation that the more customary adiabatic tip condition be adopted in the formation of the dimensionless temperature profile. Since heat transfer from the tips of the pins was present in all but the case of $C=0$, and its very presence was the primary point of interest in this study, such an assumption would seem counterproductive. Equations (11), (12a), and (12b) on the other hand, do not preclude heat transfer from the tip. Finally, while the authors did not explicitly state the range of Biot number considered, for the full range of H/D and Re reported, $0.31 \leqslant \sqrt{\mathrm{Bi}} \leqslant 0.97$, where $\mathrm{Bi} = (h_{Aw})(D_{ew})/k_{\mathrm{fin}}$. The authors would again like to thank Dr. Razelos for his constructive remarks and suggestions.

Note: Equation E1 in Dr. Razelos' discussion appears to be in error as the middle term is not dimensionless.

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