A SIMPLE MATHEMATICAL MODEL TO PREDICT HEAT PIPE
MAXIMUM HEAT TRANSFER, EQUIVALENT THERMAL
CONDUCTIVITY AND THERMAL RESISTANCE

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Abstract
The objective of this study is to provide a simple mathematical model to predict the performance of the
heat pipe such as - the maximum heat transfer, the equivalent thermal conductivity and the thermal resistance
based on the experiences of industrial products. The maximum heat transfer calculation is based on the
maximum capillary force provided by the wick against the total pressure drop associated in the heat pipe. The
calculation for the capillary force of the wick and pressure drop in heat pipe are based on traditional pressure
drop formulae for vapor and liquid flow. For heat pipe thermal resistance calculation, a new proposal of an
additional parameter function \(f(L_{\text{eff}})\) which accounts for the vapor and fluid flow pressure drop dependent on
the heat pipe length. This function dictates that the thermal resistance of heat pipe increases when heat pipe
length increases. If without this additional function, the heat pipe thermal resistance would remain constant
regardless of heat pipe length, and this assumption could be incorrect.

Analysis results showed that the maximum heat transfer and thermal conductance (inverse of thermal
resistance) of heat pipe decreases with heat pipe length increases. The correspondence equivalent thermal
conductivity increases with heat pipe length increases in the maximum heat transfer limit range. Theoretical
calculation will be validated against experimental results and are discussed in this paper. Equivalent thermal
conductivity of a heat pipe is very useful for CFD software input.