MS9008

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Professor R. Greif
Dept. of Mechanical Engineering
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Berkeley, CA 94720

Dear Professor Greif,

Enclosed is an abstract entitled "A New Look at the Relationship Between Heat Flux and Temperature Difference During Nucleate Boiling". Please consider it for presentation at your "Phase Change Heat Transfer" session, 1991 ASME/AIChE National Heat Transfer Conference.

(As you requested, I have sent a copy of the abstract to Professor Hensel.)

Sincerely,

E Adiutori

refers to telephone call on 10/4/90

Eugene F. Adiutori

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copy to Professor Edward Hensel

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A NEW LOOK AT THE RELATIONSHIP BETWEEN HEAT FLUX AND TEMPERATURE DIFFERENCE DURING NUCLEATE BOILING

Eugene F. Adiutori
October 3, 1990

For more than 40 years, it has been generally agreed that fully developed nucleate boiling data are described by the power law

$$q \alpha \Delta T^n \qquad (1)$$

where q is heat flux, T is temperature, and n is a constant which usually assumes a value of approximately 3. This widely accepted conclusion is based on plotting nucleate boiling data on log log paper, drawing the best straight line through the data points in the fully developed region, and determining the value of n from the slope of the straight line.

Drawing straight lines through data points on log log paper does *NOT* rigorously demonstrate that the data describe a power law. It evades the question of the functionality inherent in the data, and merely determines the power law which most resembles the data.

The principal difficulty with inducing functionality from straight lines drawn on log log paper is that all power laws of positive slope pass through (0,0). Therefore, when a straight line of positive slope is drawn through data points plotted on log log paper, it is implicitly assumed that the data describe a function which passes through (0,0), even if the data indicate something quite different.

For more than 100 years, it has been known that boiling requires a *finite* ΔT. Therefore there is strong reason to suppose that nucleate boiling data do *NOT* describe a power law because all power laws of positive slope pass through (0,0), whereas nucleate boiling ceases long before ΔT approaches zero.

The rigorous demonstration that nucleate boiling data describe a power law requires that the data be plotted on *linear* paper in order to allow that the function may not pass through (0,0). This requires drawing the best curve through the data, then matching the curve to a mathematical expression which may or may not be a power law.

In this paper, benchmark data from the literature are plotted on linear paper in order to rigorously determine the relationship between q and ΔT during fully developed nucleate boiling. It is found that the data which indicate an exponent of 3 on log log paper are in fact quite *LINEAR*. We therefore conclude that nucleate boiling data are *NOT* described by a power law--they are described by the linear expression

$$q = a + b\Delta T \qquad (2)$$