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C2Or2C-01: A Continuous Flow Boiling Curve in the Heating Configuration Based on New Cryogenic Universal Correlations

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To enable the design of future in-space cryogenic propellant vehicles such as Lunar and Martian ascent and descent stages and the nuclear thermal propulsion system, high accuracy models of various phases of the propellant transfer process are required. This paper focuses on modeling of steady state flow through the transfer line that connects a propellant tank to an engine or customer receiver tank, which is required to set limits on the allowable heat flux into the line. Using the largest ever collection of available cryogenic heated tube data, universal cryogenic flow boiling correlations were recently developed for various regimes of the boiling curve. However, to model flow boiling in heated tubes, these individual correlations must be patched together to provide a continuous predictive curve of wall superheat as a function of preponderant parameters. This presentation provides an overview of the individual flow boiling correlations along with the logic and methodology for patching the correlations together to produce a single continuous boiling curve. Resulting flow boiling curves are presented for a variety of flow conditions for illustration.

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