



Contribution ID: 286

Type: **Contributed Oral**

C2Or4D-06: Cryogenic Two-Phase Flow Boiling Correlations for Terrestrial and Reduced Gravity

Tuesday 20 May 2025 17:30 (15 minutes)

To enable the design of future terrestrial as well as in-space cryogenic propellant transfer systems such as Lunar and Martian ascent and descent stages, cryogenic fuel depots, nuclear thermal propulsion systems, and ground transportation equipment for liquid hydrogen systems, high accuracy analytical and design tools of various phases of the propellant transfer process are highly desired. This presentation focuses on steady state single or two-phase flow through the transfer line that connects a propellant tank to an engine or customer receiver tank. Using the largest ever collection of available historical cryogenic heated tube data in the world, along with recently gathered test data, universal cryogenic flow boiling correlations have been developed and anchored to over 17,000 data points. A complete set of cryogenic flow boiling correlations that span the entire boiling curve, from single-phase liquid to single-phase gas have been developed for the onset of nucleate boiling, nucleate boiling heat transfer coefficient (HTC), critical heat flux (CHF), film boiling HTC, and two-phase pressure drop. The nucleate boiling HTC and CHF correlations also apply to reduced gravity applications. This presentation provides an overview of each universal correlation, an explanation of the physics of each functional form, and the logic for patching the curves together to form a seamless flow boiling curve. Resulting flow boiling curves are presented for a variety of flow conditions, for illustration.

Author: HARTWIG, Jason

Co-authors: KIM, Sunjae (Purdue); GANESAN, Vishwanath; Dr MUDAWAR, Issam (Purdue)

Presenter: HARTWIG, Jason

Session Classification: C2Or4D - Aerospace Applications I