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SHORTER COMMUNICATION

A DISCREPANCY IN THE PUBLISHED RESULTS ON HEAT TRANSFER TO CRYOGENIC FLUIDS*

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THE purpose of this communication is to call attention to conflicting experimental results on heat transfer to cryogenic fluids. The problem is of some importance in connection with the design of rockets using liquid hydrogen and/or oxygen as propellants.

Kramer, Lowell and Rodebush [1] have reported calculations of the aerodynamic heating of tanks of liquid hydrogen utilizing a curve for the heat transfer from the wall to the liquid hydrogen based on measurements reported by Mulford and Nigon [2]. These measurements of the heat transfer from a 12 mm copper tube to liquid hydrogen at 520 mm pressure indicated a critical temperature difference of 2°K for the transition from nucleate to film boiling. The corresponding maximum heat flux was 6 W/cm^2. It was stated that measurements with liquid nitrogen paralleled the hydrogen curve at somewhat larger ΔT, the critical temperature difference being 4°K and the peak heat flux 6 W/cm^2.

On the other hand, Ruzicka [3] made an extensive set of measurements of heat transfer from platinum wires and copper wires and tubes ranging in diameter from 0·051 to 20 mm to liquid nitrogen at 1 atm and found a critical temperature difference of 12°K and a peak heat flux of 11 W/cm^2.

Weil and Lacaze [4, 5] measured the heat loss from copper, platinum and lead wires to liquid nitrogen over a range of pressures. At 1 atm they found a critical temperature difference of 10°K and a heat flux of 10 W/cm^2 which agrees reasonably well with Ruzicka. Furthermore, the pressure variation would not explain the discrepancy with the measurements of Mulford and Nigon.

Weil and Lacaze [6] also reported heat loss measurements from lead wires to liquid hydrogen at 1 atm. While their value of the critical temperature difference, 2°K, agrees with Mulford and Nigon, Weil and Lacaze found a peak heat flux of only 3 W/cm^2 and the shape of the heat flux–temperature difference curve differed markedly.

It should be noted that Mulford and Nigon and Weil and Lacaze state that their results are not affected by large changes in the geometrical configuration, thus making it very difficult to account for these discordant results.

* Work supported by NASA under Contract NASw-146.

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