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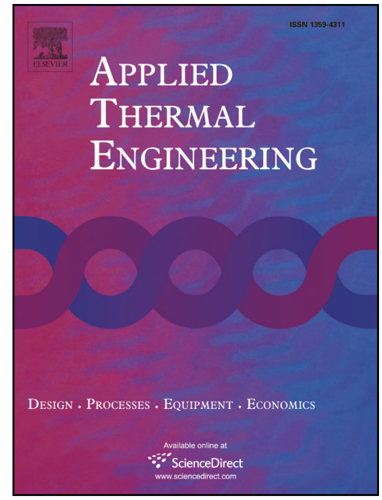

Research Paper

Modelling of Liquid Nitrogen Spray Cooling in an Electronic Equipment Cabin under Low Pressure

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Modelling of Liquid Nitrogen Spray Cooling in an Electronic Equipment Cabin under Low Pressure

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Abstract

Timely and effective cooling is essential for the performance of electronic equipment. For spacecraft, however, the severe aerodynamic heating and low-pressure environment have posed a serious challenge to the heat removal of the high-power electronic equipment. Spray cooling is considered to be an appropriate way to maintain the temperature of the electronic devices within acceptable limits. This paper considers the heat balance in spray cooling using a First Law of Thermodynamics modelling approach as well as a thermal control strategy for a semi-enclosed electronic equipment cabin. Theoretical analysis and numerical results are presented to show the applicability of the developed model and strategy. Characteristics of liquid nitrogen droplet heating, boiling and flash evaporation as well as spray patterns are discussed in detail. Furthermore, the control method of