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Standardization in Cryogenic Thermal Insulation Systems

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The close relationship between industrial energy use and cryogenics drives the need for optimized thermal insulation systems. Emerging cryofuels usage is enabled by adequate isolation of the liquid hydrogen or liquefied natural gas from the ambient environment. Thermal performance data for the total insulation system, as rendered, are essential for both engineering designs and cost-benefit decisions involving comparisons among alternatives. These data are obtained through rigorous testing with suitable apparatus and repeatable methods. Properly defined terminology, analysis, and reporting are also vital. Advances in cryogenic insulation test apparatus and methods have led to the recent addition of two new technical standards of ASTM International: C1774 - Standard Guide for Thermal Performance Testing of Cryogenic Insulation Systems and C740 - Standard Guide for Evacuated Reflective Cryogenic Insulation. Among the different techniques described in the new standards is the cylindrical boiloff calorimeter for absolute heat measurement over the full range of vacuum pressure conditions. The details of this apparatus, test method, and data analysis are given. Benchmark thermal performance data, including effective thermal conductivity and heat flux for the boundary temperatures of 293 K and 77 K, are given for a number of different multilayer insulation (MLI) systems in comparison with data for other evacuated insulation systems including perlite powder, fiberglass, and aerogel composite.

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