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C1Or4A-04: Guarded hot cylinder initial test results for insulation materials down to 20 K

With the growing interest in liquid hydrogen (LH₂) as both a green energy carrier and fuel source for a variety of mobility applications comes an increasing need for materials characterization down to 20 K. Thermal insulation materials are of particular interest, for which virtually all the standardized performance data has been obtained at liquid nitrogen temperatures (LN₂, 77 K) due to the cost, complexity, and safety challenges associated with working with liquid hydrogen or helium. Recently, NASA and its partners began development on a cryocooler-based calorimeter capable of reaching 20 K to systematically evaluate insulation materials for future LH₂ applications. This apparatus, deemed the Guarded Hot Cylinder (GHC), was designed, and constructed at the Cryogenics Test Laboratory at NASA Kennedy Space Center utilizing an existing GM cryocooler and vacuum chamber. Initial checkout testing took place in early 2024, followed by extensive testing on glass bubble bulk-fill insulation to refine the procedure and validate the results using standard LN₂ boiloff calorimetry data, which showed close agreement. An overview of the GHC apparatus will be presented, as well as initial test results at 77 K and 20 K.

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