

Performance parameters of a compact cryogenic hydrogen test platform

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Currently, there is a great need for test facilities for material samples and components for later LH2 applications. This includes low temperature compatibility at 20 K, H₂ compatibility and potential degradation or permeation effects. A versatile test apparatus has been developed without the need of an external LH₂ supply. A limited LH₂ quantity of typically 2–3 L is generated directly on site by simple condensation. Hydrogen is taken from an external reservoir (high pressure cylinders) and condensed by means of a two-stage cryocooler (115 W @ 80 K, 18 W @ 20 K). Pre-cooling is done by the 80 K stage, final cooling and liquefaction by the 20 K stage. A cylindrical pressure vessel with an inner diameter of $d = 109$ mm and a length of 1000 mm is attached. It is designed for a working pressure of 0.1 MPa up to max. 2.1 MPa. The cryocooler and the pressure vessel (sample chamber) are installed in a common vacuum cryostat and are thermally coupled at the two temperature levels. At the 20 K flange, thermal coupling is achieved by a sophisticated thermosiphon arrangement. This contribution discusses the main performance parameters of this test platform, including the cool-down and warm-up procedure, as well as the measurement of the real liquefaction rate and the maximum heat input in stationary operation.

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