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Performance test of a 1 L liquid hydrogen fuel tank for unmanned aerial vehicles.

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A 1 L liquid hydrogen fuel tank has been designed, fabricated and tested to optimize boil-off rate and minimize weight for a 200 W light weight fuel cell in an unmanned aerial vehicle (UAV). A 200 W fuel cell requires maximum flow rate of 2.6 SLPM or less of liquid hydrogen boil-off rate in the fuel tank. After looking at several different insulation schemes, the system was optimized as two concentric lightweight aluminum cylinders with high vacuum and multi-layer insulation in between. MLI thickness and support structures were designed to minimize the tank weight and maintain boil-off in appropriate range. A small heater was added to the inner vessel in order to control evaporation rate corresponding to flight conditions or power consumption of the fuel cell. For support, filling and feed gas to a fuel-cell, the system was designed with two G-10 CR tubes which connected the inner vessel to the outer shell. A secondary G10-CR support structure was also added to ensure stability and durability during a flight. After fabrication the fuel tank was filled with liquid hydrogen. A series of boil-off tests were performed in various operating conditions to confirm thermal performance of the fuel tank for a 200 W fuel cell.

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