

Testing and Results of Human Metabolic Simulation Utilizing Ultrasonic Nebulizer Technology for Water Vapor Generation

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Life support technology must be evaluated thoroughly before ever being implemented into a functioning design. A major concern during that evaluation is safety. The ability to mimic human metabolic loads allows test engineers to evaluate the effectiveness of new technologies without risking injury to any actual humans. The main function of most life support technologies is the removal of carbon dioxide (CO₂) and water (H₂O) vapor. As such any good human metabolic simulator (HMS) will mimic the human body's ability to produce these items.

Introducing CO₂ into a test chamber is a very straightforward process with few unknowns so the focus of this particular new HMS design was on the much more complicated process of introducing known quantities of H₂O vapor on command. Past iterations of the HMS have utilized steam which is very hard to keep in vapor phase while transporting and injecting into a test chamber. Also steam adds large quantities of heat to any test chamber, well beyond what an actual human does. For the new HMS an alternative approach to water vapor generation was designed utilizing ultrasonic nebulizers as a method for creating water vapor. Ultrasonic technology allows water to be vibrated into extremely tiny pieces (2-5 microns) and evaporate without requiring additional heating. Doing this process inside the test chamber itself allows H₂O vapor generation without the unwanted heat and the challenging process of transporting water vapor.

This paper presents the design details as well as results of all initial and final acceptance system testing. Testing of the system was performed at a range of known human metabolic rates in both sea-level and reduced pressure environments. This multitude of test points fully defines the systems capabilities as they relate to actual environmental systems testing.