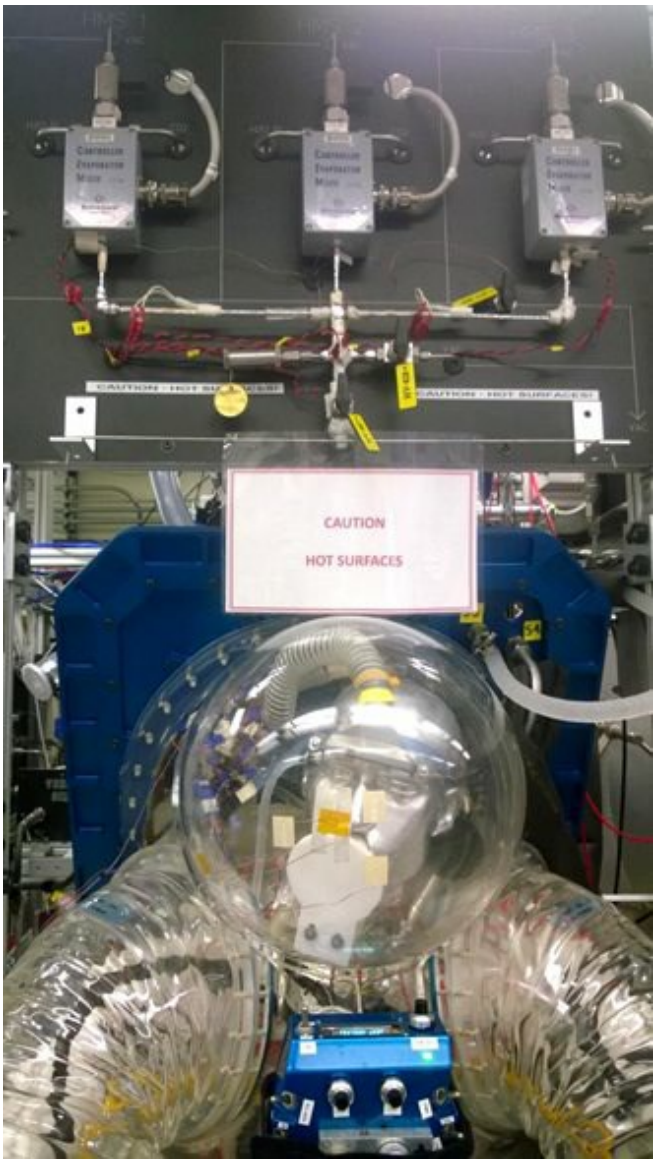
SYSTÈMES CEM POUR LES RECHERCHES DE LA NASA

APPLICATION NOTE

BRONKHORST CEM SYSTEMS FOR NASA RESEARCH

The National Aeronautics and Space Administration (NASA) recently redesigned the system used to test the new space suit Portable Life Support System (PLSS) that is under development. In order to test the PLSS a simulated human metabolic load must be applied to the various sub-systems and so NASA needed to simulate the human production of CO_2 and water vapor with its associated heat load.



Working closely with NASA engineers to fully understand the application requirements, Bronkhorst learned that accurate, stable control of water vapor was critical to efficient and repeatable testing and therefore successful development of the PLSS.

The recommended Bronkhorst solution was a Controlled Evaporation Mixing (CEM) system to properly control the mass of water being vaporized as well as the amount of CO_2 in the vapor. NASA has three CEM systems connected to an outlet manifold. Each CEM system consists of a liquid mass flow controller (H_2O), a gas mass flow controller (CO_2), a Controlled Evaporator Mixer, and a readout/control unit. The three connected CEM systems are collectively referred to as the Human Metabolic Simulator (HMS). The Bronkhorst HMS equipment is controlled via analog (0-5 Vdc) signals through the Bronkhorst readout/control units (1 per CEM system) which in turn are connected to the NASA main test system running NASA's customized LabVIEW software. This setup allows NASA to simulate those aspects of human metabolic output up to a rate of ~3500 BTU/hr, or a bit over 1000 Watts, by injecting the CO_2/water vapor mix into a simulated spacesuit volume containing a manikin ("Manny") which is wearing a Liquid Cooling and Ventilation Garment (LCVG). The LCVG removes sensible heat to keep the human core temp in nominal range, and also provides some latent heat removal via condensation of human-generated water vapor on the surface of the cooling tubes. To complete the human metabolic load simulation, NASA has placed controllable heaters on the CO_2/H_2O vapor deliver lines to prevent condensation and to add super-heat as needed. Additionally, they have controllable electric heaters on the manikin body to simulate sensible heat generation by a human being working at various levels of effort. There is also a Bronkhorst mass flow controller to remove gas from the suit at rates that simulate metabolic consumption of suit gas as well as suit leakage.

Recommended Products



CEM EVAPORATOR W-101A

Max. 2 g/h liquide;
Max. 4 ln/min gaz

Pression 100 bar

Débit de vapeur très stable

Ratio de gaz/liquide flexible



CEM EVAPORATOR W-202A

Max. 120 g/h liquide;
Max. 10 ln/min gaz

Pression 100 bar

Débit de vapeur très stable

Ratio de gaz/liquide flexible



CEM EVAPORATOR W-303B

Max. 1200 g/h liquide;
Max. 100 ln/min gaz

Pression 100 bar

Débit de vapeur très stable

Ratio de gaz/liquide flexible

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