Tech Note

- **Space Suit Cooling**
- **Environmental Chamber**
- **Correction for Contaminants**
- **Monitor Dew Point**

Environmental Chambers are used extensively around the world. Environmental Chambers provide a controlled atmosphere for research, testing and production. Chambers come in all sizes, from small tabletop units to large, room-sized systems. Many physical and analytical measurements are made of the gases/air inside a chamber. Reliable, accurate dew point measurement is typically required. Here's one case…

Background:

During manned space flight, the safety and comfort of crew members is one of NASA's primary concerns. Astronauts, who must wear bulky, pressurized space suits, are called upon to perform a variety of tasks during missions, such as test of equipment and scientific experiments. These activities inevitably lead to an increase in body temperature and perspiration, which can place a heavy load on the cooling system that controls the atmosphere within the astronaut's space suit. A key factor in maintaining desired conditions within the suit is the effective control of moisture.

Temperature fluctuation in space is extreme. Surfaces exposed to the sun can reach temperatures exceeding 150°F. Once behind a space structure or the Earth, temperatures can plummet to -300°C. Such extremes challenge the best heating/cooling systems. Moisture condensation on the inside of a space suit is compounded by the extreme environmental conditions. NASA file footage has shown pioneering astronauts during space walks that could not see beyond the helmet visor. In one case, the astronaut could not immediately determine how to get back into the space craft.

The Challenge:

NASA officials at the Johnson Space Center near Houston, Texas contracted Lockheed Martin to conduct a series of tests to determine if the space suit cooling system functioned appropriately. During testing, an astronaut in a near-vacuum environmental chamber performs various exercises, such as running on a treadmill, to generate perspiration. The sizes of environmental chambers at the Lockheed Martin site are quite varied.

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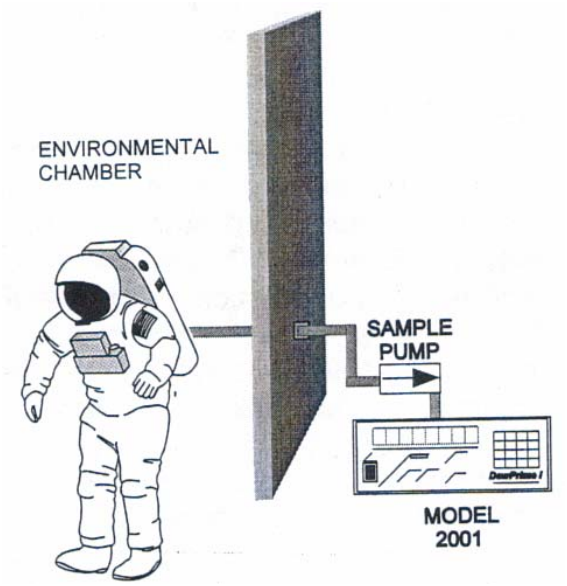
One unique chamber measures six stories high and thirty feet in diameter, and can pull a vacuum equivalent to an altitude of approximately 200,000 feet! Such chambers can be used to simulate the unique conditions of space (including hot lamps to simulate the sun). Other "man-rated" chambers test heat load conditions on new suit designs, or even newly initiated astronauts. Testing the cooling systems required all the resources at Lockheed Martin's disposal.

The Solution:

Lockheed Martin installed EdgeTech's DewPrime Model 2001-S2 dew point hygrometer on the environmental chamber to analyze moisture in the space suit.

Air samples are extracted through sample lines from the astronaut's space suit and are analyzed by instrumentation outside the environmental chamber.



Suit pressures are below atmospheric pressure, so samples are drawn by vacuum pump to the instruments. Tests are performed to determine oxygen and moisture levels as the temperature inside the space suit changes.

Accurate monitoring of moisture inside the space suits requires equipment that can compensate for high levels of contamination produced by the human body (skin, hair, etc.). The DewPrime uses EdgeTech's patented chilled mirror sensing scheme, which provides direct, NIST-traceable measurements of absolute moisture. It incorporates a highly polished mirror that continuously heats and cools, allowing condensation to form a dew layer. Dew on the mirror's surface is detected electro-optically by reflecting a collimated LED light at an angle off the mirror surface, and then measuring the reflectivity with a photo detector. Heating the mirror to dry conditions indicates a full transmission. Cooling the mirror to the condensation temperature detects a less than full transmission, and thus, the true dew point temperature. The EdgeTech DewPrime can be specified for a wide temperature range from -50° to 100°C, which was a key criterion for the Lockheed Martin system.

The EdgeTech DewPrime has become the choice of users around the world for precision moisture and humidity control in various types of environmental chambers. Keeping track of moisture inside space suits has proven to be no sweat with EdgeTech technology.

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