Supporting Life on the International Space Station

While the U.S. Laboratory *Destiny* serves as a centerpiece for scientific research aboard International Space Station (ISS), it will also serve as the second module designed to support human life. The Russian module Zvezda serves as the other. In 2004, a module called Node-3 is scheduled to arrive to ISS with the final life support hardware. Up to four ISS crew members will be able to comfortably live and work on *Destiny* in an environment equal to, and in some aspects, better than that found on Earth.

"We have replicated Earth's environment in this small space," explained Dick Reysa, Environmental Control and Life Support Subsystem (ECLS) Manager. "The atmospheric conditions, humidity level, temperature, and water all mirror conditions on Earth. The difference, and one that has challenged us, is the process of recycling those conditions. On Earth it typically takes months for water leaving a household, to flow through a community water purification system, before being used again. On the station, it takes less than a day for water and air to be revitalized and reused."

This seemingly excessive reuse of resources on the station is due to limitations on available space and weight aboard Station. Historically, U.S. spacecraft have carried oxygen, nitrogen, carbon dioxide removal canisters and water to orbit to provide crew life support. To compensate, the Boeing ECLS team equipped *Destiny* with an Atmospheric Revitalization System and Water Recovery system that recycles air and recoups excess water, nitrogen and oxygen from the Space Shuttle.

The Atmospheric Revitalization System provides carbon dioxide removal, trace contaminant control, and gas constituent analysis. Crew-generated carbon dioxide is removed from the cabin atmosphere by sorbent beds that are designed to absorb carbon dioxide. The beds are regenerated upon exposure to heat and space vacuum. A Trace Contaminant Control System ensures that over 200 various trace chemical contaminants generated from material off-gassing and crew metabolic functions in the habitable volume remain within allowable and safe concentration limits. Gas is analyzed by a mass spectrometer, measuring oxygen, nitrogen, hydrogen, carbon dioxide, methane and water vapor present in the cabin. The mass spectrometer samples these gases throughout the United States modules.

The water recovery system for *Destiny* consists of a tank that collects condensed water from the Temperature and Humidity Control (THC) System to vent to space, or to transfer to the Russian module for recovery. The arrival of Node-3 on ISS in 2005 will enable station to also recover water.

The THC system provides air movement for crew comfort, air filtration, temperature selectivity between 65 to 85 degrees Fahrenheit, and cabin humidity in the range of 40 to 60 degrees Fahrenheit. Humidity control is accomplished by an air-to-water heat exchanger to remove cabin heat. Water condensed, as a result of passing across the cold heat exchanger, is separated from the air stream and collected in a condensate tank for later recovery or venting to space. In addition, ventilation fans provide the necessary air circulation for controlling temperature, humidity and gas partial pressure control in Station modules not equipped with the THC system.

Fire detection in the lab is provided by laser smoke sensors mounted in the cabin aisle and behind panels. Fire suppression is accomplished by the use of carbon dioxide portable fire extinguishers.

Destiny is also the only U.S. module that supplies a space vacuum source for payload venting. The system is capable of exhausting waste gases from a single payload, or multiple payloads simultaneously.

Astronauts will be able to easily maintain the life support system. Key ECLS systems are located in laboratory racks, endcones, and standoff areas that are readily accessible for removing and replacing faulty hardware.

The U.S. Laboratory *Destiny* - centerpiece of scientific research aboard the ISS - is set to launch aboard the Space Shuttle Atlantis on February 7. It is the first of six planned research modules on the station, and also will serve as the command and control center for the entire complex.

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