NASA Facts

National Aeronautics and
Space Administration

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Human Research Facility Rack 1

Missions: Expedition Two, ISS Mission 5A.1, STS-102 Space Shuttle Flight
Experiment Location on ISS: U.S. Laboratory
Project Manager: Dennis Grounds, Johnson Space Center, Houston, Texas

Overview

The Human Research Facility provides an on-orbit laboratory that will enable life science researchers to study and evaluate the physiological, behavioral and chemical changes in human beings induced by space flight. Research performed with the Human Research Facility will provide data relevant to longer term adaptation to the space flight environment.

The Human Research Facility is a rack which provides services and utilities to experiments and instruments installed within it. These include electrical power, command and data handling, cooling air and water, pressurized gases and vacuum.

The first of two Human Research Facility racks was transported to the International Space Station

Astronaut C. Michael Foale, Expedition 8 commander, balances on the footplate of a special track attached to the Human Research Facility (HRF) rack in the Destiny laboratory on the International Space Station (ISS).

during the second expedition. The facility launched aboard the Space Shuttle mission STS-102, part of Space Station mission 5A.1. NASA fuels discoveries that make the world smarter, healthier and safer.

Experiment Operations

The Human Research Facility Rack 1 houses a Computer Workstation and Portable Computer Laptop for crew members to command and test the rack's equipment, collect and store experiment data, send data to and from scientists on Earth, provide a place for the crew to keep notes, and for human life sciences experiments.

Beginning with Expedition Two, the Space Station crew will use the computers to transmit data from environmental experiments which measure radiation, such as the Phantom Torso, Bonner Ball Neutron Detector and Dosimetric Mapping experiments. They also transmit data from the H-Reflex life sciences physiological experiment, and Crew Interactions psychological surveys.

Also housed in the rack is equipment for the Gas Analyzer System for Metabolic Analysis Physiology, or GASMAP, and Ultrasound human life sciences experiments. These are generic diagnostic research tools designed to support a variety of future human research investigations.

GASMAP is used for periodic assessment of crew aerobic capacity. It analyzes human metabolics, cardiac output, lung diffusing capacity, lung volume, pulmonary function and nitrogen washout.

The GASMAP is made up of two pieces of hardware, the Analyzer Module and the Calibration Module. The Analyzer contains sensor and electronic hardware to measure and analyze the inhaled and exhaled breath stream of Space Station crew members. The Calibration Module supplies high-pressure calibration gases to the Analyzer Module. The calibration gases are housed in three cylinders:

- Cylinder 1 contains 20 percent oxygen, 80 percent nitrogen
- Cylinder 2 contains 15 percent carbon dioxide, 1 percent argon, 84 percent oxygen
- Cylinder 3 contains 10 percent nitrogen, 10 percent argon, 10 percent helium, 5 percent carbon dioxide, 0.7 percent acetylene, 2 percent sulfur hexafloride, 0.3 percent carbon monoxide, 62 percent oxygen

None of these gases present a safety hazard if they leak into the cabin.

A Random Access Mass Spectrometer allows the gas mixtures from the Calibration Module into the Analyzer Module for gas analysis.

Crew members set up and activate the GASMAP hardware and perform brief health checks of the equipment every 30 days to maintain high internal vacuum—in other words, to make sure the unit remains empty and uncontaminated. A full functional health check is conducted every 90 days. Each crew member has his or her own mouth piece and saliva filter, and receives a new one every 90 days.

To protect equipment from contamination, catheter filter changes are made in the analyzer module. The catheter is a plastic tube that transfers gas samples from the Calibration Module to the Analyzer Module.

The Ultrasound Imaging System provides three-dimensional image enlargement of the heart and other organs, muscles and blood vessels. It is capable of high resolution imaging in a wide range of applications, both research and diagnostic, such as:

- Echocardiography (ultrasound of the heart)
- Abdominal ultrasound (deep organ)
- Vascular ultrasound
- Gynecological ultrasound
- Muscle and tendon ultrasound
- Transcranial ultrasound
- Ultrasound contrast studies
- Small parts ultrasound

The only maintenance to be performed by Space Station crew members on the Ultrasound system is vacuuming an inlet air debris screen as necessary.

Other equipment stowed in the Human Research Facility Rack 1 are sample collection kits, a continuous blood pressure device, a foot ground interface, and a lower body negative pressure device.

Flight History/Background

Experiments conducted on board Spacelab, the Space Shuttle and the Russian space station Mir have required unique equipment to be transported for individual investigations. The Human Research Facility is unique to the International Space Station because its standardized equipment can support multiple experiments, reducing the amount of equipment transported to and from the Space Station.

The development phase began in 1996 with the formation of a science working group made up of non-NASA researchers and medical practitioners. They defined the needs of prospective science experiment investigators and assisted NASA in designing and developing the rack and its hardware.

The Human Research Facility is the first rack-sized payload to be installed in the U.S. Laboratory module of the International Space Station.

Benefits

Human Research Facility hardware will enable the standardized, systematic collection of data from the Space Station's crew members, which the medical and research community will require in order to assure crew health.

Scientific research, including human research, is a primary goal of the International Space Station. Areas of concern to human well-being and performance, such as renal stone risk, bone density deterioration and the effects of ionizing radiation, will be studied using the Human Research Facility system and hardware.

The human research will contribute to improving the scientific foundation of our understanding of the processes related to life, health and disease; strengthening the scientific underpinning of programs to assure safe and productive human space flight; and developing various applications of space technologies relevant to solutions of scientific and medical problems on Earth.

The Human Research Facility makes possible a variety of life sciences experiments on board the International Space Station. For more information and photos on the Human Research Facility, visit: **www.nasa.gov**

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