Glovebox

Project Scientist: Dr. Donald A. Reiss, NASA Marshall Space Flight Center

The Spacelab Glovebox, provided by the European Space Agency, offers scientists the capability to carry out experiments, test science procedures, and develop new technologies in microgravity. It enables crewmembers to handle, transfer, and otherwise manipulate experiment hardware and materials in ways that are impractical in the open Spacelab. In addition, the facility is equipped with photographic equipment that allows a visual record of experiment operations. Many investigations will benefit from the increased crew involvement and the photographic and video capabilities that the facility permits.

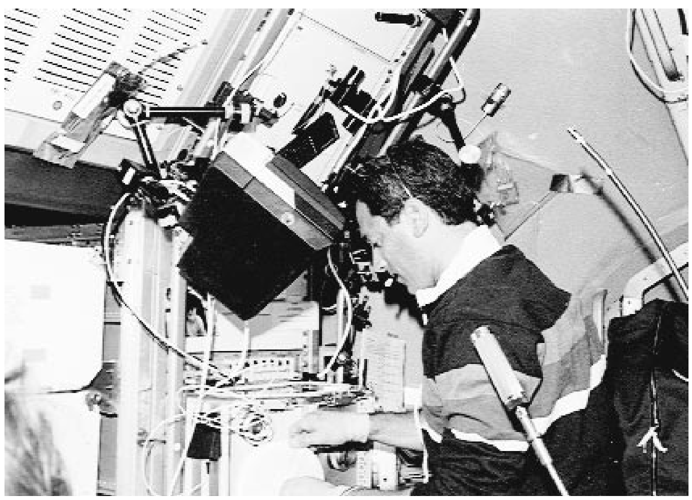
The Glovebox has an enclosed cabinet that offers a clean working space and minimizes the contamination risks, both to Spacelab and to experiment samples. It provides two types of containment for small quantities of materials: physical isolation and a negative air pressure differential between the enclosure and the rest of the Spacelab working area. An air-filtering system also protects the Spacelab environment from experiment products that could be harmful to the crew. The Glovebox facility can contain fluids, powders, bioproducts, and even toxic or irritating materials, preventing them from entering the Spacelab environment. By the same means, the facility protects samples from contamination when experiment procedures call for containers to be opened.

The Glovebox provides the following features to microgravity experiments: a large viewing window atop the cabinet, experiment mounting and positioning equipment, real-time downlink of experiment video and housekeeping data, electrical power, partial temperature control, time-temperature display, lighting, and cleaning supplies. It has two color and two black-and-white video channels to record experiment operations and the behavior of specimens, a backlight panel, a 35-mm camera, and a stereomicroscope that offers high-magnification viewing and the capability to record images when used in concert with the video or still cameras.

The crew manipulates samples or experiment equipment through three doors: two glovedoors and a central port through which experiments are placed in the Glovebox. The glovedoors are located on each side of the central port and serve three functions. When an airtight seal is required, crewmembers can insert their hands into rugged gloves attached to the glovedoors, allowing no airflow between the enclosure and the Spacelab. If the experiment requires more sensitive handling, crewmembers may put on surgical gloves and insert their arms through a set of adjustable sleeves. Each of the glovedoors also provides a viewport for the facility's video cameras.

General operations require the crew to unstow experiment modules and specimens, move them to the Glovebox enclosure, and place them inside. Most of the experiment modules in the Glovebox have magnetic bases or strips that hold them to the metal floor of the enclosure, or they can be mounted to attachment points on the floor, while others attach to a laboratory jack in the enclosure that can position the module at a chosen height above the cabinet floor. Experiment equipment also may be bolted to the left wall of the working space or attached outside the facility with Velcro™.

Once the experiment equipment is secured, the crew will proceed with operations specific to a particular investigation. Following the experiment, the crew will clean up any spills or leaks in the workspace, reassemble the hardware if necessary, and move it back into stowage. They also will store any samples that must be preserved for postflight analysis.



Payload Specialist Dr. Larry DeLucas Preparing to Start Experimentation in the Glovebox on USML-1

Glovebox

Interface Configuration Experiment

Principal Investigator:
Dr. Paul Concus,
University of California-Berkeley, Berkeley, California

Purpose: To explore the behavior of equilibrium liquid-vapor interfaces in low gravity
Significance: Currently, the behavior of free liquid-vapor interfaces, such as in spacecraft fuel tanks, cannot be predicted satisfactorily in the microgravity environment. Since many on-orbit operations involve fluids and depend on their behaviors, it is important to test and refine the models used to determine how container shape can affect the location and shape of fluid surfaces.

Oscillatory Thermocapillary Flow Experiment

Principal Investigator:
Dr. Yasuhiro Kamotani,
Case Western Reserve University, Cleveland, Ohio

Purpose: To study the conditions for the onset of oscillations in thermocapillary flows
Significance: Temperature variations along a free liquid surface generate thermocapillary flows in bulk fluids. On Earth, flows begin to oscillate under certain conditions. By studying the conditions present when oscillations begin in microgravity and by comparing them to onset conditions present on Earth, scientists will be able to determine the cause of the oscillations.

Fiber Supported Droplet Combustion

Principal Investigator:
Professor F.A. Williams,
University of California, San Diego, California

Purpose: To test a technique of droplet deployment and ignition using thin fibers for positioning
Significance: Droplet combustion studies are very difficult to perform on Earth. Gravity causes high-density droplets to sink, and buoyancy-induced acceleration forces combustion products to rise, resulting in drops that burn unevenly. A new technique for conducting droplet combustion studies will give researchers access to a tool for studying fundamental combustion processes, such as how pollutants are formed.

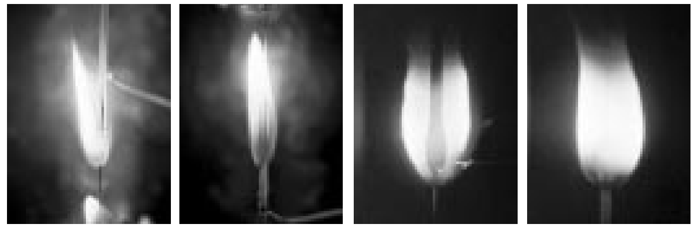
Protein Crystal Growth-Glovebox

Principal Investigator:
Dr. Lawrence J. DeLucas,
Center for Macromolecular Crystallography, Birmingham, Alabama

Purpose: To confirm the advantages of crew interaction with microgravity protein crystal growth experiments

The Glovebox provides a range of capabilities to experimenters in an environment isolated from the open Spacelab.

NORMAL GRAVITY | MICRO GRAVITY



BUOYANT, UPWARD FLOW UPWARD-BURNING | BUOYANT, UPWARD FLOW DOWNWARD-BURNING | FORCED, CONCURRENT FLOW BURNING | FORCED, OPPOSED FLOW BURNING

Wire insulation burning on Earth in the buoyant air flow induced by gravity was compared on USML-1 with burning in a low-speed air flow in microgravity in the Glovebox.

Significance: Protein crystals are very difficult to produce. This experiment will give investigators the ability to modify protein crystal growth parameters as a method of enhancing or optimizing the scientific return in real time and to revise or redesign experiments accordingly. Such optimization will include investigating mixing procedures, crystal seeding methods, crystal mounting techniques, and crystal preservation. This research will have a direct impact on the protein crystals grown on this mission, on future Shuttle missions, and on the space station.

Zeolite Crystal Growth-Glovebox

Principal Investigator:
Dr. Albert Sacco, Jr.,
Worcester Polytechnic Institute, Worcester, Massachusetts

Purpose: To evaluate on-orbit mixing protocols for middeck zeolite crystal growth experiments, to optimize on-orbit crystal growth conditions, and to study clustering and aggregation of secondary building units
Significance: Zeolite crystals are used as catalysts and filters in the chemical processing industry. To produce useable crystals, the growth solutions must be precisely mixed. This experiment will provide valuable mixing information to researchers using the Zeolite Crystal Growth Furnace facility.

Colloidal Disorder-Order Transitions

Principal Investigator:
Dr. Paul M. Chaikin,
Princeton University, Princeton, New Jersey

Purpose: To measure the fundamental properties of a colloid at the crystallization phase boundary where it is solidifying from a liquid in microgravity.
Significance: Colloids are suspensions of finely divided solids or liquids in gaseous or liquid fields. For example, aerosols are colloidal dispersions of liquids in gases, smoke is a dispersion of solids in a gas, and sols are colloidal mixtures of liquids and solids. Researchers want to know what is occurring at the boundary between the liquid and solid states of a colloid. This will help them improve materials processing methods on Earth, as well as in microgravity.

Particle Dispersion Experiment

Principal Investigator:
Dr. John Marshall,
NASA Ames Research Center

Purpose: To study the dispersion disaggregation and re-agglomeration of fine natural particles in microgravity
Significance: By understanding how dust particles in an atmosphere form aggregates and by developing a concept of the natural end-product of aggregation, scientists can better assess how planetary atmospheres are cleansed of dust, such as that produced during a volcanic explosion.