Operations and Utilisation

ACCOMMODATION & TRANSPORT

The MSG rack was launched in passive mode inside the Multi Purpose Logistics Module LEONARDO during ISS flight UF-2 on 5 June 2002. It was then moved to its location in the Destiny laboratory, where it was subject to the on-orbit commissioning. After successful conclusion of this phase, it was ready to start its operational life.

Experiments can be launched/retrieved within stowage drawers (EXPRESS Racks or Re-supply/Stowage Racks) or Shuttle Middeck Lockers. During certain MSG operations (such as cleaning of the working volume, filters change out) the experiments can be stored temporarily within MSG or other racks stowage drawers.

OPERATIONAL CONCEPT

The MSG can operate in an open mode, with air circulating from the working volume to the MSG rack interior and in a closed mode, with air circulating within the MSG working volume only. Further, the MSG has the capability to maintain in the working volume an inert atmosphere with dry nitrogen such that the oxygen volume is kept equal or less than 10%.

The MSG also accommodates ISS laboratory support equipment such as general purpose tools, fluid handling tools, cleaning equipment, mass measurement devices, a pH-meter, dissecting microscope and supplies, digital multi-meters and compound microscope.
Apart from the equipment required for the general upkeep of the working volume, a significant amount of resources is available for scientific investigations.

The MSG offers many different command and control capabilities to allow the performance of investigations attended or not attended by the crew.

In the local mode, the crew can introduce commands via the Control and Monitoring Panel and, in some cases and for a limited set of commands, also through the Internal Control Panel inside the working volume.

- In the remote mode, commanding is possible via:
- MLC, which can be hooked up to the MSG internal MIL 1553 Bus at the MSG front panel. A subset of non-safety related commands is available.
- MLC (MSG Laptop Computer) connected to the ISS MIL 1553 Bus, out of MSG.
- US Lab System via the Payload MDM.
- Ground commands, which are accepted in parallel to controls via the Control and Monitoring Panel. This mode would also allow unattended operations for non-hazardous investigations or unattended stand by control.

UTILISATION SCENARIO

The MSG facility has been built for a projected operational use of ten years on-orbit and is currently accommodated in the Destiny laboratory.

BACKGROUND

The design and development of the MSG has evolved substantially from the former Spacelab and Middeck Gloveboxes that have been flown on numerous Space Shuttle missions and on the Mir space station.

Significant enhancements include a substantially larger working volume to house bigger experiments, increased power availability, enhanced diagnostics and data control, and temperature and humidity control.

The MSG has been designed as a modular multi-user facility for performing a wide variety of materials, combustion, fluids and biotechnology investigations in the microgravity environment. Primarily it provides an enclosed and sealed Work Volume equipped with lighting, mechanical, electrical, data, gas and vacuum connections, and thermal control.

The Working Volume is provided with built-in glove ports for safe handling by the crew and isolates the item under investigation from the operator area and the general ISS environment. An attached Airlock allows specimens and tools to be inserted or removed during MSG operations with limited environmental exchange between the Working Volume and the ISS cabin. The MSG will also accommodate minor repair/servicing of hardware requiring a clean and/or an encapsulated working environment.

In addition to the flight unit, there are three ground units; the Ground Laboratory Unit, the Training Unit and the Engineering Unit, all of which have been used extensively for experiment development and crew training.

To assist potential investigators, an MSG Investigation Integration Team has been established based at the Marshall Space Flight Center in the US. This team oversees the interface and safety requirements, the schedule for meeting ISS template milestones, the administrative support for documenting interfaces to the MSG facility, and the investigation manifesting, analytical integration, and flight operations. It also supports the investigation development teams in ensuring that the engineering interfaces to the MSG and ISS are met.

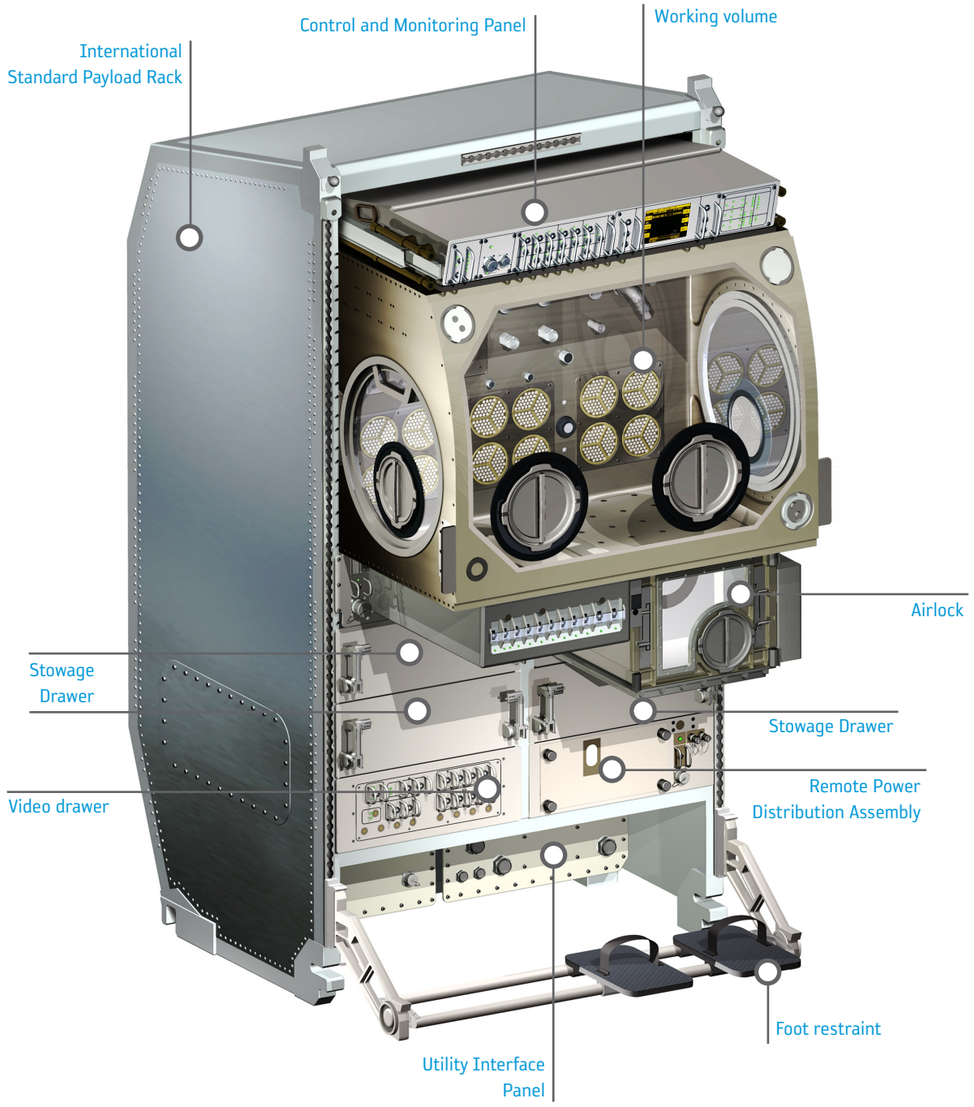
SCHEDULE

The MSG for the ISS completed its development and verification in Europe in October 2001, and was integrated into the Multi Purpose Logistics Module LEONARDO on 1 March 2002. The facility was launched aboard the Space Shuttle on Utilisation Flight UF-2 on 5 June 2002, and underwent commissioning shortly afterwards.
The facility is now available for experiments, and will provide the ISS with a unique and multidisciplinary laboratory support capability for at least 10 years.

→ MICROGRAVITY SCIENCE GLOVEBOX (MSG)

Class 100,000 protected environment experiment facility

The Microgravity Science Glovebox is an International Standard Payload Rack size facility where experiments in the field of material science, biotechnology, fluid science, combustion science and crystal growth research can be conducted in a closed and protected environment.



esa	PROJECT: International Space Station		
TITLE: Microgravity Science Glovebox		DOCUMENT N°: ESA-HSO-COU-014	REV. 2.0

Facility Description

The Microgravity Science Glovebox system architecture is built around the core facility, hosting the investigations in the working volume and providing them with all the needed resources.
The other main parts of the facility are:

- Rack infrastructure with ESA's Standard Payload Outfitting Equipment, consisting of the Remote Power Distribution Assembly (RPDA), the Standard Payload Computer (SPLC), the Avionics Air Assembly (AAA);
- 3 ISIS stowage drawers with supporting equipment for payload operations and consumables for facility operations;
- ISIS based Video Drawer Assembly for support of investigation diagnostics.

CORE FACILITY

The Core Facility occupies the upper half of the overall rack and includes the large working volume, an Airlock and electronics for control, housekeeping and investigation resources.
The command and monitoring panel monitors the facility status and performance and provides all means for the manual operation of MSG by the crew.

The working volume is a large confined volume of 255 litres offering two levels of containment for investigations. The first level is achieved by the physical wall barrier and the second level is achieved through an under-pressure of the working volume versus the environment. The under-pressure is achieved through continuous air circulation inside the working volume and Airlock. The circulated air is filtered and cooled, giving a clean room environment and the possibility to remove up to 200 W from the investigation area. The working volume is provided with front and side ports, equipped with gloves, for access and loading of sample and support equipment. The working volume can slide in and out of the rack to gain access to the side ports for the initial introduction and manipulation of investigations and to fix accessories. The fully extended position will not be used nominally for routine operations to avoid a permanent protrusion in the ISS module aisle.
The entire window surface of the working volume is made of Lexan and allows for a wide view angle to the operator.
The window and the lateral panels can be covered with dedicated stray light covers when required. Investigations can be bolted both on the working volume bottom and on the left part of the back wall.
The intensity of illumination in the working volume can be varied and a dedicated Spotlight is available.
An investigation cold plate embedded in the floor of the working volume allows the removal of up to 800 W from the baseplate of the investigations.

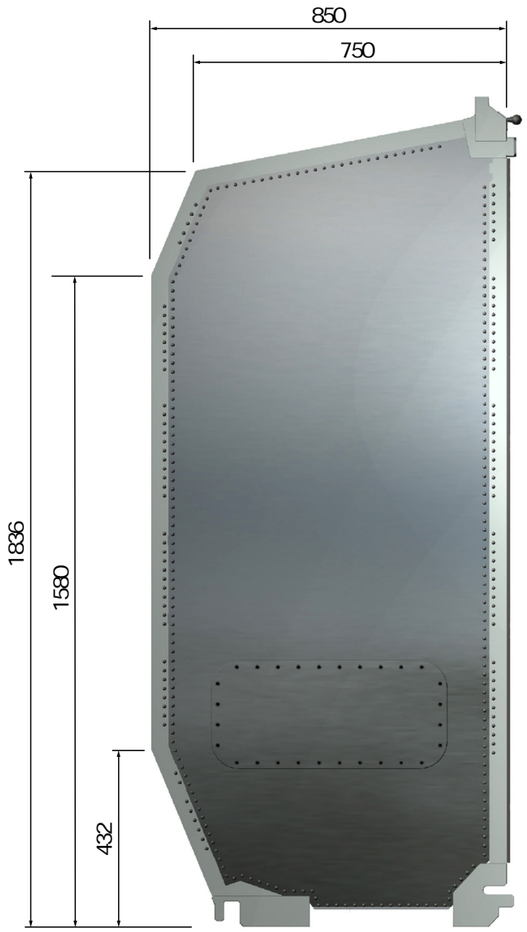
The Airlock provides access to the working volume and to the investigations and provides access to contained specimens for the investigations and laboratory support equipment items during sealed operations. The Airlock has its own internal lighting in support of investigations, operating independently of the working volume.

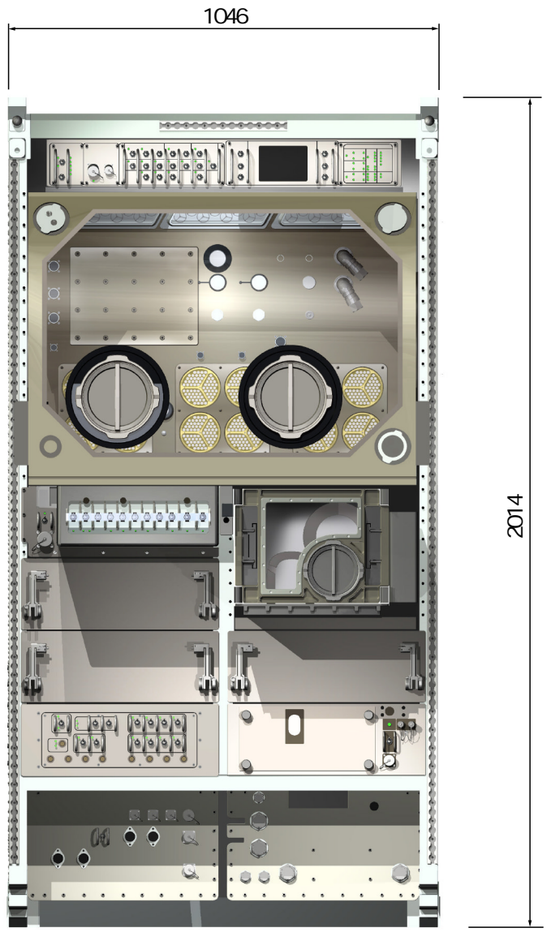
VIDEO ASSEMBLY

The video assembly is a self-standing subsystem, integrated into a dedicated active International Subrack Interface Standard (ISIS) drawer, including 4 colour cameras, 2 monitors, 2 analogue and 2 digital recorders, a touchpad, a power distribution unit, a power and data line and a controller board.
Thermal control for the powered components inside the video drawer is provided by a backside suction fan that is able to transfer a maximum 125 W of heat to the MSG internal air-cooling loop. The video assembly has a dedicated controller that allows the user to command the video system via an input device that is connected to the RS-422 serial interface or via the touchpad.
The functionality provided through these digital interfaces is in addition to the fully hardwired command possibility via the drawer front panel switches and the individual local command functions on the recorder, monitor and camera units themselves.

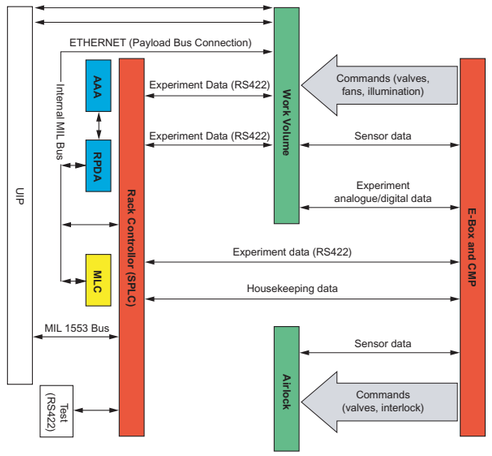
MSG DATA HANDLING SYSTEM

The standard payload computer interfaces with the MIL 1553 bus of ISS, acting as a remote terminal versus the ISS Payload computer. It also hosts and controls an internal MIL-STD-1553B bus. This bus controls the remote power distribution assembly and avionics air assembly and has stubs for two working volume connectors (external and internal) to which the MSG Laptop Computer or a facility laptop can be connected.
Five RS422 lines are provided. Two lines are devoted to the working volume for direct up/download of investigations data. Two lines connect the standard payload computer and the Electronics box and command and monitoring panel; one line is used for housekeeping data and the other for the investigations data, converted within the electronics box from analogue/digital data. The last RS422 output is used for test.
The Control and Monitoring Panel and the Electronics box are the heart of the facility and control the basic glove box functions. Detailed parameter setting and control is performed via the information and control centre, which consists basically of a menu driven display and a keypad.





CHARACTERISTICS	
Working volume:	255 litres
Largest access dimension:	40 cm diameter
Pressure environment with respect to cabin:	Negative pressure with air circulation and filtration
Airlock module capability for transfer of payload and equipment:	max. 40 litres
Power:	+ 120 Vdc, + 28 Vdc, ± 12 Vdc, 5 Vdc
Video link (analogue):	yes
Video cameras:	4
Video recorder:	3 + 1 hard disc
Gaseous Nitrogen:	yes
Vacuum and venting:	yes
Cooling:	up to 200 W by air up to 800 W by cold plate




View of the Microgravity Science Glovebox (MSG) with the SPHERE experiment inside.


ESA astronaut Frank de Winne working in the Microgravity Science Glovebox