Life Sciences Glovebox

ASGSR 2018

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LSG Facility

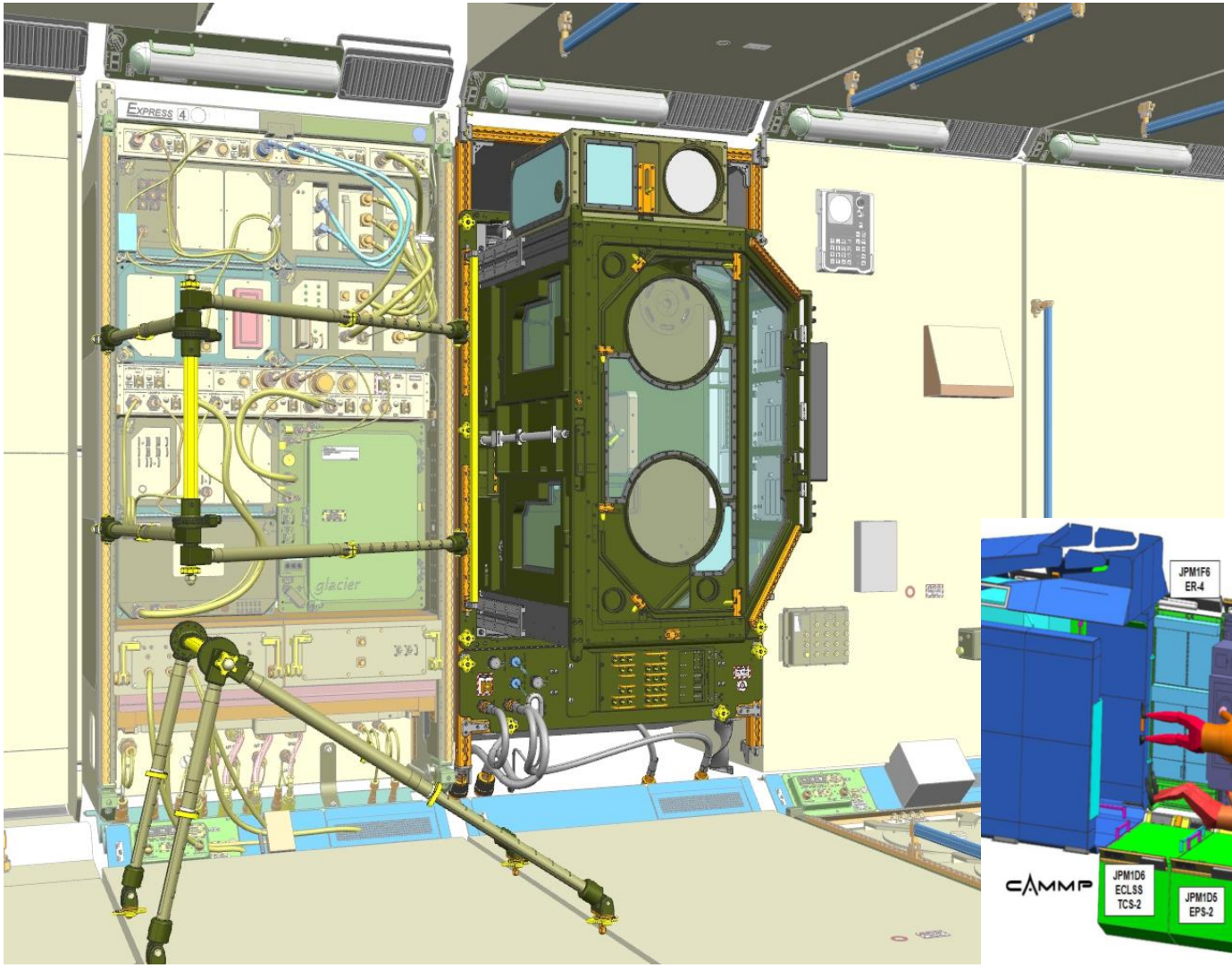
- LSG is a Rack Level Facility rack-level payload facility designed to house biological investigations in a “workbench” type environment aboard the International Space Station (ISS).

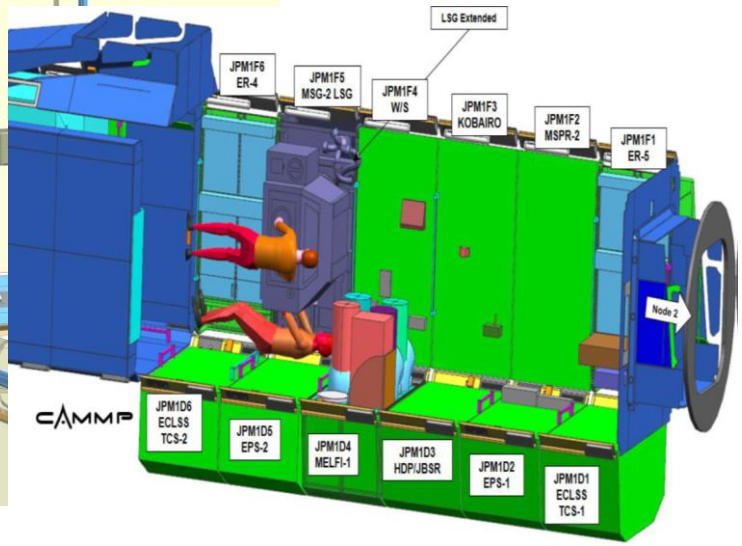
- LSG provides two levels of containment, multiple resources, and a variety of attachment hardware for investigation use

- Many similarities with the Microgravity Science Glovebox (MSG), but the two facilities do not provide all the same resources (or at the same levels)

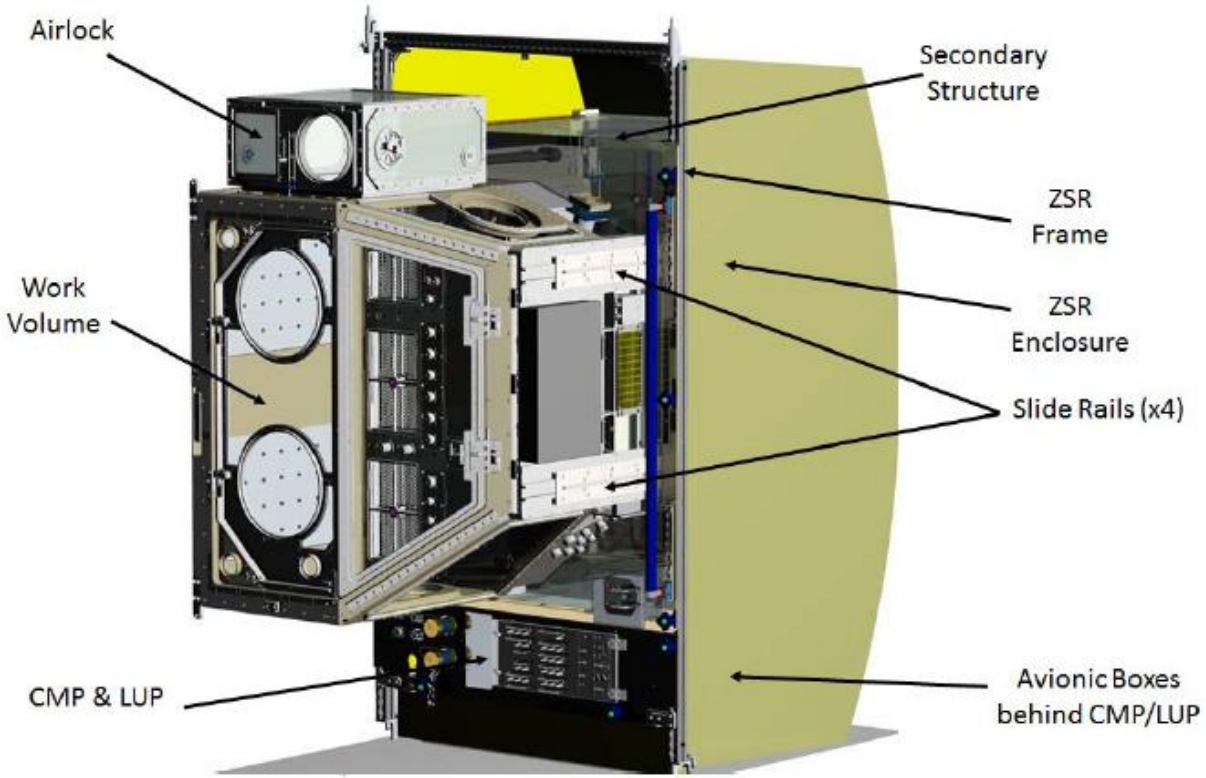
- There are currently five LSG units:
  - Flight Unit (on-orbit; to be commissioned in November 2018)
  - Engineering Unit (at MSFC)
  - HiFi Unit (at MSFC)
  - Training Unit (at JSC)
  - Development Unit (at AMES)

LSG Facility in JPM1F5





LSG Rack Overview

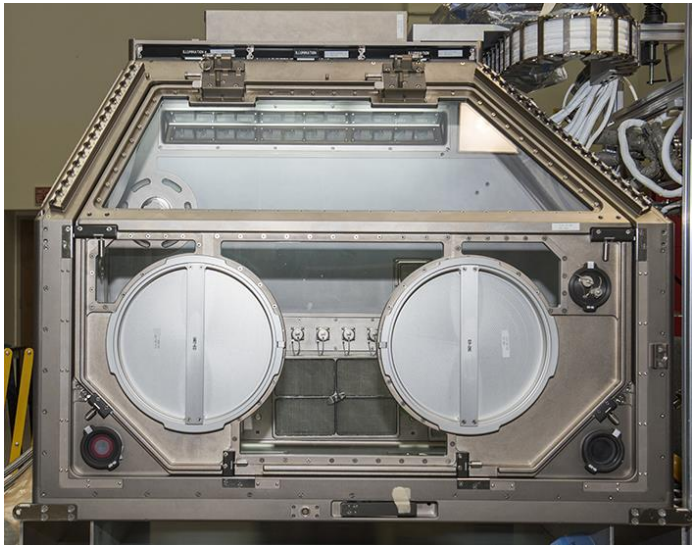


LSG with Airlock attached and Work Volume (WV) extended (extends approx. 31.6”)

LSG with Work Volume (WV) retracted

LSG Capabilities

Capability	LSG
WV volume	450 L or 16 ft^3 (660 mm high x 910 mm wide x 610 mm deep) Extendable/Retractable Main Door – 660 mm high x 660 mm wide
Two levels of containment	Negative pressure from airflow Physical barrier of structure
General illumination	1000 lux @200mm above WV floor LSG Spotlight or MagLight (1000 lux at 140 mm spot dia)
Filtration	3 HEPA/charcoal/catalyst filter stacks (Replaceable on orbit)
WV Air flow	3000 l/m max (1200 l/m to 2250 l/m based on setting)
120Vdc for payloads	None
28 Vdc for payloads	5 connectors on WV rear wall
110 Vac for payloads	1 connector on WV rear wall
Payload attachment	Ferrous plates
Max payload heat dissipation	Less than 350W total (At max fan condition)
Data handling connections	ISS provided Z-Book 2 Ethernet, 1 RS422, 1 RS232, 1 2” USB Feedthrough
Video	Via cable to VUE drawer in EXPRESS rack (420 MB/s) 4 GigE inputs, 4 LSG provided cameras, 1 LSG feedthrough
Airlock	Optional, removable side-mounted 30 L (1.06 ft^3) Allows items 180 mm x 410 mm x 410 mm to be transferred
Vacuum	None
Nitrogen	None
Glove Ports	2 10” glove ports 2 8” glove ports 2 6” glove ports (1 in AAD)
FDS	Rack - Parameter Monitoring (Temp) WV – Parameter Monitoring (Temp) PFE Port – Avionics and WV



Glovebox Comparison

Life Sciences Glovebox

Microgravity Science Glovebox

IPGB

- Approx. 6.5 cubic feet
- 1 Level of Containment
- Tox 1/BSL 1
- Bags come with gloves affixed; 3 different glove sizes available

LSG

- 16.0 cubic feet
- 2 Levels of Containment
- Tox 2/BSL 2
- 28 Vdc/120 Vac
- 350 Watts/MTL
- VUE
- RS422/232/Ethernet/USB
- 3 gloveport sizes (6”, 8”, 10”)
- 3 glove sizes for use with 8” and 10” gloveports
- All MSG gloves can be used with 6” LSG gloveport

MSG

- 9.0 cubic feet
- 2 Levels of Containment
- Tox 2/BSL 2
- 120/28/±12/5 Vdc
- 1000 W (800 coldplate, 200 air)
- Nitrogen/VES/VRS
- VUE
- RS422/232/Ethernet/USB
- 5 glove sizes for use with 6” gloveports

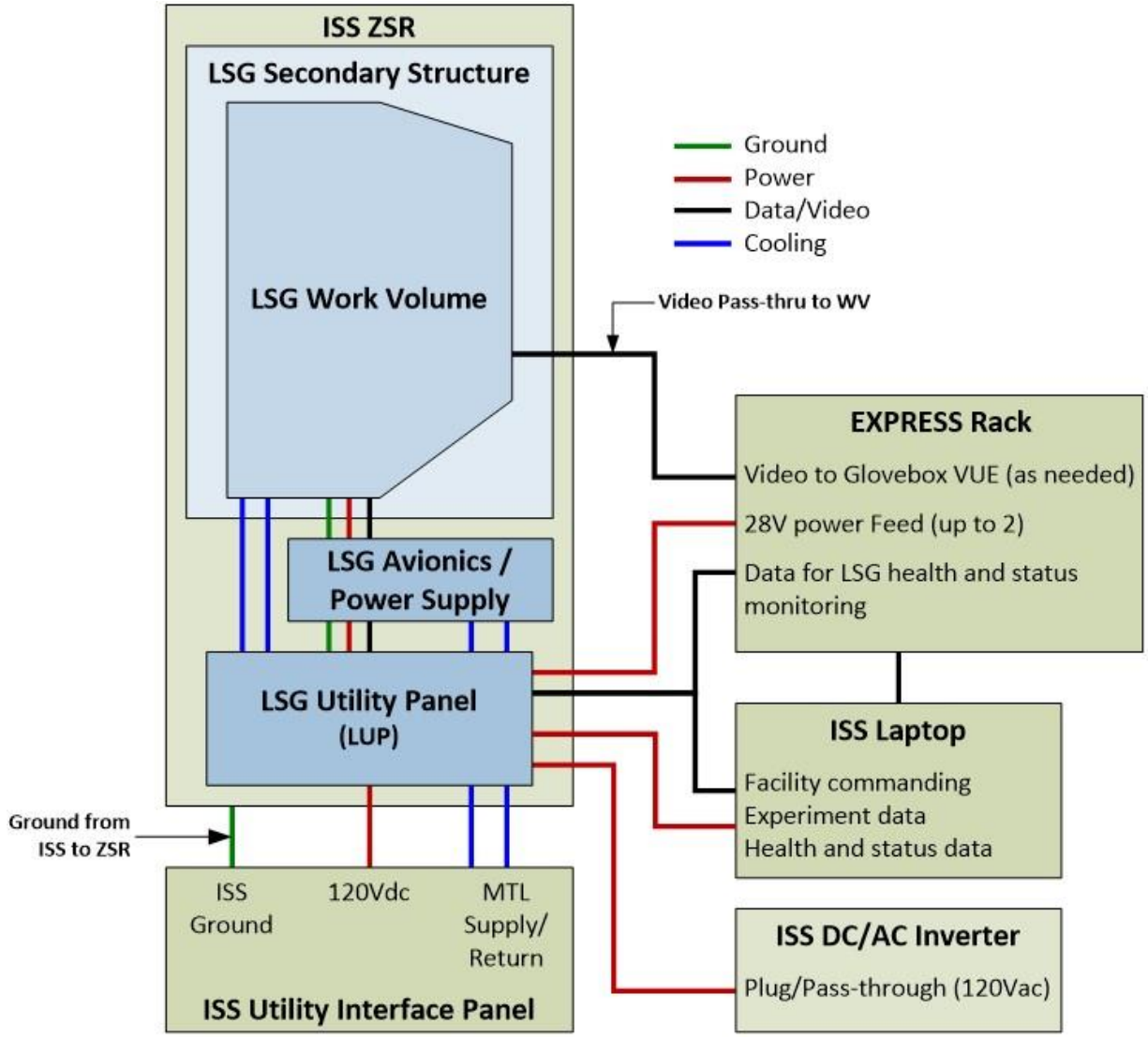
Life Sciences Glovebox

Glovebox Comparison

Microgravity Science Glovebox

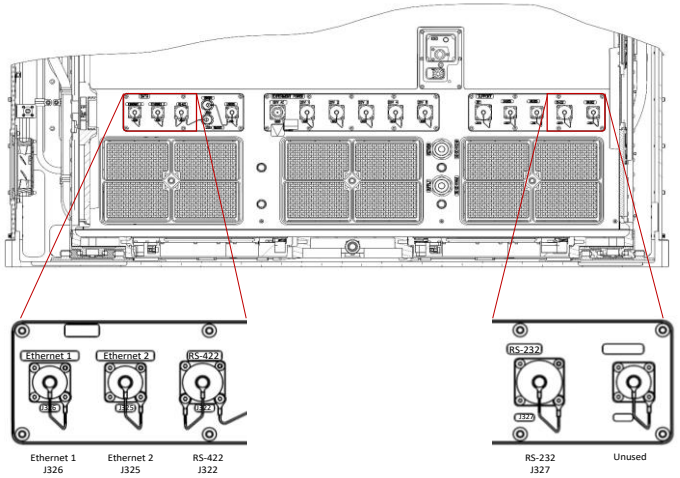
Resource	IPGB	LSG	MSG
1 Level of Containment	✓	✓	✓
2 Levels of Containment		✓	✓
6.5 cubic feet in size	✓		
9.0 cubic feet in size			✓
> 9.0 cubic feet in size		✓	
Tox 1/ BSL level 1	✓	✓	✓
Tox 2/ BSL level 2		✓	✓
120 VDC			✓
120 VAC		✓	
28 VDC		✓	✓
±12 VDC, 5VDC			✓
Thermal – Less than 350 Watts		✓	✓
Thermal – Greater than 350-1000 Watts (800 Coldplate, 200 Air)			✓
MTL connections		✓	
Nitrogen, VES, VRS			✓
Video Resources inside work volume		✓	✓
Data – (RS422/232/Ethernet/USB)		✓	✓
Laptop		✓	✓
Magnetic Attachments		✓	* In work

LSG Resource Interfaces



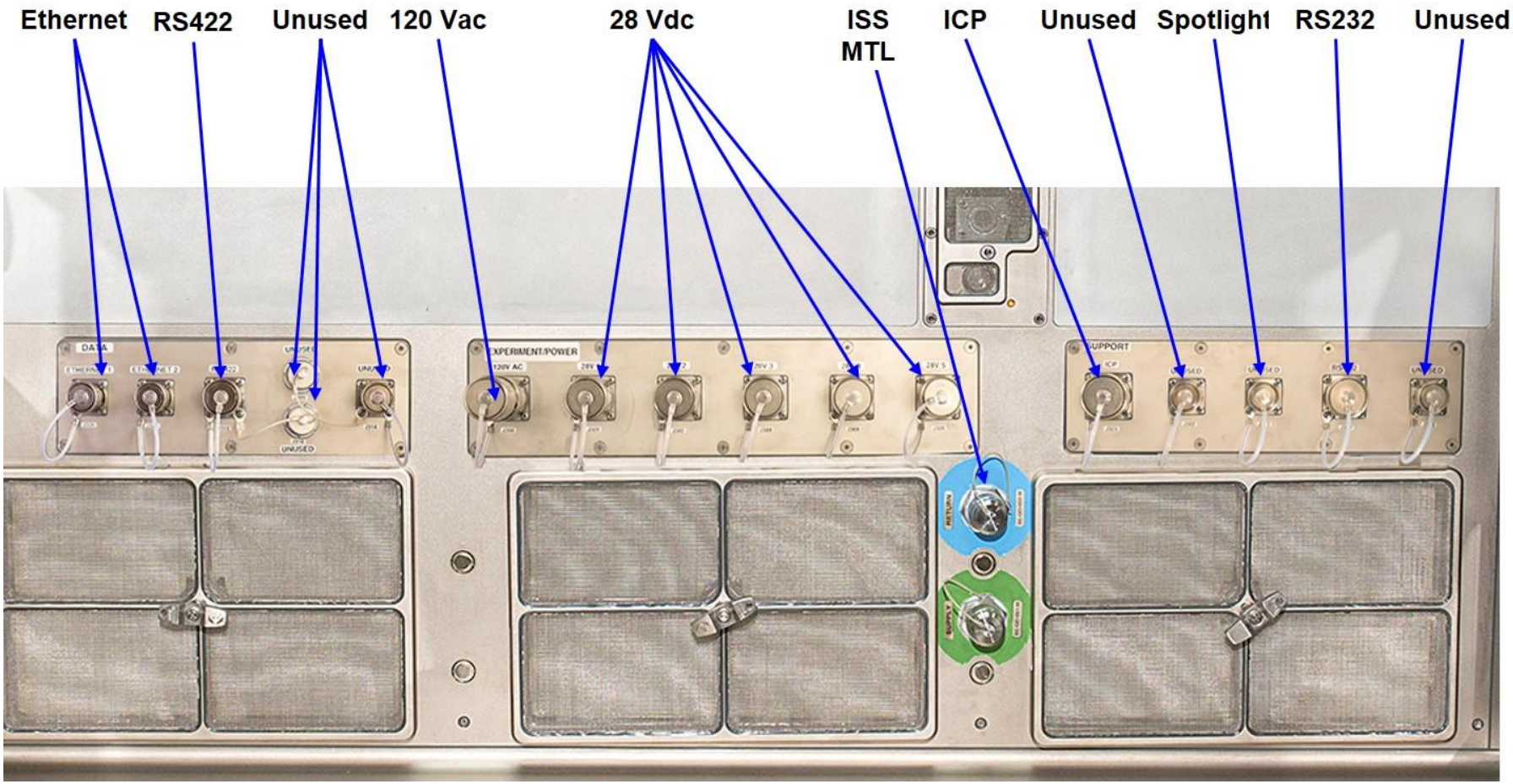
Command and Data Handling

- Rack internal components: Power Control Module, E-Box, Serial Adapter
- LSG Laptop Computer (LLC) for payload and facility command and control
  - Payloads communicate with the LLC via their choice of one: RS-422, RS-232, Ethernet, USB
  - RS-422, RS-232, and Ethernet connections to the LLC are available on the WV rear wall (via the Internal Control Panel)
  - USB connection to the LLC is available via the USB feedthrough
- Video to be provided by COTS cameras
  - Camera selection is underway
  - Must be backward compatible with MSG VUE hardware with capabilities the same or better than MSG VUE (up to 420 Mbps, selectable signal processing area, and recording format H.264 or raw)
  - Four HD-SDI inputs; four GigE inputs
  - Operable by the crew or from the ground

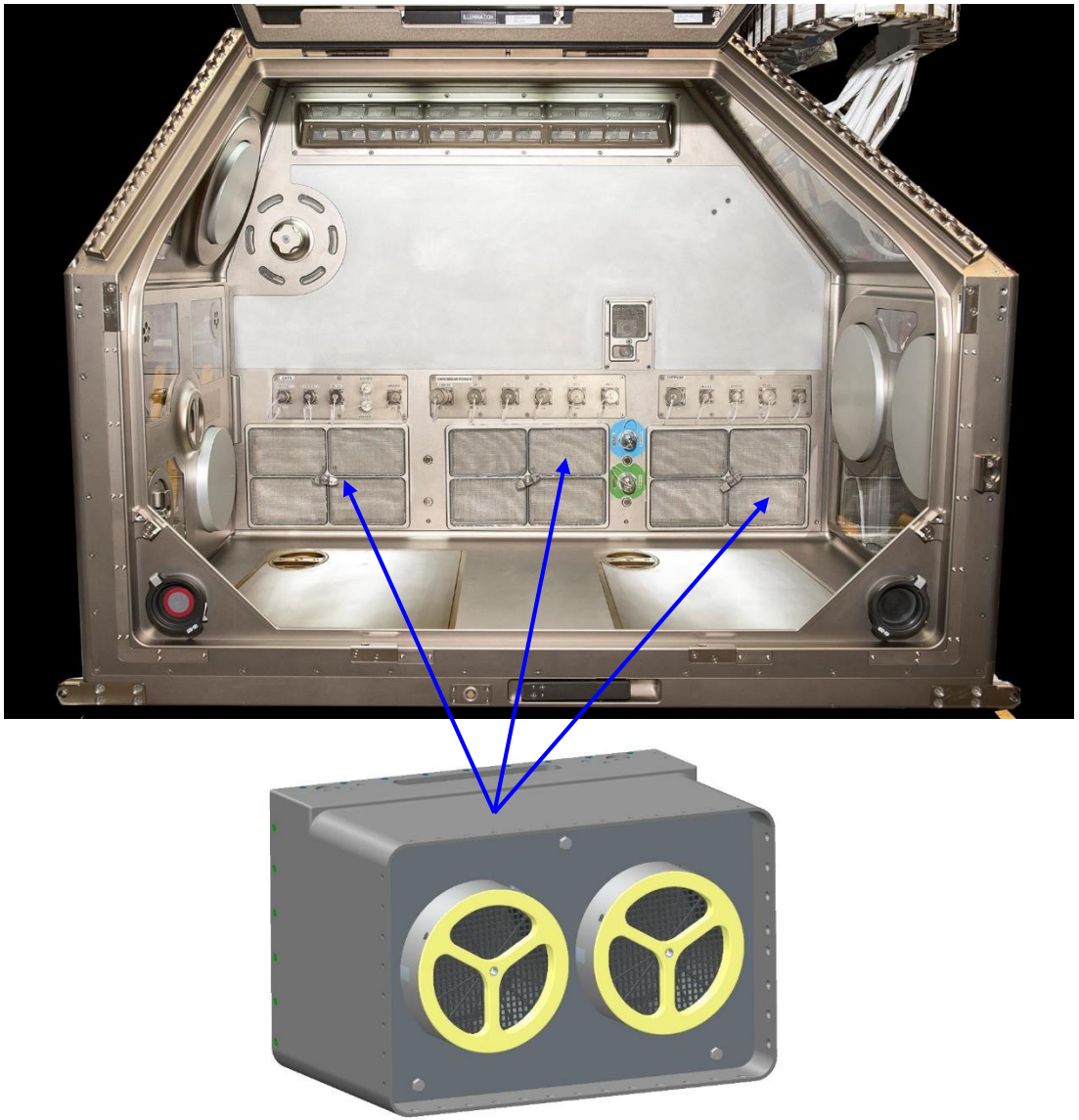


C&DH Interfaces on WV Back Wall

Internal Control Panel

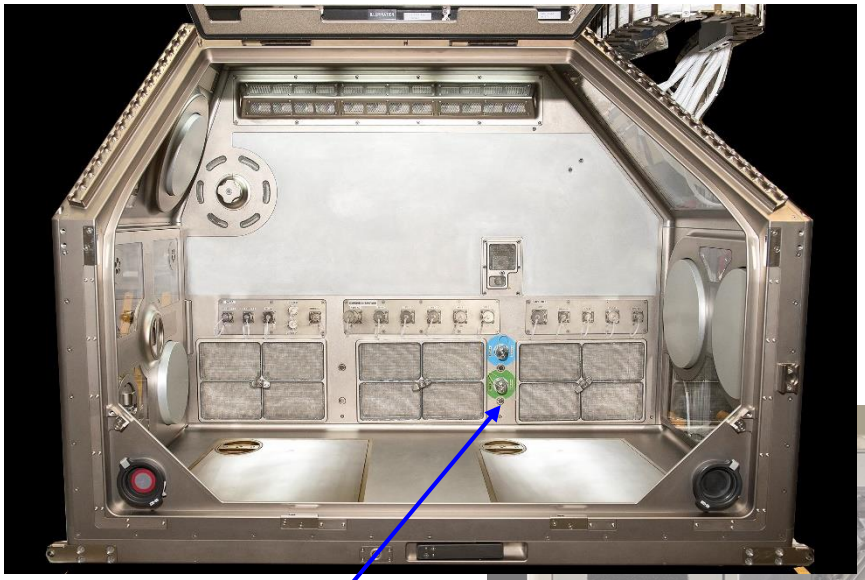


Heat Rejection and Filters



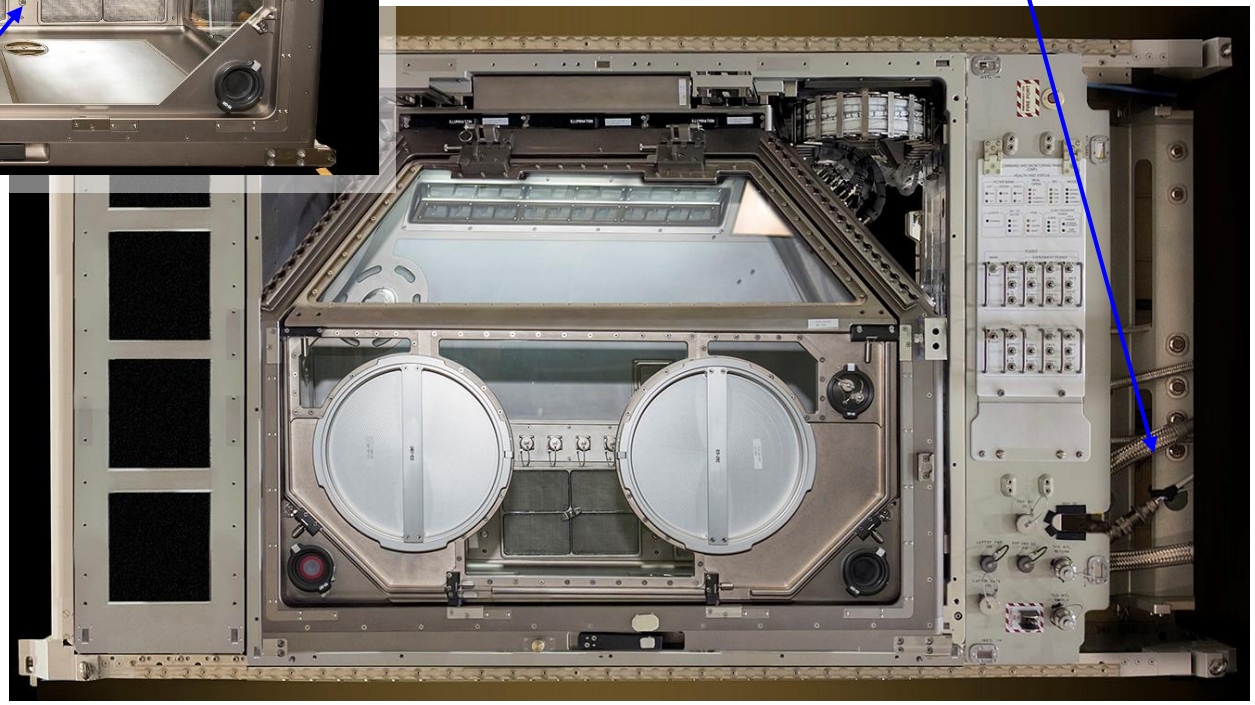
- Air circulation system and MTL provide a maximum 350W of heat rejection
- Filter adapters allow use of six MSG LSAH filters in place of original LSG filters
- Original LSG filters and MSG LSAH filters both consist of a HEPA layer and an activated charcoal layer

MTL Connections

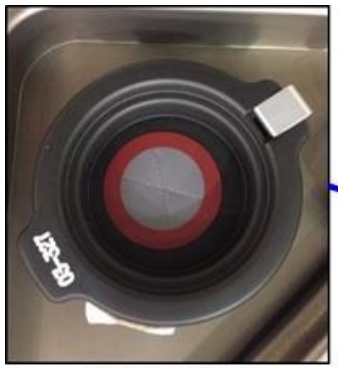


MTL connections outside the WV

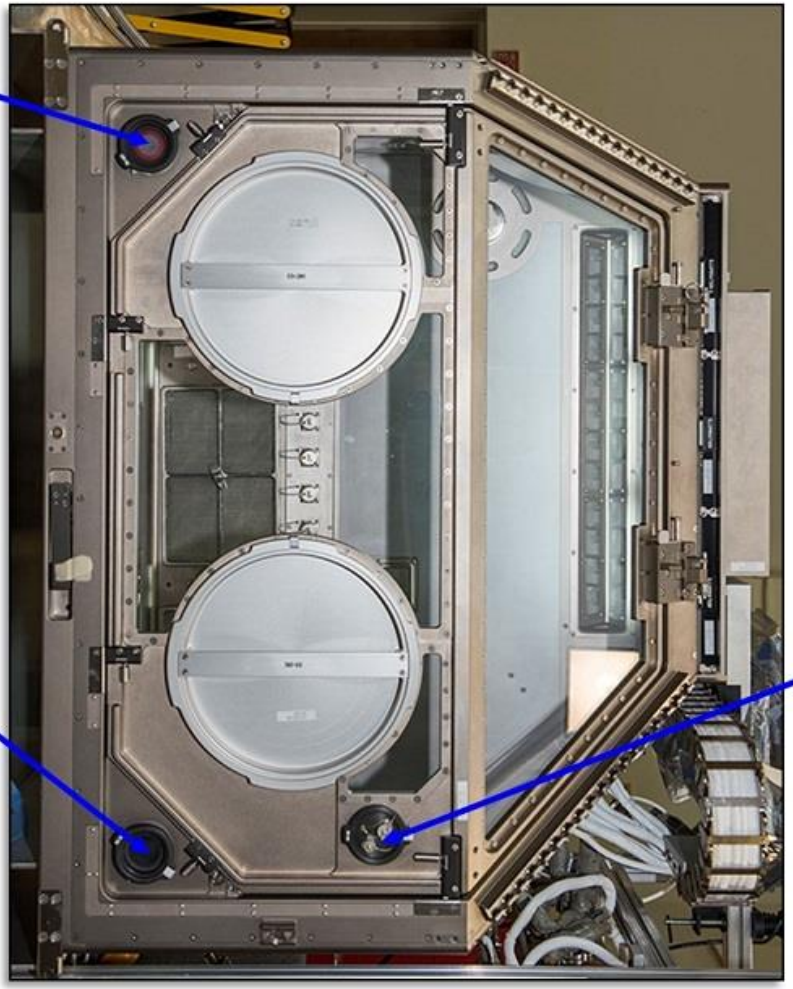
MTL connections inside the WV



LSG Feedthroughs



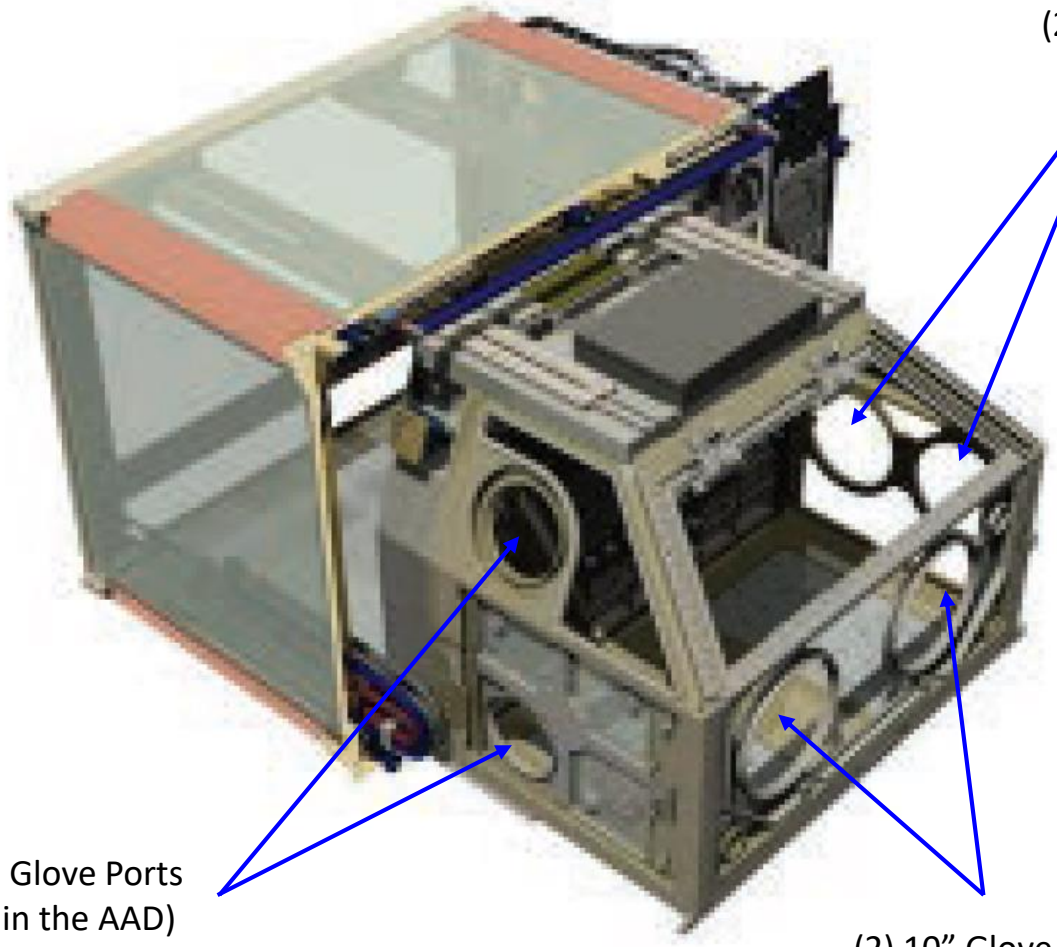
2” Fire Port



LSG J405 USB Feedthrough common with MSG

Video Feedthrough common with MSG

Glove Ports



LSG Gloves

- 3 glove sizes (S, M, L) for both 8” and 10” glove-ring ports
- MSG 6” gloves can be used on the 6” ports

LSG Sleeves and Nitrile Gloves

LSG Sleeve with single Nitrile

LSG 16”Nitrile Glove

LSG Sleeve with two 16” Nitriles

LSG Sleeve with single Surgical Glove

- 3 Size Sleeves (S, M, L) for both 8” and 10” Glovering ports
- 3 Size (M, L, XL) for 16” and 24” Nitrile Gloves

MSG Life Science Gloves

The Life Science Sleeve is a reusable part of MSG's glove hardware that covers the arm of the crew member as required when working with Life Science payloads. One end of the sleeve is fitted with a 6" Glove Ring that attaches to any of the four the Work Volume Glove Ports. The other end has a locking wrist connector that attaches to either a Life Science Glove or a Life Science Iris. The various glove configurations are designed to provide a level of containment for the crew to handle materials within the Work Volume. The sleeve materials were selected for their compatibility with chemicals used in typical life science research.

Each assembly consists of a Hypalon rubber sleeve mounted to a clear-anodized aluminum ring with 3M 465 transfer tape and polyester/synthetic elastomer lacing cord staked with 3M Scotchweld DP 190 adhesive. An EPDM seal is attached with DP 190 adhesive to the aluminum ring on the surface that interfaces with the glove port. The locking wrist ring is made of Makroblend plastic and is attached to the Hypalon sleeve with Aquaseal urethane adhesive.

Typically, 8 sleeves will be kept on orbit.

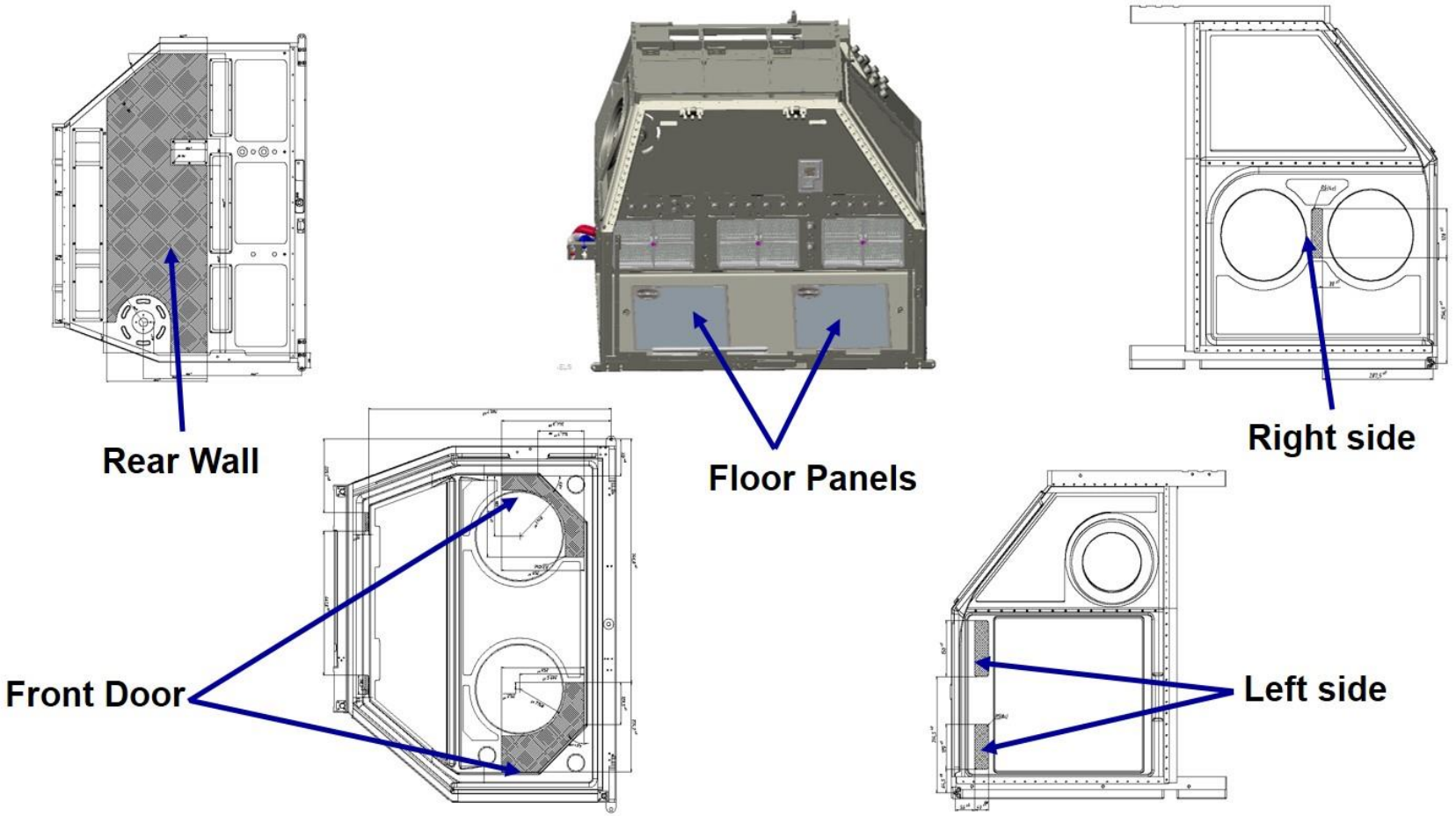
Life Science Sleeve


Life Science Sleeve with Iris and Disposable Glove


Life Science Sleeve with Life Science Glove

P/N	Part Name [Op Nom]	Mass kg	Length cm	Dia cm	Volume cm^3
1483420-001	LSAH Sleeve Assembly [Life Science Sleeve]	0.4	3.8	20.6	1270

LSG Ferrous Surfaces

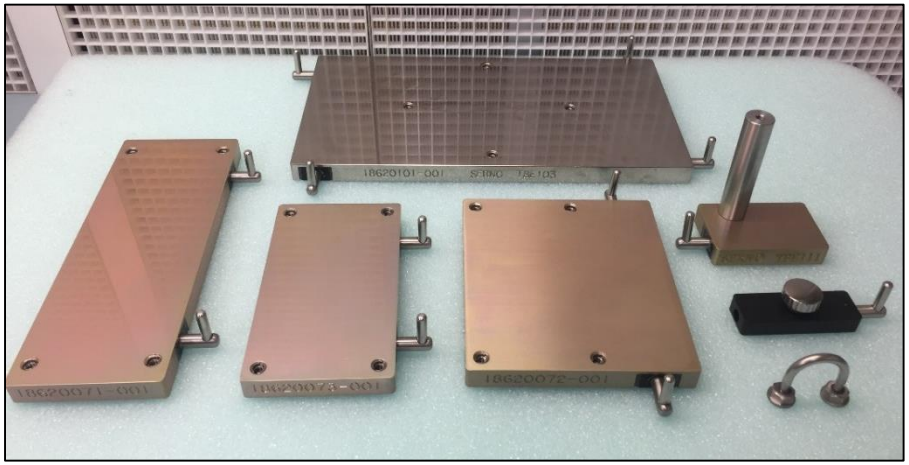


LSG Ferrous Rear Wall Panel

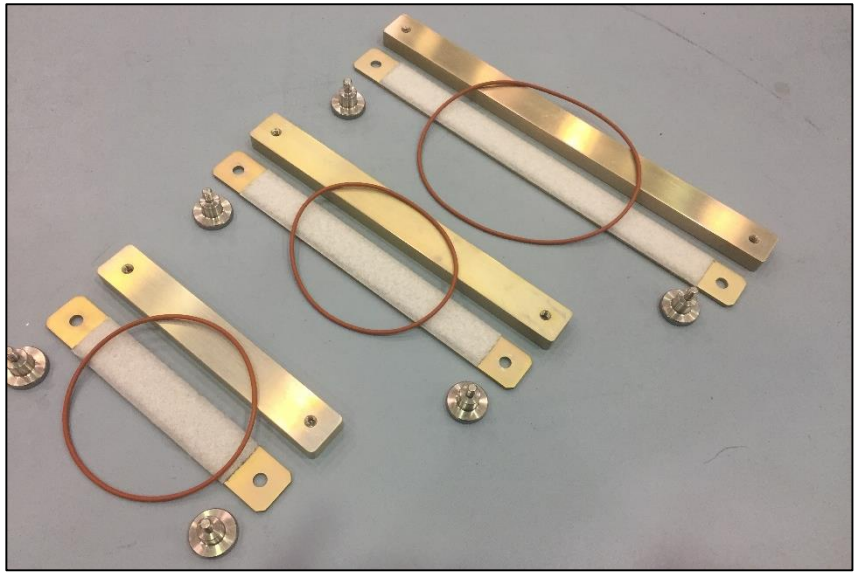
Solid Ferrous Rear Wall Panel with Magnetic Attachments

LSG Magnetic Mounting Systems

LSG provides a number of magnetic mounting devices that allow payloads to mount hardware to the ferrous surfaces inside the Work Volume. For items that require a higher attachment force, switchable magnets allow the crew to place the mount and then engage the magnet with an actuator lever. Some of the magnetic mounting devices are intended for use with the Decontamination System, the Dissection Table and the Rear Wall Cover; however, they can be used by payloads for other configurations.



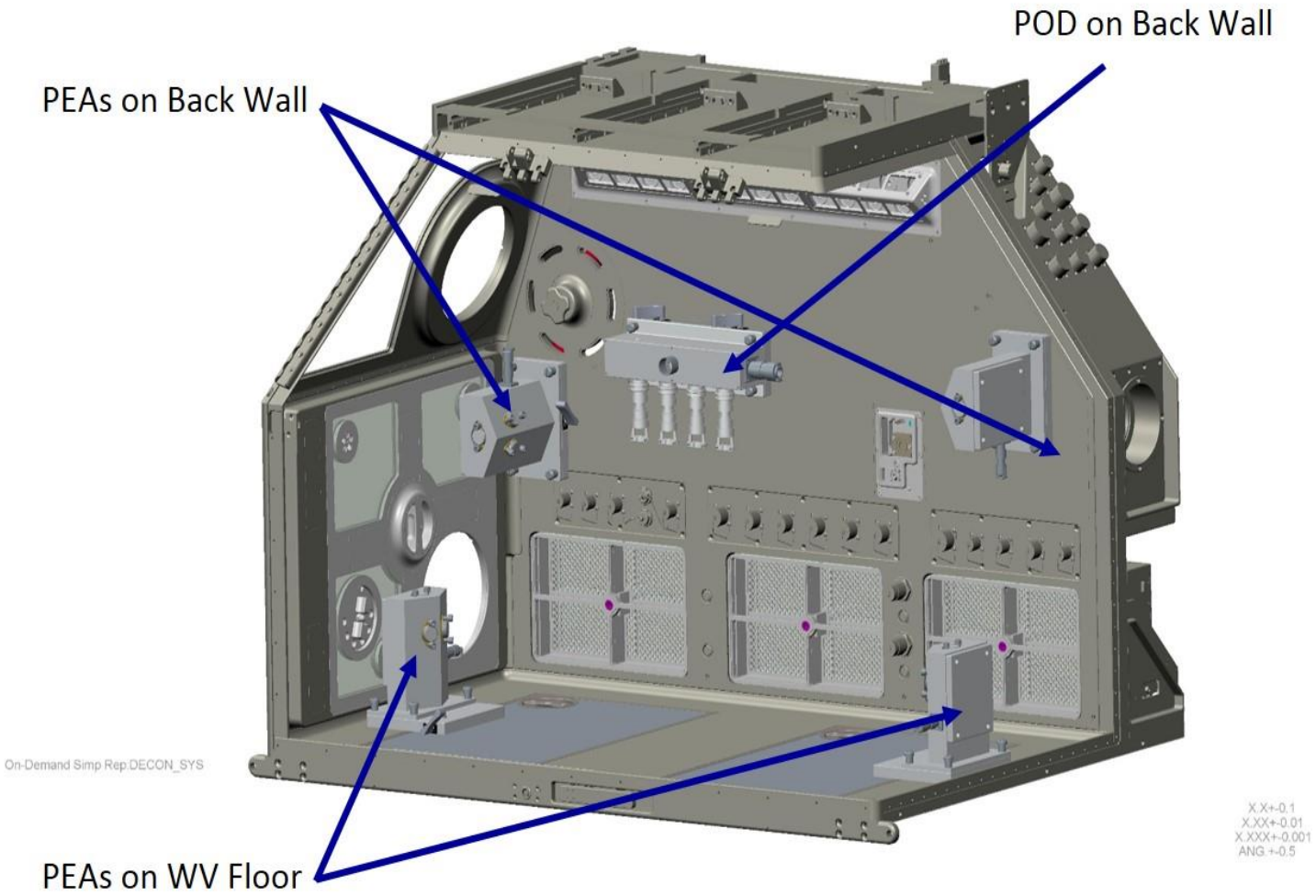
Six mounting devices with switchable magnets and the Cable Mount Assembly



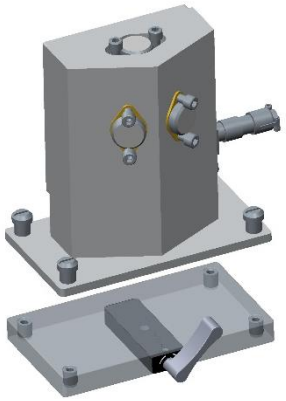
Magnetic Adapters, Velcro Strips and Bungees are available in three different sizes.

US Part Name	Op Nom	Part Number
Cable Mount Assembly - LSG AH	Cable Mount	18620074
Adapter Assembly, Thumbnut, LSG AH	Magnetic Bungee Mount	18620103-001
Adapter Assembly Loop Tape/Bungee 6 in	6" Magnetic Adapter	18620109-001
Adapter Assembly Loop Tape/Bungee 9 in	9" Magnetic Adapter	18620110-001
Adapter Assembly Loop Tape/Bungee 12 in	12" Magnetic Adapter	18620111-001
Strip Assembly, 6", Loop Tape	Velcro Strip 6"	18620104-001
Strip Assembly, 9", Loop Tape	Velcro Strip 9"	18620104-003
Strip Assembly, 12", Loop Tape	Velcro Strip 12"	18620104-005
O-Ring	2.5" Bungee	9396K164
O-Ring	3.75" Bungee	9396K175
O-Ring	5" Bungee	9396K181
Seat Track Adapter Assembly	Magnetic Seat Track	18620134-001
Adapter Assembly, POD, LSG AN	Power UV Adapter	18620071-001
Adapter Assembly, Floor, PEA, LSG AH	Floor UV Adapter	18620072-001
Adapter Assembly, Rear Wall, PEA, LSG AH	Rear Wall UV Adapter	18620073-001
Adapter Assembly	Restraint Table Adapter	18620101-001
Adapter Assembly, Rear Wall Cover	Rear Wall Cover Adapter	18620108-001
LSG Rear Wall Cover, Ferrous	Magnetic Rear Wall Cover	38620114

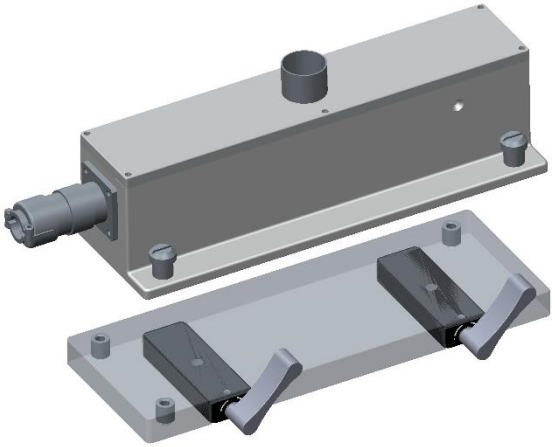
LSG Decontamination System



LSG Decontamination System

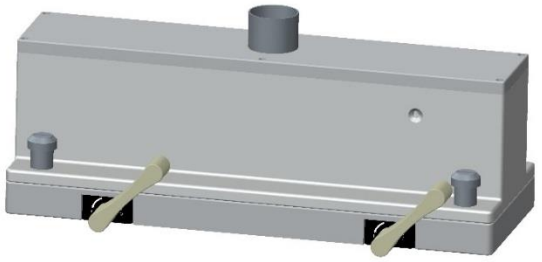


PEA with back wall adapter plate



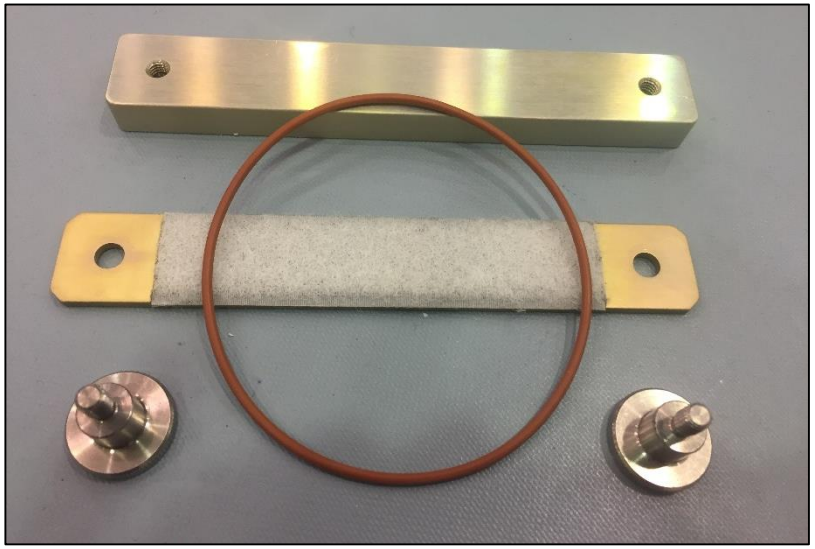
POD with back wall adapter plate

PEA with floor adapter plate

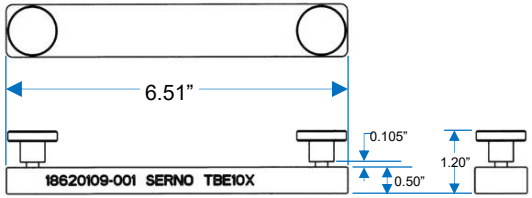


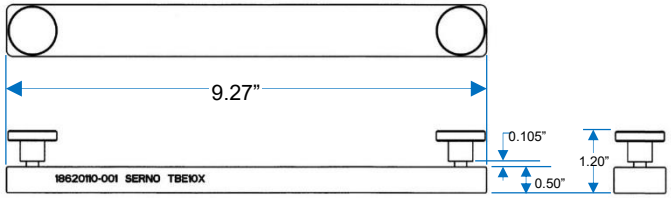
Magnetic Adapters

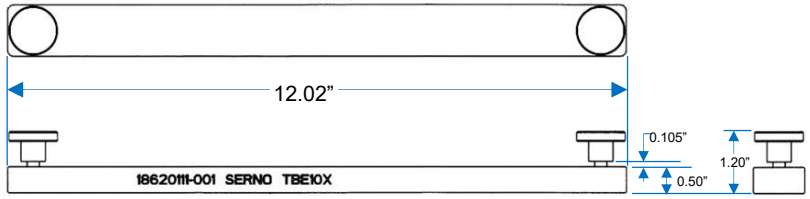
A set of Magnetic Adapters provide a flexible means for temporarily restraining payload hardware inside the Work Volume. The Magnetic Adapters contain Polymagnets which mount to the ferrous surfaces. Using a pair of threaded fasteners, the Magnetic Adapter bars can be fitted with a Velcro Strip or a Bungee. When configured with a Bungee, the Magnetic Adapters are suited for holding thin items such as empty Ziploc bags and Q-tips. When configured with a Velcro Strip which has a loop surface, the Magnetic Adapters provide a location to restrain items fitted with a Velcro hook surface.



6” Magnetic Adapter, Velcro Strip, Bungee and threaded fasteners







The Magnetic Adapters are machined from 7075-T7351 aluminum alloy. Neodymium iron boron magnet finished with nickel over copper are attached to the aluminum bars with 3M Scotchweld DP-190 epoxy. The Magnetic Adapters come in 6”, 9” and 12” lengths and are alodined with a MIL-DTL-5541 Type I, Class 3 chemical conversion coating. The threaded fasteners are stainless steel MJAL60M90062x10 fasteners.

Six of each size Magnetic Adapters are typically kept on orbit.

Op Nom	Part Number
6" Magnetic Adapter	18620109-001
9" Magnetic Adapter	18620110-001
12" Magnetic Adapter	18620111-001

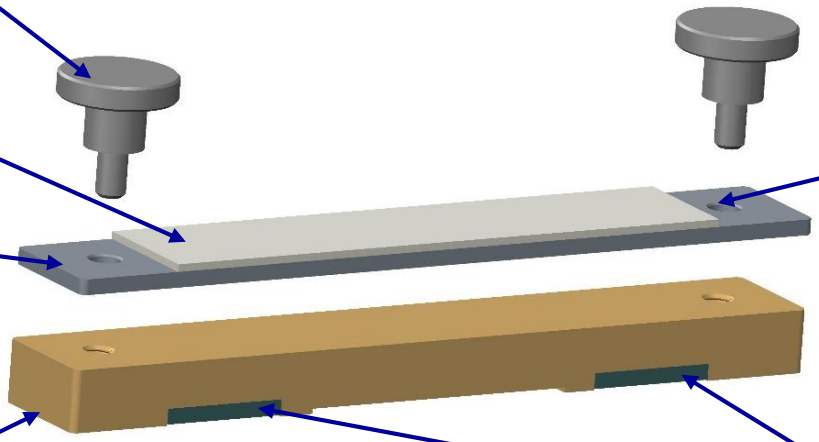
Velcro Bars

Standard MSG 6mm Thumbscrews

Note: Velcro pile bar is removed to convert to a bungee bar.

Velcro pile

Velcro pile Substrate



6mm threaded hole 2 places

Velcro/Bungee Bar

Fixed magnets embedded in aluminum bar

Velcro Strips

Velcro Strips provide a means for temporarily restraining payload hardware fitted with Velcro. Velcro Strips can be attached to Magnetic Adapters or Magnetic Bungee Mounts. The Velcro Strips have a loop surface that will conveniently attach to items that have a Velcro hook surface.

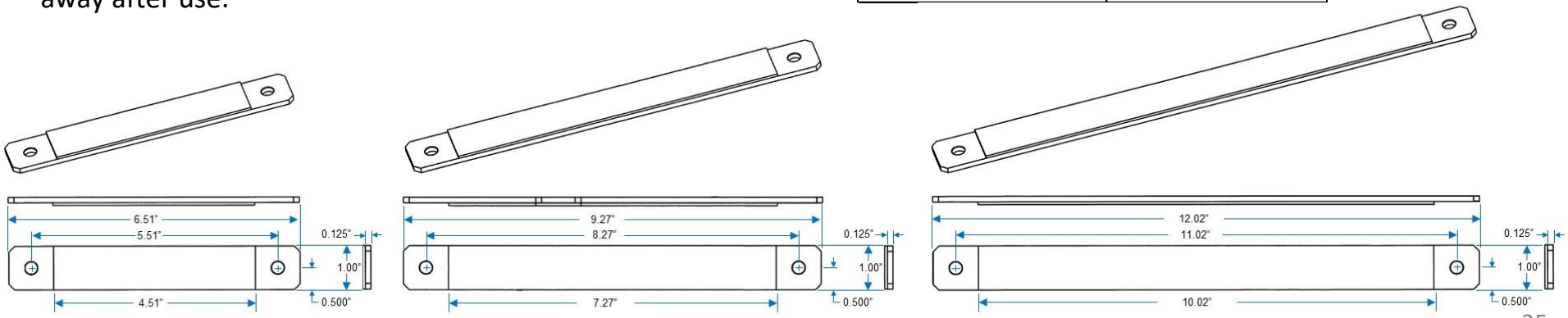
The Magnetic Adapters and Magnetic Bungee Mounts contain magnets which mount to the ferrous surfaces.

The Velcro Bars are machined from 6061-T6511 aluminum alloy with nylon loop fastener tape attached with 3M Scotchweld DP-190 epoxy. The Velcro Strips come in 6”, 9” and 12” lengths and are alodined with a MIL-DTL-5541 Type I, Class 3 chemical conversion coating.

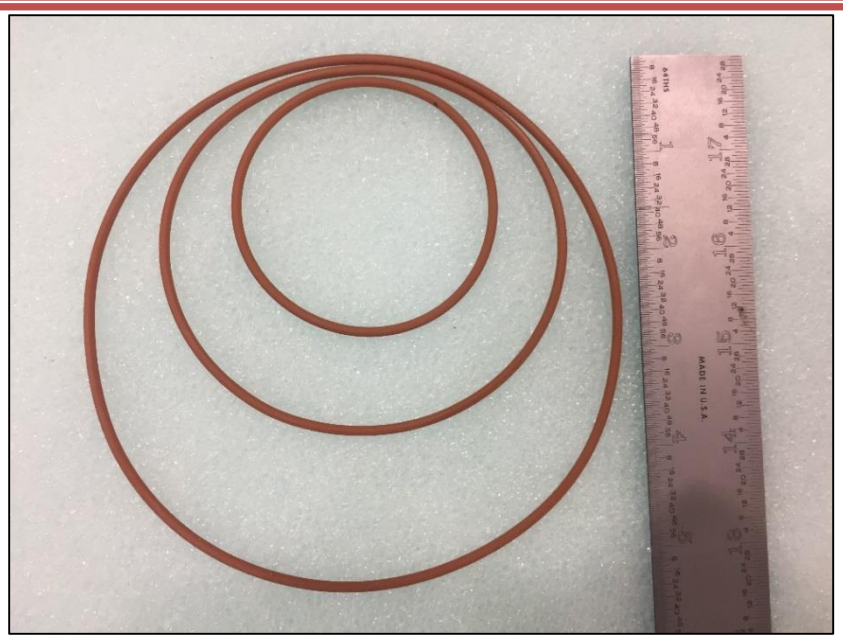
Twelve of each size Velcro Strip are typically kept on orbit. Velcro Strips are a consumable and are intended to be thrown away after use.

6” Velcro Strip shown between a 6” Magnetic Adapter and fasteners

Op Nom	Part Number
Velcro Strip 6"	18620104-001
Velcro Strip 9"	18620104-003
Velcro Strip 12"	18620104-005



Bungees



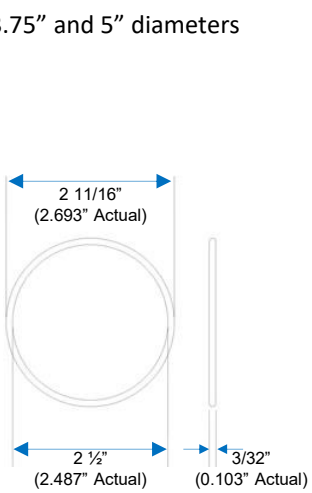
Bungees are provided in 2.5”, 3.75” and 5” diameters

Three sizes of silicone bungees provide a simple method for mechanically restraining items in the work volume. When used with the Magnetic Bungee Mounts or the Magnetic Adapters, they provide a quick and flexible means for the crew to stow small to medium size items during payload operations.

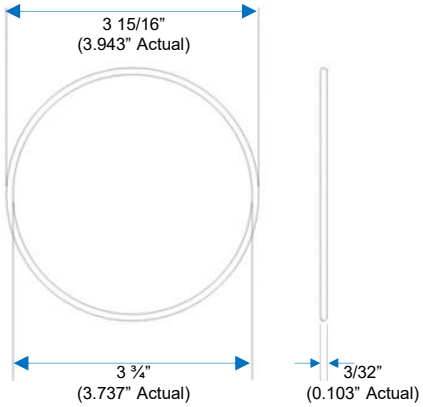
The Bungee part numbers are commercially available parts from McMaster-Carr. They are high-temperature, high-purity silicone O-rings that are advertised as suitable for use with Animal Oils, Bases, Butyl Alcohol, Calcium Hydroxide, Diluted Salt Solutions, Ethanol, Ethylene Glycol, Glycerin, Isopropyl Alcohol, Methanol, Mineral Oils, Motor Oil, Sodium Bicarbonate, and Vegetable Oils.

Typically 80 bungees of each size are kept on orbit.

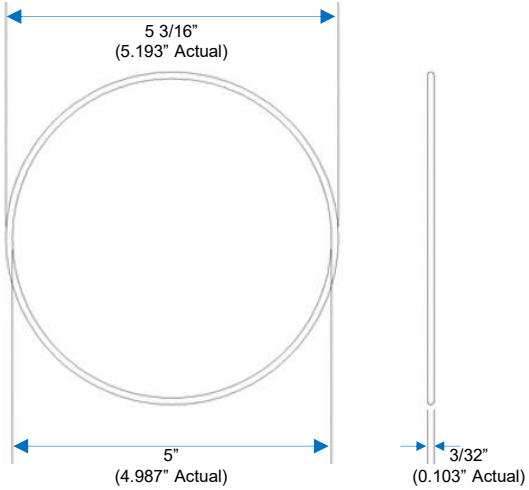
Op Nom	Part Number
2.5" Bungee	9396K164
3.75" Bungee	9396K175
5" Bungee	9396K181



2.5” Bungee



3.75” Bungee



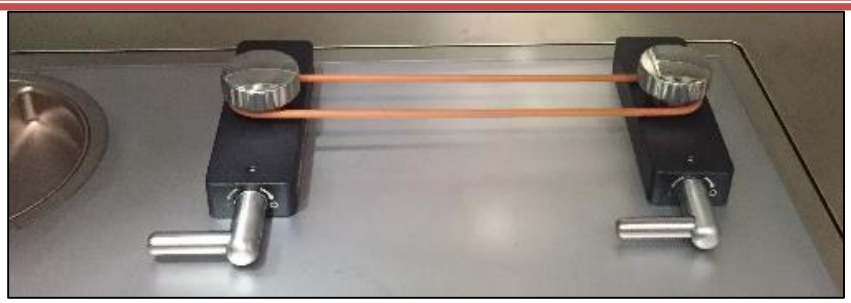
5” Bungee

Magnetic Bungee Mount

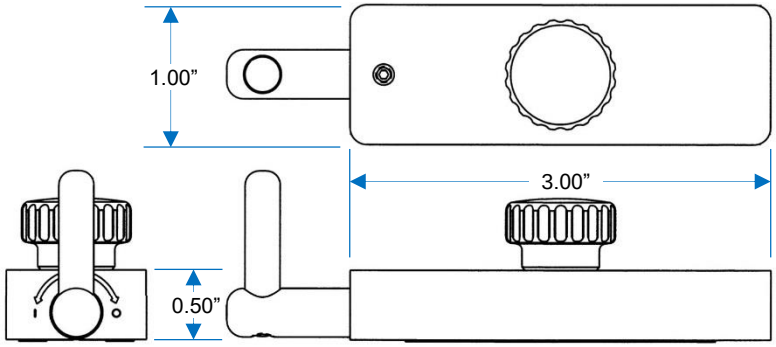
The Magnetic Bungee Mounts provide a quick, flexible and simple method for restraining items in the Work Volume. When used with the available bungees, they provide a means for restraining medium-sized items; given the height of the magnetic base, the Mount/Bungee configuration works better with items larger than 0.5 inches thick. While the residual magnetic force holds the Mount in place, a 90º turn of the actuator lever fully engages the large internal magnets for a hold that easily resists crew contact. If required the thumbnut can be removed exposing the 1/3” long M6 metric thread.

Construction of the Bungee Mount starts with a ThorLabs PHM1/M Switchable Magnet made of EN1A steel, 316 stainless steel and Neodymium iron boron magnets. An actuator lever made of 316 CRES and 18-8 stainless steel is held in place with 3M Scotchweld DP-190 Epoxy and Loctite 243. The M6 metric thread is fitted with a removable stainless steel thumbnut.

Typically 6 Magnetic Bungee Mounts are kept on orbit.



Two Magnetic Bungee Mounts shown with the actuator levers engaged.



The Magnetic Bungee Mount has a switchable magnet that engages when the level is turned to the left and disengages when turned upright. Removing the thumbnut provide access to a 1/3” long M6 metric thread.

Cable Mount

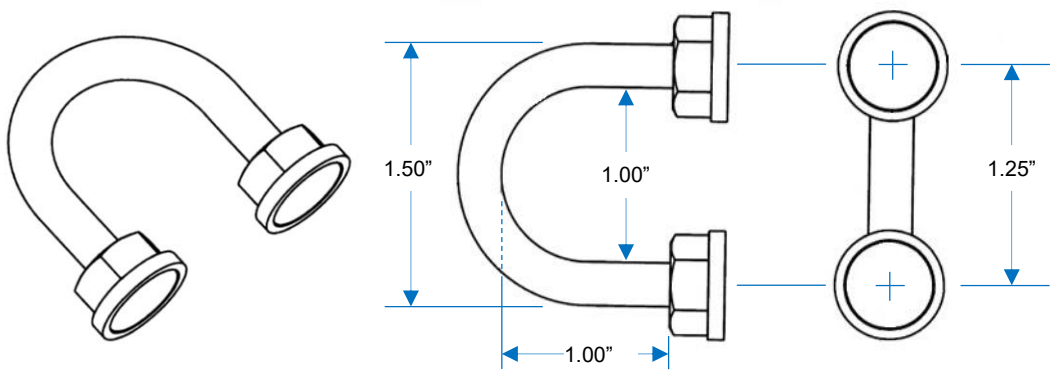
The set of LSG Cable Mounts are intended to restrain temporarily installed cables to the walls of the Work Volume. Permanent Polymagnets at the ends of the Mount attach to the ferrous surfaces of the LSG Work Volume. While these Polymagnets are strong enough to hold small cables in place, the are easily removable by the crew.

The Cable Mount consists of a CRES 304 ¼" U-bolt which is epoxied with 3M Scotchweld DP-190 to a CRES 18-8 flange nut and a Neodymium iron boron magnet finished with nickel over copper.

Typically 10 Cable Mounts are kept on orbit.

Two Cable Mounts shown attached to the ferrous surface of the LSG WV back wall.

Two Cable Mounts shown attached to the ferrous floor panels.

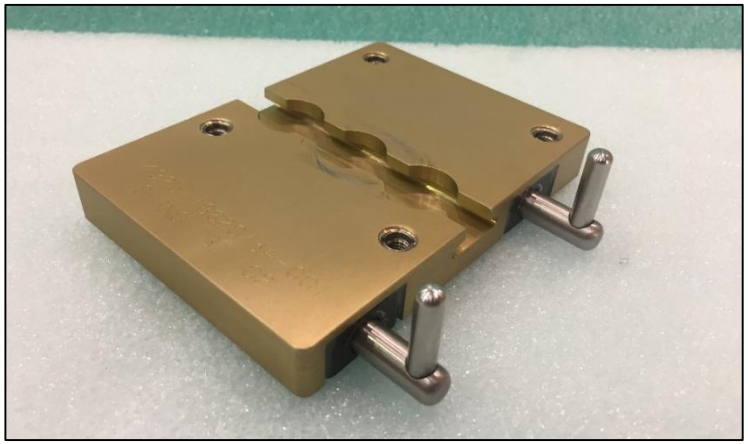


Magnetic Seat Track

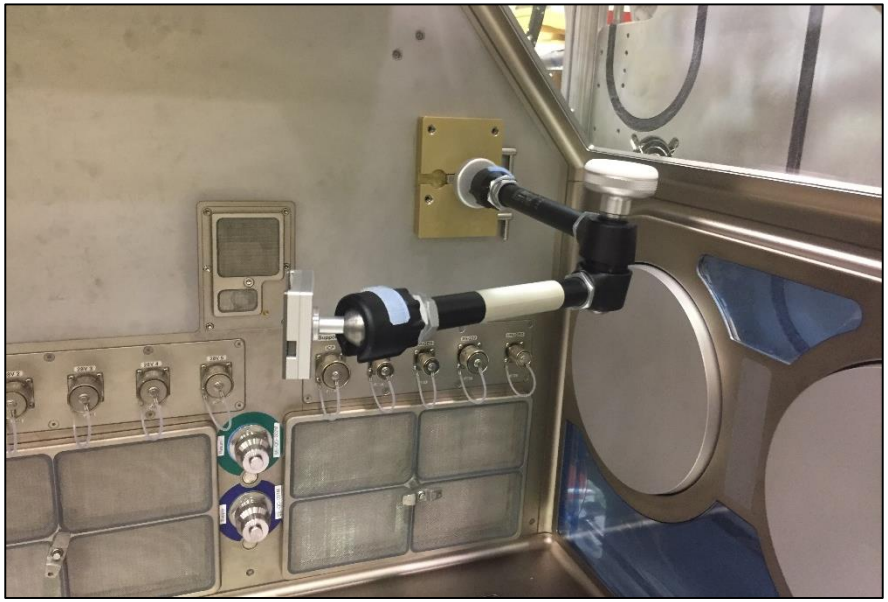
The Magnetic Seat Track has two switchable magnets for attaching to the ferrous surfaces in the LSG Work Volume. It replicates two payload mounting interfaces found in MSG: a short portion of a seat track and four M6 threaded fastener locations.

The mounting plate of the Magnetic Seat Track is made from 6061-T651 Aluminum Alloy alodined with a MIL-DTL-5541 Type I, Class 3 chemical conversion coating. 3M Scotchweld DP-190 Epoxy is used to attach two ThorLabs PHM1/M Switchable Magnets made of EN1A steel, 316 stainless steel and Neodymium iron boron magnets. Actuator levers made of 316 CRES and 18-8 stainless steel are held in place with 3M Scotchweld DP-190 Epoxy and Loctite 243. Four EZ Lok M6 inserts are installed in the mounting plate.

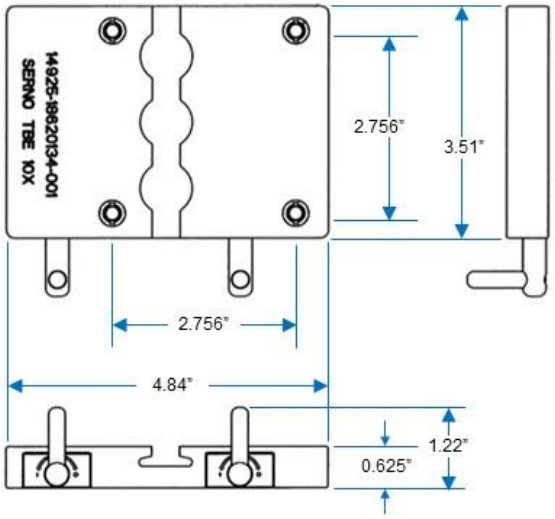
Typically 5 Magnetic Seat Tracks are kept on orbit.



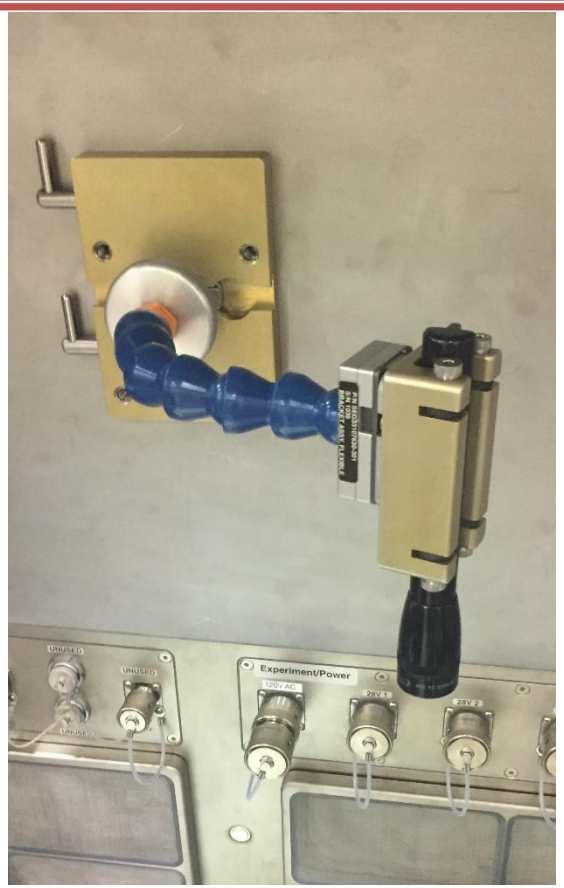
Magnetic Seat Track has 4 M6 threaded inserts



The seat track is a standard mechanical mounting interface on ISS.



Flashlight Adapter



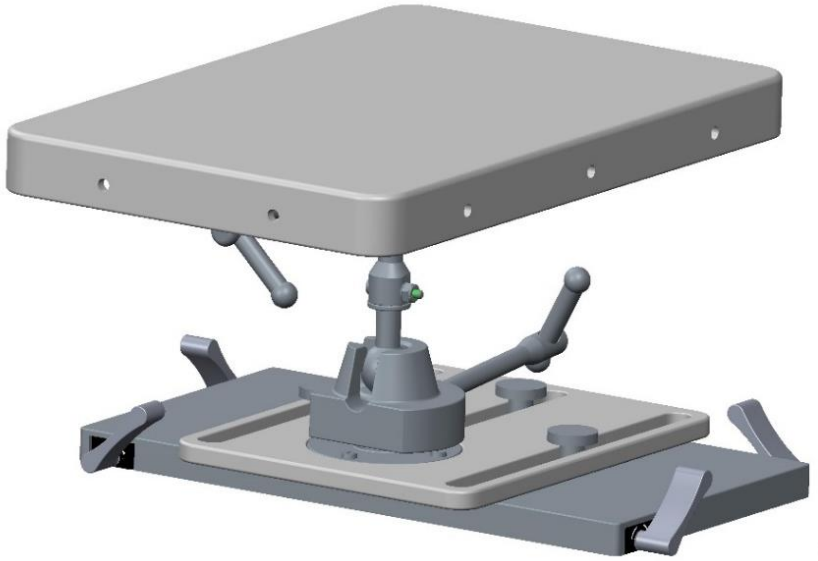
Flashlight Adapter fits a standard ISS provided mag light and will mount on top of an ISS multi-purpose arm or flexible arm.

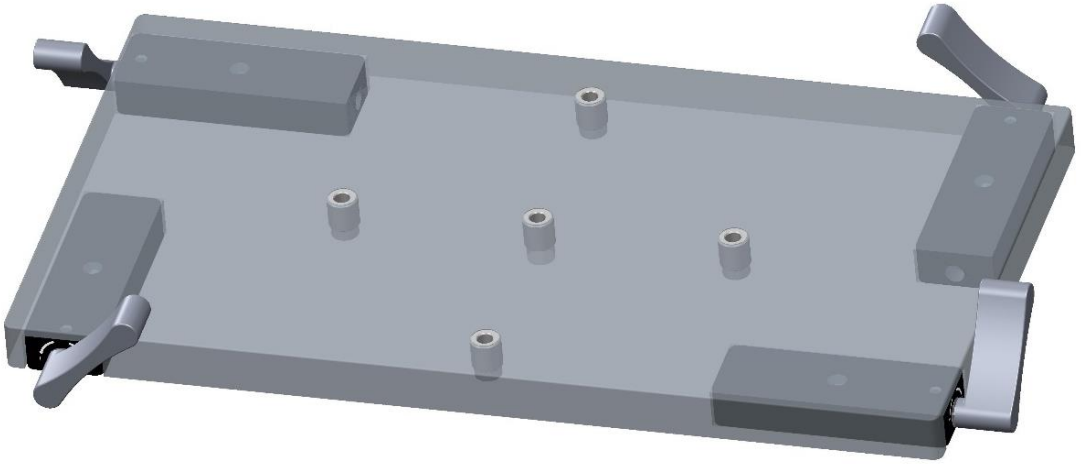
IPad Mount

IPad Mount is planned to be COTS with minor modifications to include a magnetic base so as to allow the IPad to be located on any of the CRES 430 surfaces inside the WV or built into the LSG Ancillary hardware.

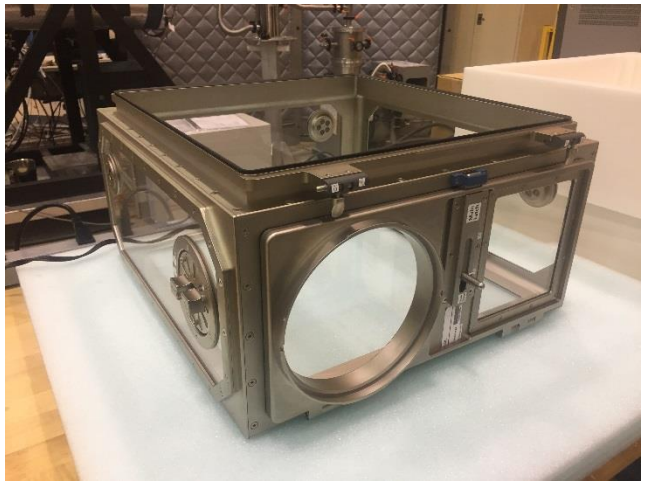
Restraint Table with Magnetic Adapter

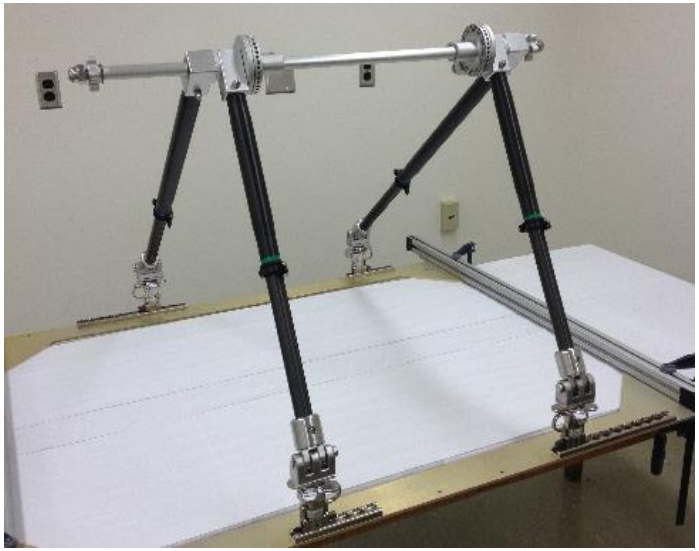
- Switchable magnets in each corner of a 6 ½ “ x 11 “ plate
  (Restraint table base is 6 ½” x 8 ½”)
- 6mm holes provide axial and cross mount options.
- All holes are covered by dissection table base.
- Magnetic strips around edge of table not shown

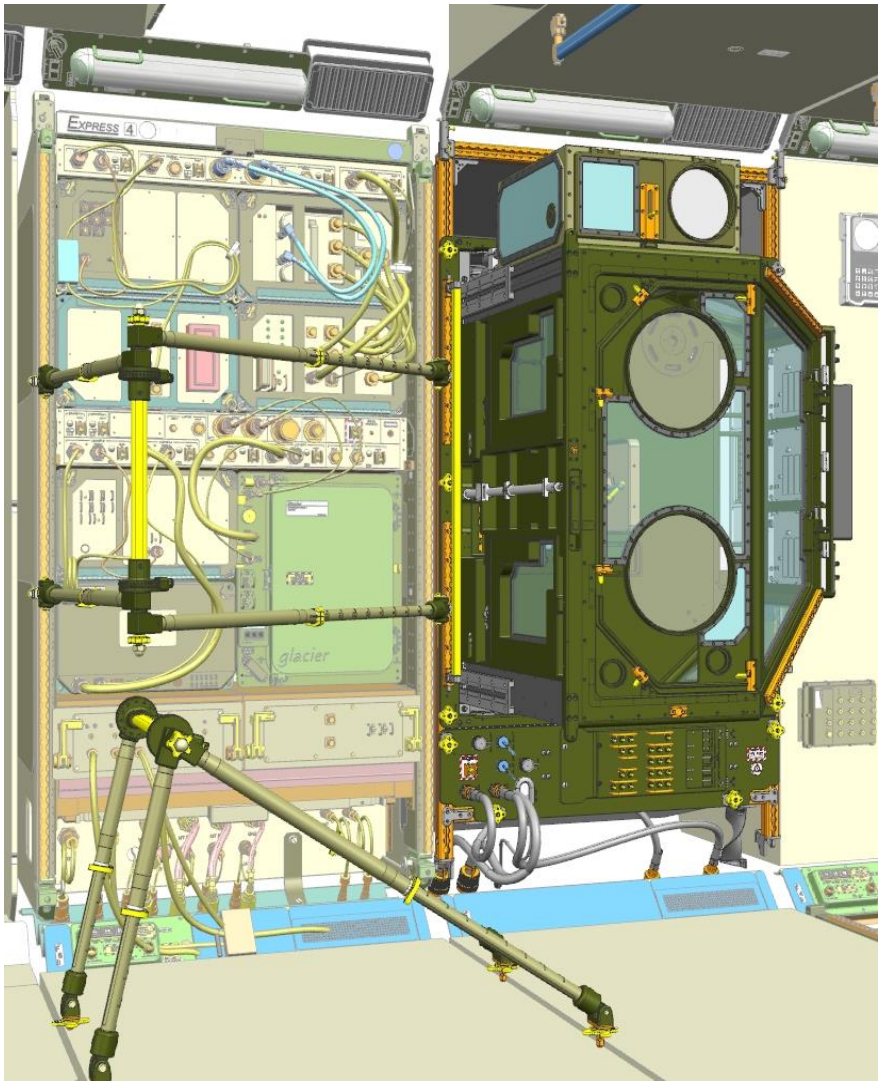




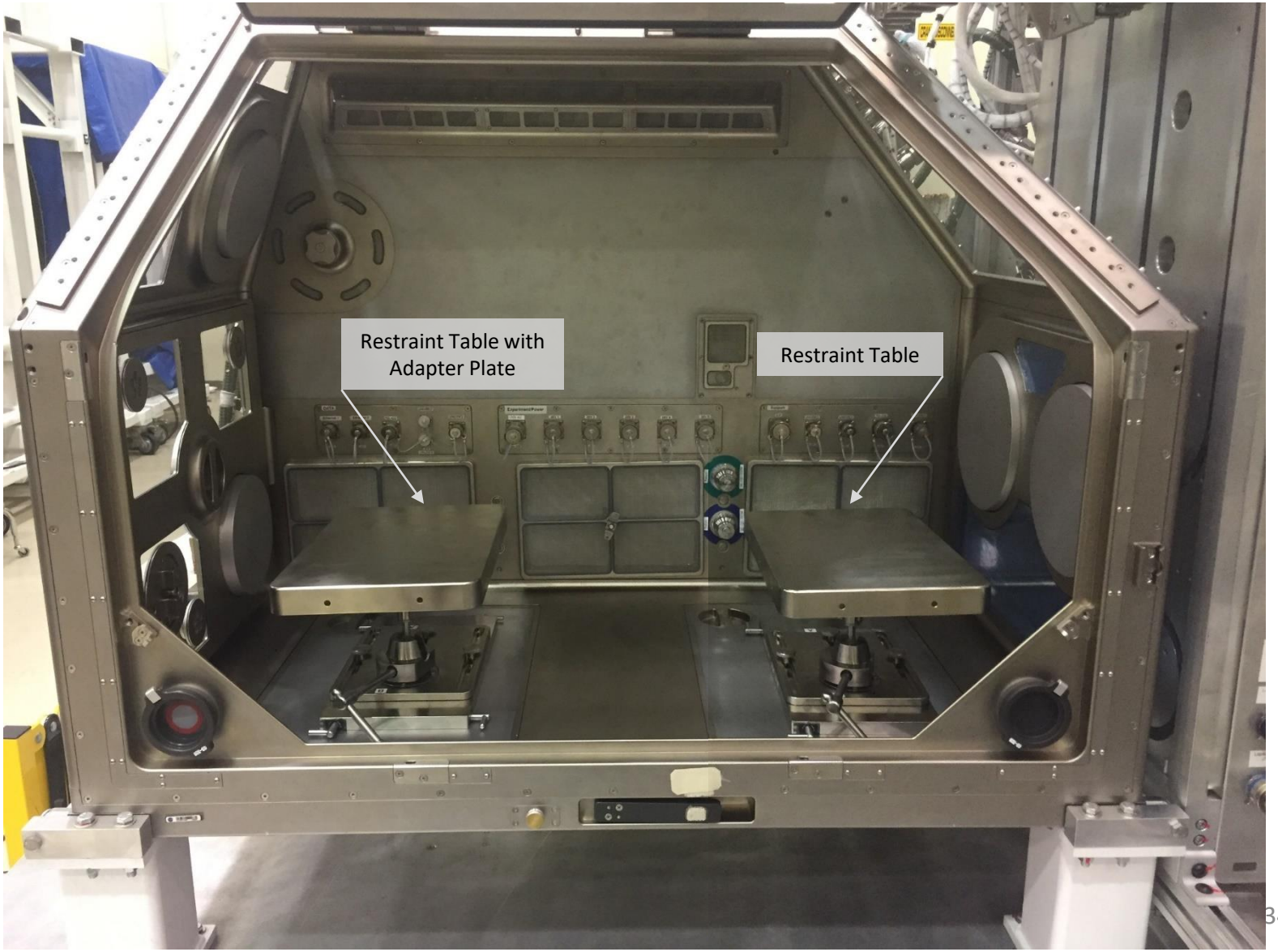
Airlock and Crew Restraints



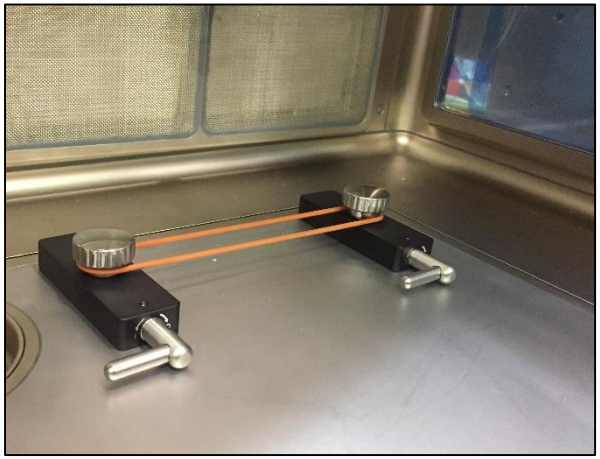




Applications



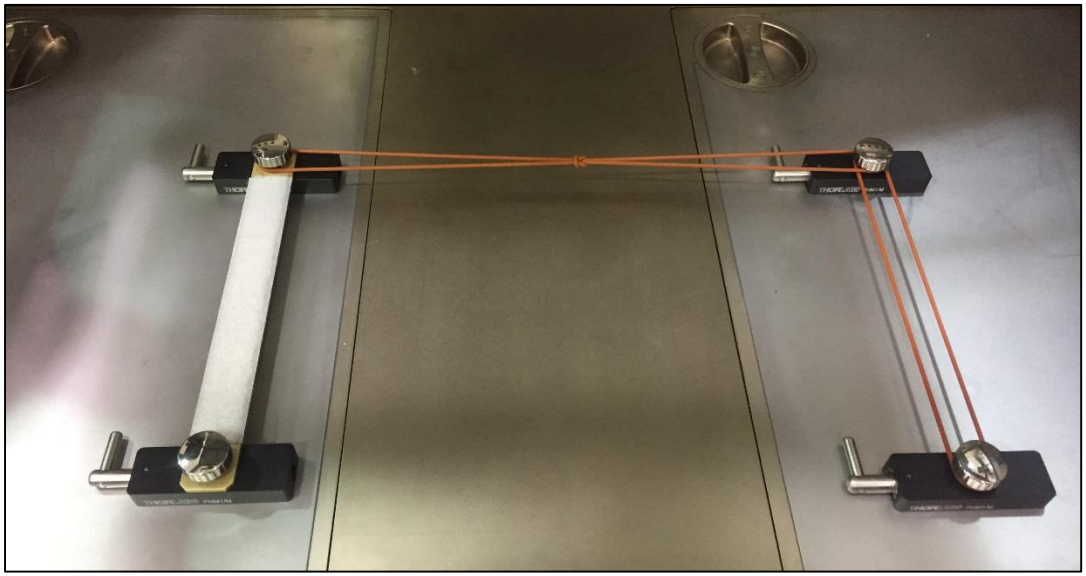
Applications



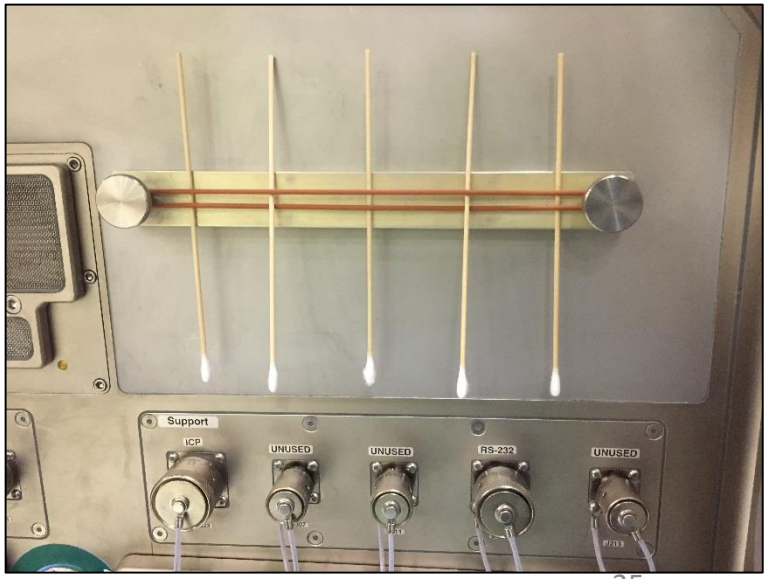
Magnetic Bungee Mounts and 3 ¾” Bungee

Three sizes of Magnetic Adapters with Velcro Strips: 6”, 9”, & 12”

Typical mount for Velcro Bag

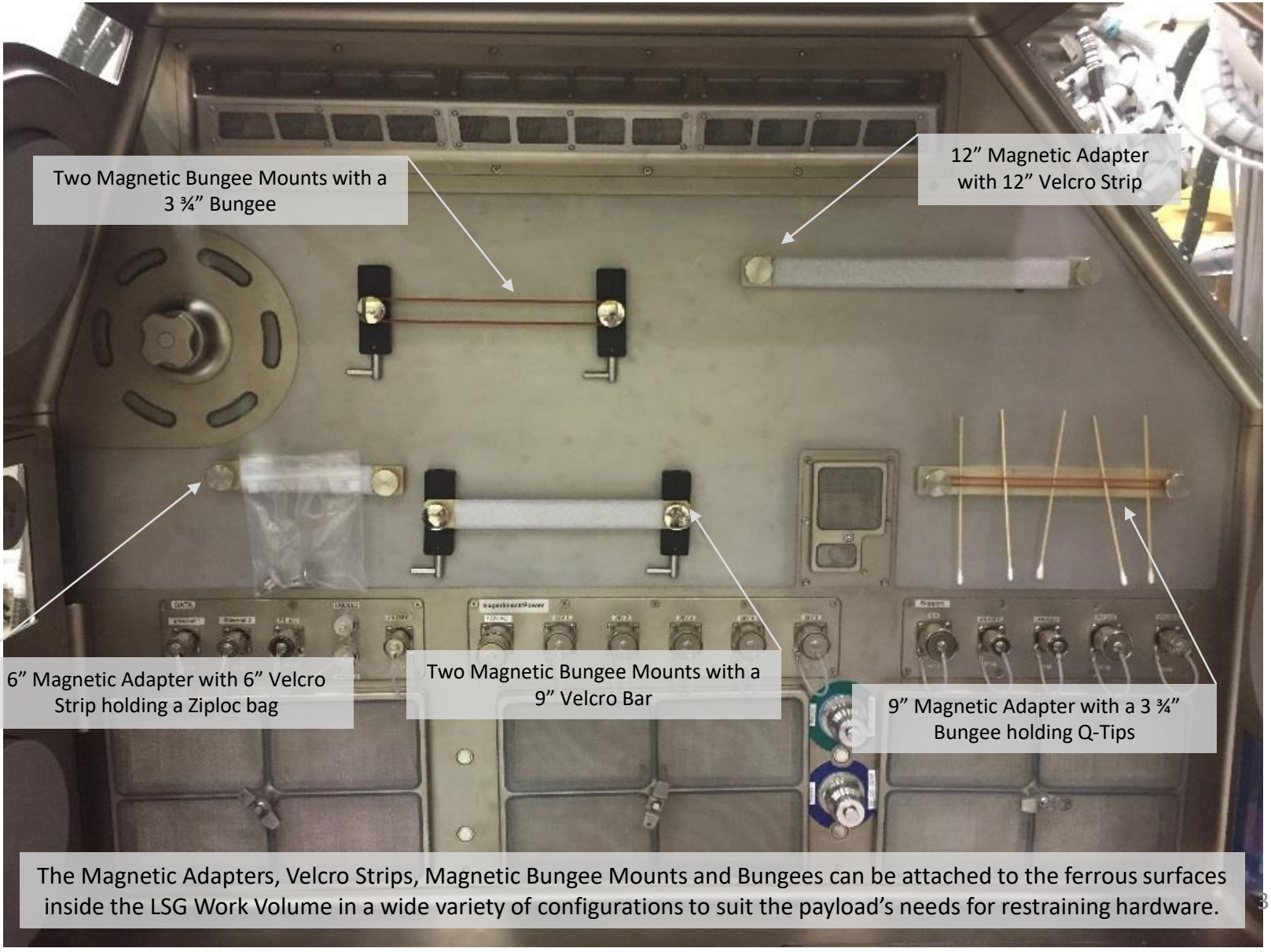


Magnetic Bungee Mounts with 9” Velcro Strip, looped 3 ¾” bungees, and 5” Bungee



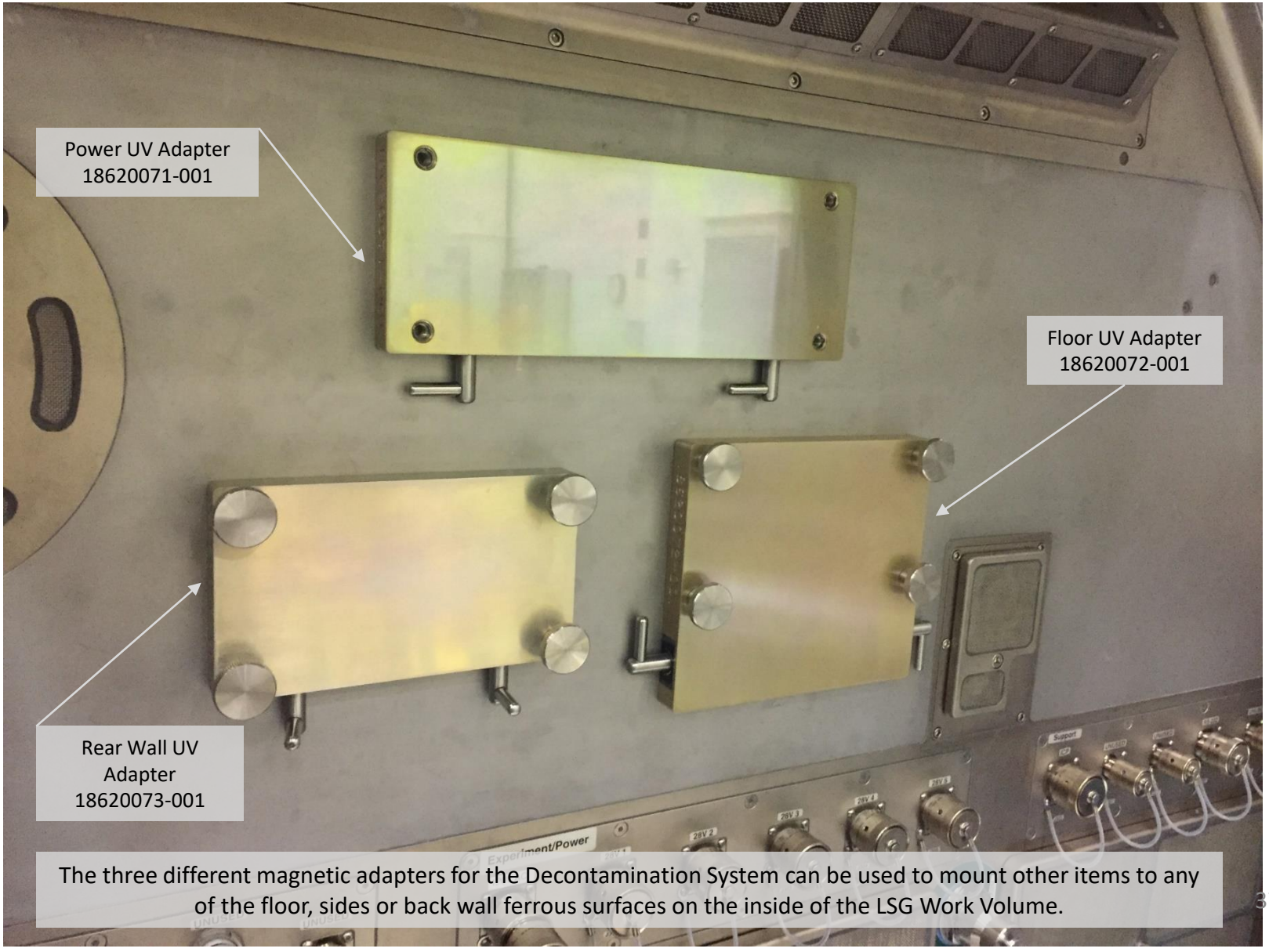
Magnetic Adapters can be used with Bungees to hold thin items

Applications

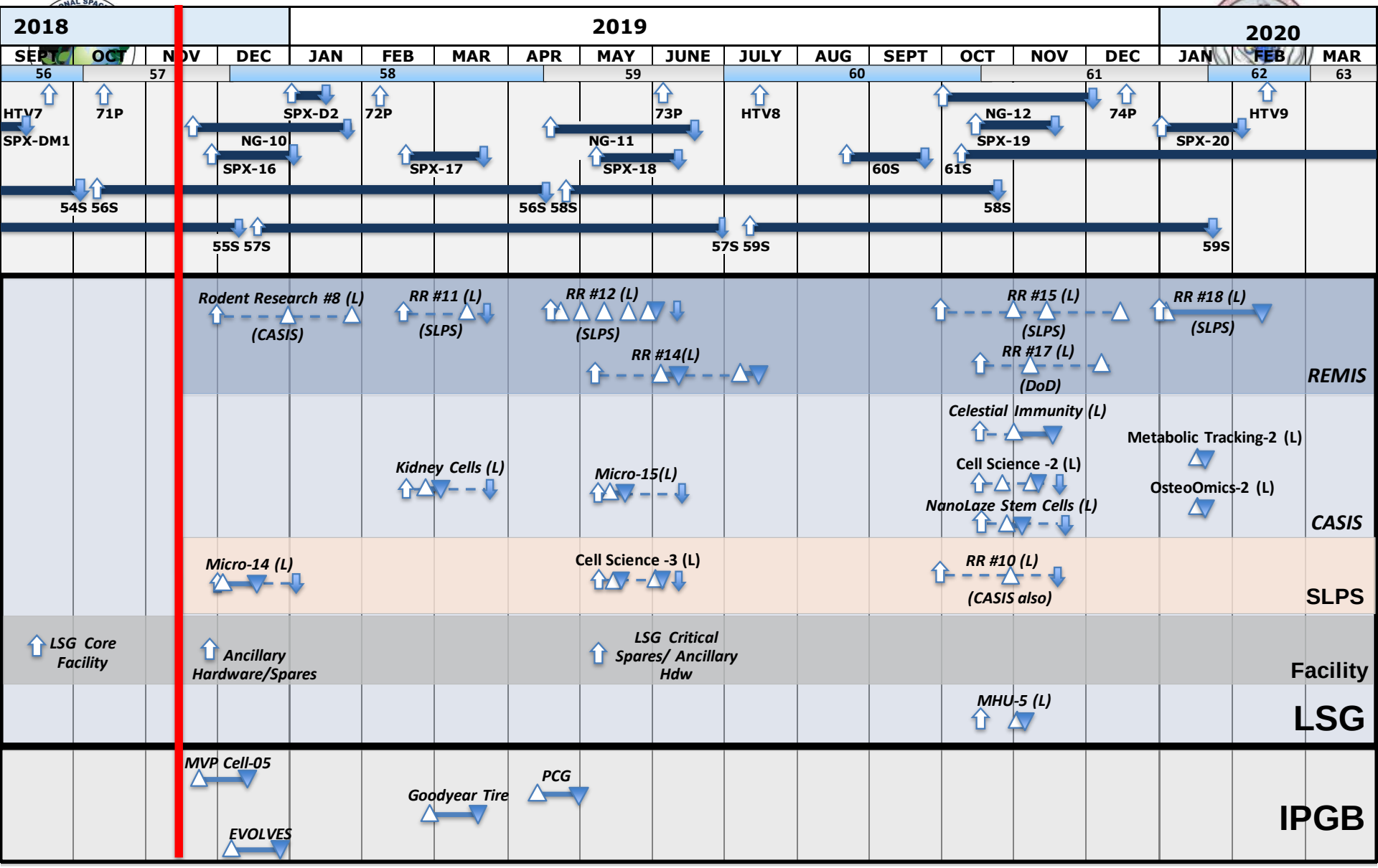


The Magnetic Adapters, Velcro Strips, Magnetic Bungee Mounts and Bungees can be attached to the ferrous surfaces inside the LSG Work Volume in a wide variety of configurations to suit the payload’s needs for restraining hardware.

Applications



The three different magnetic adapters for the Decontamination System can be used to mount other items to any of the floor, sides or back wall ferrous surfaces on the inside of the LSG Work Volume.



* Note - This is not a baselined schedule and is subject to change at anytime.