

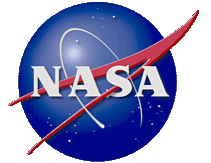
# ISS Medical Project On-Orbit Hardware

---

ORIGINAL 10/21/2015

REVISED 6/14/2016

EXPORT CONTROL APPROVED DAA#36565



# Current On-Orbit Hardware

---

- Actiwatch Spectrum System
- Cerebral Cochlear Fluid Pressure Analyzer (CCFP)
- Distortion Product Otoacoustic Emissions device (DPOAE)
- Holter Monitor 2 (HM2)
- Human Research Facilities 1 and 2 (HRF 1 & 2)
- On-orbit laptops
- Pulmonary Function System (PFS)
  - Pulmonary Function Module (PFM)
  - Photoacoustic Analyzer Module (PAM)
  - Gas Delivery System (GDS)
- Refrigerated Centrifuge (RC)
- Space Linear Acceleration Mass Measurement Device (SLAMMD)
- Human Research Facility Ultrasound 2 (Ultrasound 2)
- Consumable Hardware
  - HRF Supply Kits (Purple and Green)
  - Blood Collection
  - Saliva Collection
  - Urine Collection
- Experiment Specific Hardware
  - Fine Motor Skills
  - Fluid Shifts
  - Lighting Effects
  - Microbiome

# Actiwatch Spectrum System

- Waterproof, nonintrusive, sleep-wake monitor worn on the wrist
- Measures motion and ambient lighting
- Can be used to analyze circadian rhythms, sleep-wake patterns and activity
- Useful for the investigation of sleep quality, sleep onset, hyperactivity and other daily routines
- Modified commercial-off-the-shelf (COTS) system consisting of the Actiwatch Spectrum Kit, Actiwatch Spectrum, Actiwatch Spectrum Dock, Actiwatch Spectrum USB Cable, and Actiware Software (v. 5.52 or later)

[For more information click here](#)

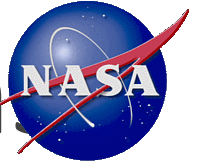


# Cerebral Cochlear Fluid Pressure Analyzer (CCFP)

- Indirectly measures Intracranial Pressure (ICP) by measuring Tympanic Membrane Displacement (TMD) under various stimuli
  - Can also perform Tympanometry
- Sensors for CCFP analysis are in the CCFP Headset and will interface with crewmember's ear canal via tubing with an ear tip
- Two other components work with the headset:
  - The Pulse Oximeter is placed on the finger to measure Pulse and O2 saturation
  - The Cannula interfaces with the nostrils to monitor respiration



# Distortion Product Otoacoustic Emissions (DPOAE)



- The DPOAE is a commercial off the shelf unit called Otoport Advance, produced by Otodynamics Audiology Systems
- Used to take Otoacoustic Emissions (OAE) measurements
- Handheld device with an ear probe fitted with a speaker and microphone
- Measures cochlear response pairs of f1 and f2 frequencies used in turn to acquire emissions from areas along the cochlea
- These measurements allow the first signs of deafness to be detected

[For more information click here](#)





# Holter Monitor 2

- Ambulatory ECG which accurately and non-invasively measures the electrical activity of the heart for up to 24 hrs.
- A snap-lead cable connects to electrode pads that have been applied to the torso
- The LCD displays subject information, instructions, messages, date, and time of day
- Three pushbuttons are used to navigate through the LCD screen

[For more information click here](#)





# Human Research Facilities 1 and 2 (HRF-1, 2/HRF Rack 1, 2)

---

- Consist of items mounted in a rack [based on the EXpedite the PROcessing of Experiments to Space Station (EXPRESS) rack design] as well as equipment kept in stowage and brought out as needed
- The HRF drawers provide power, command and data handling, cooling air and water, pressurized gas, and vacuum to experiments
- The racks have front-panel access ports for the laptop, vacuum system, deployed payloads, and nitrogen delivery system
- The International Space Station (ISS) moderate temperature cooling loop is extended into the HRF to keep the rack at ambient temperature
- Payloads in HRF-1 can operate independently of each other regardless of their cooling and power needs and the flight schedule.
- Each payload can use up to 500W of power and the sum of all payloads can use up to 2000 W of power. The HRF power converter delivers 120V of direct current (DC) power from the utility outlet panel to the rack and converts it to 28 Vdc for distribution to the payloads
- The racks are connected to the ISS video services and Ethernet, which allow the ISS and ground operations crews to control payloads. Payload computer and video operations can be conducted from the ground or on the space station.



# Human Research Facility 1 (HRF-1/HRF Rack 1)

- The hardware housed in HRF-1 Includes:
  - Portable computer (HRF PC), which is used to install and execute software that supports the experiments. It is used to control equipment; to collect and store data, crew notes, and equipment notes; and to provide uplink and downlink capabilities.
  - Another PC (designated HRF PC3) containing HRP experiment-specific software utilizes HRF Rack 1 for experiment data downlink.
  - Two Cooling Stowage Drawers (CSD) provide stowage for equipment at a uniform temperature
  - The HRF 8PU Utility Drawer provides stowage for consumables with added radio-frequency identification (RFID) that automates inventory of the tagged contents without crew intervention.
  - Space Linear Acceleration Mass Measurement Device (SLAMMD)
  - A stowage drawer holds the Ultrasound 2. When deployed, the Ultrasound 2 is connected to the front of HRF-1 for power and to allow real-time downlink of scanhead video.

[For more information click here](#)



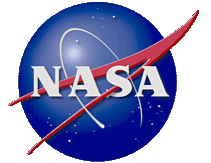


# Human Research Facility 2 (HRF-2/HRF Rack 2)

- The hardware housed in HRF-2 includes:
  - Portable computer (HRF PC), which is used to install and execute software that supports the experiments. It is used to control equipment; to collect and store data, crew notes, and equipment notes; and to provide uplink and downlink capabilities.
  - Two Cooling Stowage Drawers (CSD) provide stowage for equipment at a uniform temperature
  - The HRF 8PU Utility Drawer provides stowage for consumables with added radio-frequency identification (RFID) that automates inventory of the tagged contents without crew intervention.
  - Pulmonary Function System (PFS) including the PFS/PAM and GDS
  - Refrigerated Centrifuge (RC)

[For more information click here](#)





# On-Orbit Laptops

---

- There are 3 HRF PC Laptops currently on-orbit
- Lenovo ThinkPad T61p (type 6457)
- Running Windows XP for PC1 and PC2, and Windows 7 for PC3
- HRF PC1 and PC2 are expected to be upgraded to Windows 7 in 2016
- In addition to the software interfacing with the HRF rack hardware, HRP experiment-specific software may be used when necessary

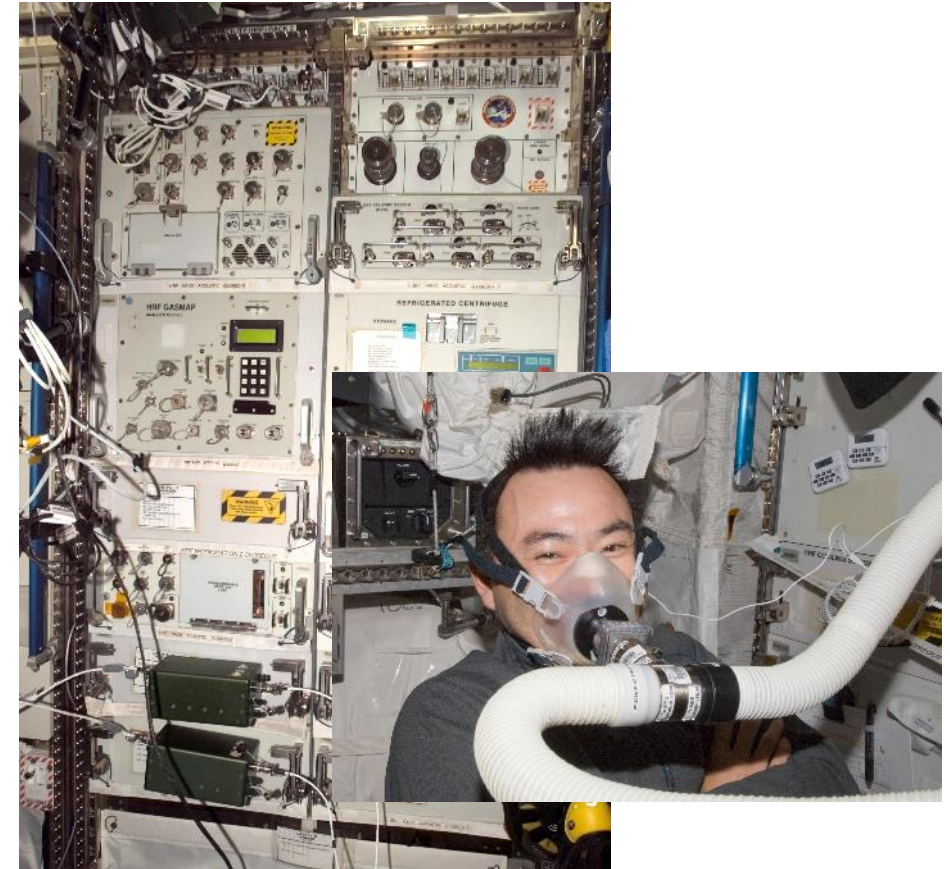
[For more information click here](#)



# Pulmonary Function System (PFS)

- Currently includes three major components, which make it possible for the system to take respiratory and cardiovascular measurements
  - Pulmonary Function Module (PFM)
  - Photoacoustic Analyzer Module (PAM)
  - Gas Delivery System (GDS)
- Breath-by-breath measurements, diffusing capacity of the lung, expiratory reserve volume, forced expired spirometry, functional residual capacity, cardiac output, alveolar ventilation, volume of pulmonary capillary blood, and numerous others
- Multiple hardware accessories for rebreathing and mixing bag operations, an electronics unit accommodated in an 8 panel unit drawer
- Allows additional inputs for turbine and differential pressure flowmeters, and respiratory inductive plethysmograph (RIP)

[For more information click here](#)



# Refrigerated Centrifuge (RC)

- Used to separate biological substances of varying densities by spinning at a high rate
- Six chamber RC rotor chamber can hold samples sized from 2 to 50-ml
- Twenty-four chamber RC rotor can hold samples sized from 0.5 to 2.2 ml
- Speed can be selected from 500 to 5000 rpm for 1 to 99 minute durations, or it can be set to run continuously
- The RC was designed to provide refrigeration with temperatures that range from ambient ISS temperature to 4 degrees C, but currently, the on-orbit unit is not cooling

[For more information click here](#)

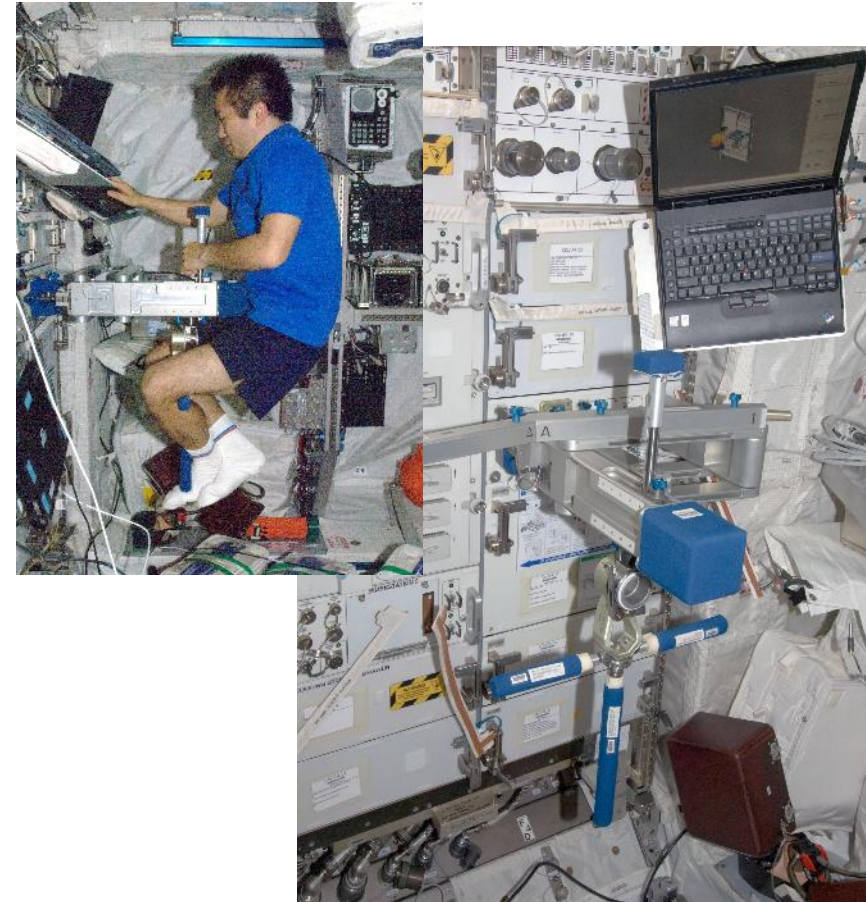




# Space Linear Acceleration Mass Measurement Device (SLAMMD)

- Follows Newton's Second Law of Motion by having two springs generate a known force against a crewmember mounted on an extension arm, the resulting acceleration being used to calculate the subject's mass
- Accurate to 0.5 pounds over a range from 95 pounds to 240 pounds
- Intended to provide an accurate means of determining the on-orbit mass of humans between the 5th percentile Japanese female and the 95th percentile American male

[For more information click here](#)

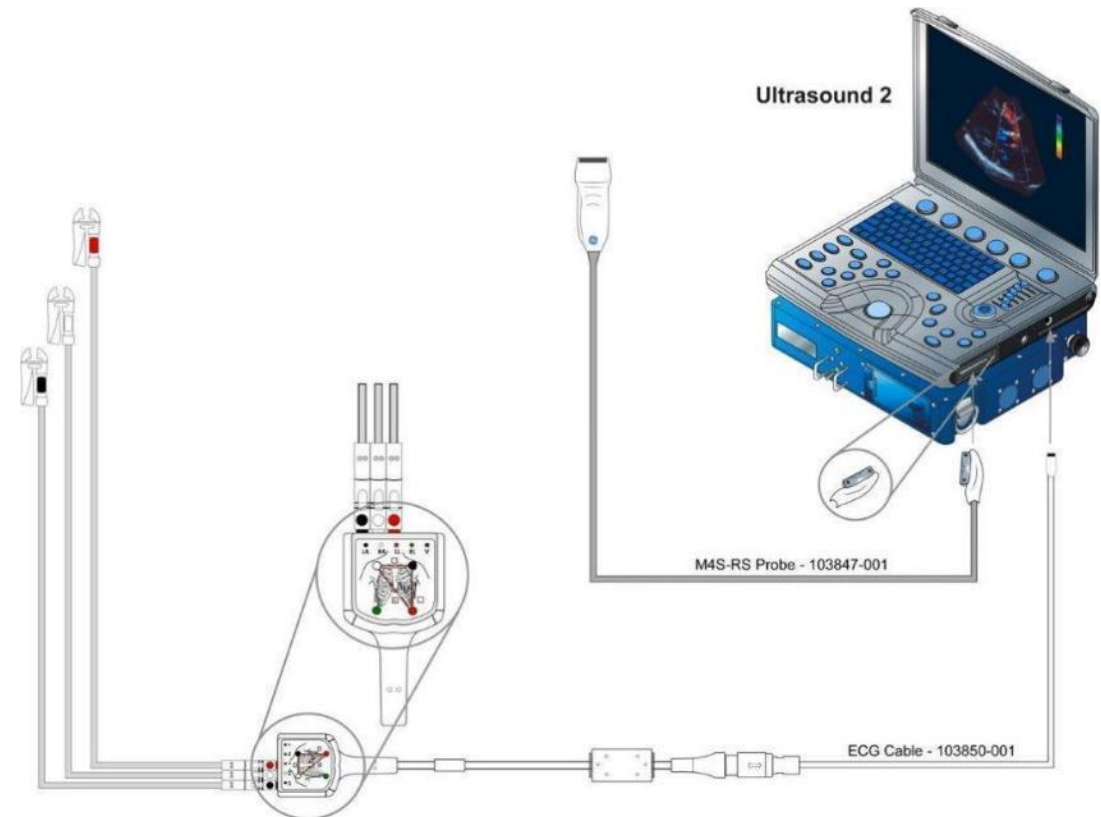


# Human Research Facility Ultrasound 2 (Ultrasound 2)



- General Electric (GE) Medical Systems Vivid-q™ model
- Can be used for a variety of experiments for cardiac, muscle, vessel, and blood flow analysis
- Curved, phased, or linear array probe
- Includes additional features that allow for panoramic image construction to estimate muscle volume changes, speckle tracking functions to analyze cardiac stress-strain, and dynamic morphology

[For more information click here](#)







# Consumables: HRF Supply Kit Purple

- Urine tube kits
- Blood tubes (vacutainers)
- Disposable gloves
- Blood collection belts
- Sharps containers
- Liner bags (biohazardous trash)



# Consumables: HRF Supply Kit Green

- Saliva Session Packs
- Tourniquet
- Timed Saliva Session Packs
- Sharpie
- Butterfly Needles
- Echo Gel
- Iodine Wipes
- Dry Wipes
- Biocide Wipes
- Electrodes
- Gauze
- Centrifuge Counterweight Tubes
- Tape
- Band-Aids



# Consumables: blood collection



Open Blood Tube Kit



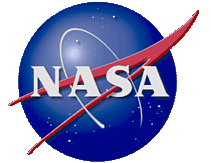
Large Blood Sample Kit



Blood Sample Kit



Insulated Blood Pouch



# Consumables: Blood collection tubes

Processing	Name	Fill Volume (ml)
Ambient	Blood 10ml Heparin	8.5
	Blood 8.5ml ACD	8.5
	Blood 6ml EDTA	6
	Blood 6ml Heparin	6
	Blood 10ml EDTA	10
	Blood Sodium Heparin	6
Frozen or Ambient	Blood 4ml CPT	4
Frozen	Blood 7.5ml Serum	7.5
	Blood 7ml Heparin	4.5
	Blood 7ml EDTA	5

# Consumables: Saliva Collection

- Rolled or sublingual saliva collection - Saliva Session pack
  - Salivette bag- holds multiple salivettes
    - Salivette- roll-shaped synthetic saliva collector
  - Saliva bag- contains salivettes after sampling



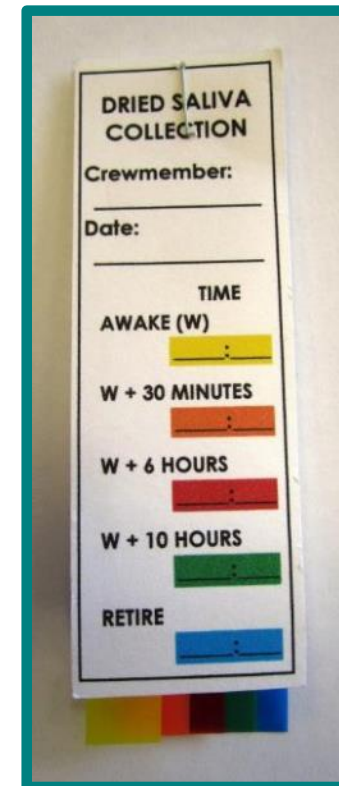


# Consumables: Saliva Collection

- Sublingual Saliva Collection - Timed Saliva Session Pack
  - Saliva Vial- contains salivette
  - Salivette- cylindrical-shaped synthetic swab



- Dried Saliva Collection Booklet
  - 5 filter strips separated by wax paper with a tab





# Consumables: Urine collection



Urine collection device –  
Male or female



Urine sample syringes



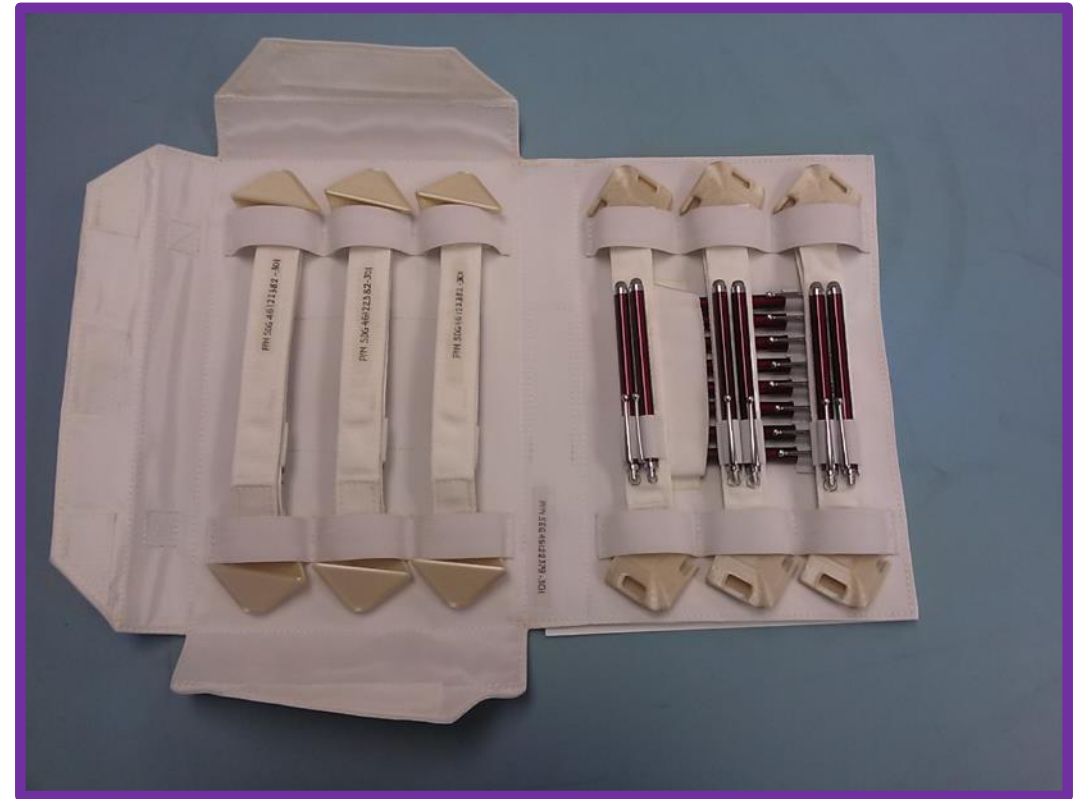
Urine pH kit



Urine containment bag

# Experiment Specific: Fine Motor Skills

- Stylus – required for experiment specific objectives using an iPad app
- Handhold – use to facilitate one handed operations with the iPad 3s



# Experiment Specific: Fluid Shifts

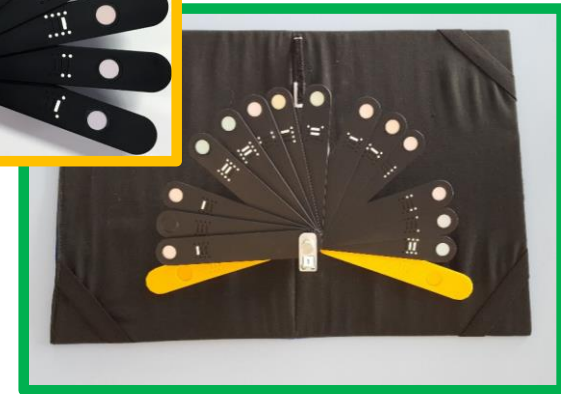
- Fluid Shifts tracer kit – contains NaBr tracer used during experimentation
- Earmuffs – Used in conjunction with the DPOAE to isolate ISS noise during measurements
- Vein Press – attaches to USND2 linear probe to non-invasively measure blood vessel pressure via a glycerin-filled membrane/transducer assembly
- Manometer – measures differential pressure across two sample ports





# Experiment Specific: Lighting Effects

- Visual Performance Test Kit – Includes the following items:
  - Color Test - Sixteen (16) independent black matte sticks with the Lanthony Desaturated D-15 color pallet which are identified by a unique key and used to test crewmembers on color discrimination proficiency
  - Test Surface - Matte black nomex surface required for visual performance testing
- Light Meter – a portable handheld spectrometer with stylus and distance guide designed to measure different light sources (e.g., LED, fluorescent, natural light) and provide data feedback via a USB connection



# Experiment Specific: Microbiome

- Microbiome Fecal Kit

- Fecal swab – Used to collect and then store fecal samples in MELFI
- Water Collection Hardware – Teflon bag and adapter used to collect and store water from the Potable Water Dispenser (PWD)
- Swab Kit – contains differently colored saline swabs for microbial collection of different body parts, for surface sample collection, and sweat sample collections

