



Extravehicular Activity (EVA) Tools

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EVA Tools and Equipment

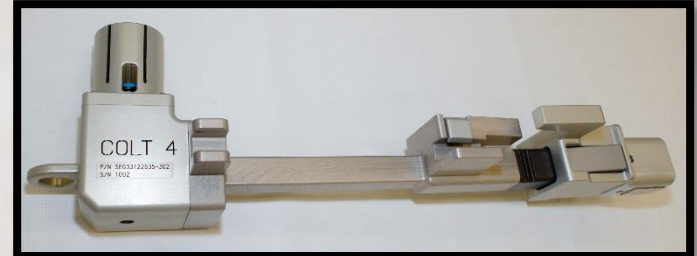
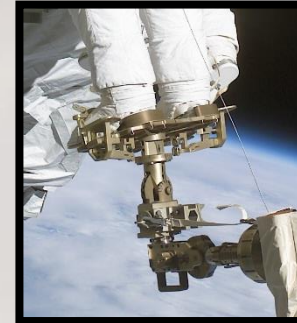


- The team is comprised of employees at NASA JSC working in the Tools, Equipment and Habitability Systems Branch of the Crew and Thermal Systems Division.
- The team houses Project Managers, Project Engineers, and ISS EVA Tools System Management that develop Flight Hardware for ISS and lead early development of Exploration focused tools.
- Exploration EVA Tool Development
 - The goal is to use a lean funding model to develop and test hardware in support of Operations Concept formulation at the program level AND becoming “smart buyers” for future Flight Hardware development.
 - Hardware development guided by EVA System Maturation Team (SMT) Gap List
 - Methodology:
 - Rapid development cycles
 - Focus on functionality
 - Low cost solutions

Flight Hardware



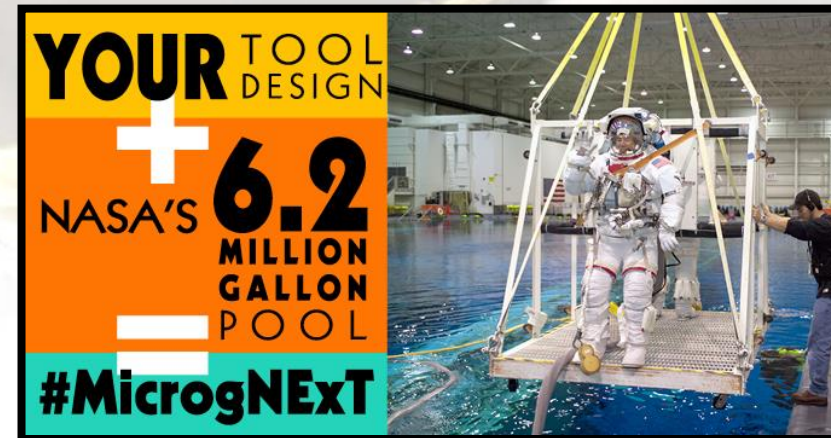
- EC7 houses project managers with experience developing and certifying Flight hardware.
- Previous projects:
 - Articulating Portable Foot Restraint (APFR)
 - Body Restraint Tether (BRT)
 - Contingency Operations LAPA Tool (COLT)
- Recent projects:
 - EVA GoPro
 - Dual Tether Points
 - EVA Inspection Mirror
 - EVA Cap Keeper
- Current projects:
 - Alpha Magnetic Spectrometer (AMS) Repair Tools



Recent Exploration Tool Work



- Micro-G NExT
 - The Micro-G Neutral Buoyancy Experiment Design Teams (Micro-G NExT) Program challenges undergraduate students to propose, design, build, and test a tool that addresses an authentic, current space exploration problem.
- Z2 Tool Integration
 - Supporting development of prototype spacesuits.
 - Specifically figuring out methods for integrating tools onto the suit.
- NEEMO 22 Mission
- Integrated Geology Sampling System



Integrated Geology Sampling System



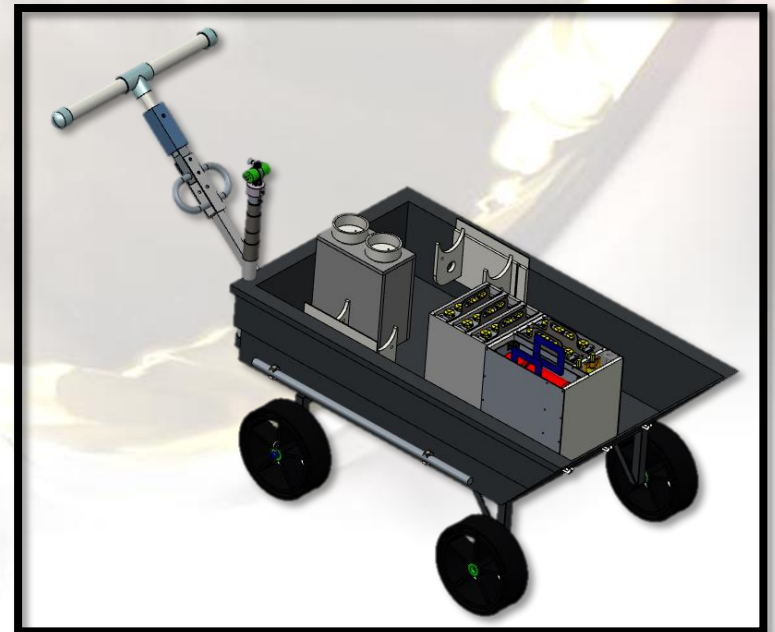
- In support of the Asteroid Redirect Mission, the team developed an *integrated* sampling kit that focused on sample containment and a cross-contamination protocol.
- This prototype was tested in various environments and took in account more stringent contamination requirements than existed during Apollo.
- **Sample Briefcase**
 - The **Sample Briefcase** is the carrying case in which the end effectors are housed prior to and after use.
 - Serves as a method to transport end effectors to and from worksites and provides final containment once a sample is collected.
- **Drivers**
 - **Manual Driver** is used to obtain loosely adhered samples that can be liberated using hand strength alone.
 - **Powered Driver** is used when an increased force is needed to remove samples from the surface.



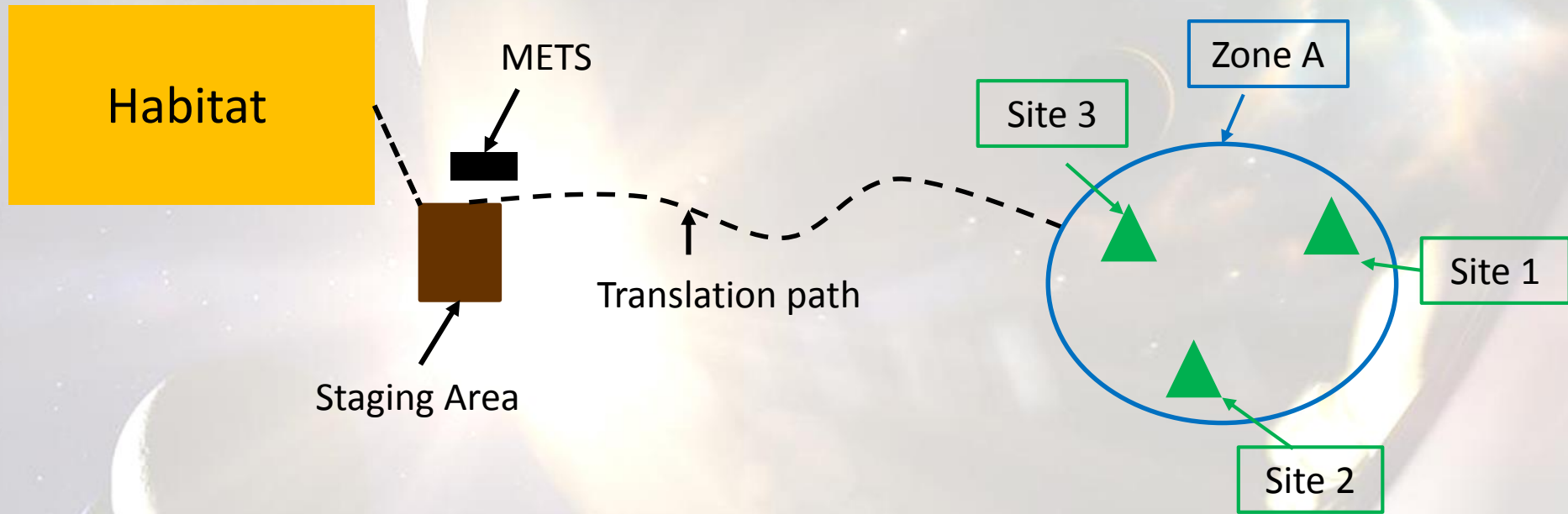
Surface Exploration Work



- During the NEEMO 22 mission, the team tested a new method for transporting equipment across a planetary surface.
- The Modular Equipment Transport System (METS) is a method for transporting equipment using an understanding of the planned EVA tasks to intelligently group hardware into Modules.
- The METS was also outfitted with other features to support EVAs such as: situational awareness camera, Navigation Mount, flexible mount for procedure viewer.
- The benefits of this method are:
 - Provide increased efficiency for crew translation (minimize back and forth trips to retrieve and return tools).
 - Minimize crew exertion.
 - Enable the crew to get tools into locations that are unreachable by their larger caddy.



Operations Overview



Exit Habitat
Head to
Staging Area

Retrieve
Modules
needed for
the day's
operations
and place in
METS

Translate
with
METS to
Zone of
interest

Place
METS at
edge of
Zone

Remove
the
Modules
needed for
the
Task, head
for Site

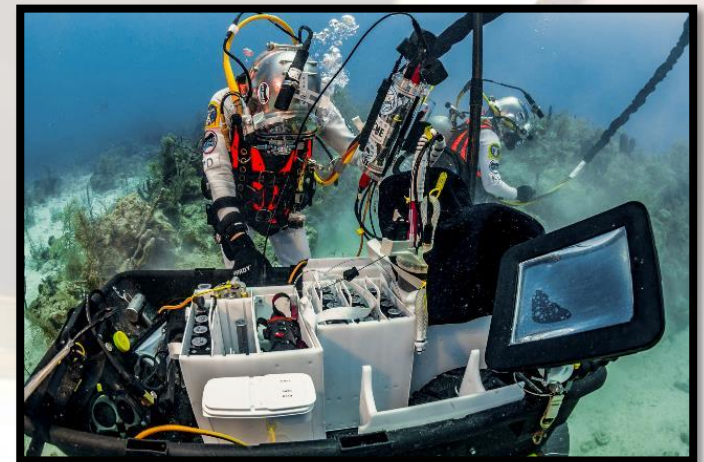
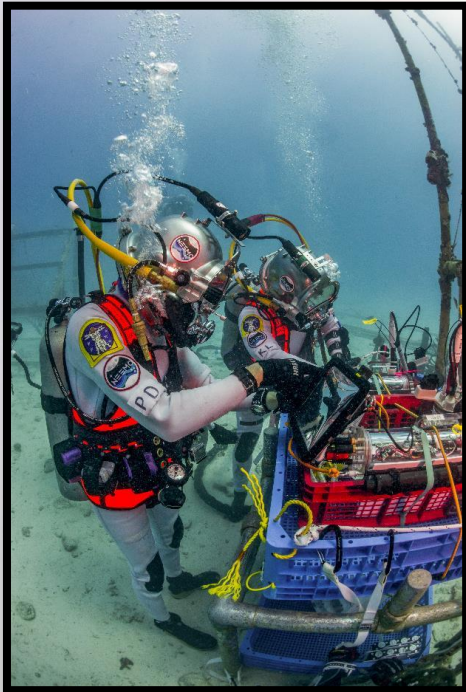
Arrive at
the Site
and
perform
Task

Return to
METS and
replace
the
Modules

Lessons Learned



- In order for this concept to work, every piece of hardware involved in EVAs needs to be accounted for in order to develop the modules appropriately.
 - Development process needs to be closely integrated.
- Crew comment: It was nice to be able to park the METS in one location and only carry what was needed to the different sampling sites.
- Has potential to be over-constraining. But should be evaluated further moving forward.



Future Work



- The team is closely integrated with colleagues across the Agency and Industry working on Exploration EVAs.
 - XX Exploration EVA Management
 - XI Astromaterials Research and Exploration Science
 - XM Exploration Mission Planning
 - Honeybee Robotics
- Continue working to close gaps on the SMT Gap List.
- Top areas of focus moving forward:
 - Crew operated core drills
 - Surface tool transportation
 - Handheld, portable geology instruments space-ification
 - Incapacitated crew rescue
 - Support science and operations colleagues in various testing