Recycling Flight Hardware Components and Systems to Reduce Next Generation Research Costs

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Recycling Flight Hardware Components and Systems to Reduce Next Generation Research Costs

With the recent 'new direction' put forth by President Obama identifying NASA's new focus in research rather than continuing on a path to return to the Moon and Mars, the focus of work at Kennedy Space Center (KSC) may be changing dramatically. Research opportunities within the μ-gravity community potentially stands at the threshold of resurgence when the new direction of the agency takes hold for the next generation of experimenters.

This presentation defines a strategy for recycling flight experiment components or part numbers, in order to reduce research project costs, not just in component selection and fabrication, but in expediting qualification of hardware for flight.

A key component of the strategy is effective communication of relevant flight hardware information and available flight hardware components to researchers, with the goal of 'short circuiting' the design process for flight experiments.

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The resources required to build flight hardware experiments are substantial. These experiments (space and reduced gravity flight) must be qualified for flight, driving extensive documentation to meet vehicle specifications. Satisfying these minimum requirements involves costly physical testing, analysis and inspection; this component of the work often takes longer than the design and assembly of the flight hardware.

For these reasons, an experimenter can realize tremendous cost savings by reusing all or part of any experiments that have already flown.

Substantial cost savings can also be realized on a component by component basis, where flown hardware can be re-used on new experiments to take advantage of previous analysis and documentation.

The Kennedy Space Center Flight Hardware List is a database of component references, technical points of contact (POC's) and flight hardware available at the NASA-KSC site.

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Definitions

Space Flight Experiment – An experiment (or hardware used in a scientific investigation) prepared for use in a microgravity environment, for use internal or external to the flight vehicle in space. Hardware of this nature has been built to a high standard for environmental extremes, to established engineering and tolerances, having or designed to accommodate flight interfaces, panels, hardware, cables, electronics, and tubing.

Reduced Gravity Flight Experiments – An experiment (or hardware used in a scientific investigation or subsystem test equipment) prepared for use in a microgravity environment, aboard reduced gravity aircraft. Hardware of this nature has been built to a high standard for gravitational extremes, to established engineering and tolerances, having or designed to accommodate aircraft interfaces, panels, hardware, cables, electronics, and tubing. This work would include Sounding Rocket experiments.

Other Opportunities – These include Space and Reduced Gravity Flight Experiments (or hardware used in a scientific investigation or subsystem test equipment) prepared for use in a microgravity environment not currently assigned to flight work and presently not located at KSC. This is hardware being used for preliminary ground experimentation (with the possibility of use as a flight experiment in follow on) or devices that are being considered to be used in conjunction with devices flying from KSC.

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This comprehensive list of Kennedy Space Center (KSC) Space Flight and Reduced Gravity Flight Experiments will be used for reference within the KSC science/research community, with the goal of 'short circuiting' the design process for flight experiments.

An experimenter using the **keyword index** included in this list can identify experiment components by category for further review; if someone is looking to develop flight hardware requiring certain components or sub-systems they can review the list (this document) for experiments utilizing these components (for example, experiments that fly a "test chamber"). Those developing concepts for a future experiment might also review these existing experiments for potential modification and re-use.

Finally, this list can help create awareness of activities by other KSC science groups and would allow for synergy between various scientific disciplines (bio-medical, materials science, space science, Core Technologies, etc.) allowing everyone to 'work smart'. The purpose of this **KSC Flight Experiment List** is to begin a dialogue between science groups that might not otherwise discuss the commonality of their work.

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The listing for each item will include:

ABSTRACT: The abstract is a brief outline of the experiment and devices used to derive information.

Keywords: These identifiers (ex: Dynamic Light Scattering) will be pulled from the abstract and referenced in the Index.

Last Flown (or anticipated flight date): Vehicle and date (Ex: STS-95, October 1998).

Task the Experiment is supporting: Organization or group (ex. Space Flight Medicine)

POC: Point of Contact

Start of use date: When the hardware was or is planned to be used.

End of use date: When the hardware will be available for use (expected).

Affiliations: Other NASA facility or organization involved (ex. FIT, GRC, KSC, etc.)

Papers and references: papers written to support the experiment of derived from data acquired from the experiment.

Current status: funding

General Comments: Additional experiment information. (ex. This experiment is utilizing existing Flight Hardware previously flown as the Colloidal Disorder Order Transition (CDOT) Space Experiment Investigation flying from Glenn Research Center).

Image: Showing experiment components and or set up. (ex. Image of the experiment installed in the ISS experiment Glovebox).

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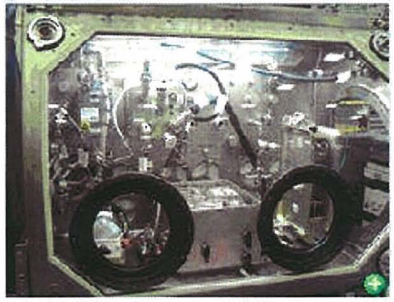
Space Flight Experiments

1. In-Situ Intravenous Fluid Generation

ABSTRACT: Services to catalyze the production of a prototype for the Intravenous Fluid Generation (IV Gen) technology demonstration on the International Space Station. Funded through NASA's Human Research Program. The team seeks to produce medical-grade saline solution in a zero-gravity environment. If successful, the process solves the challenge of packing IV solution that expires during the shuttle cycle, and alleviates mass and volume storage constraints. The process of converting potable water into purified water (via a custom purifier), combining it with sodium chloride, and sterilizing the resulting saline met with obstacles. To meet U.S. Pharmacopeia standards, all components of the assembly need to withstand gamma irradiation for sterilization. Additionally, mixing the solution sufficiently without gravity proves challenging. In response, ZIN Technologies developed an "in-the-bag" agitation using a magnetic stir bar and remote motor. BioConnect provided a unique customized assembly. One bag was preloaded with sodium chloride and the magnetic stir bar. Pall Corporation supplied the sterilizing filters. After assembly and packaging, BioConnect sterilized all parts to 10^{-6} SAL by gamma irradiation.
Keywords: catalyze, saline solution, IV solution, fluid connectors, fluid containment, sample fluid combination in flight, sterilization, magnetic stir bar and remote motor for mixing, fluid transfer in flight

Last Flown (or anticipated flight date) : (ISS 2012).
Task the Experiment is supporting: Space Flight Medicine/ Human Research Program
POC: Dr. Dan Woodard (KSC-IHA) and Walt Turner (KSC-ASRCA)
Start of use date: (expected)
End of use date: (expected)
Affiliations: GRC, ZIN Technology, KSC
Papers and references: to follow
Current status: (funded)
General Comments: This experiment is being fabricated using contracted services a team from NASA's Glenn Research Center (Cleveland, OH) and ZIN Technologies (Cleveland) and Bio Connect.

Image: Shows a prototype of the device assembled in the International Space Station (ISS) Glovebox Facility mock up.



Equipment Name	Quantity	Purchase Date	Purchase Cost	Equipment Life	POC	Location	Description
IV Gen	X	2009	X	X	Dr. D. Woodard (KSC-IHA)	GRC	Microgravity flt hardware

Martian and Lunar Dust Mitigation (MLDM)

FAST 2009

Test Plan and Objectives

Technology Description: Test chamber with triboelectric charging and deployment system, monitored by video cameras. Flew for EGM-001 experiment from NASA GRC.
Planned Test Objectives: Characterize unit for Martian and lunar gravity levels. Determine whether charged particles will be uniformly dispersed and re-dispersed using a variety of dispersal rates, charge levels, geometries, and angles.
Test requirements:
Number of flight days: 4
Number of personnel: 3 (per day)
Project dimensions (meters): 0.94 L × 0.56 W × 1.25 H
Gravity level(s): Martian, 0.38 g; lunar, 0.16 g
Special Needs: External vent accommodation (may be waived)

Value & Relevance to NASA

Primary Relevant Mission Directorate: Applied Technology (KT)
Primary Relevant NASA Center: KSC

Technology Focus Area: Dust mitigation systems and test

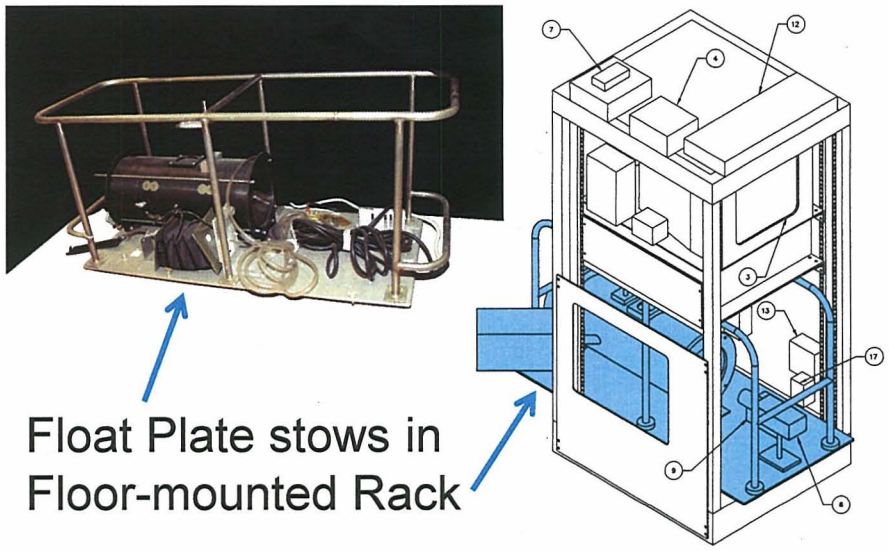
Specific Benefits of Technology: This device will further research on mitigation of dust effects on Martian and lunar surface missions. Technology and method have been proven in microgravity flight environment.

Team Members and Resources

Primary Organization Name: ASRC Aerospace Corporation
Project Manager: Walt Turner (walter.b.turner@nasa.gov)

Planned Team Expenditures:
Labor: $6k Travel: $9k Procurement: $0

Image or Schematic of Experiment



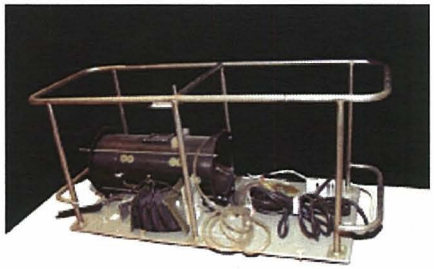
Reduced Gravity Flight Experiments

1. Characterization of Test Chamber and Tribo-Charging system for use in Martian and Lunar Dust Mitigation (MLDM) and Plume Dust Density Studies

ABSTRACT: The purpose of this experiment/test is to characterize the functionality of the Lunar Martian Dust Mitigation (MLDM) Test Chamber for future use in Dust Mitigation studies and using the opportunity to collect data for Rocket Nozzle Plume, Lunar Dust Density studies currently being performed by Dr. Phil Metzger (NASA-KSC) and is considered a principal investigator for this work. The proofing of functionality and mechanics of dust tribo-charging, the dust deployment system, camera dust density tracking and techniques during dust deployment could be useful for follow on dust density and dust mitigation studies. This existing hardware successfully flown several years ago, in support of a Microgravity Physical Sciences experiment as the Electrostatic Granular in Microgravity (EGM-001) in March of 2001, flying from Glenn Research Center (GRC) aboard the KC-135 reduced gravity flights and has been modified (updated) slightly for work in Lunar an Martian environments but was only flown in support microgravity (zero G) materials science experiments previously. The test chamber and tribo- charging system to apply electrostatic charge to granular (sand) particles were developed and used for a material science experiment in a 'zero gravity' microgravity environment.

Keywords: containment test chamber (dust), tribo-charging, electrostatic charging, LED lighting, power supply, HD digital video camera, dust deployment system, float platform, umbilical cable, camera mount, power control, electrical connectors

Last Flown (or anticipated flight date) : JSC, IPP FAST Reduced Gravity Flights, August 2009.
Task the Experiment is supporting: ISRU Lunar
POC: Dr. Phil Metzger (KSC-NASA) and Walt Turner (KSC-ASRCA)
Start of use date: (June 2009)
End of use date: (October 2009)
Affiliations: GRC, KSC
Papers and references: to follow
Current status: (funded)
General Comments: This experiment is utilizing existing Flight Hardware previously flown aboard Reduced Gravity Flight (RGF) for study of Electrostatic Granular particle charging studies as EGM flying from Glenn Research Center (GRC)
Image: Shows the flight chamber, float plate and deployment system, umbilical tribocharger and controls.



Equipment Name	Quantity	Purchase Date	Purchase Cost	Equipment Life	POC	Location	Description
MLDM	1	X	<$10K	20 years	W.B .Turner	KSC-MPPF/EDL	RGF Hardware

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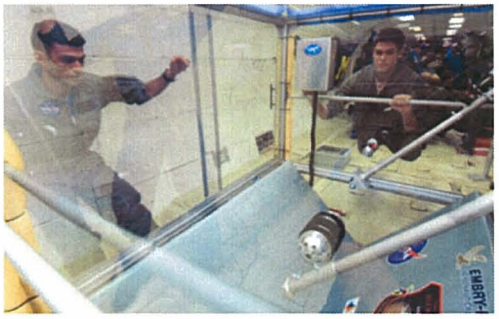



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KSC Facility Capabilities

Comprehensive Flight Experiment Hardware Design, Fabrication and Test currently capabilities exist at KSC Facility.

- Engineers and Designers
- Certified Flight Hardware Fabricators
- Testing facilities, Including Vibration, RFI and EMI qualification testing
- Offline Processing, Checkout, Clean Room, and Preparation facilities

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The KSC Flight Hardware List can be found at

<(KSC Home page) Link……>

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Questions???