**TEST EQUIPMENT DATA PACKAGE**

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***Use of Boron-Enhanced High-Density Polyethylene for Radiation Shielding***

TEDP Completion Date:

**IMPORTANT THINGS TO NOTE:**

**Avoid permanent magnets if possible**

**Avoid Shaterable materials if possible (e.g. class) However there are ways to secure these items, just be sure Mentor and NanoRacks are aware so that they can be packaged appropriately.**

**Avoid pressure vessels**

**Avoid substances with toxicity higher than 2 on MSDS’s**

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**QUICK REFERENCE DATA SHEET**

Team Name: Awty International School 8th Grade

Principal Investigator: Angela Glidewell

Contact Information: 7455 Awty School Lane, Houston,Tx 77055

Experiment Title: Use of Boron-Enhanced High-Density Polyethylene for Radiation Shielding

Work Breakdown Structure (WBS):

Flight Date(s):

Overall Assembly Weight (lbs):

Assembly Dimensions (L x W x H):

Equipment Orientation Requests in reference to NanoRack:

Proposed Mounting to NanoRack:

Does Experiment need to be located next to fan on NanoRack: (Yes or No)

Power Requirement (Voltage 9and Current Required):

Camera or Video Requested? (Yes or No):

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**BASIC MISSION OBJECTIVE:**

*Cosmic radiation poses a serious threat to humans as they continue to inhabit the International Space Station (ISS), as well as, embarking on missions to the Moon or Mars in the future. Many studies address the allowable doses of radiation in space, and effects of various forms of shielding against this radiation. The goal is to investigate the feasibility of using Boron-enhanced high-density polyethylene(BE-HDPE) in the construction of spacecraft for the purpose of shielding against galactic cosmic radiation (GCR) and solar particle events (SPE).*

**EXPERIMENT BACKGROUND**

*Due to the damaging effects of ionizing radiation, there is an unmistakable need for astronauts to be protected while in space for significant lengths of time. The ISS modules are presently made from an outer layer of aluminum, an insulation layer, a debris shield layer similar to Kevlar and a second debris shield layer of aluminum for added protection against debris and micrometeoroids, as well as reflection of the intense sunlight.(1) GCR and SPE are composed of 1% Beta rays or electrons, 9% Alpha particles or Helium nuclei and 90% Hydrogen nuclei or protons.(2) In order to be feasible alternative, a shielding material needs to be inexpensive, easy to manufacture, moldable and easily integrated into the construction process. One such material fulfilled these criteria. The proposal for this experiment is to use a Boron-enhanced High Density Polyethylene (BE-HDPE). This material has been studied as a shielding source against neutron radiation due to its naturally Hydrogen-rich composition which attenuates neutrons rather effectively.(3)*

1 "Defense, Space & Security." *Boeing: International Space Station*. Boeing, 1995-2013. Web. 01 Oct. 2013.

2 Mattson, Barbara. "Cosmic Rays." *- Introduction*. NASA Goddard Spaceflight Center, 03 Feb. 2010. Web. 01 Oct. 2013.

3 "Quadrant EPP'S Borotron® Enhanced HDPE Used in Radiation Shielding." *- Quadrant*. Quadrant EPP, 30 July 2008. Web. 01 Oct. 2013.

**EXPERIMENT DESCRIPTION**

*In this experiment, a Geiger counter would be used to measure the amount of radiation that passes through the ISS over the span of one hour and data would be taken again at four different time intervals during a 24 hour time period and this value would be used as our control value. A layer of BE-HDPE of a given thickness would be employed to shield against radiation that enters the ISS and the data would be collected again over a 24 hour period. Multiple layers would be added to determine the optimal thickness needed to attenuate the radiation to a safer level. A correlation could also be drawn between the position of the ISS and the maximum amount of radiation received.*

**OPERATIONAL SCENARIO**

1. *High Level Summary of Payload Operations, general overview*
2. *Specific constraints for payload (ie. Activation requirements, temperature requirements to/on/from ISS, orientation requirements during transport to ISS)*
3. *How long does the experiment need to operate for? Does the experiment require any crew interaction?*
4. *Will payload need to be returned or disposed of once ops complete*
5. *What kind of data needs to be collected during the mission and will ground operations be required (ie. Downlinking to NanoRacks mission control?)*

**EQUIPMENT DESCRIPTION**

1. Ground-Based and Flight Equipment (if there is no difference just reference the flight Equipment. Please make excel spreadsheet for all categories of the equipment.)
   1. Pictures
   2. Descriptions of each piece of equipment
   3. Dimensions
   4. Mass
   5. Hardware Class (different classes based on toxicity of material)
2. Equipment Layout for Take-off, in Flight, and Landing (some of this information provided by NanoRacks. Equipment may be stowed in flight stowage bag during liftoff and landing. Show how the ardulab should be interfacing the NanoRack with orientation. Diagrams are helpful.
3. Special Handling/Special Hazards/Special Requirements

*Crew handling during mission? Will crew be handling toxic materials?*

1. Bio/Chemical Contents :

*Complete JSC form 27472 if applicable and provide MSDS . Avoid substances with toxicity higher than a 2 on MSDS form.*

1. Inventory of In-flight Items

*Any extra materials that will need to be stowed outside of the ardulab? If you have items that are going to be operated by the crew outside of the module provide a sketch or enough details to create a drawing. Photographs are great if available.*

**ELECTRICAL ANALYSIS**

1. Schematic drawing with all current and voltage draws
2. Load Table
3. Stored Energy
4. Electrical Kill Switch

*How will experiment be turned off in event of an emergency?*

1. Loss of Electrical Power (Fail-Safe)
2. TRY TO DESIGN without Batteries and just use the NanoRacks platform with USB power. If Batteries cannot be avoided, please include the following information and specifications:
   1. Schematics of entire unit must include the batteries (if batteries are rechargeable, include the schematics of the battery charging circuits).
   2. Protection circuit
      1. Manufacturer, details, and model number
      2. Schematics
      3. Voltage and current cutoff levels
   3. Battery type and configuration
   4. Battery manufacturer
   5. Battery history
      1. Testing history, including reports
      2. Previous NASA use, if any.
      3. Lot and cell Data
   6. Specifications on any active thermal system (N/A if no heater internal to Module experiment.)

**INSTITUTIONAL REVIEW BOARD**

*Only for human or vertebrate animal test subjects.*

**HAZARD ANALYSIS**

1. General Hazard Identification Checklist

[*http://jsc-aircraft-ops.jsc.nasa.gov/Reduced\_Gravity/docs/NS-STO-CH01.pdf*](http://jsc-aircraft-ops.jsc.nasa.gov/Reduced_Gravity/docs/NS-STO-CH01.pdf)

**TOOL REQUIREMENTS**

1. Additional Tools that will be required in flight for crew monitoring of the project.

**PHOTO REQUIREMENTS**

1. Camera/Video required? How often during mission required?
2. Downlink Requirements
3. Still/Video Photographer Special Requests

**HAZARDOUS MATERIAL**

*List any hazardous material being used and it hazard number associated with it. Include MSDS sheet for that material in section below.*

**MATERIAL SAFETY DATA SHEETS (MSDS)**

**EXPERIMENT PROCEDURES DOCUMENTATION** *This section is to include procedures for all aspects of the experiment from shipping to KSC to unloading and return to Houston. Please be specific about all procedures, especially those procedures that need to take place while on the Space Station. If there are not specific aspects to consider then please put N/A*

1. Equipment shipment to KSC
2. Ground Operations while at KSC
3. Loading/Stowing
4. Pre-Flight
5. Ascent (Launch)
6. On-Orbit
7. Descent (Return/landing)
8. Post-Flight
9. Off-Loading
10. Emergency/Contingency

**BIBLIOGRAPHY**

*Include at least 5 sources*

**DEVIATIONS/EXCEPTIONS/WAIVERS**

*Include any waivers or exceptions documentation from CASIS, NanoRacks, or NASA JSC if applicable.*