

**WARNING: THIS PROCEDURE CONTAINS
HAZARDOUS OPERATIONS**



HESSI SPACECRAFT HANDLING PROCEDURES

HSI_MIT_021D.doc
2001-Jan-09

30 SW Safety Approval: _____ Date _____

As Run on: _____ (Date/Time)

By _____ (Test Conductor)

Operation _____

Document Revision Record

Rev.	Date	Description of Change
A	2/13/00	Initial Version
B	2000-11-14	Added Hydraset Setup, Instrument Constraints
C	2000-12-30	<p>Cover. Add 30 SW Safety approval signature block on cover page(EWR 127-1, Chapter 6, Appendix 6B, para. 6B2.2a.).</p> <p>1.2. List/Identify any tools/equipment that may be required to run this procedure (EWR 127-1, Chapter 6, Appendix 6B, para. 6B.2.8).</p> <p>1.3. List/Identify required personnel protective equipment(PPE) (EWR 127-1, Chapter 6, Appendix 6B, para. 6B.2.7)..</p> <p>6. Add the appropriate emergency and backout steps per EWR 127-1, Chapter 6, Appendix 6B, para., 6B.2.15.</p> <p>1.1. Add EWR 127-1 to the Reference Documents (EWR 127-1, Chapter 6, Appendix 6B, para. 6B.2.10c.)</p> <p>Specific Comments</p> <p>2.0. Pg 3 - In the Introduction, provide a brief description of the hazards involved in the tasks to be performed. Also describe the spacecraft configuration (e.g., solar arrays are installed/not installed, etc.) (EWR 127-1, Chapter 6, Appendix 6B, para. 6B.2.4).</p> <p>1.4. Pg 4, sec 4 - Add the Test Conductor and Safety Monitor to the required personnel section.(EWR 127-1, Chapter 6, Appendix 6B, para. 6B.2.9).</p> <p>6.3.1. Pg 7, sec 6.3.1 - In step three, specify the size of the safety control area. At step 7, recommend that the portion/steps of HSI_MIT_023 describing disconnection of the vacuum pump be identified.</p> <p>6.3.1. Pg 7, prior to the BEGINNING OF HAZARDOUS OPERATIONS statement - Add steps to verify the safety clear area, change the area warning lights, and make the appropriate PA announcement (EWR 127-1, Chapter 6, Appendix 6B, para. 6B.2.14).</p> <p>6.8. Pg 9, sec 6.8 - In the last step, identify the "Spacecraft Lifting Procedure" -- Removed comment</p> <p>6.9 Pg 9, sec 6.9 - In step two, when replacing the grounds, identify whether there is a specific sequence to be followed to prevent electrostatic discharge (ESD). In the last step, change the area warning lights to green and include making the appropriate PA announcement. (EWR 127-1, Chapter 6, Appendix 6B, para. 6B.2.14).</p> <p><u>Other Comments</u> (administrative/clerical, non-safety)</p> <p>6.6.3. Pg 7, sec 6.6.6 – In step 4, change reference from “Flotron rollover device” to “Flotron Rollover Fixture”.</p> <p>6.3.2. Pg 7, sec 6.3.2 and 6.3.3 - Define the acronym "RFA”.</p> <p>1.0 Any changes to the hazardous sections of this procedure should be approved by safety (Orbital/30 SW/SE).</p> <p>5.0 All equipment used for lifting should have their proofloads current within one year.</p> <p>1.3 Also specify the hard hat policy (hard hats within the control area except for the folks actually touching HESSI. Specify safety shoe policy.</p>

		<p>6.3.1 When setting up the control area, make a facility announcement that hazardous operations are commencing and change the facility light to amber.</p> <p>6.3.1 Verify that you have a traveling ground on the SC prior to first step.</p> <p>Page 9, End of hazardous operations. Make facility announcement that haz ops are complete</p>
D	2001-01-09	<p>NASA SAFETY REVIEW COMMENTS</p> <p>Page 6 item 6.2 Add as 1st sequence: Verify crane preoperational checks have been performed.</p> <p>Page 6 item 6.3.1 Add: Task Leader Verify all equipment needed to perform task is on hand. All personnel are trained and ready to proceed.</p> <p>Page 7 item 6.3.1 Add/Insert: List or Number of Essential Personnel required to support the hazardous operation</p> <p>Page 7 item 6.3.1 Insert: Turn on flashing amber light (No P. A. in Bldg. 836, Lab 1)</p> <p>Page 7 item 6.3.1 Insert: In Bldg. 836, Obtain NASA Safety concurrence to proceed with HAZARDOUS Operations</p> <p>Page 7 Warning Add to Warning: Personnel will not work under the suspended load.</p> <p>Page 9 item 6.9 Add a step at completion of hazardous operations in Bldg 836, Obtain NASA Safety concurrence to return area to normal operation, turn amber light off (No P. A. in Bldg. 836, Lab 1)</p> <p>Page 9 Insert: EMERGENCY INSTRUCTIONS -WARNING-</p> <p>Loss of electrical power, crane malfunction, or an anomaly during crane operations will require securing the load/operation, turning off crane power switches, cordoning off the area to prevent personnel from accessing the load, standing by until power/ problem has been restored/resolved</p>

Western Range/NASA Safety: _____ Date _____

Project Manager: _____ Date _____
Peter Harvey

System Engineer: _____ Date _____
David Curtis

QA: _____ Date _____
Ron Jackson

1.0 INTRODUCTION

The following document describes the HESSI spacecraft handling procedures required at VAFB 836 and 1555, while the spacecraft is being processed for launch.

1. Rotation Fixture Adapter Assembly
2. Crane Setup with Hydraset
3. Spacecraft Lifting Procedures
4. Spacecraft Rotations

Any changes to the hazardous sections of this procedure should be approved by safety (Orbital/30 SW/SE).

1.1 REFERENCE DOCUMENTS

1. NSS/GO-1740.9 NASA Safety Standard for Lifting Devices and Equipment
2. NHB5300.4(3L) Requirements for Electrostatic Discharge Control
3. FED-STD-209 Airborne Particulate Cleanliness Classes in Clean Rooms and Clean Zones.
4. AM-109837 HESSI Spacecraft Assembly Drawing
5. AM-617638 HESSI Thermal Vacuum Fixture
6. AM-617648 HESSI Rotation Fixture Adapter
7. NSS/GO 1740.9 NASA Safety Standard for Lifting Devices and Equipment
8. 0000-WI-Q08193 Control of Electrostatic Discharge
9. 0000-EP-K12143 Contamination Control Plan
10. EWR 127-1

1.2 TOOLS/EQUIPMENT

Equipment Item	Used for
Flotron	Rolling Spacecraft from Horizontal to Vertical and back
Rollover Fixture Adapter (RFA)	Used to Hold the Spacecraft to the Flotron
Hydraset	Used for Fine Lift Control and Weight
Crane	Used to lift the spacecraft and RFA
Torque Wrenches	General Assembly steps

1.3 PROTECTIVE EQUIPMENT

Hard hats are required for personnel within the control area except those actually touching HESSI. Safety shoes or shoe covers are required for those whose feet will be either under, or nearly under, suspended loads exceeding 50 kg.

1.4 ESSENTIAL PERSONNEL

Personnel who are authorized and able to perform this procedure are as follows:

David Pankow (Mechanical Lead Engineer), Paul Turin (Mech Engineer), Bob Pratt (Mech Engineer). One is needed to be the Lift Coordinator. A Safety Monitor will also be identified for each operation.

1.5 DESCRIPTIONS OF HAZARDS CONTAINED IN THIS PROCEDURE

Personnel. This procedure is hazardous to both personnel and the spacecraft as the combined weight of the spacecraft and GSE is enough to crush someone.

Arrays. With the solar arrays attached, extreme care must be taken to prevent contact with the solar cells, as these are easily damaged. During lifts, the spacecraft may shift laterally damaging these exposed surfaces. Care should be taken to make sure the S/C is directly under the crane hook.

2.0 APPLICATION

The HESSI payload will be transported from environmental testing to VAFB Building 836 and from there to building 1555 as required to support payload processing. During these operations, the spacecraft will be fully configured with solar arrays, flight battery and blankets:

1. Lift and Rotation for Spectrometer Warm Up Procedure (Building 836);
2. Lift and Rotation in Preparation for Byrdmobile Integration (Building 1555).

3.0 CLEANLINESS AND ENVIRONMENT

The HESSI payload should be treated as ESD sensitive, and handled per MIL-STD-1686 Class 1, and NHB5300.4(3L) Requirements for Electrostatic Discharge Control.

The HESSI payload is contamination sensitive, and must be handled with appropriate care. At all times, the payload will be handled per FED-STD-209 Airborne Particulate Cleanliness Classes in Clean Rooms and Clean Zones.

All moving operations outside of a clean room will take place with the payload covered with anti-static bagging.

The payload will be handled only by personnel wearing attire appropriate for a FED-STD-209 Class 100,000 clean room, including gloves. If the payload is double bagged, personnel will not need full clean room suits. However, gloves and wrist straps will be required.

4.0 REQUIRED PERSONNEL

4.1 Lift Personnel

A Lift Coordinator (LC) shall be identified and be present at all times through the duration of the lifts. A Quality Assurance representative shall be available to inspect the initial test setup and any configuration changes that may occur during any operation. Crane and Hydraset Operators shall be identified prior to the start of the procedure.

5.0 SAFETY

The Lift Coordinator is responsible for establishing the safety precautions necessary for each specific procedure and verifying that the precautions are in place before the

procedure is started. The LC shall hold a Pre-Task Briefing before the procedure begins. The Pre-Task Briefing shall include the following subjects:

- Details of the task to be completed.
- Potential Hazards Involved.
- Use of Protective Equipment.
- Identification of a Safety Monitor.”

The area where lifts are to occur shall be accessible to only those personnel directly involved in the lifts, and only those who have been briefed on these procedures. The LC shall determine if there are unnecessary personnel in the area who should be cleared.

This procedure contains lifting operations where personnel may be required to work near a suspended load, but personnel shall not be allowed under a suspended load at any time.

All hoisting equipment; including cranes, lifting jigs and load bearing attachments shall have in date servicing and proof load verification within 1 year. Each lifting line; including bolts and shackles shall be inspected before use. Slings shall show no evidence of damage, kinking or misuse. Unapproved devices shall not be used for lifting applications.

Crane Operation

The Lift Coordinator will give all instructions to the crane operator for crane movements. Only certified crane operators shall operate the crane. The Safety Monitor will be positioned at the power cutoff to the crane and will cut power in the event of a crane runaway condition.

Tool Tethering

Tools used over the upper titanium ring on the imager on the spacecraft will be tethered at all times.

6. PROCEDURES

6.1 Rotation Fixture Adapter Assembly AM-617648

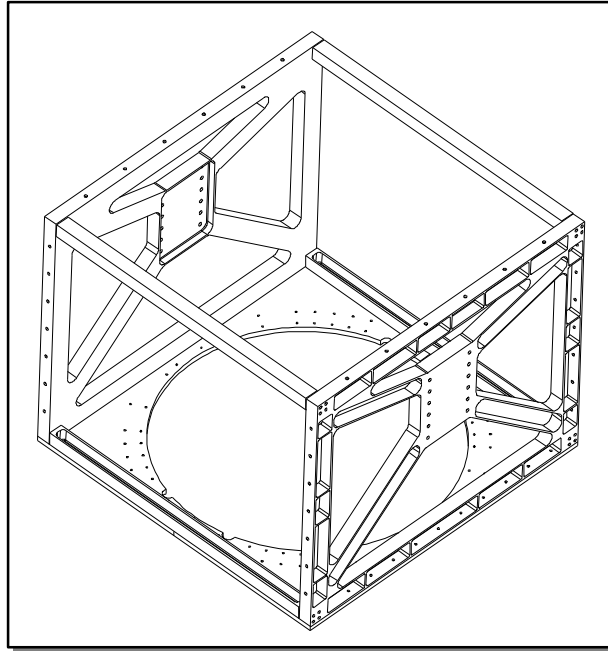


Figure 1. Rotation Fixture Adapter

6.1.1 Assembling the Rollover Fixture Adapter Plates on the Spacecraft

- Install 12 ea. Interface Brackets (DM-617642-1) at the Base Ring of the Spacecraft with Isolator (DM-617643-1), NAS1351N4-20 Screw, and MS21043-4 Nut. Refer to drawing AM-617688. Install the brackets at the following locations: 12°, 36°, 60°, 120°, 142°, 168°, 192°, 216°, 240°, 300°, 324°, 348° (+X at 0°). Torque to 73 in-lb.
- Install 2 ea. Plates (DM-617639-1) with cut-outs aligned to Z-axis Torqrod. Use Alloy Steel SHCS .25-28 x 1.25 Lg. at 12 locations. Torque to 73 in-lb.
- Install 2 ea. Supports (DM-617651-1) to Plates. Use Alloy Steel SHCS .25-28 x 1.00 Lg. and MS21043-4 Nut at 22 locations. Torque to 73 in-lb.

6.1.2 Assemble the Rollover Fixture Adapter Upper Section

- Install 2 ea. Side Plates (DM-617649-1) to Plates. Use Alloy Steel SHCS .25-28 x 1.00 Lg. and MS21043-4 Nut at 22 locations. Torque to 73 in-lb.
- Install 2 ea. Supports (DM-617651-2) to Plates. Use Alloy Steel SHCS .19-32 x 1.00 Lg. at 16 locations. Torque to 40 in-lb.
- Install 4 ea. Hoist Rings (P/N 2994T64) at corners of the Rotation Fixture Adapter (AM-617648) using .375-16 Grade 8 Hex Nut. Torque to 12 ft-lb.

6.2 Crane Setup with Hydraset

- Verify crane preoperational checks have been performed.
- Secure the Hydraset to the crane with a shackle.
- Attach the Hydraset control lines to the *up* and *down* levers. Make sure that the control line labeled “up” is attached to the up lever.
- Remove the lock-pin holding the Hydraset to its stand and lift the Hydraset out of the stand.
- Attach the pre-load weight to the lower eye-bolt on the Hydraset with a shackle.
- Leave both Hydraset control levers in the down position. Lift the weight from its dolly with the crane.
- Once the ram of the Hydraset is extended roughly 4”, unclip the lever lock from the control levers.
- Release cable from the control cable housings. Assign one person to each control cable.
- Secure the lifting jig to the shackle beneath the pre-load weight using the stainless steel shackle.

6.3 Spacecraft Lifting Procedure

NOTE: This procedure applies to lifting of the spacecraft via the Rotation Fixture Adapter (AM-617648) in both the horizontal and vertical orientations.

6.3.1 Lift / Rotate Preparations.

- The Lift Coordinator shall conduct a pre-task briefing before the procedure begins.
- The Lift Coordinator shall verify that all equipment needed to perform the lift is on hand and that all personnel are trained and ready to proceed. The positions required: Mechanical Engineering, Crane Operator, Hydraset Operator, Safety Monitor, Quality Assurance, and at least 1 Mechanical Technician.
- Attach the following components to the crane hook: Hydraset, Spreader Beam, Wire Rope Sling (72 in.) with Shackles.
- Prepare destination equipment. If the destination is the Flotron, set mounting flange spacing to 50 in. wide and lock casters.
- Verify that the destination is properly grounded.
- Attach a travelling ground strap to the spacecraft.
- Disconnect the vacuum pump in accordance with the HSI_MIT_023.
- IMPORTANT:** The spacecraft can not be disconnected from the vacuum pump for more than 15 hours
- Define a 4m x 5m clear area around the HESSI spacecraft and assure only authorized personnel are in the control area.
- In Bldg. 836, Obtain NASA Safety concurrence to proceed with HAZARDOUS Operations
- Change warning light to amber and announce over the Public Address system that there will be a spacecraft operation which could result in personnel injury.

BEGINNING OF HAZARDOUS OPERATIONS

WARNING : Performing the procedure below may result in severe personnel injury, loss of life, or major equipment damage if not followed exactly.

WARNING : Personnel will not work under the suspended load.

6.3.2 Integrate RFA to Spacecraft.

- Assemble the Rollover Fixture Adapter (RFA) bottom plates on the spacecraft. See section 6.1.
- Attach a tag line and travelling ground to the Upper RFA fixture.
- Translate the crane to a position above the RFA and lower slings until they can be attached to the hoist rings.
- Lift RFA and translate to above Spacecraft.
- Position four people at each axis and lower around spacecraft, making sure there is clearance around spacecraft at all times.
- Match Upper RFA bolt pattern to the bottom plates.
- Connect Upper RFA to Bottom Plates using Alloy Steel SHCS .25-28 x 1.00 Lg. and MS21043-4 Nut at 20 locations. Torque to 73 in-lb.

6.3.3 Lifting the Spacecraft

- Position four people on each side of the spacecraft to ensure that it does not swing into anything while being raised.
- Raise crane in inch mode until the Hydraset displays 300 lbm.
- Lift the spacecraft using the Hydraset by pulling repeatedly on the control line attached to the **up** lever. Spacecraft and Rollover Fixture Adapter (RFA) should weigh approximately 780 lbs.
- Remove securing fasteners. As required, 60 ea. fasteners attaching the Spacecraft Base Ring to the Dolly, or 8 ea. fasteners attaching S/C to Flotron..
- Once the spacecraft bus is free, lift the spacecraft in 'inch' mode until it is at least 1" above the fixture.
- Continue lifting in 'slow' mode until spacecraft is entirely above previous fixture and translate to the target location. Verify ground strap is tensed during the operation. While moving the spacecraft, at least two people should keep the spacecraft from swinging.
- If the destination is the Flotron, go to section 6.6 "Placing Spacecraft on Flotron". If the destination is the Byrdmobile, see HSI_MIT_024.

6.4 Placing the spacecraft on the dolly

- Rotate the spacecraft so that the +X side of the spacecraft is facing the +X of the dolly.
- Lower the spacecraft in inch mode until it is 1/4" above the surface.
- With four people guiding the spacecraft, slowly lower the spacecraft down with the Hydraset while locating the first four fasteners.
- Lower the spacecraft the rest of the way using the Hydraset.
- Secure replace with 10-32 socket-head cap-screws and washers.
- Tighten each bolt to 50 in-lbs.

6.5 Removing the RFA from the Spacecraft

- Disconnect Upper RFA from Bottom Plates by removing Alloy Steel SHCS .25-28 x 1.00 Lg. and MS21043-4 Nut at 20 locations.
- Position four people around spacecraft to make sure there is clearance between the Upper RFA and the spacecraft at all times.
- Raise the Upper RFA until it clears the top of the spacecraft, and translate to storage location and disconnect slings from RFA.
- Remove 2 ea. Supports (DM-617651-1) to RFA Plates.
- Remove 2 ea. Plates (DM-617639-1) with cut-outs aligned to Z-axis Torqrod.
- Remove 12 ea. Interface Brackets (DM-617642-1) at the Base Ring of the Spacecraft with Isolator (DM-617643-1), NAS1351N4-20 Screw, and MS21043-4 Nut.

6.6 Placing Spacecraft on Flotron

- Using crane in inch mode, lower spacecraft between mounting flanges until assembly CG is aligned with Flotron rotation axis. Note: Position 1 for S/C without arrays. Position 2 for S/C with arrays (Position 1 is most aft position).
- Use Hydraset to align flanges with mounting holes and adjust flange spacing such that flanges are in contact with mounting surfaces.
- Install 8 ea. .50-13 x .88 Lg Alloy Steel SHCS and torque to 20 ft-lb.

- Secure Flotron width adjustment set-screws at 4 locations.
- Lower Flotron jackstands and secure.
- Install rotation locking pin.
- Using Hydraset lower S/C until weight is off-loaded from crane and slings show slack.
- Disconnect slings from S/C and raise crane to clear S/C. Insure that the slings are tended as they are raised to prevent contact with the Solar Arrays.

6.7 Rotating Spacecraft on Flotron

- Remove rotation locking pin.
- Rotate S/C assembly approximately 15 degrees. Verify rotation is smooth with little effort. Heavy effort is an indication of excessive CG offset from rotation axis.
- Continue to rotate S/C to desired position.
- Install rotation locking pin.

6.8 Removing Spacecraft from Flotron

- Translate the crane to a position above the S/C and lower slings until they can be attached to the hoist rings. Insure that the slings are tended as they are lowered to prevent contact with the Solar Arrays. Verify shackle attachment to hoist rings.
- Using the Hydraset, offload approximately 100 lb. to remove cable slack.
- When removing S/C from Flotron rollover device, use hydraset to offload 100% of S/C and fixture weight. Lift coordinator to record weight: _____. Weight to be approximately 780 lb. for S/C with arrays and fixturing.
- Remove 8 ea. .50-13 x .88 Lg Alloy Steel SHCS from mounting flanges.

END OF HAZARDOUS OPERATIONS

6.9 Post Lift / Rotate Activities

- Reconnect the vacuum pump in accordance with the HSI_MIT_022.
- Replace travelling ground strap from source location with appropriate ground strap at the destination. If during the switch over, the spacecraft is momentarily ungrounded, personnel should not make contact with the spacecraft.
- In Bldg 836, Obtain NASA Safety concurrence to return area to normal operation.
- Change warning light to green and announce over the Public Address system that the hazardous operation is complete.

A. EMERGENCY INSTRUCTIONS

- WARNING-

Loss of electrical power, crane malfunction, or an anomaly during crane operations will require securing the load/operation, turning off crane power switches, cordoning off the area to prevent personnel from accessing the load, standing by until power/ problem has been restored/resolved