

**WARNING: THIS PROCEDURE CONTAINS  
HAZARDOUS OPERATIONS**



# HESSI SPACECRAFT SPECTROMETER LN2 OPERATIONS

HSI\_MIT\_039E.DOC

2001-JAN-09

PETER HARVEY

As Run on: \_\_\_\_\_ (Date/Time)

By \_\_\_\_\_ (Test Conductor)

**DOCUMENT REVISION RECORD**

Rev.	Date	Description of Change
A	11/09/00	Initial Version
B	11/13/00	Added Photo of LN2 Dewer and Fill Hose
C	11/14/00	Two dewer operation
D	01/08/01	<p><b>General Comments</b></p> <ol style="list-style-type: none"> <li>1. HSI_MIT_012 General Comments 2 and 3 apply.               <ol style="list-style-type: none"> <li>2. List/Identify any tools/equipment that may be required to run this procedure ( EWR 127-1, Appendix 6B, para. 6B.2.8). See 4.1</li> <li>3. List/Identify required personnel protective equipment(PPE) (EWR 127-1, Appendix 6B, para. 6B.2.7). See 4.2</li> </ol> </li> <li>2. Add diagram of the LN<sub>2</sub> Fill System showing configuration, number of dewars, etc.</li> <li>3. Add EWR 127-1 to list of Reference Documents ( EWR 127-1, Appendix 6B, paragraph 6B.2.10). See 1.1.</li> <li>4. Add step for conducting a pre-task briefing (EWR 127-1, Appendix 6B, paragraph 6B.2.12). See 7.1 Step 0.</li> <li>5. Add Emergency Shutdown and Backout procedures, including steps to be taken in the event of a spill (EWR 127-1, Appendix 6B, paragraph 6B.2.15). See section 8.0</li> <li>6. Clarify whether all HESSI technicians are trained to handle cryogenics as indicated in Section 4., last sentence. Added "trained in this procedure."</li> </ol> <p><b>Specific Comments</b></p> <ol style="list-style-type: none"> <li>1. Page 5, sec 7.0 - Add step to verify O<sub>2</sub> monitor is in place and operational. See 7.0 step 1.</li> <li>2. Page 5, sec 7.1 - Prior to and after performance of the hazardous operations, add steps to make the appropriate PA announcement, specify the safety clear area and change the area warning lights (EWR 127-1, Appendix 6B, para 6B.2.14). See 7.1.2 and 7.1.3</li> <li>3. Page 4, sec 6.0 - Items 2 and 3 need to be Warning statements since an LN<sub>2</sub> spill can become a personnel hazard. ( EWR 127-1, Appendix 6B, paragraph 6B.2.14)</li> </ol>
E	01/09/01	<p>NASA SAFETY REVIEW COMMENTS</p> <p>Page 4 Item 6.0, Page 5,Item 7.1.2 : Add: face shield. See 7.1.4.2</p> <p>Page 5 item 7.1 Insert: A crew briefing shall be made prior to start of hazardous ops. See 7.1.1</p> <p>Page 5 item 7.1 Add/Insert: List or Number of Essential Personnel required to support the hazardous operation. 7.1.1</p> <p>Page 5 Item 7.1 Add: Task leader verify all equipment needed to perform task is on hand. All personnel are trained and ready to proceed. See 7.1.1</p> <p>Page 5 Item 7.1 Add: Establish a Safety Control area. See 7.1.2</p> <p>Page 5 item 7.1 Insert: Turn on flashing amber light. See 7.1.3. (No P. A. in Bldg. 836 Lab 1)</p> <p>Page 5 item 7.1 Insert: In Bldg 836, Obtain NASA Safety concurrence to proceed with HAZARDOUS Operations</p>

		Page 5 Add a step, Denoting completion of hazardous operation and (In Bldg 836) obtain NASA Safety concurrence to return area to normal operations, turn amber light off. (No P. A. in Bldg. 836 Lab 1 Page 6 Add: EMERGENCY Instructions See section 8. (exposure, spills, etc.)

Western Range/NASA Safety: \_\_\_\_\_ Date \_\_\_\_\_

Project Manager: \_\_\_\_\_ Date \_\_\_\_\_  
 Peter Harvey

System Engineer: \_\_\_\_\_ Date \_\_\_\_\_  
 David Curtis

QA: \_\_\_\_\_ Date \_\_\_\_\_  
 Ron Jackson

**1.0 INTRODUCTION**

This procedure provides the necessary instructions for connecting, disconnecting and operating the Spectrometer LN2 Fill System.

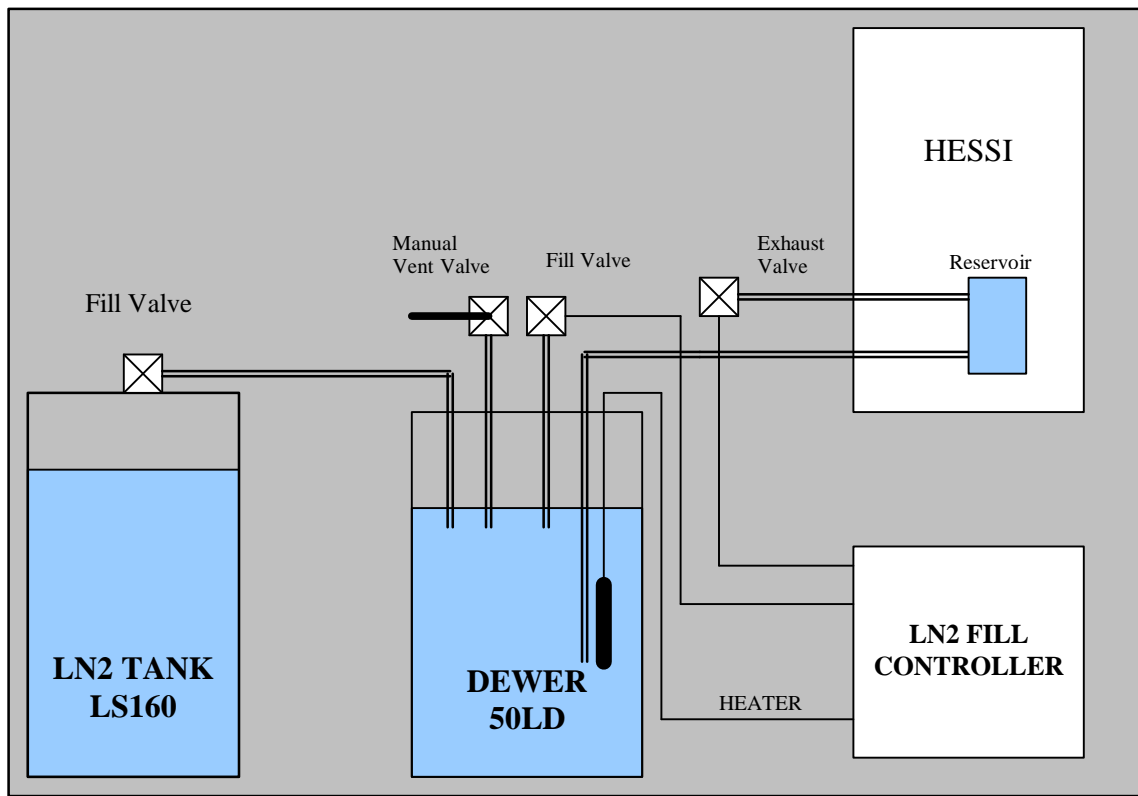
The Spectrometer contains 9 Germanium detectors on a single cold plate, surrounded by a thermal shield, surrounded by thermal blankets and finally the container walls. The entire assembly is a vacuum tight device, maintained at high vacuum on the ground using an external pump cart. Typically, Germanium detectors are kept at cryogenic temperatures using the LN2 fill system described herein.

**1.1 Reference Documents**

1. NHB5300.4(3L) Requirements for Electrostatic Discharge Control
2. FED-STD-209 Airborne Particulate Cleanliness Classes in Clean Rooms and Clean Zones.
3. EWR 127-1.

**2.0 APPLICATION**

The HESSI payload will be transported from JPL to VAFB Building 836 with the Spectrometer Germanium detectors at cryogenic temperatures. The LN2 fill system will be attached and LN2 will be maintained until further processing. Each time the spacecraft is moved, the LN2 GSE will be removed for the duration of the move, and reattached to maintain detector temperatures.



**LN2 FILL SYSTEM BLOCK DIAGRAM**

### **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.

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

### **4.0 REQUIRED PERSONNEL AND EQUIPMENT**

The spectrometer LN2 connection and disconnection operations may be performed by either Paul Turin or David Smith. The LN2 filling operation may be performed by any HESSI technician trained in this procedure.

#### **4.1 Tools Required**

<b>Equipment Item</b>	<b>Used for</b>
LN2 Fill Controller & Dewer	LN2 Maintenance
Oxygen level sensor	O2 Monitoring
Tool Kit	Connection/Disconnection

#### **4.2 Protective Equipment**

Gloves, eye protection and apron.

### **5.0 SAFETY**

Liquid Nitrogen (LN2) is a particularly dangerous material and safeguards should be followed carefully. In liquid form, LN2 will cause immediate burns to unprotected skin and is a significant eye hazard. As LN2 warms and turns to gaseous nitrogen (GN2), it displaces Oxygen in the local environment. If there is a significant flow of GN2 or insufficient ventilation in the area, the lack of Oxygen can have deadly results. As an undetectable gas, GN2 can kill in as little as 2 breaths, after which the victim loses consciousness.

Wherever LN2 operations are performed, or LN2 is stored, an Oxygen monitoring system will be in place to warn of low O2 conditions. Personnel will be trained to leave the area immediately if the alarm sounds. Warning signs will be posted wherever LN2 is present to identify the hazard.

### **6.0 PRECAUTIONS**

The following precautions shall be taken before working with the LN2 systems:

1. Personnel shall wear eye protection, apron and gloves appropriate for LN2 use.

2. Since hoses become brittle at cryogenic temperatures, all hoses should be at room temperature when moved. Causing a split in a hose may result in spilling LN2 when the filling operation begins.

## **7.0 CONNECTING THE SPECTROMETER LN2 FILL TUBE**

1. Verify O2 monitor is in place and operational.
2. Verify LN2 Fill tube is at room temperature.
3. Put on clean room gloves and ESD strap. Connect to the spacecraft dolly.
4. Pull back condensation over shield, exposing fill and drain lines.
5. Attach tubes to spectrometer and secure condensation overshield such that there is no LN2 tubing exposed to air. (These lines will drip water on the side of the spectrometer if not sealed).
6. Add strain relief straps between the spacecraft dolly and the fill tube so that the tube will be protected against sharp bends. (When cryogenic, the internal lines will be fragile and a broken line may pour LN2 on the spectrometer.)

## **7.1 FILLING THE SPECTROMETER LN2 DEWER (OPEN FILL)**

- 7.1.1. If the procedure will involve more than one person, the lead will hold a pre-task briefing to explain the steps in the operation. Generally, the operation requires only one person. The lead will verify all equipment needed to perform task is on hand and all personnel are trained and ready to proceed.
- 7.1.2 Install the 2m clear area markers around the LN2 equipment.
- 7.1.3 Obtain NASA Safety concurrence to proceed with HAZARDOUS Operations.
- 7.1.4 Change warning light to amber and announce over the Public Address system that the spacecraft will be performing LN2 procedures.

### **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.**

#### 7.1.4 Fill Operation

1. Turn OFF the LN2 Fill Controller and note the time.
2. Put on thermal gloves, face shield and apron.
3. Roll spare Spectrometer LN2 Dewar to the LN2 supply tank.
4. Place supply line in the LN2 Dewar and open the valve.
5. When the tank is approximately 3/4 full, close the supply tank valve and remove the supply line.
6. Roll spare Spectrometer LN2 Dewar to the Spectrometer.
7. Carefully transfer LN2 Fill Valve and Heater from the empty LN2 Dewar to the newly filled Dewar. Insert the LN2 Fill Valve and Heater slowly so that the LN2 does not boil out.
8. Holding the Fill Valve flush on the top of the Dewar, attach restraining straps.
9. Remove gloves, face shield and apron.
10. If less than 10 minutes has elapsed since step 1, wait the remainder of 10 minutes to be sure that the fill hose is warm.
11. Turn ON the LN2 Fill Controller and press 'Reset' to clear the alarm.
12. Verify that the LN2 Dewar is reading nearly full.
13. Press the 'Fill' button to force the system to fill LN2 into the Spectrometer.
14. Verify that the Fill Valve light is ON.

15. In a few minutes, visually confirm that cool GN2 is venting from the Fill Valve exhaust port.
16. If the Spectrometer GSE is plotting temperatures, one may also confirm that the cold plate temperature is falling slightly during a fill operation.

### **END OF HAZARDOUS OPERATION**

- 7.1.5 In Bldg 836, obtain NASA Safety concurrence to return area to normal operations.
- 7.1.6 Remove the area markers around the LN2 equipment.
- 7.1.7 Change warning light to green and announce over the Public Address system that the spacecraft has completed LN2 procedures.

## **7.2 TRANSFERRING LN2 FROM TANK TO DEWER (CLOSED)**

- 7.2.1. Press STOP FILL on the LN2 controller to shut off timer
- 7.2.2. Open Manual Vent Valve by turning black handle level.
- 7.2.3. Open LN2 tank LS160 Fill Valve by turning handle counter-clockwise.
- 7.2.4. Watch the fill gauge until it shows the dewar is full - about 95-100%
- 7.2.5. Close LN2 Tank valve by turning clockwise.
- 7.2.6. Wait until the GN2 flow from gas relief valve is low.
- 7.2.7. Close the Manual Vent Valve by turning the black handle UP (to the right)
- 7.2.8 If pressure gauge reads over 3 psi, open Manual Vent Valve and go to 7.2.6.
- 7.2.9. Press FILL button on LN2 controller front panel to start a fill cycle.

## **7.3 DISCONNECTING THE SPECTROMETER LN2 FILL TUBE**

1. Put on clean room gloves and ESD strap. Connect to the spacecraft dolly.
2. Verify LN2 Fill tube is at room temperature.
3. Remove strain relief straps between the spacecraft dolly and the fill tube
4. Pull back condensation overshield, exposing fill and drain lines.
5. Detach fill and drain lines from spectrometer.
6. Immediately install the spectrometer LN2 port caps (Red Tag Items).

## **8.0 Emergency Procedures**

### **8.1 IN THE EVENT OF LN2 SPILL DUE TO DEWER BOILOVER**

1. If LN2 begins to boil over the top of the dewar when the filling apparatus is inserted, slow down the insertion of the apparatus.
2. Do not move cables or electronics in the area of the spill, since the conductors may be extremely cold and possibly brittle.
3. Once the LN2 has evaporated, continue the procedure.

### **8.2 IN THE EVENT OF LN2 SPILL DUE TO FEED LINE BREAK**

1. If a feed line to the spacecraft leaks, turn OFF the LN2 controller unit. This will stop the fill operation and close the feed valve.
2. Do not move cables, or tubes or electronics in the area of the spill, since the conductors may be extremely cold and possibly brittle.
3. Once the LN2 has evaporated and items are warm, replace the feed lines as necessary.



**8.3 IN THE EVENT OF LN2 SPILL DUE TO OVERFILL**

1. If the LN2 fill controller fails to sense that the Spectrometer is full of LN2, it may not stop the fill operation. LN2 will vent through the exit line and spill on the floor.
2. Turn OFF the LN2 Controller Unit. This will stop the fill operation.
3. Do not move cables, or tubes or electronics in the area of the spill, since the conductors may be extremely cold and possibly brittle.
4. Check the lines and adjustments from the temperature sensing diode to the LN2 feed controller unit. Replace as necessary.

**8.5 IN THE EVENT OF EYE OR SKIN CONTACT WITH LN2**

- [1] Stop the operation;
- [2] Shake LN2 off so it does not stay in contact for any length of time;
- [3] Seek medical attention for LN2 Burn.

**8.5 IN THE EVENT OF FIRE**

- [1] Stop the operation;
- [2] Evacuate the area;
- [3] Call 911.

**8.6 IN THE EVENT OF EARTHQUAKE**

- [1] Stop the operation;
- [2] Evacuate the area.