GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

MAIN TANK FILL WITH GUARD TANK PRECOOL
MAIN TANK AT NBP

To be performed at Vandenberg Air Force Base building 1610

WARNING: THIS DOCUMENT CONTAINS HAZARDOUS OPERATIONS

P1032 Rev. -

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Prepared by:

_____Date_____
Mike Taber
Cryogenic Test

Checked by:

_____Date_____
Dave Murray
Cryogenic Test

Approvals:

_____Date_____
Dorrene Ross
Quality Assurance

_____Date_____
H. Moskowitz
LMMS Safety

_____Date_____
Rob Brumley
Payload Technical Manager

_____Date_____
NASA/KSC Safety

REVISION RECORD

REVISION	*ECO*	*CHANGES*	*DATE*

Table of Contents

List of Abbreviations and Acronyms

AG-x	Gauge x of Gas Module auxiliary section
AMI	American Magnetics Inc.
ATC	Advanced Technology Center
Aux	Auxiliary
AV-x	Valve x of Gas Module auxiliary section
Bot	Bottom
CN [xx]	Data acquisition channel number
DAS	Data Acquisition System
EFM	Exhaust gas Flow Meter
EG-x	Gauge x of Gas Module exhaust section
EM	Electrical Module
ERV-x	Relief valve of Gas Module exhaust section
EV-x	Valve number x of Gas Module exhaust section
FCV	Fill Cap Valve
FIST	Full Integrated System Test
GHe	Gaseous Helium
GM	Gas Module
GP-B	Gravity Probe-B
GSE	Ground Support Equipment
GT	Guard Tank
GTVC	Guard Tank Vent Cap
GTVC-G	Guard Tank Vent Cap pressure gauge
GTVC-RV	Guard Tank Vent Cap relief valve
GTVC-V	Guard Tank Vent Cap valve
GTV-G	Guard Tank vent pressure gauge
GTV-RV	Guard Tank vent relief valve
GTV-V	Guard Tank vent valve
HX-x	Vent line heat exchanger in Gas Module
KFxx	Quick connect o-ring vacuum flange (xx mm diameter)
LHe	Liquid Helium
LHSD	Liquid Helium Supply Dewar
Liq	Liquid
LL	Liquid level
LLS	Liquid level sensor
LMMS	Lockheed Martin Missiles and Space
LMSC	Lockheed Missiles and Space Co.
MTVC-G	Main Tank Vent Cap pressure gauge
MTVC-RV	Main Tank Vent Cap relief valve
MTVC-V	Main Tank Vent Cap valve
NBP	Normal boiling point
ONR	Office of Naval Research
PCI	PDU Circuit Instrumentation (Console)
PDU	Power Distribution Unit
PFCG	Fill Cap assembly pressure Gauge
PFM	Pump equipment Flow Meter
PG-x	Gauge x of Pump equipment
PM	Pump Module
psi	pounds per square inch
psig	pounds per square inch gauge
PV-x	Valve x of the Pump equipment
QA	Quality Assurance
RAV-x	Remote Actuated Valve-x
RGA	Residual Gas Analyzer
SMD	Science Mission Dewar
STV	SMD Thruster vent Valve
SU	Stanford University
SV	Space Vehicle
SV-x	SMD Valve number x
TD	Test Director
TG-x	Gauge x of Utility Turbo System
TV-x	Valve x of Utility Turbo System
UTS	Utility Turbo System
Vac	Vacuum
VCP-x	Vent cap pressure gauge
VCRV-x	Vent cap relief valve
VCV-x	Vent cap valve
VDC	Volts Direct Current
VF-x	Liquid helium Fill line valve
VG-x	Gauge x of Vacuum Module
VM	Vacuum Module
VV-x	Valve x of Vacuum Module
VW-x	Valve x of Dewar Adapter

MT	Main Tank
MTVC	Main Tank Vent Cap

LIST OF SPECIFIC HEADING DEFINITIONS

Each type of alert message will precede the procedural step to which it applies

Note:
Used to indicate an operating procedure of such importance that it must be emphasized.

CAUTION:
Used to identify hazards to equipment.

WARNING:
Used to identify hazards to personnel.

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A. SCOPE

This procedure describes the steps necessary to perform an external fill of the SMD Main Tank with normal boiling point liquid helium. The steps include:

Pre-cool SMD internal fill line from Guard Tank

Pre-cool external transfer line

Fill Guard Tank

Fill Main Tank

Terminate transfer

The procedure has the option to change out the liquid helium supply dewar after the initial one is depleted. This procedure is classified as hazardous because it involves the use of liquid helium, which is a cryogenic asphyxiant (see Sec. B.1, below).

B. SAFETY

Potential Hazards

Personal injury and hardware damage can result during normal positioning, assembly and disassembly of hardware.

Liquid helium used in the SMD represents a hazardous material for the personnel involved in the operations. Cryogenic burns can be caused by contact with the cold liquid or gas, high pressures can result if boiling liquid or cold gas is confined without a vent path, and asphyxiation can result if the vent gas is allowed to accumulate.

The SMD Safety Compliance Assessment, document GPB-100153C and the Missile System Prelaunch Safety Package LM/P479945 discuss the safety design, operating requirements and the hazard analysis of the SMD.

Mitigation of Hazards

Lifting hazards

There are no lifting operations in this procedure

Cryogenic Hazards

A rupture of the main tank burst disk(s) will be obvious due to the plume of cold gas. Emergency vent lines are installed over the burst disks on the SMD vacuum shell to eliminate the possibility of direct plume impingement on personnel. Orderly evacuation shall be performed in the event one or more of these burst disks rupture. An oxygen deficiency monitor that alarms when the oxygen level is reduced to 19.5% will be utilized as an added precaution. Temperature and pressure alarms, provided by the DAS, warn of potential over-pressure conditions.

Only authorized and trained personnel are allowed in VAFB facilities without escort. All personnel working on platforms at a height 30 inches or more off the floor are required to have an approved air tank (emergency breathing apparatus) within easy reach. Note that tank

need not be kept available when working from a ladder. In the unlikely event of a large LHe spill all employees have been instructed to evacuate the room and contact NASA and VAFB safety. The fallback area is building 1605. The following additional requirements apply to all personnel involved directly in cryogenic operations: Insulated gloves when handling equipment that has been cooled to cryogenic temperatures. A protective apron, gloves impervious to liquid cryogens, impermeable shoes, and full-face shields with goggles/glasses are to be worn whenever the possibility of splashing or impingement of high velocity cryogens exists.

Other Hazards

All tools or other items used with the potential to damage the SV shall be tethered.

Mishap Notification

Injury

In case of any injury or illness requiring emergency medical treatment **DIAL 911.**

Hardware Mishap

In case of an accident, incident, or mishap, notification is to proceed per the procedures outlined in Lockheed Martin Engineering Memorandum EM SYS229 and Stanford University GP-B P0879. Additionally, VAFB NASA Safety and 30th Space Wing Safety will be notified as required.

Contingency Response

Responses to contingencies (e.g., power failure, burst disk failure) are listed in Appendix 3.

C. QUALITY ASSURANCE

QA Notification

The NASA program and NASA safety representative and SU QA shall be notified 24 hours prior to the start of this procedure. Upon completion of this procedure, the QE Manager will certify his/her concurrence that the effort was performed and accomplished in accordance with the prescribed instructions by signing and dating in the designated place(s) in this document.

Red-line Authority

Authority to red-line (make minor changes during execution) this procedure is given solely to the TD or his designate and shall be approved by the QA Representative. Additionally, approval by the Payload Technical Manager shall be required, if in the judgement of the TD or QA Representative, mission functionality may be affected. Within Hazardous portions of this procedure, all

steps shall be worked in sequence. Out-of-sequence work or redlines shall be approved by NASA Safety prior to their being performed.

Discrepancies

A Quality Assurance Representative designated by D. Ross shall review any discrepancy noted during this procedure, and approve its disposition. Discrepancies will be recorded in a D-log or a DR per Quality Plan P0108. Any time a procedure calls for verification of a specific configuration and that configuration is not the current configuration, it represents a discrepancy of one of three types. These types are to be dealt with as described below.

If the discrepancy has minimal effect on procedure functionality (such as the state of a valve that is irrelevant to performance of the procedure) it shall be documented in the procedure, together with the resolution. Redlines to procedures are included in this category.

If the discrepancy is minor and affects procedure functionality but not flight hardware fit or function, it shall be recorded in the D-log. Resolution shall be in consultation with the PTD and approved by the QA representative.

All critical and major discrepancies, those that effect flight hardware fit or functions, shall be documented in a D-log and also in a Discrepancy Report, per P0108.

D. TEST PERSONNEL

Personnel Responsibilities

The performance of this procedure requires a minimum complement of personnel as determined by the Test Director. However, during the startup of the transfer (Sec. G.12), there are to be a minimum of two qualified persons (Sec. D.3) in attendance. The person performing the operations (Test Director or Test Engineer) is to sign the “Completed by” sign-off. Any other qualified person or QA person who can attest to the successful performance of this procedure may sign the “Witnessed by” sign-off. The Test Director will perform pre-test and Post-Test briefings in accordance with P0875 “GP-B Maintenance and Testing at all Facilities”. Checklists will be used as directed by P0875.

Personnel Qualifications

The Test Director must have a detailed understanding of all procedures and facility operations and experience in all of the SMD operations. Test Engineers must have SMD Cryogenic operations experience and an understanding of the operations and procedures used for the cryogenic servicing/maintenance of the Dewar.

Required Personnel

The following personnel are essential to the accomplishment of this procedure:

FUNCTIONAL TITLE	NUMBER	AFFILIATION
Test Director/Test Engineer	1	Stanford
GP-B Quality Assurance	1	Stanford

NASA Safety Rep	1	SFAO or ANALEX

E. REQUIREMENTS

Electrostatic Discharge Requirements

Any person who comes in contact with the SV must use a grounding wrist strap that has been tested that day. Appropriate attachment points are positioned around the SV. All wrist straps will be checked using a calibrated checker prior to use.

Lifting Operation Requirements

There are no lifting operations in this procedure

Hardware/Software Requirements

Commercial Test Equipment

No commercial test equipment is required for this operation.

Ground Support Equipment

The Ground Support Equipment includes the Gas Module, the Electrical Module. The Gas Module provides the capability to configure vent paths, read pressures and flow rates, and pump and backfill vent lines. The Pump Module provides greater pumping capacity than the Gas Module, together with additional flow metering capabilities. The vent output of the Gas Module flows through the Pump Module. The Electrical Module contains the instruments listed in Table 1, and provides remote control of valves in the Gas Module, Pump Module, and SMD.

Computers and Software:

The Data Acquisition System (DAS) and data acquisition software are required for this procedure. The DAS reads and displays pressures, temperatures, and flow rates and monitors critical parameters. No additional computers or software are required.

Spacecraft Support:

With connector J802 connected to flight electronics, operation of RAV-2 must be commanded through the spacecraft instead of the RAV controller in the Electrical Module.

Additional Test Equipment

Description	***Manufacturer***	***Model***
AMI Level Sensor Readout for LHSD	American Magnetics, Inc.	110
O_2 Monitor and Alarm	Alpha-Omega Instruments	1000

Additional Hardware

Description	*Manufacturer*	*Model*
Filter Line assembly	LMMS	5833827
Liquid He Transfer Line	LMMS	5833804
Liquid He Stinger	LMMS	5833803
GHe supply fittings to LHSD	N/A	N/A
Bayonet Cap with Nupro Valve	LMMS	N/A
500/1000 Liter Dewars, Liquid Helium	Cryofab	CMSH-500/1000

Personnel Protective Equipment

Cryogenic safety gloves and apron

Face shield

Goggles or glasses

Non-absorbent shoes

Tools

Description
Torque Wrench, 1-1/4-in socket, 60 +/- 5 in-lb Cal Due Date: _____S/N: _____

Expendables

WARNING

Alcohol is a skin irritant, potentially toxic if skin absorbed, and flammable.
All hazardous waste will be placed into approved waste containers.

Description	*Quantity*	*Mfr./Part No.*
Alcohol	AR	N/A
99.999% pure gaseous helium	AR	N/A
Vacuum Grease	AR	Dow Corning High Vacuum or Apiezon N
Liquid Helium	AR	N/A
Tie wraps - large size	AR	N/A

Instrument Pretest Requirements

The GSE instruments required to perform this procedure are listed in Table 1, together with their serial numbers, where available. Instruments that are required to have current calibrations are indicated in the Cal-Required column. Instruments that do not require calibration are those not used to verify performance requirements and are not connected to flight instrumentation. The status column is to be filled in with the due date of the instrument calibration sticker and verified to be in calibration by QE or QE designee. Serial numbers are to be updated as appropriate.

Table 1. Required Instrumentation and Calibration Status

No.	*Location*	*Description*	*User Name*	*Serial No.*	*Cal Required*	*Status Cal due date*
1	DAS	Power Supply, H-P 6627A	-	3452A01975	Yes	
2	DAS	Power Supply, H-P 6627A	-	3452A01956	Yes	
3	DAS	Data Acquisition/Control Unit H-P 3497A	-	2936A245539	No	-
4	DAS	Digital Multimeter H-P 3458A	-	2823A15047	Yes	
5	EM	Vacuum Gauge Controller Granville-Phillips Model 316	EG-1a, -1b	2827	No	-
6	EM	Vacuum Gauge Controller Granville-Phillips Model 316	AG-2a, -2b	2826	No	-
7	EM	Vacuum Gauge Controller Granville-Phillips Model 316	EG-3	2828	No	-
8	EM	MKS PDR-C-2C	EG-2, FCG	92022108A	No	-
9	EM	Flow meter – Matheson 8170	EFM-1	96186	No	-
10	EM	Flow meter totalizer Matheson 8124	EFM-1	96174	No	-
11	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Main Tank	96-409-11	No	-
12	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Guard Tank	96-409-10	No	-
13	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Well	96-409-9	No	-
14	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Axial Lock	96-409-12	No	-
15	EM	Pressure Controller – MKS 152F-92	EV-7a, -7b	96203410A	No	-
16	EM	Power Supply HP 6038A	H08D Tank Heater	96023407A	Yes	
17	EM	Power Supply HP 6038A	H09D Tank Heater	3511A-13332	Yes	
18	EM	Power Supply HP 6038A	RAV Power Supply	3329A-12486	Yes	
19	EM	Vac Ion Pump power supply Varian 929-0910, Minivac	SIP	5004N	No	-
20	EM	Flow meter totalizer Veeder-Root	PFM-1	576013-716	No	-
21	GM	Pressure Gauge, Heise	AG-1	CC-122077	No	-
22	GM	Pressure Gauge, Marshall Town	AG-3	N/A	No	-
23	GM	Main Tank Heat Exchanger: a) Thermocouple, b) Current meter, c) Temperature set point controller	-	C-19950	No	-
24	GM	Guard Tank Heat Exchanger: a) Thermocouple, b) Current meter, c) Temperature set point controller	-	C-09920	No	-
25	VM	Vacuum Gauge readout,	VG-3	2878	No	-

No.	*Location*	*Description*	*User Name*	*Serial No.*	*Cal Required*	*Status Cal due date*
		Granville-Phillips 316	VG-4			
26	VM	Vacuum Gauge readout, Granville-Phillips 360	VG-1, VG-2 VG-5	96021521	No	-

Configuration Requirements

Main Tank

Liquid in the Main Tank must be at its normal boiling point (NBP). The SMD is vertical with the +z axis up.

Guard Tank

The Guard-Tank liquid level (Guard Tank LLS-B) must be at least 15% to adequately precool the internal fill line. Document No. P1029, *Internal Main Tank to Guard Tank Transfer*, contains the procedure for raising the Guard Tank level.

Well

The Well is evacuated

SMD Vacuum Shell

The Vacuum Shell pressure must be less than 5×10^{-5} torr. Document No. P1015, *Connect Vacuum Module to SMD*, contains the procedure for connecting to and pumping on the SMD vacuum shell.

Alarm System

The DAS alarm system must be enabled and contain the following alarm set-points:

Top of lead bag temperature set (CN 40) at $T \leq 6.0$ K.

Top of lead bag temperature set (CN 41) at $T \leq 6.0$ K.

Relative Guard Tank Pressure (CN 46) set at $\Delta P \geq 0.3$ torr.

The DAS watchdog timer and alarm are enabled.

GSE and Non-flight Hardware

GSE cabling must be connected between the SMD and the Electrical Module (P/N 5833812) and between the SMD and the Data Acquisition System (P/N 5833811).

The Main Tank vent line must be connected to the Gas Module with a vacuum insulated line. Document No. P1006, *Connect Main Tank Vent Line to Gas Module – Main Tank at NBP,* contains the procedures for connecting the Main Tank vent line.

The Guard Tank vent line must be connected to the Gas Module with a vacuum insulated line (P/N 5833813). Document No. P1008, *Connect Guard Tank Vent Line to Gas Module*, contains the procedures for connecting the Guard Tank vent line.

The Fill Cap Assembly must be installed at SV-13 (Figure 3)

The ion-pump magnet must be installed.

Optional Non-flight Configurations

The following non-flight modifications of the basic SMD and optional GSE configurations are incidental to the performance of this procedure. Any combination represents an acceptable configuration.

The Vacuum shell pump out port at SV-14 may be connected to the Vacuum Module (P/N 5833816) via a 2-in valve and pumping line, with the valve in either the closed position or in the open position. The Vacuum Module pump may be off, actively pumping the pumping line up to a closed SV-14, or actively pumping the vacuum shell.

F. REFERENCE DOCUMENTS

Drawings

Drawing No.	*Title*
LMMS-5833394	Instrumentation Installation

Supporting documentation

Document No.	*Title*
LMMC-5835031	GP-B Magnetic Control Plan
GPB-100153C	SMD Safety Compliance Assessment
LM/P479945	Missile System Prelaunch Safety Package
LMSC-P088357	Science Mission Dewar Critical Design Review
SU/GP-B P0108	Quality Plan
LMMS GPB-100333	Science Mission Dewar Failure Effects and Causes Analysis
SU/GP-B P059	GP-B Contamination Control Plan
EWR 127-1	Eastern and Western Test Range Safety Requirements
LM EM SYS229	Accident/Incident/Mishap Notification Process
KHB 1710, rev E	Kennedy Space Center Safety Practices Handbook

Additional Procedures

Document No.	*Title*
SU/GP-B P1029	Internal Main Tank to Guard Tank Transfer
SU/GP-B P1015	Connect Vacuum Module to SMD
SU/GP-B P1006	Connect Main Tank Vent Line to Gas Module – Main Tank at NBP
SU/GP-B P1008	Connect Guard Tank Vent Line to Gas Module

Operation Number:_____

Date Initiated:_____

Time Initiated:_____

G. OPERATIONS

Verify Performance of Pre-Operations Items

- Verify SU QA notified.

  Record: Individual notified _____,

  Date/time _____/_____.

- Verify NASA representative notified.

  Record: Individual notified _____,

  Date/time _____/_____.

- Verify NASA Safety representative has been notified and has given concurrence to proceed.

  Record: Individual notified _____,

  Date/time _____/_____.

- Record calibration information in Table 1 (Sec. E.4) and Sec. E.3.8.
- Verify that the persons performing this procedure, the test director, and safety engineer are identified in Sec. D.3.
- Verify performance of pre-operations checklist (Appendix 1).
- Verify availability of equipment, hardware, tools, and expendables listed in sections E.3.5 through E.3.9.
- Verify the hazardous operation area is identified as a safety clear area
- Verify proper operation of the GP-B Cryogenic Group oxygen monitor
- Verify that the Spacecraft is powered up, arming plug P222 is installed, and control personnel are prepared to command RAV-2 when requested.
- Verify that the PCI console is configured to monitor RAV-2 closure.
- Verify availability and functioning of emergency shower

Section G.1 complete _____ QA.

Verify Purity of All Sources of Helium Gas

Record serial number on helium bottle/s.

1. _____ 2._____ 3. _____
4. _____ 5 _____ 6. _____

Verify helium bottle/s have been tested for purity and record Op. Number.
Op. Number:_____

Section G.2 complete _____ QA.

Verify Configuration Requirements

Verify dewar is in the proper orientation (+z up).

Verify liquid in Main Tank is at NBP (4.2<T<4.3) and record temperature at bottom of tank CN [9] _____K.

Record initial liquid helium levels.

Main Tank _____%

Guard Tank – ensure level ≥ 15% to precool internal transfer line. If necessary, perform procedure P1029, *Internal Main Tank to Guard Tank Transfer*, to raise level and record Op. No._____.

_____%

Ensure ion-pump magnet is installed and readout is connected.

Verify Vacuum Shell Pressure < 5 x 10^{-5} torr.

Turn on Vac-ion pump and record time of day _____

Use DAS [Monitor Data] for CN 99.

When value is steady, record pressure (IP) _____ torr. If pressure is above 5x10^{-5} torr, turn off Vac-ion pump and perform procedure P1015, *Connection of High Vacuum Pumping Module*, to connect Vacuum Module and pump out SMD vacuum shell. Record Op. No._____.

Exit [Monitor Data] and collect data with [Set Data Interval] to 5 min.

When data cycle is complete, turn off Vac-ion pump.

Ensure DAS alarm system enabled and record set points.

Top of lead bag temperature – ensure [CN 40] on DAS alarm list and that the alarm set point is ≤ 6.0 K.
Record set point. _____K

Top of lead bag temperature – ensure [CN 41] on DAS alarm list and that the alarm set point is ≤ 6.0 K. Record set point.

_____K

Relative Guard Tank Pressure – ensure [CN46] on DAS alarm list and that the alarm set point is ≥ 0.3 torr diff. Record set point.

_____tor
r

Ensure liquid-level alarms enabled and record set points.

Main Tank – ensure liquid-level alarm set ≥ 20%.
Record set point. _____
%

Guard Tank – ensure liquid-level alarm set ≥ 20%.
Record set point. _____
%

Ensure DAS watchdog timer and alarm enabled.

Verify electrical cabling between SMD and GSE is as indicated in figure 6.

Verify DAS configuration is set to 4Z

Ensure Main Tank vent line connected to Gas Module. If not perform procedure P1006, *Connect Main Tank Vent Line to Gas Module – Main Tank at NBP,* to connect Main Tank vent.

Ensure Guard Tank vent line connected to Gas Module. If not, perform procedure P1008, *Connect Guard Tank Vent Line to Gas Module,* to connect Guard Tank vent.

Verify that the primary helium vent and the AP-1 vane pump exhaust of the Gas Module are vented to the outside.

Ensure Fill Cap Assembly installed at SV-13.

Section G.3 complete _____ QA.

Verify Gas-Module Configuration and Record Initial Conditions

Verify open EV-9 and EV-16.

Record Guard Tank vent path:

- Common manifold:
  1. Verify open EV-13.
  2. Verify closed EV-20.
- Bypass:
  1. Verify open EV-20.
  2. Verify closed EV-13.

If the Guard Tank vent path is in the common manifold mode, change to the bypass mode by closing EV-13, and opening EV-20. (This is to standardize the valve configuration for the following operations.)

Ensure all other EV valves (except EV-7a/b) closed.

Ensure all AV valves closed.

Record initial temperatures

Top of Lead Bag CN [40] _____ K.

Top of Lead Bag CN [41] _____ K.

Record pressures.

Guard Tank (EG-1a):_____ torr.

Main Tank (EG-3):_____ torr.

Record Fill Cap Assembly pressure and verify that it reads > 0.0 psig Fill Cap Assembly (PFCG): _____ psig/torr.

Record Vacuum Module Pressure (if connected): (VG-1):_____ torr.

Ensure that Top Plate heaters on SMD are operational.

Section G.4 complete _____ QA.

Verify SMD in Standard Configuration

Using the RAV logbook verify that the dewar's internal valves are in the following positions. If not, investigate to ensure previous RAV operations properly recorded. If necessary, note resolution in D-log.

Open:RAV-3, and RAV-6B.

Closed:RAV-1, RAV-2, RAV-5, RAV-6A, and RAV-7.

Verify that SMD external valves are in the following positions.

Open:SV-9.

Closed: SV-12, SV-13, and FCV.

Valve state summary (ref. only):

Open:	Closed:
EV-7a/-7b, EV-9, EV-16, EV-20	All other EVs
	All AVs
SV-9, GTV-V	FCV, SV-13, SV-12
RAV-3, -6B	All other RAVs

Section G.5 complete _____ QA.

Set Up Data Acquisition System

Comment: refer to DAS operating instructions for information on configurations and mechanics of keyboard/mouse operation.

Ensure DAS set to configuration choice 4M by using [Other Menus] + [Data Config.].

While in the [Data Config.] submenu, select [fast scan] option.

Start “Special Data Cycle” by using [Other Menus] + [Special Data Col] + [Use Pre-Selected] + [Init. Collectn] + [Enter] (=use default file).

Set Main Tank and Guard Tank Liquid Level Sensor sampling intervals to 1 min.

Ensure printer is displaying special Data Cycle data.

Section G.6 complete _____ QA.

Check Initial Pressure in Fill Line

Install a pumping line between valve FCV on the Fill Cap Assembly and the Access Port #1 of the Auxiliary gas section.

Turn on pump AP-1.

Open AV-8 and AV-3.

Open valve FCV and evacuate to 20 mtorr as measured at AG-2.

Close AV-8 and FCV.

Once the pressure in the Fill Cap Assembly has stabilized, record

Fill Cap Assembly pressure (PFCG): _____ torr.

Open valve SV-13 to bring Fill Cap Assembly up to SMD Fill line pressure and record

Fill line pressure (PFCG): _____ torr.

Section G.7 complete _____ QA.

Raise Pressure in Fill Line

Confirm that operations personnel are ready to operate RAV-2.

Open RAV-2:

Request operations personnel to open RAV-2 and record time of day: _____.

Have operations personnel confirm valve has opened.

When convenient, record operation in RAV log book.

Verify that the Fill Cap Assembly pressure rises to the Dewar Guard Tank pressure.

Record Fill line pressure (PFCG): _____ psig/torr.

Record Guard Tank Pressure (EG-1a) _____torr.

Close SV-13 and torque to 60 in-lbs ± 5 in-lbs.

Quality_____

Verify valve configuration

Open:	Closed:
EV-7a/-7b, EV-9, EV-16, EV-20	All other EVs
AV-3	All other AVs
SV-9, GTV-V	FCV, SV-12, SV-13
RAV-2	

Section G.8 complete _____ QA.

Install Stinger in LHSD

WARNING:
The following steps are hazardous. Cold helium gas will be expelled from the stinger and transfer lines. The operator performing the operation must wear a face shield with goggles/glasses, apron, non-absorbent shoes, and cryogenic gloves. Failure to comply may result in personal injury.

Note:
Use appropriate extension for the LHSD being used and clean all O-rings and mating surfaces. See Fig. 4 for transfer plumbing configuration.

Request NASA Safety turn on the amber warning light and make a PA announcement stating, "Attention all personnel, the GP-B program is now performing a hazardous cryogenic operation, all nonessential personnel clear the area.".

Ensure a controlled area is established (15 feet).

Ensure all nonessential personnel are clear of controlled area.

Reduce LHSD pressure to < 1.0 psig by temporarily opening the vent valve on the LHSD (LHV-1).

Open valve VF-1 (Liquid withdrawal valve) on the stinger.

Slowly insert the stinger into the LHSD while allowing it to be purged.

Close valve VF-1 just as cold gas is expelled from stinger.

Close the primary (low-pressure) relief valve on the LHSD (LHV-2).

Increase LHSD ullage pressure to 8 to 10 psig by attaching an external source of GHe to ullage inlet (LHV-1, labeled VENT on LHSD) per the following:

Attach a GHe hose to the VENT outlet of the LHSD while purging the hose and the VENT outlet.

Adjust pressure regulator to obtain 8 to 10 psig LHSD driving pressure.

Record LHSD data:

Date / time: _____ / _____
Liquid level _____ %
LHSD serial number: _____

LHSD valve positions:

Open: LHV-1; Closed: all others

NOTE

Hazardous Operations are now complete. Request NASA Safety make PA announcement that all hazardous operations are now complete. Ensure area operation light is returned to green. Disband controlled area.

Install Fill Line Assembly

Comment: Two transfer lines are available for use. One has an integrated filter and connects directly to bayonet B3 at the dewar. The other has a separate filter that is first installed at bayonet B3 (the latter case is shown in Fig. 5), after which the fill line is connected to the filter.

Record fill line used:

- o Fill line with integrated filter
- o Fill line and separate filter

Backfill Pumping line and Fill Cap Assembly as follows:

Ensure AV-8 closed.

Open AV-1

Open AV-9 until pressure reaches 0 psig at AG-1, then close AV-9.

Close AV-1.

Remove the pumping line from the fill cap assembly.

Remove fill cap assembly.

Install Filter Line Assembly (P/N 5833827) to Dewar Fill Bayonet B3, if used.

Install Fill Line Assembly as follows:

CAUTION:
Be sure to provide adequate support to the Fill Line by the use of music stands or other means so as to not apply excessive load on the Filter Assembly and Stinger. Failure to comply may result in equipment damage.

Mate the Fill Line (P/N 5833804) with the LHSD stinger at VF-1.

Mate VF-2 end of transfer line with Filter Line Assembly or B3 as appropriate.

Ensure VF-2 and relief valve stems pointed upwards.

Ensure VF-3 closed.

Connect a low-impedance facility vent line to the KF fitting at VF-3.

Condition Transfer Line/Filter/Stinger Assembly

Configure Pumping Line as follows:
Ensure 1.5-in flexible pumping line mated to Access Port #1 of Auxiliary Gas section.
Mate other end to outlet of VF-2.

Evacuate Transfer Line:
Open valve VF-2.
Open/verify open AV-3.
Open AV-8.
Close AV-8 when pressure reaches less than 50 mtorr as read on gauge AG-2.

Backfill Transfer Line:
Open AV-1.
Open AV-9 until pressure reaches 0.5 psig as read on gauge AG-1 and then Close AV-9.
Close AV-1.

Evacuate Transfer Line (second time):
Open AV-8.
Close AV-8 when pressure reaches less than 50 mtorr as read on gauge AG-2.

Backfill Transfer Line (second time):
Open AV-1.
Open AV-9 until pressure reaches 0.5 psig as read on gauge AG-1 and then Close AV-9.
Close AV-1.

Verify valve configuration:

Open:	Closed:
EV-7a/-7b, EV-9, EV-16, EV-20	All other EVs
AV-3	All other AVs
SV-9, GTV-V	SV-12, SV-13
VF-2	VF-1, VF-3

Sections G.9-G.11 complete _____ QA.

Start Transfer

Comment: This section starts the transfer by pre-cooling the SMD internal Fill Line by pushing liquid up from the Guard Tank.

CAUTION:
Transfer startup is a critical operation. All potentially interfering operations must be suspended. A qualified test director/engineer must be assigned to monitor temperatures at the top of the lead bag during precool and initial startup of transfer. Failure to comply may result in equipment damage.

Turn on Main and Guard Tank vent line heat exchangers (EH-1/2).

Open SV-13.

Record Guard Tank pressure (EG-1a): _____ torr.

Verify Guard-Tank vent valve EV-13 is closed, close EV-20, and record time: _____.

Turn on power supply for Guard Tank heater (H-3D or H-4D)

Set power supply current limit to 0.07 amps.

Set to 50 VDC and record: V _____Vdc and I _____A.

Open VF-3.

Monitor Guard Tank pressure (EG-1a) and maintain above atmospheric and below 810 torr by adjusting the heater voltage as necessary.

When air condensation is evident on the vent line at VF-3 and Fill Valve (SV-13) temperature T-24D [42] is < 75 K, Power off Guard Tank heater(s).

Close SV-13.

Immediately open VF-1.

Close EV-9. (This prevents hot gas from being dumped into the Main Tank when EV-13 is opened in the next step).

Open EV-13

When heavy air condensation is evident from the vent line at VF-3:

Close VF-2 and immediately

Open SV-13.

Open EV-6 and EV-18.

When the Guard Tank pressure (EG-1a) drops to less than 3 torr above the Main Tank pressure (EG-3), open EV-9.

Section G.12 complete _____ QA.

Verify Start of Transfer

Note:
Do not exceed 100 LL/hr transfer rate as read on PFM-1 (scale B) as this exceeds the capacity of the vent line heat exchangers (EH-1 and EH-2) in the Gas Module.

Verify flow meter (PFM-1) reading of 30 to 100 liquid liters/hour.

PFM-1 (scale B) reading: _____

Start Time: _____

Record LHe level of LHSD:_____%

Input comment to DAS "Starting External Fill of Guard Tank".

Valve configuration:

Open:	Closed:
EV-7a/-7b, EV-9, EV-13, EV-16, EV-6, EV-18	All other EVs
AV-3	All other AVs
SV-9, SV-13, GTV-V	STV
RAV-2	
VF-1, VF-3	VF-2

Record all fill data on the attached data sheets every 15 minutes.

Adjust LHSD pressure:

Close pressurization valve at the LHSD and adjust the gas supply pressure regulator to the desired pressure not to exceed 10 psig.

Reopen pressurization valve at the LHSD.

Select desired Guard Tank fill level _____%

When Guard Tank is at desired level, record Guard Tank level and proceed to G.14.

Guard Tank Level (LL-5D or LL-6D)_____%

Section G.13 complete _____ QA.

Switch from Guard Tank to Main Tank Fill

Open RAV-1 (MT fill valve) by performing the following operations:

Ensure all RAV controller selection switches in OFF position.

Turn on RAV power supply and adjust current limit to 1.85 A.

Adjust power supply to 28 VDC.

Power up controller #1.

Position controller #1 selection switch to RAV-1.

Record RAV status lights (4): Open: θ θ Closed: θ θ

Activate controller #1 to open RAV-1 and record:
Run time: _____ seconds
Current draw: _____ amp
Time of day: _____
Record RAV status lights (4): Open: θ θ Closed: θ θ
When convenient, record operation in RAV logbook.

Close RAV-2 (GT fill valve) by performing the following operations:
Request operations personnel to close RAV-2 and record time of day: _____.
Verify that the PCI indicates valve closure.
When convenient, record operation in RAV logbook.

Input comment in DAS "Switch from Guard Tank to Main Tank Fill".

Valve configuration:

Open:	Closed:
EV-7a/-7b, EV-9, EV-13, EV-16, EV-6, EV-18	All other EVs
AV-3	All other AVs
SV-9, SV-13, GTV-V	SV-12
RAV-1	RAV-2
VF-1, VF-3	VF-2

Continue to record all fill data on the attached data sheets every 15 minutes.

Close VF-3 when it thaws out.

Section G.14 complete _____ QA.

Select Option

Select and perform one or more of the following options:

θ LHSD change-out (G.16) Date: _____ Time: _____

θ Termination of transfer (G.17) Date: _____ Time: _____

(Option) Liquid Helium Supply Dewar Change-Out

WARNING:
The following Steps are hazardous. In the following steps cold helium gas will be expelled from the stinger and transfer lines. The operator performing the operation must wear a face shield with goggles/glasses apron, non-absorbent shoes, and cryogenic gloves. Failure to comply may result in personal injury.

Request a PA announcement be made stating that hazardous operations are about to

begin.

Establish a 15 foot controlled area.

Request facility operation light be changed to Amber.

Ensure all nonessential personnel are clear of the controlled area.

Install Stinger in new LHSD as follows:

Note:
Use appropriate extension for the LHSD being used. Clean O-rings and mating surfaces as needed.

Reduce the pressure in the LHSD to < 1.0 psig by temporarily opening the vent valve on the LHSD (LHV-1).

Open valve VF-1 (Liquid withdrawal valve) on the stinger.

Slowly insert stinger into LHSD while purging.

Close valve VF-1 just as cold gas is expelled from stinger.

Close the primary (low pressure) relief valve (LHV-2) on the LHSD.

NOTE
THE HAZARDOUS OPERATION IS NOW COMPLETE

Request PA announcement that Hazardous operation is complete.

Request operation light be turned to green.

Disband controlled area.

Record LHSD data:

	2nd LHSD
Date:	_____
Time:	_____
LHe level:	_____%
Serial number	_____

Discontinue liquid flow from expended dewar as follows:

Record:

	1st LHSD
Time of day:	_____
MT LHe Level:	_____

Close inlet valve SV-13 and torque to 60 +/- 5 in-lbs.

Quality_____

Close EV-6 and EV-18.

Input comment to DAS “Stop transfer to change LHSD.”

Detach cold transfer line from stinger, as follows:

Close VF-1

Open Nupro valve on the Bayonet Cap Assembly.

Remove transfer line from stinger and immediately install Bayonet Cap Assembly.

Note:
If the Bayonet Cap Assembly is not immediately installed, frost will accumulate on the end of the bayonet. Wipe off excess frost before installing the Cap Assembly.

Perform following steps to warm transfer line by purging with helium gas

Close/verify closed AV-8, AV-1 and AV-9.

Close/verify closed VF-3.

Open VF-2.

Open AV-1.

Open AV-9 and pressurize line to 1 – 2 psig as read at gauge AG-1 . Use APR-1 to control this pressure.

After purging for 10 minutes, close Nupro valve on Bayonet Cap Assembly.

If not already performed, disconnect the gas supply to the first LHSD as follows:

Close off GHe pressurization gas supply.

Close LHV-1.

Disconnect gas hose to the first LHSD.

Increase the second LHSD ullage pressure to 8 to 10 psig by attaching the source of GHe to ullage inlet (LHV-1, labeled VENT on LHSD) per the following:

Attach a GHe hose to the VENT outlet of the LHSD while purging the hose and the VENT outlet.

Adjust pressure regulator to obtain 8 to 10 psig LHSD driving pressure.

Remove Bayonet Cap Assembly and connect transfer line to Stinger in replacement LHSD.

Close AV-9 and AV-1.

Evacuate Transfer Line:

Ensure AP-1 on.

Open AV-8.

Close AV-8 when pressure reaches less than 25 mtorr as read on gauge AG-2b.

Backfill Transfer Line:

Open AV-1.

Open AV-9 until pressure reaches 0.5 psig as read on gauge AG-1 and close AV-9.

Close AV-1.

Prepare to precool transfer line from Guard Tank. Open RAV-2 (GT fill valve) and close RAV-1 (MT fill valve) as follows:

Request operations personnel to open RAV-2 and record time of day: _____.

Have operations personnel confirm valve has opened.

Verify that controller No. 1 is already powered up and that controller #1 selection switch is already set to RAV-1. If not perform the following:

Ensure controller #1 selection switch in off position

Power up controller #1.

Position controller #1 selection switch to RAV-1.

Record RAV status lights (4): Open: θ θ Closed: θ θ

Activate controller #1 to close RAV-1 and record:

Run time: _____ seconds

Current draw: _____ amp

Time of day: _____

Record RAV status lights (4): Open: θ θ Closed: θ θ

When convenient, record both valve operations in RAV log book.

EnsureVF-3 closed.

Open SV-13.

CAUTION:
Transfer startup is a critical operation. All potentially interfering operations must be suspended. A qualified test director/engineer must be assigned to monitor temperatures at Station 200 and the top of the lead bag during precool and initial startup of transfer. Failure to comply may result in equipment damage.

Ensure VF-2 open.

Ensure EV-17 closed.

Ensure EV-9 open.

Record Guard Tank pressure: EG-1a _____ (torr)

Close Guard Tank vent EV-13.

Record time of day: _____

Turn on Guard-Tank heater power supply (H-3D or H-4D).

Set power supply current limit to 0.07 amps.

Set heater to 50 VDC and record: V _____Vdc and I _____A..

Open VF-3.

Monitor Guard Tank pressure (EG-1a) and adjust tank heater voltage to maintain pressure above atmospheric and below 810 torr.

When air condensation is evident on the vent line at VF-3 and Fill Valve (SV-13) temperature T-24D [42] is < 75K, Power off Guard Tank heaters.

Close SV-13.

Immediately open VF-1.

Close EV-9 (This prevents hot gas from being dumped into the Main Tank when EV-13 is opened).

Open EV-13 to vent Guard Tank.

When heavy air condensation is evident from on the vent line at VF-3, close VF-2 and immediately open SV-13.

Open EV-6 and EV-18.

When Guard Tank pressure (EV-1a) drops within 3 torr of Main Tank pressure, open Main Tank vent EV-9

Note:
Do not exceed 100 LL/hr transfer rate as read on PFM-1 (scale B) as this exceeds the capacity of the vent line heat exchangers (EH-1 and EH-2) in the Gas Module.

Verify tank flow meter (PFM-1) of 30 to 100 liquid liters/hour.

PFM-1 (scale B) reading: _____

Start Time: _____

Record LHe level of LHSD: _____%

Input comment to DAS "Starting External Fill of Guard Tank."

Valve configuration:

Open:	Closed:
EV-7a/-7b, EV-9, EV-13, EV-16, EV-6, EV-18	All other EVs
AV-3	All other AVs
SV-9, SV-13, GTV-V	SV-12
RAV-2	
VF-1, VF-3	VF-2

Record all fill data on the attached data sheets every 15 minutes.

Adjust LHSD pressure:

Close pressurization valve at the LHSD and adjust the gas supply pressure regulator to the desired pressure not to exceed 10 psig.

Reopen pressurization valve at the LHSD.

Select desired Guard Tank fill level: _____%

Once the level in the Guard Tank has achieved the desired value, record liquid levels as appropriate

Guard Tank Level (LL-5D or LL-6D) _____%

Main Tank Level (LL-1D or LL-2D) _____%

Open Main Tank fill valve (RAV-1) and close Guard Tank fill valve (RAV-2) by performing

the following:

Verify that controller #1 is already powered up and that controller #1 selection switch is already set to RAV-1. If not, perform the following steps:

Ensure controller #1 selection switch in off position

Power up controller #1.

Position controller #1 selection switch to RAV-1.

Record RAV status lights (4): Open: θ θ Closed: θ θ

Activate controller #1 to open RAV-1 and record:

Run time: _____ seconds

Current draw: _____ amp

Time of day: _____

Record RAV status lights (4): Open: θ θ Closed: θ θ

Request operations personnel to close RAV-2 and record time of day: _____.

Verify that the PCI indicates valve closure.

When convenient, record both valve operations in RAV logbook.

Input comment to DAS "Switched from Guard Tank to Main Tank Fill".

Verify valve configuration:

Open:	Closed:
EV-7a/-7b, EV-9, EV-13, EV-16, EV-6, EV-18	All other EVs
AV-3	All other AVs
SV-9, SV-13, GTV-V	SV-12
RAV-1	RAV-2
VF-1, VF-3	VF-2

Close VF-3 when it thaws

Section G.16 complete _____ QA.

Terminate Transfer

Comment: A full Dewar or empty LHSD is indicated by a rapid and consistent increase in the flow rate.

Stop the flow of liquid helium:

Close VF-1.

Close SV-13 and torque to 60 ± 5 in-lbs and **immediately open** VF-2.

Quality_____

Close EV-6 and EV-18.

Remove the pumping line and vent line at valve VF-3.

Remove the Transfer and Filter Lines from the Dewar fill bayonet B3 and immediately install the Fill Cap Assembly.

Disconnect the Transfer Line from the Stinger bayonet.

Section G.17 complete _____ QA.

Condition Dewar Fill Line

Connect a pumping line between the Fill Cap Assembly at valve FCV and the Auxiliary Gas Section access port no. 1.

Ensure valves AV-1 and AV-9 closed.

Open AV-8 and ensure AV-3 is open.

Open valve FCV and evacuate Fill Cap Assembly to <25 mtorr measured at AG-2B.

Close FCV.

Open SV-13.

Close RAV-1 (**Comment:** Relief of fill line is through Fill Cap Assembly.)

Verify that RAV controller #1 is already on and that controller #1 selection switch is already set to RAV-1. if not perform the following steps:

Ensure controller #1 selection switch in off position

Power up controller #1.

Position controller #1 selection switch to RAV-1.

Record RAV status lights (4): Open: θ θ Closed: θ θ

Activate controller #1 to close RAV-1 and record:

Run time: _____ seconds

Current draw: _____ amp

Time of day: _____

Record RAV status lights (4): Open: θ θ Closed: θ θ

When convenient, record operation in RAV log book.

Turn OFF all RAV controllers as follows:

Turn all RAV selection switches to OFF.

Power off all controllers.

Turn off RAV power supply.

Open FCV and evacuate the Dewar fill line to < 25 mtorr as measured at AG-2b.

Close SV-13 and torque to 60 +/- 5 in-lbs.

Quality_____

Close FCV.

Close AV-8.

Open AV-1.

Open AV-9 until pressure reaches 1.5 psig as read on gauge AG-1 and then close AV-9.

Close AV-1.

Monitor the pressure in the Fill Cap Assembly PFC for 15 minutes to be assured that no gas is leaking into the Fill Cap Assembly (i.e. it maintains vacuum) and record:

Initial PFCG pressure: _____ Date/Time: _____

Final PFCG pressure: _____ Date/Time: _____

Section G.18 complete _____ QA.

Record Configuration of Dewar and GSE

Ensure that the valves in the exhaust section of the gas module are in the following positions:

Ensure EV-9, EV-16, and EV-13 open.

Ensure all other valves in exhaust section (excepting EV-7a/b) are closed.

Record the reading on flowmeter EFM-1 to verify that helium is venting.

EFM-1 reading _____

Record the final liquid levels as appropriate:

Main Tank level(LL-1D or LL-2D): _____ %

Guard Tank Level (LL-5D or LL-6D): _____ %

Record Main Tank pressure (EG-3): _____ torr:

Turn off Main Tank and Guard Tank vent line heat exchangers (EH-1 and EH-2).

Ensure all RAV operations recorded in logbook.

Section G.19 complete _____ QA.

Place Data Acquisition System in Standard Configuration

Comment: refer to DAS operating instructions for information on configurations and mechanics of keyboard/mouse operation.

Input comment to DAS “Completed External NBP fill of Main Tank”.

Using [Other Menus] + [Data Config.], select the [Normal Scan] option.

Stop Special Data Cycle by using [Other Menus] + [Special Data Col] + [Stop Data Col].

Set DAS data cycle interval to 15 minutes.

Set Main Tank liquid level sampling interval to 10 minutes.

Set Guard Tank liquid level sampling interval to 10 minutes.

Ensure that all liquid level sensors are set at a sampling rate of 10 minutes or turned off.

Ensure that Vac-ion pump is off.

Ensure DAS alarm enabled and record set points if changed

- Thermal conditions substantially unchanged, alarm set points for lead bag are unchanged and set to alarm.
- Thermal conditions substantially changed, temperature alarm points reset as follows:

  Top of Lead Bag set point [CN 40] _____ K (≤ 6.0 K)

  Top of Lead Bag set point [CN 41] _____ K (≤ 6.0 K)

Ensure liquid level sensor alarms enabled on Main Tank and Guard Tank, and record set points if changed.

Main Tank Level	Set Point_____%
Well Level	Set Point_____%
Guard Tank	Set Point _____%

CAUTION:
The Guard Tank may tend to subcool following the completion of this procedure. Establish continuous monitoring of the Guard Tank pressure by placing it on the DAS alarm list. Maintain positive pressure in the Guard Tank by ensuring that it vents in common with the Main Tank through EV-13. Failure to comply may result in equipment damage.

Ensure Guard Tank pressure on DAS alarm list and set to alarm at 0.3 torr differential.

Ensure Facility Main Alarm System enabled.

Section G.20 complete _____ QA.

Secure LHSD(s)

WARNING:
In the following steps cold helium gas will be expelled from the LHSD vent (LHV-1). In addition, removal of the stinger involves handling of a cold surface. Both the cold gas and the stinger surface are capable of quickly causing severe frostbite. The operator performing the operation must ensure that the cold gas is directed away from all personnel and must wear a face shield, apron, non-absorbent shoes, and cryogenic gloves. Failure to comply may result in personal injury.

Request PA announcement that a hazardous operation is about to begin.

Request operation light be changed to Amber

Establish a 15 foot controlled area.

Ensure all nonessential personnel are clear of area.

Shut off the helium gas supply used to pressurize the LHSD.

Ensure that LHV-1 is closed.

Disconnect the gas supply hose from LHV-1.

Crack open LHV-1 and allow the LHSD to blow down to atmosphere.

After the LHSD pressure is reduced to atmospheric, close LHV-1.

Open the primary relief valve (LHV-2).

Remove the stinger from the LHSD and close the stinger access ball valve.

If two LHSDs were used, repeat steps G.21.4 through G.21.7 for the other LHSD.

NOTE

HAZARDOUS OPERATIONS ARE NOW COMPLETED

Request PA announcement that Hazardous tasks are now complete.

Request facility operating light be changed to Green.

Disband controlled area.

Perform Final Closure of SV-13 and Condition Dewar Fill Cap Assembly

Once SV-13 has warmed sufficiently to try final closure perform the following steps. **Comment**: The time required to warm up until the valve seals correctly may be a few hours.

Verify that the Fill Cap Assembly is still evacuated and record:

Date:_____ Time of day _____

PFCG pressure:_____

Retorque SV-13 to 60 ± 5 in-lbs.

Quality_____

Open FCV.

Open/Verify open AV-3.

Open AV-8 and evacuate to < 25 mtorr as measured at AG-2b.

Close AV-8.

Ensure EV-12 closed.

Open AV-1.

Open AV-9 until pressure reaches 1.5 psig as read on gauge AG-1 and then close AV-9.

Close FCV.

Close AV-1 and record:

Time of day:_____

PFCG pressure:_____

Open AV-8 and evacuate to < 25 mtorr as measured at AG-2b.

Close AV-8.

Verify closure of SV-13 and FCV by observing the pressure in the Fill Cap Assembly (PFCG) until satisfied that no gas is leaking from the fill cap. After 30 minutes record:

Time of day:_____

PFCG pressure:_____

If PFCG drops by more than 0.5 torr in 30 minutes, repeat steps G.20.2 through G.20.14.

Open AV-1.

Open AV-9 until pressure reaches 0 psig as read on gauge AG-1 and close AV-9.

Close AV-1.

Close AV-3.

Turn off pump AP-1

[Optional] Remove pumping line from Fill Cap Assembly.

[Optional] Install KF-25 blank-off cap on valve FCV.

Perform Post-Operations Checklist (Appendix 2)

Completed by:_____

Witnessed by:_____

Date: _____

Time:_____

Quality Manager_____**Date**_____

Payload Test Director_____**Date**_____

Data Sheet 1

Date/Time	LHSD Level (%)	LHSD press (psig)	Main Tank pressure EG-3 (Torr)	Guard Tank pressure EG-1a (Torr)	Lhe Flow PFM-1 [B] (ll/hr)	Well press (oz/ in^2)	Main Tank Liquid He Level (%)	Guard Tank Liquid He Level (%)

Data Sheet 2

Date Time	Lead bag top T-22D [40] (K)	Lead bag top T-23D [41] (K)	G.T. bottom T-15D [24] (K)	HX-4 T-08D[8] (K)	M.T. bottom T-09D [9] (K)	Vac-Ion Pump (torr)	Gas Mod HX MT/GT (°C/ °C)	M.T. Vent Bayonet /O-ring (°C/ °C)	Valve SV-9 /Top Plate (°C/ °C)	Dewar Adapter (°C)

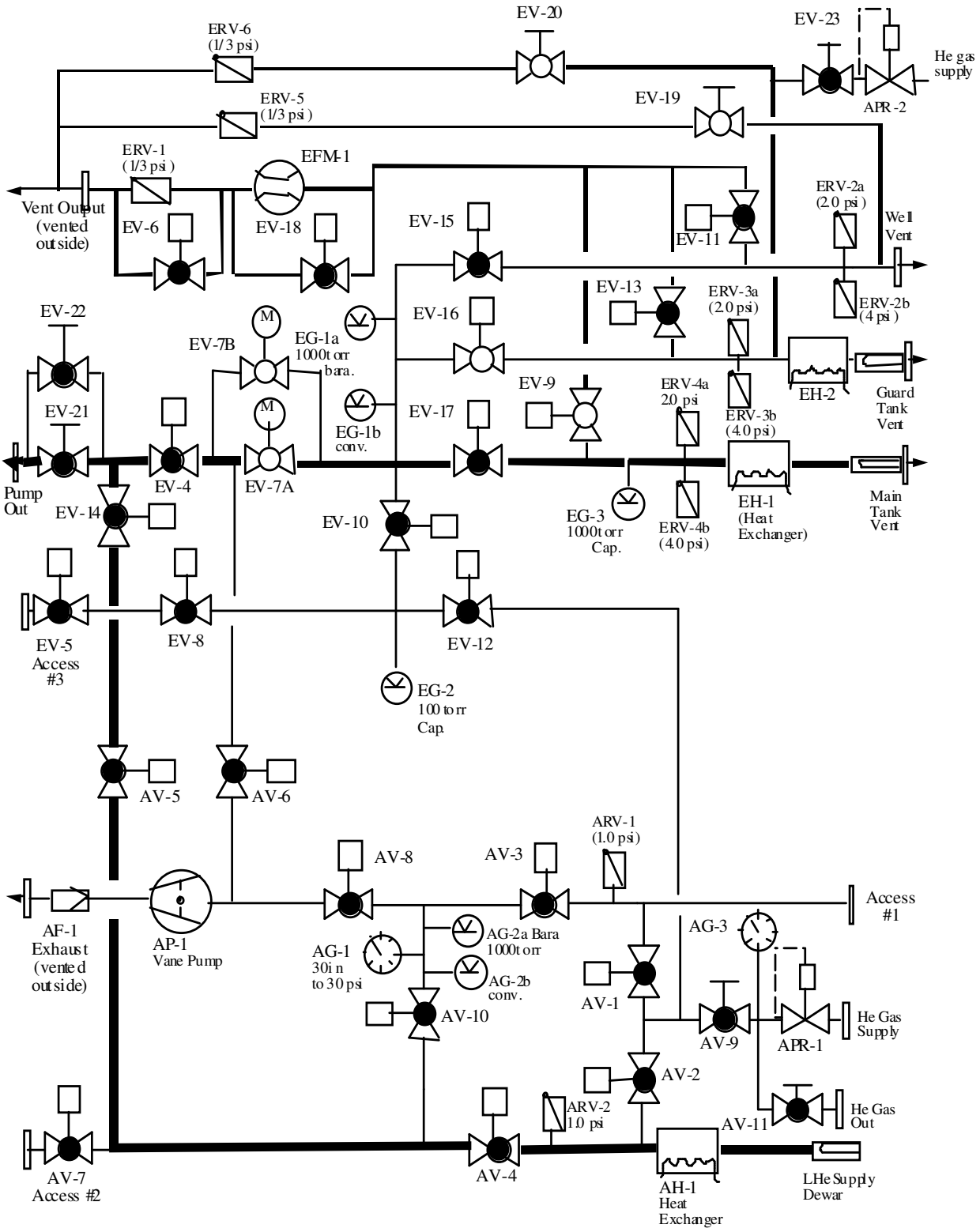

Figure1. Schematic of Gas Module Plumbing. The valve configuration corresponds to the standard bypass configuration with the Main Tank, Guard Tank, and Well each venting independently.

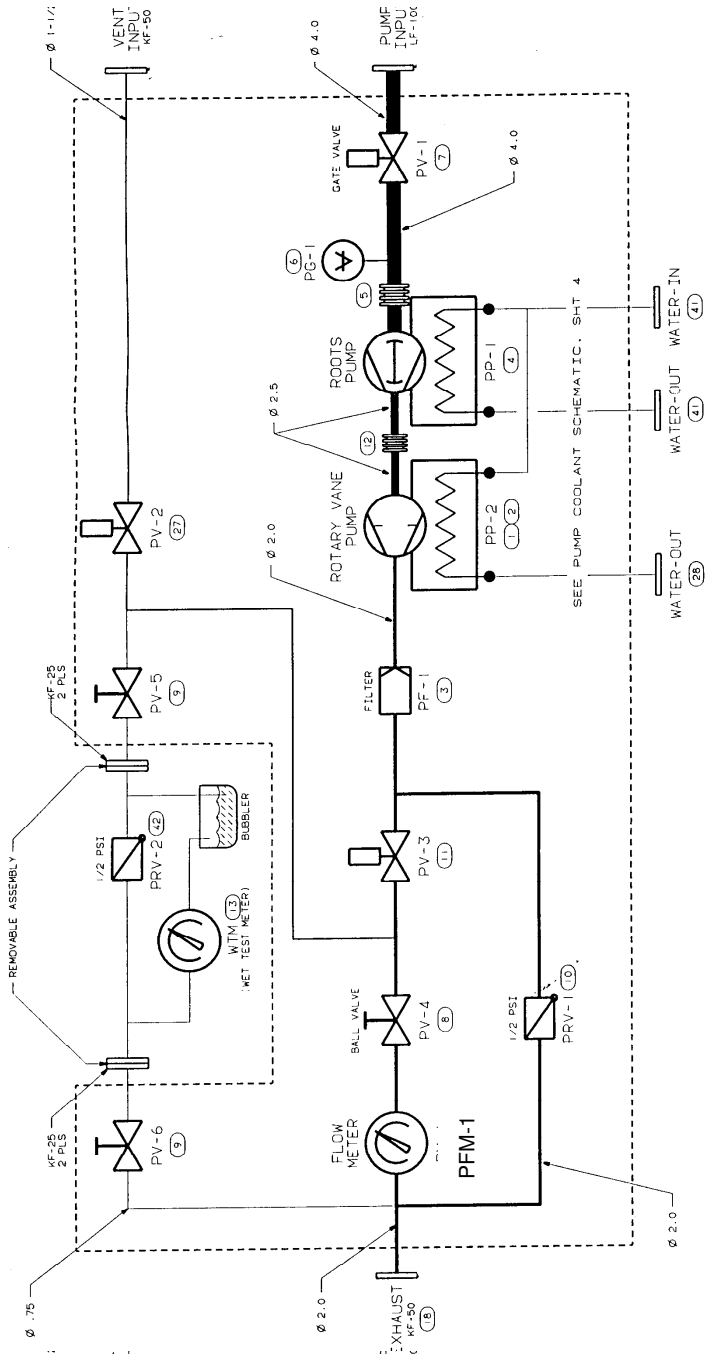

Figure 2. Schematic of Pump Module plumbing.

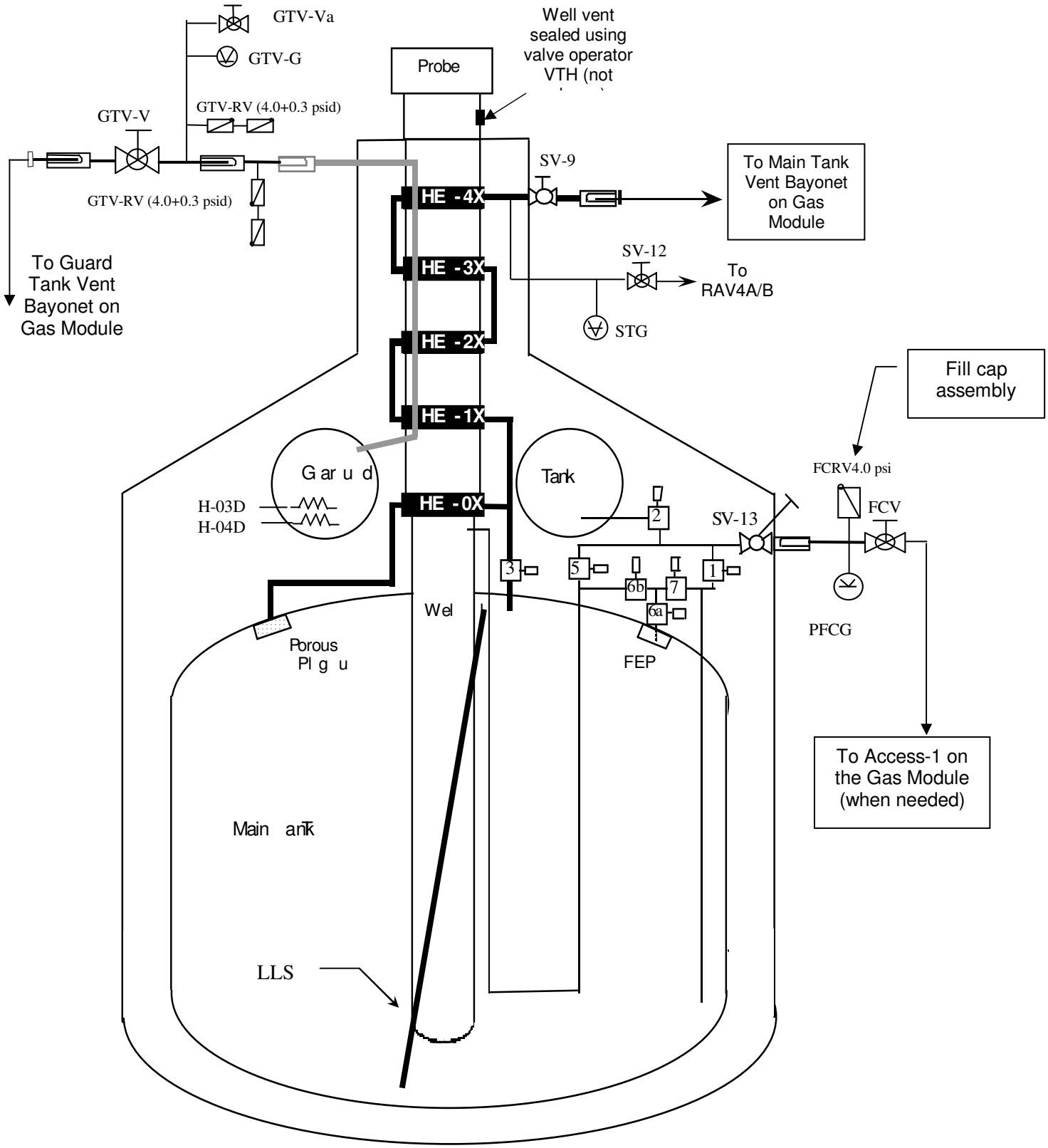

Figure 3 Schematic representation of SMD showing interfaces with Gas module.

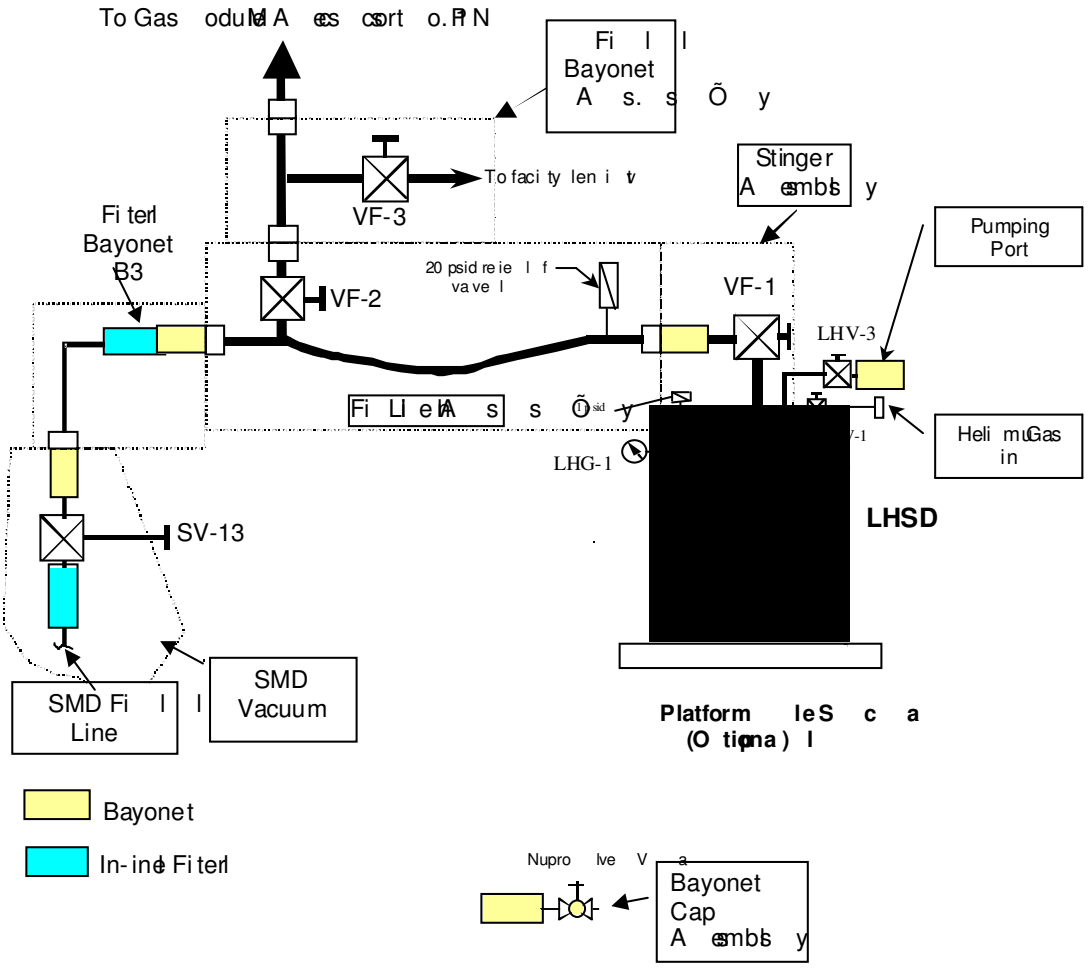

Figure 4. Schematic of liquid helium transfer plumbing

APPENDIX 1 – PRE-OPERATIONS CHECKLIST

DATE	CHECKLIST ITEM	COMPLETED	REMARKS
	1. Verify the test procedure being used is the latest revision.		
	2. Verify all critical items in the test are identified and discussed with the test team.		
	3. Verify all required materials and tools are available in the test area.		
	4. Verify all hazardous materials involved in the test are identified to the test team.		
	5. Verify all hazardous steps to be performed are identified to the test team.		
	6. Verify each team member is certified for the task being performed and knows their responsibilities..		
	7. Confirm that each test team member clearly understands that he/she has the authority to stop the test if an item in the procedure is not clear.		
	8. Confirm that each test team member clearly understands that he/she must stop the test if there is any anomaly or suspected anomaly.		
	9. Notify management of all discrepancy reports or d-log items identified during procedure performance. In the event an incident or major discrepancy occurs during procedure performance management will be notified immediately.		
	10. Verify/Perform pre-task engineering walk down. Verify noted discrepancies have been corrected		.
	11. Confirm that each test team member understands that there will be a post-test team meeting		
	Team Lead Signature: _____		

APPENDIX 2 – POST OPERATIONS CHECKLIST

DATE	CHECKLIST ITEM	COMPLETED	REMARKS
	1. Verify all steps in the procedure were successfully completed.		
	2. Verify all anomalies discovered during testing are properly documented.		
	3. Ensure management has been notified of all major or minor discrepancies.		
	4. Ensure that all steps that were not required to be performed are properly identified.		
	5. Verify all RAV operations recorded in logbook.		
	6. If applicable sign-off test completion.		
	Team Lead Signature: _____		

APPENDIX 3– CONTINGENCY RESPONSES

Condition	Circumstance	Response
Power Failure	Before Sec. G.12 (start of transfer)	Wait for power restoration, re-establish valve configuration, and resume procedure
	Section G.12 through G.16	Safemode: Close VF-1, SV-13, if open; Immediately open VF-2; Open EV-20; Close VF-3, when possible.
	After G.16	Wait for power restoration, re-establish valve configuration, and resume procedure
Temperature limits (CN 40 or 41 exceeded	Section G.12 or step G.16.31	Safemode: Close VF-1, SV-13, if open; Immediately open VF-2; Open EV-6, EV-18, if closed; Re-close EV-6 after temperatures have stabilized.
Burst disk rupture (MT/GT)	Anytime	Request 100% facility make-up air purge Evacuate facility
Oxygen Monitor Alarm	Anytime	Evacuate room
Liquid helium spill	Anytime	Clear area until all spilled liquid has evaporated.