GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

PROCEDURE TO SUPPORT S/V RAV TEST

P0986

April 8, 2003

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REVISION RECORD

REVISION	*ECO*	*PAGES*	*DATE*

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List of Abbreviations and Acronyms

AG-x	Gauge x of Gas Module auxiliary section
AMI	American Magnetics Inc.
APR-x	Pressure regulator x of Gas Module
AV-x	Valve x of Gas Module auxiliary section
CGSE	Cryogenic GSE
CG-x	Gauge x of portable helium pressurization source
CPR-x	Pressure regulator x of portable helium pressurization source
CV-x	Valve x of portable helium pressurization source
CN [xx]	Data acquisition channel number
DAS	Data Acquisition System
EEB	Electrical Equipment Building
EFM	Exhaust gas Flow Meter
EG-x	Gauge x of Gas Module exhaust section
EH-x	Vent line heat exchanger in Gas Module
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
KFxx	Quick connect o-ring vacuum flange (xx mm diameter)
LHe	Liquid Helium
LHSD	Liquid Helium Supply Dewar
LHV-x	Liquid Helium Supply Dewar valves
LLS	Liquid level sensor
LM	Lockheed Martin Co.
LV	Launch Vehicle
MST	Mobile Service Tower (of SLC-2W)
MT	Main Tank
MTVC	Main Tank Vent Cap
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
PAF	Payload Adapter Flange
PFCG	Fill Cap ass'y pressure Gauge
PFM	Pump equipment Flow Meter
PG-x	Gauge x of Pump equipment
PM	Pump Module
PRT	Platinum resistance thermometer
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
SLC-2W	Space Launch Complex 2W (Vandenberg AFB)
SMD	Science Mission Dewar
STG	SMD Thruster vent pressure gauge
SU	Stanford University
SV	Space Vehicle
SV-x	SMD Valve number x
TD	Test Director

List of Abbreviations and Acronyms (cont'd)

TG-x	Gauge x of Utility Turbo System
TN	Thrust Nullifier
TV-x	Valve x of Utility Turbo System
UTS	Utility Turbopump 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 Well pumping line

A. Scope

This procedure describes the steps needed to support the test of the RAVs that can be operated by the SV. The RAVs that can be operated by the SV are RAV2, RAV4A, RAV4B, and RAV6B (see Figure 1). This procedure can be used to support test of any or all of the RAVs in any sequence. It is assumed that the valves are to be initially operated as they will in flight, i.e., RAVs 2, 4A, 4B are to be opened and RAV6B is to be closed. This procedure actually involves the steps needed to support the return of the valves to their initial states, i.e., closing of RAVs 2, 4A, 4B. (RAV6B may be opened without any intervention.) It is assumed that the SV is in its vertical orientation (+Z up) and that there is access to the fill bayonet (B3), the main tank ground vent valve, SV-9, and the thruster shutoff valve, SV-12 (V12).

B. Safety

B.1. Potential Hazards

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 discusses the safety design, operating requirements and the hazard analysis of the SMD.

B.2. Mitigation of Hazards

B.2.1. Lifting hazards

There are no lifting operations in this procedure

B.2.2. Cryogenic Hazards

The LM Building may have an oxygen deficiency monitor that alarms when the oxygen level is reduced to 19.5%. Additional temperature and pressure alarms, provided by the DAS, warn of potential over-pressure conditions. Emergency vent line deflectors are installed over the four burst disks on the SMD vacuum shell.

Only authorized and trained LM and SU personnel are allowed In the high-bay without escort. All personnel working at a height 30 inches or more off the floor are required to have an LM approved air tank within easy reach. In the unlikely event of a large LHe spill all employees have been instructed to evacuate the room and contact LM safety.

The following additional requirements apply to all personnel involved directly in cryogenic operations. Gloves that are impervious to liquid helium and liquid nitrogen are to be worn whenever the possibility of splashing or impingement of high-velocity cryogens exists or when handling equipment that has been cooled to cryogenic temperatures. Protective clothing and full-face shields are to be worn whenever the possibility of splashing cryogens exists.

B.2.3. Other Hazards

When appropriate, tools or other items used with the potential to damage the SMD or Probe shall be tethered.

B.3. Mishap Notification

B.3.1. Injury

In case of any injury obtain medical treatment by immediately calling LM **Call 117**

B.3.2. 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.

B.3.3. Contingency Response

Contingency responses to possible equipment troubles or irregularities (e.g., power failure) are listed in Appendix 3.

C. Quality Assurance

C.1. QA Notification

The NASA 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.

C.2. Red-line Authority

Authority to red-line (make minor changes during execution) this procedure is given solely to the Test Director or his designate and shall be approved by the QA Representative. Additionally, approval by the Payload Technical Manager shall be required, if in the judgment of the test director or QA Representative, experiment functionality may be affected.

C.3. 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.

C.3.1. 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.

C.3.2. 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 Test Director and approved by the QA representative.

C.3.3. 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

D.1. Personnel Responsibilities

The performance of this procedure requires a minimum complement of personnel as determined by the Test Director. 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.**

D.2. 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.

Qualified Personnel

The names of those actually performing this procedure are to be initialed and the name of the person acting as Test Director should be circled.

Test Director	***Test Engineer***
Mike Taber	Tom Welsh
Dave Murray	Ned Calder
Ned Calder	

E. Requirements

E.1. 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.

E.2. Lifting Operation Requirements

There are no lifting operations in this procedure

E.3. Hardware/Software Requirements

E.3.1. Commercial Test Equipment

No commercial test equipment is required for this operation.

E.3.2. Ground Support Equipment

The Ground Support Equipment includes the Gas Module, the Pump Module, the Electrical Module, and the Vacuum 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(see the *Electrical Module Manual* for details), and provides remote control of valves in the Gas Module, Pump Module, and SMD. The Vacuum Module contains a turbo pump, backed by a vane pump, and provides the capability to pump out the SMD vacuum shell.

This procedure uses hardware located in the Gas Module (Figure 2) and the Electrical Module (Table 1).

E.3.3. 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.

E.3.4. Spacecraft Support:

All RAV commanding is to be done by the spacecraft in coordination with this procedure.

E.3.5. Additional Test Equipment

Description	***Manufacturer***	***Model***

E.3.6. Additional Hardware

Description	***Manufacturer***	***Model***

E.3.7. Tools

Description
Seekonk 60 in-lb. Torque wrench or similar

E.3.8. Expendables

Description	*Quantity*	*Mfr./Part No.*

E.4. 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	A1, A2, A3, A4	3452A01975	Yes	
2	DAS	Power Supply, H-P 6627A	B1, B2, B3, B4	3452A01956	Yes	
3	DAS	Data Acquisition/Control Unit H-P 3497A	-	2936A24553 9	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	-

No.	Location	Description	User Name	Serial No.	Cal Required	Status Cal due date
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	EH-1	C-19950	No	-
24	GM	Guard Tank Heat Exchanger: a) Thermocouple, b) Current meter, c) Temperature set point controller	EH-2	C-09920	No	-
25	VM	Vacuum Gauge readout, Granville-Phillips 316	VG-3 VG-4	2878	No	-
26	VM	Vacuum Gauge readout, Granville-Phillips 360	VG-1, VG-2 VG-5	96021521	No	-

E.5. Configuration Requirements

E.5.1. Space Vehicle

The SV is vertical with the +Z axis up. The FEE skins allowing access to SV-9 and SV-12 (V12) are removed.

E.5.2. Main Tank

Liquid in the Main Tank must be at its normal boiling point (NBP), 4.2 K. The actuator control valve for EV-9 switches the state that EV-9 defaults to, should a power failure occur. It should be placed in the “NBP.” position, for this procedure, ensuring that EV-9 remains open in the event of power failure.

E.5.3. Guard Tank

The Guard Tank is depleted and regulated to a pressure > 30 torr above atmosphere. Care must be taken at all times to keep its pressure above atmospheric.

E.5.4. Well

The Well is evacuated.

E.5.5. SMD Vacuum Shell

The Vacuum Shell pressure should be less than 1×10^{-4} torr. However, the exact value is not critical to this procedure and is not measured.

E.5.6. Alarm System

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

   a. Top of lead bag temperature set (CN 28/175) at $T \leq 6.0$ K.

   b. Top of lead bag temperature set (CN 29/178) at $T \leq 6.0$ K.

   c. Relative Guard Tank Pressure (CN 46) set at $\Delta P \geq 30$ torr.

2. The Watch Dog alarm must be armed.

E.5.7. GSE and Non-flight Hardware

1. 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).

2. The Fill Cap Assembly may be installed at SV-13/B3 (Figure 1). If it is not, this procedure installs it as a preparation for RAV2 operation (if RAV2 is to be operated). As an option, this procedure installs the flight fill cap at the end.

E.6. 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.

1. The ion-pump magnet may be installed.

2. 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

E.7. Verification/ Success Criteria

N/A

E.8. Payload Constraints and Restrictions

N/A

F. Reference Documents

F.1. Drawings

Drawing No.	*Title*
LMMS-5833394	*Instrumentation Installation*

F.2. Supporting documentation

Document No.	*Title*
LMMC-5835031	*GP-B Magnetic Control Plan*
GPB-100153C	*SMD Safety Compliance Assessment*
EM SYS229	*Accident/Mishap/Incident Notification Process*
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*

F.3. Additional Procedures

Document No.	*Title*

Operation Number:_____
Date Initiated:_____
Time Initiated:_____

G. Operations

G.1. Verify Preparations

G.1.1. Verify SU QA notified.

Record: Individual notified _____,

Date/time _____/_____.

G.1.2. Verify NASA representative notified.

Record: Individual notified _____,

Date/time _____/_____.

G.1.3. Record calibration due dates in Table 1 (Sec. E.4).

G.1.4. Verify that persons performing this procedure have initialed their names in Sec. D.3 and the name of the Test Director is circled.

G.1.5. Verify that a pre-test coordination meeting has been held with the SV test group to determine which RAVs will be operated and in what sequence. If RAV4A/4B are to be tested, verify that the SV mechanical team is available to remove a thruster cap when needed.

G.1.6. Verify Pre-ops meeting with operations group has been conducted. (Checklist is in Appendix 1.)

Quality _____

G.2. Verify Configuration Requirements

G.2.1. Specify which of the RAVs are to be tested:

- RAV2
- RAV4A/4B (must be tested as a pair)
- RAV6B

G.2.2. Verify that the SV is vertical.

G.2.3. Using the RAV log book 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.

1. Open: RAV-3, and RAV-6B.
2. Closed: RAV-1, RAV-2, RAV-5, RAV-6A, and RAV-7.

G.2.4. Verify SV-9 open.

G.2.5. Verify SV-13, and FCV (if applicable) closed.

G.2.6. If RAVs 4A/4B are to be tested, perform the following:

1. Verify access is available to SV-9 and SV-12.
2. Verify SV-12 is closed.
3. Verify the main tank is at NBP and that its pressure is above atmospheric. Record STG (CN 49): _____ torr relative to atm.
4. Request spacecraft personnel to remove the cap from an accessible thruster on the aft end of the vehicle.

G.2.7. Verify liquid in Main Tank is at NBP ($4.2<T<4.3$) and record temperature at bottom of tank CN [9] _____K.

G.2.8. Verify Actuator Control for EV-9 set to "NBP" position.

G.2.9. If RAV2 is to be tested, verify that the Guard Tank is depleted and regulated to a pressure > 30 torr above atmosphere. Record GTV-G (CN 46): _____ torr relative to atm.

G.2.10. If RAV6B is to be tested, verify that the well is evacuated by reference to the last performance of P0613, *Repump Well with UTS*. Record date and Op. No.: _____

G.2.11. Ensure DAS Watch Dog Alarm enabled.

G.2.12. Verify GSE cabling connected between SMD and Electrical Module and between SMD and Data Acquisition System.

G.2.13. Verify DAS alarm system enabled and record set points.

1. Top of lead bag temperature – verify [CN 28] on DAS alarm list and set to alarm at $T \leq 6.0$ K. Record set point _____K
2. Top of lead bag temperature – verify [CN 29] on DAS alarm list and set to alarm at $T \leq 6.0$ K. Record set point _____K
3. Relative Guard Tank Pressure – verify [CN 46] on DAS alarm list and set to alarm at $\Delta P \geq 30$ torr. Record set point _____torr

G.2.14. Ensure Main Tank liquid-level alarm set ≥ 20%. Record: _____%

G.2.15. If RAV2 is to be tested, verify Fill Cap Assembly (GSE, with pressure gauge PFCG) is installed at SV-13. If the flight fill cap (or equivalent) is installed instead of the Fill Cap Assembly, perform the following:

1. Verify that SV-13 is closed and torqued to 60 in-lb. Record torque wrench S/N: _____ and cal. due date: _____

Quality _____

2. Remove the Swagelok cap and open the fill cap valve, SV-8, on the installed fill cap.
3. Remove the flight fill cap, "Fill Valve Weldment Assembly", (5833270-101) (or similar).
4. Install the GSE fill cap assembly on the fill bayonet.
5. Connect the Fill Cap pressure gauge, PFCG, to its readout.

G.2.16. If RAV2 is to be tested, measure the pressure in the internal fill line as follows:

1. Install a pumping line between valve FCV on the Fill Cap Assembly and the Access Port #1 of the Auxiliary gas section.
2. Turn on pump AP-1.
3. Open AV-8 and AV-3.
4. Open valve FCV and evacuate to 20 mtorr as measured at AG-2.
5. Close AV-8 and FCV.
6. Once the pressure in the Fill Cap Assembly has stabilized, record fill Cap Assembly pressure (PFCG): _____ torr.
7. Open valve SV-13 to bring Fill Cap Assembly up to SMD Fill line pressure and record
8. Fill line pressure (PFCG): _____ torr.

Section G.2 Complete Quality _____

Note:
In the following, any number of the SV-operated RAVs may be tested in any sequence. However, if one of the RAV4 pair are operated, the other must be also.

G.3. Record Initial RAV Operation

G.3.1. Enter a comment in the DAS: "Commencing with test of RAVs (list the RAVs to be tested)".

G.3.2. Record date/time of opening of RAV4A: _____

G.3.3. Record date/time of opening of RAV4B: _____

G.3.4. Record date/time of opening of RAV2: _____

1. Verify that PFCG rises to guard tank pressure and record: _____torr

G.3.5. Record date/time of closing of RAV6B: _____

Section G.3 complete. Quality_____

G.4. Support Final RAV Operation

G.4.1. Closure of RAV4A/4B:

1. Just prior to closure of RAV4A/B, purge the volume between SV-12 and RAV-4A/B as follows:
   a. Close SV-9 to hand tight.
   b. Verify that at the cap has been removed from at least one of the thrusters.
   c. Crack open SV-12.
   d. Observe gas flow out of the open thruster.
   e. After 30 seconds of flow, request SV operations personnel close both RAV-4A and RAV-4B. Record date/time: _____
   f. After verification of RAV-4A/B closure, close SV-12.
2. Open SV-9

G.4.2. Closure of RAV2

1. Record date/time of closure: _____

G.4.3. Opening of RAV6B

1. Record date/time of opening: _____

G.4.4. Record all RAV operations in the RAV Operations Logbook.

G.4.5. Record any SV-12 operations in the SV-12 operations log.

G.4.6. Request spacecraft personnel to replace the cap removed from a thruster.

Section G.4 complete. Quality_____

G.5. Recovery From RAV2 Operation

G.5.1. If RAV2 has been operated, perform the following steps:

1. Ensure pumping line installed between Fill Cap Assembly at valve FCV and Auxiliary Gas Section access port no. 1.
2. Ensure FCV closed.
3. Close/verify closed AV-1 and AV-9.

4. Open AV-8 and AV-3 and evacuate pumping line to <25 mtorr measured at AG-2b.
5. Open FCV and evacuate Dewar fill line to < 25 mtorr as measured at AG-2b, and record AG-2b: _____ torr
6. Close SV-13 and torque to 60 +/- 5 in-lbs.
7. Close AV-8.
8. Open AV-1
9. Open AV-9 until pressure reaches 1.5 psig at AG-1, then close AV-9.
10. Close FCV.
11. Close AV-1 and record:
    a. Time of day:_____
    b. Initial PFCG pressure:_____
12. Open AV-8 and evacuate to < 25 mtorr as measured at AG-2b.
13. Close AV-8.
14. Verify closure of SV-13 and FCV by verifying the pressure in the Fill Cap Assembly (PFCG) does not drop by more than 1.0 torr over 30 minutes.. After 30 minutes record:
    a. Time of day:_____
    b. Final PFCG pressure:_____

    Note: If PFCG drops by more than 1.0 torr in 30 minutes, retorque SV-13, check FCV, and remeasure PFCG for another 30 minutes.
15. Open AV-1.
16. Open AV-9 until pressure reaches 0 psig as read on gauge AG-1 and close AV-9.
17. Close AV-1.
18. Close AV-3.
19. (Optional) Turn off pump AP-1
20. Remove pumping line from Fill Cap Assembly.
21. Install KF-25 blank-off cap on valve FCV.

G.5.2. (Optional) Replace the GSE fill cap with the flight fill cap as follows:

1. Record Fill Cap pressure (PFCG): _____torr, and record date / time:_____.

2. Remove the installed Fill Cap.
3. Install the flight fill cap, “Fill Valve Weldment Assembly” (5833270-101) per 65113-5833500C. Install a pumping line between the Nupro valve on the Fill Cap Assembly and the Access Port #1 of the Auxiliary gas section. Provide strain relief as necessary.
4. Turn on pump AP-1.
5. Ensure EV-12 closed.
6. Open AV-8 and AV-3.
7. Open Nupro valve on the Fill Cap Assembly and evacuate to <25 mtorr as measured at AG-2B.
8. Close AV-8.
9. Open AV-1.
10. Open AV-9 until pressure reaches 1.5 psig as read on gauge AG-1 and then close AV-9.
11. Close AV-1.
12. Open AV-8 evacuate to <25 mtorr as measured at AG-2B.
13. Close AV-8.
14. Open AV-1.
15. Open AV-9 until pressure reaches 1.5 psig as read on gauge AG-1 and then close AV-9.
16. Close the Nupro valve on the fill cap and torque 25 ± 2 in-lb. Record S/N _____ and cal. due date: _____
17. Close AV-1.
18. Close AV-3.
19. Turn off AP-1.
20. Disconnect the pumping line at the Nupro valve on the fill cap.
21. Install a Swagelok plug on the port at the Nupro valve on the fill cap.

G.5.3. Perform Post-Operations Checklist (Appendix 2)

Section G.5 complete. Quality_____

H. Procedure Completion

Completed by: _____

Witnessed by: _____

Date: _____

Time: _____

Quality Manager	**Date**
Payload Test Director	**Date**

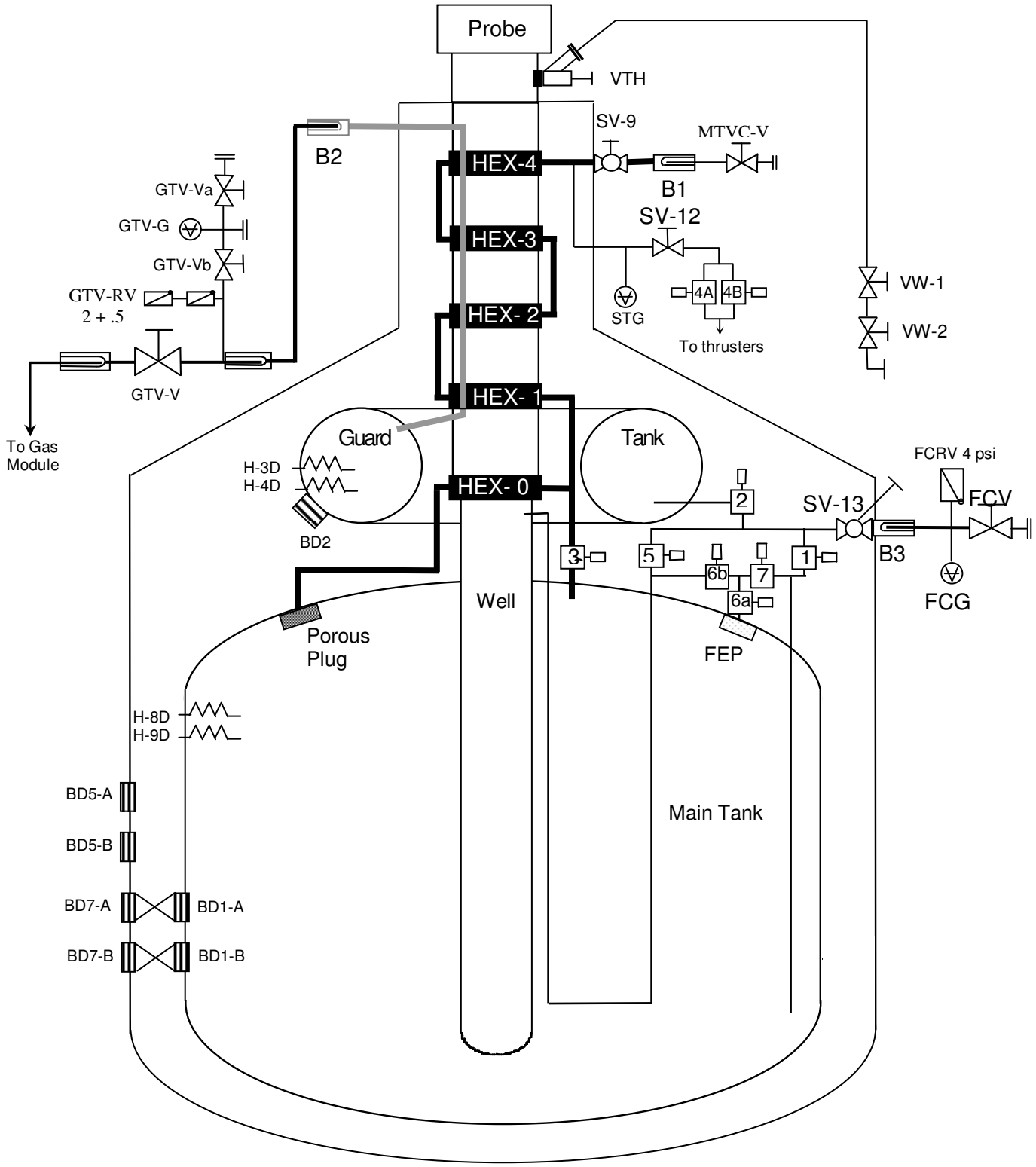

Figure 1. Schematic of Science Mission Dewar plumbing

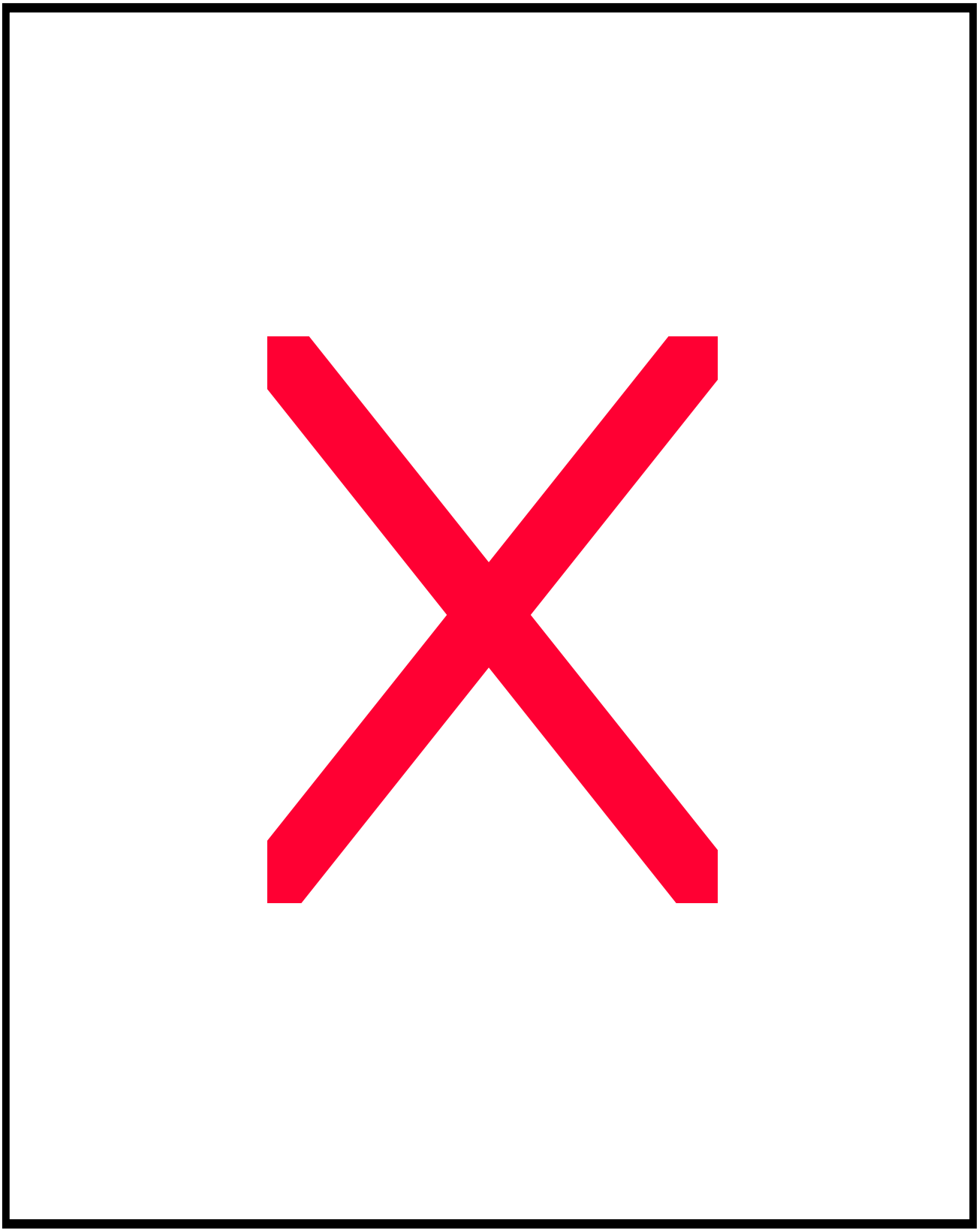

Figure 2. Schematic of Gas Module Plumbing.

Appendix 1 Pre-ops 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 knows their individual 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. Confirm that each test team member understands that there will be a post-test team meeting.		
	Team Lead Signature: _____		

Appendix 2 Post-ops 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. If applicable sign-off test completion.		
	6. Verify all RAV valve operations have been entered in log book		
	7. Verify the as-run copy of procedure has been filed in the appropriate binder		
	Team Lead Signature: _____		

Appendix 3– Contingency Responses

	Condition	Circumstance	Response
1	Power Failure	Any time	**Wait for power restoration** **Note**: the DAS computer will continue to function for several hours, however no data will be collected DAS computer still operating: Reset GM valving per the last configuration in procedure and resume procedure DAS computer not operating: Reboot computer and launch DRP_SMD and select auto startup option Reset GM valving per the last configuration in procedure and resume procedure in coordination with spacecraft test personnel
2	Burst disk rupture (MT/GT)	ANY TIME	Evacuate room