GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

CERTIFICATION OF ELECTRICAL MODULE, GAS MODULE, AND DATA ACQUISITION SYSTEM

To be performed at Vandenberg Air Force Base building 1610/EEB/MST

WARNING: This document contains hazardous operations

P1020

November 12, 2002

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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.
AP-1	Vane Pump in Gas module
APR-x	Pressure regulator x of Gas Module
AV-x	Valve x of Gas Module auxiliary section
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
EFM-x	Exhaust gas Flow Meters
EG-x	Gauge x of Gas Module exhaust section
EH-x	Vent line heat exchanger in GM
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
GTV-G	Guard Tank vent pressure gauge
GTV-RV	Guard Tank vent relief valve
GTV-V	Guard Tank vent valve
GTV-Va	Guard Tank Vent line valve for independent pressure regulation
HEX-x	SMD heat exchanger x
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.
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
ONR	Office of Naval Research
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
PTD	Payload Test Director
PV-x	Valve x of the Pump equipment
QA	Quality Assurance
RAV-x	Remote Actuated Valve-x
RGA	Residual Gas Analyzer
RGA-LV	RGA leak valve (needle valve)
RGA-SOV	RGA shut off valve
SMD	Science Mission Dewar
STV	SMD Thruster vent Valve
SU	Stanford University
SV-x	SMD Valve number x
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

LIST OF SPECIFIC HEADING DEFINITIONS

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

1. NOTE: Used to indicate an operating procedure of such importance that it must be emphasized
2. CAUTION: Used to identify hazards to equipment
3. WARNING: Used to identify hazards to personnel

A. SCOPE

This document describes the steps necessary to interconnect the components of and certify for operation the Payload GSE. This GSE interfaces with the Science Mission Dewar instrumentation and plumbing. The GSE are the Electrical Module, Gas Module and Data Acquisition System.

The hazardous cryogenic operation in this procedure is the filling of the cold trap on the leak detector with liquid nitrogen.

B. SAFETY

B.1. 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.

B.2. Mitigation of Hazards

B.2.1. Lifting hazards

There are no lifting operations in this procedure

B.2.2. Cryogenic Hazards

In VAFB building 1610 and the MST, the GP-B cryogenic team provides 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 lines are installed over the four burst disks to direct any flow to an outside area.

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 ladder. In the unlikely event of a large LHe spill all employees have been instructed to evacuate the building and contact NASA 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, non-absorbent shoes, goggles/glasses 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 space vehicle shall be tethered.

B.3. **Mishap Notification**

B.3.1. Injury

In case of any injury or illness obtain medical treatment as follows **Dial 911**

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 and Stanford University GP-B P0879. Additionally, VAFB NASA Safety and 30th Space Wing Safety will be notified as required.

B.3.3. Contingency Response

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

C. **QUALITY ASSURANCE**

C.1. **QA Notification**

The NASA program and the 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.

C.2. **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, experiment 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 performance.

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.

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.
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 PTD and approved by the QA representative.
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.

D.3. 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

E.1. Electrostatic Discharge Requirements

When working on the space vehicle, an ESD wrist strap is required. The wrist strap continuity shall be verified prior to use with a calibrated checker.

E.2. Lifting Operation Requirements

There are no lifting operations in this procedure

E.3. Hardware/Software Requirements

E.3.1. Commercial Test Equipment

Description	Cal Information
Varian Helium Leak Detector with calibrated leak	Cal S/N#:_____ Due Date:_____

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E.3.2. 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.

E.3.3. Computers and Software:

The Data Acquisition System (DAS) is 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. Additional Test Equipment

1. SMD simulator
2. Test RAV

E.3.5. Personal Protective Equipment

1. Glasses/goggles
2. Face Shield
3. Cryogenic safety apron
4. Cryogenic safety gloves
5. Non-porous shoes

E.3.6. Additional Hardware

1. 4 liter liquid nitrogen thermos

E.3.7. Tools

Description
ESD wrist strap

E.3.8. 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	NA	N/A

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.

Table 1. Required Instrumentation and Calibration Status

No.	*Location*	*Description*	*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	-

No.	*Location*	*Description*	*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	-	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, 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. Main Tank

Liquid in the Main Tank must be at its normal boiling point (NBP) or Subatmospheric

E.5.2. Guard Tank

The Guard Tank may contain liquid or be depleted.

E.5.3. Well

The Well must be evacuated.

E.5.4. SMD Vacuum Shell

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

E.5.5. 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 175 and CN178) at $T \leq 6.0$ K.

b. Relative Guard Tank Pressure (CN 46) set at □P ≥ 10 torr.

E.5.6. GSE and Non-flight Hardware

1. N/A

E.6. Optional Non-flight Configurations

The following modifications or non-flight arrangement of the basic SMD configuration may also be in place. They are incidental to the performance of this procedure and not required.

1. The SMV may be installed in its transportation and test fixture.

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-6, or actively pumping the vacuum shell.

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
LM/P479945	Missile System Prelaunch Safety Package
SU/GP-B P0141	FIST Emergency Procedures
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
EM SYS229	Accident/Mishap/Incident Notification Process
EWR 127-1	Eastern and Western Range Safety Requirements
KHB 1710.2 rev E	Kennedy Space Center Safety Practices Handbook

F.3. Additional Procedures

Document No.	***Title***
SU/GP-B P0879	Accident/Incident/Mishap Notification Process
SU/GP-B P1015	Connect Vacuum Module to SMD
SU/GP-B P0875	GP-B Maintenance and Testing at all Facilities

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

G. OPERATIONS

G.1. Pre-Operations Verifications

- Verify SU QA notified.

  Record: Individual notified _____,

  Date/time _____/_____.

- Verify NASA program representative notified.

  Record: Individual notified _____,

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

  Record: Individual notified _____

  Date/Time:_____,

- Record calibration due dates in Table 1 (Sections. E.3.4, E.4)
- Persons actually performing this procedure should list their names in Sec D.3.
- Verify completion of the pre-operations checklist (Appendix 1).
- Verify proper operation of GP-B Cryogenic Team oxygen monitor
- Verify availability and functioning of emergency shower

Section Complete QA Witness:_____

G.2. 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 Complete QA Witness:_____

G.3. Configure Ground Support Equipment

G.3.1. Verify power switches on the Data Acquisition System (DAS), Electrical Module (EM), Pump Module (PM) and Gas Module (GM) are off

G.3.2. Connect the DAS, GM, EM, and PM with appropriate cables per figure 1

G.3.3. Power of DAS

1. Turn on power to DAS
2. Power on HP Scanner, Extender and DVM
3. Power on power supplies A and B

G.3.4. Power on EM

1. Turn on power to EM
2. Power on all instruments on the left side panel including power supplies
3. Power on GE Fanuc 5Vdc power supply

G.3.5. Configure Gas Module

1. Verify all manual valves closed
2. Verify blank off flanges installed at the following locations
    a. EV-21/22
    b. Access Port 1
    c. Access Port 2
    d. Access Port 3
    e. Vent Out Port
    f. Well Vent
    g. LHSD Port
    h. He Gas Out Port

G.3.6. Verify 'Purge Gas' valve is in the off position

G.3.7. Verify the 'Actuator Control for EV-9' is in the NBP position

G.3.8. Connect compressed air to 'Purge and Valve Actuator' port

G.3.9. Verify the 'Helium Out' port is capped off

Note:
In the following step do not activate the circuit breakers for the two GT and MT heat exchangers

G.3.10. Activate the two GM, 'Main" and "Pump", main circuit breakers

G.3.11. Connect a certified helium source to the 'Helium In' port

1. Adjust bottle pressure to ~80 psig
2. Adjust APR-1 to give approximately 2psig at AG-3
3. Open AV-11 and AV-9
4. Crack open 'Helium Out' port and adjust helium supply to purge through AV-11 for 1 minute, then close AV-11

5. Close AV-9
6. Vent Pump Exhaust to outside of building

G.4. **Verify Proper Operation of Gas Module**

G.4.1. Evaluate condition of post ship pressures

1. Record EG-1b:_____
2. Record AG-2:_____
3. Record EG-3:_____

G.4.2. Verify all AV valves are closed

G.4.3. Record initial pressure AG-2a/b:_____torr

G.4.4. Open AV-3 and record AG-2a/b:_____torr

G.4.5. Open AV-1 and record AG-2a/b:_____torr

G.4.6. Open AV-2 and record AG-2a/b:_____torr

G.4.7. Open AV-10 and record AG-2a/b:_____torr

G.4.8. Open AV-4 and record AG-2a/b:_____torr

G.4.9. Open AV-6 and record AG-2a/b:_____torr

G.4.10. Open AV-5 and record AG-2a/b:_____torr

G.4.11. Close AV-5 and record AG-2a/b:_____torr

G.4.12. Turn on roughing pump AP-1

G.4.13. When pressure bottoms out record AG-2a/b:_____torr

G.4.14. Close AV-8

G.4.15. Perform leak up test for 15 minutes

1. Time:	_____	_____	_____	_____
2. Pressure (torr):	_____	_____	_____	_____

G.4.16. Close all AV valves, leaving system evacuated

WARNING:

A Hazardous Operation is about to begin. The following steps pose a cryogenic hazard. When filling the liquid nitrogen trap on the leak detector, the individual performing the operation must wear safety goggles, face shield, cryogenic safety apron, cryogenic safety gloves and non-porous shoes. Failure to comply may result in personal injury.

G.5. **Leak Check EV Section of Gas Module**

G.5.1. Ensure six foot control area (level 4) around leak detector

G.5.2. Make PA announcement stating that a hazardous operation is about to take place

G.5.3. Turn on amber warning light

G.5.4. Clear the area of all nonessential personnel.

G.5.5. Turn on and calibrate leak detector

1. Record Standard leak: _____scc/s He
2. Record Measured leak: _____scc/s He

Note:

The hazardous operation is now complete.

G.5.6. Disband control area around leak detector

G.5.7. Make PA announcement stating that the hazardous operation is now complete

G.5.8. Turn off amber warning light and ensure green light is on

G.5.9. Connect leak detector to Access-3

G.5.10. Activate leak detector up to EV-5 and leak check up to EV-5

G.5.11. Open EV-21, -19, -20, -10, and -6

G.5.12. Ensure EV-7a/b fully open

G.5.13. Open in sequence EV-14, -4, -10, -15, -16, -17, -9, -13, -11

G.5.14. Rough out EV section of GM

1. Verify AP-1 on
2. Open AV-6
3. When EV-2b <50 torr close AV-6

G.5.15. Open EV-5

G.5.16. Leak check EV section

1. Record background leak rate:_____scc/s He
2. Leak check all areas of GM EV section
3. Record final leak rate:_____scc/s He
4. Ensure no rise detected

G.5.17. Open AV-1, -2, -3, -10, -4, -7 and-5

G.5.18. Open AV-5

G.5.19. Leak check AV+EV section

1. Record background leak rate:_____scc/s He
2. Leak check all areas of GM EV section

3. Record final leak rate:_____scc/s He
4. Ensure no rise detected

G.5.20. Close all EV and AV valves except EV-7a/b

G.5.21. Vent and disconnected leak detector

Section Complete QA Witness:_____

G.6. **Set Up Gas Meter**

G.6.1. Remove the blank off from "Vent Exit" and plumb this port to Gas Meter

G.6.2. Connect the electrical output leads of the Gas Meter to the Veeder Root input of the EM

G.6.3. Vent the Gas Meter exit to the outside of the building

G.7. **Verify Proper Operation of DAS with EM and PM**

G.7.1. Connect the SMD simulator to the EM and DAS using the appropriate cables

G.7.2. Boot PC and start program DRP_SMD.

G.7.3. Perform Auto- Restart

G.7.4. Perform a data collection with [Get Data] of Main Menu

G.7.5. Compare data print out with expected values from last certification operation

1. Record Opt Number:_____

G.7.6. Verify no temperature differences greater than .01K

Section Complete QA Witness:_____

G.8. **Verify proper operation of EM RAV Controller and Power Supply**

G.8.1. Open Simulated RAV-1

1. Connect the test RAV to the SMD simulator at SRAV-1
2. Verify all RAV selector switches are off
3. Power on RAV power supply to 1.8 Amps and 28 Volts
4. Power on RAV drive units No: 1, 2, 3, and 4
5. Turn RAV selector switch N0.1 to RAV-1
6. Record micro switch lights: Open: Close:
7. Activate Drive Unit #1 to open and record:
    a. Run Time:_____sec
    b. Current Draw:_____amp

c. Time of Day:_____

8. Record micro switch lights: Open: Close:

G.8.2. Close Simulated RAV-1

1. Record micro switch lights: Open: Close:
2. Activate Drive Unit #1 to close and record:
    a. Run Time:_____sec
    b. Current Draw:_____amp
    c. Time of Day:_____
3. Record micro switch lights: Open: Close:

G.8.3. Turn selector switch No.1 to off

G.8.4. Turn Drive Unit #1 off

G.8.5. Open Simulated RAV-3

1. Connect the test RAV to the SRAV-3 on the SMD simulator
2. Turn RAV selector switch N0.2 to RAV-3
3. Record micro switch lights: Open: Close:
4. Activate Drive Unit #3 to open and record:
    a. Run Time:_____sec
    b. Current Draw:_____amp
    c. Time of Day:_____
5. Record micro switch lights: Open: Close:

G.8.6. Close Simulated RAV-3

1. Record micro switch lights: Open: Close:
2. Activate Drive Unit #3 to close and record:
    a. Run Time:_____sec
    b. Current Draw:_____amp
    c. Time of Day:_____
3. Record micro switch lights: Open: Close:

G.8.7. Turn selector switch No.3 to off

G.8.8. Ensure all drive units off

G.8.9. Ensure all selector switches are off

G.8.10. Turn off RAV power supply

G.8.11. Disconnect the test RAV from the simulator

Section Complete QA Witness:_____

G.9. **Establish Final Configuration**

G.9.1. Verify performance of post-operations checklist (Appendix 2)

Section Complete QA Witness:_____

H. **PROCEDURE COMPLETION**

Completed by:_____

Witnessed by:_____

Date: _____

Time:_____

Quality Manager_____**Date**_____

Payload Test Director_____**Date**_____

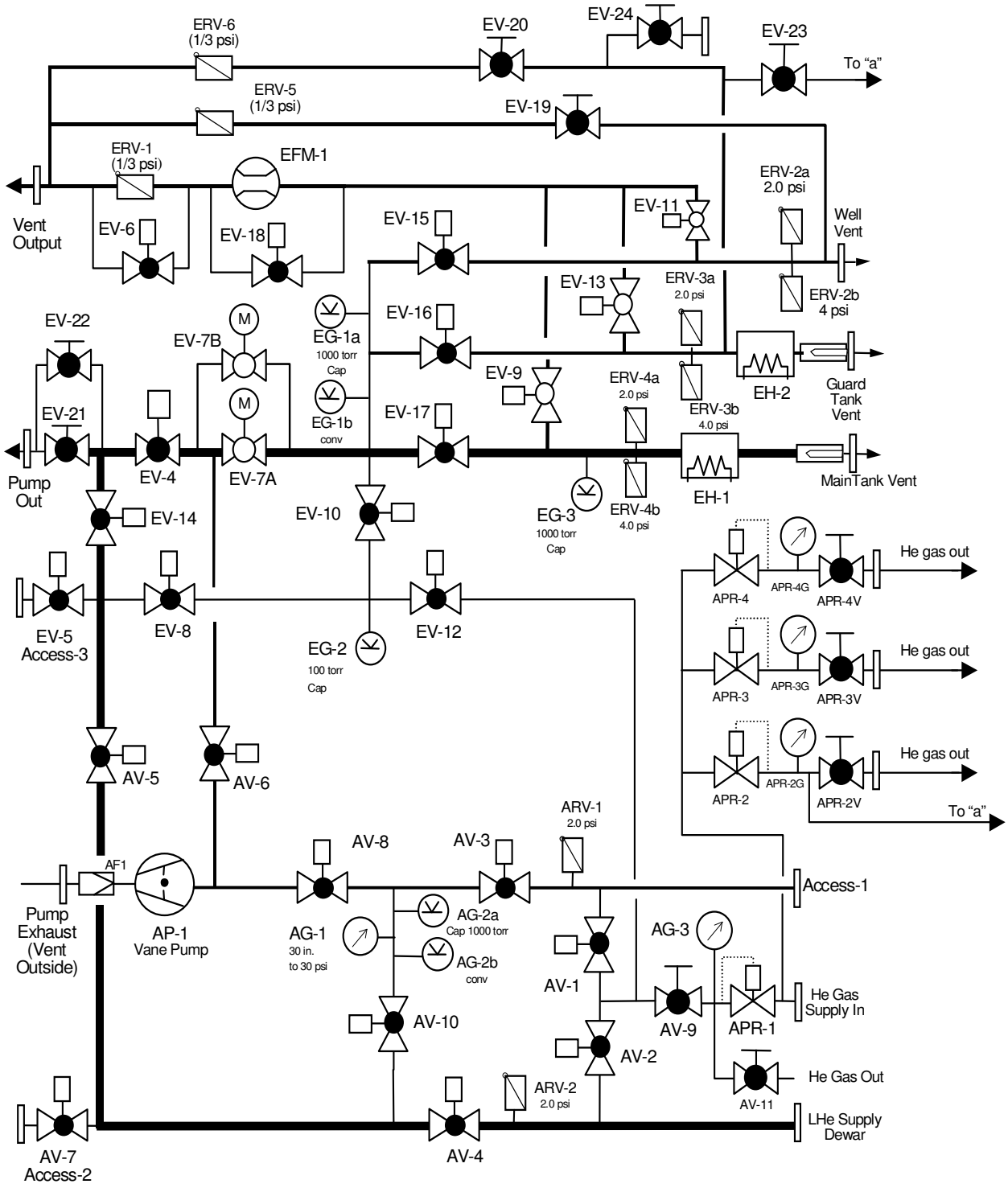

Figure 1. Gas Module

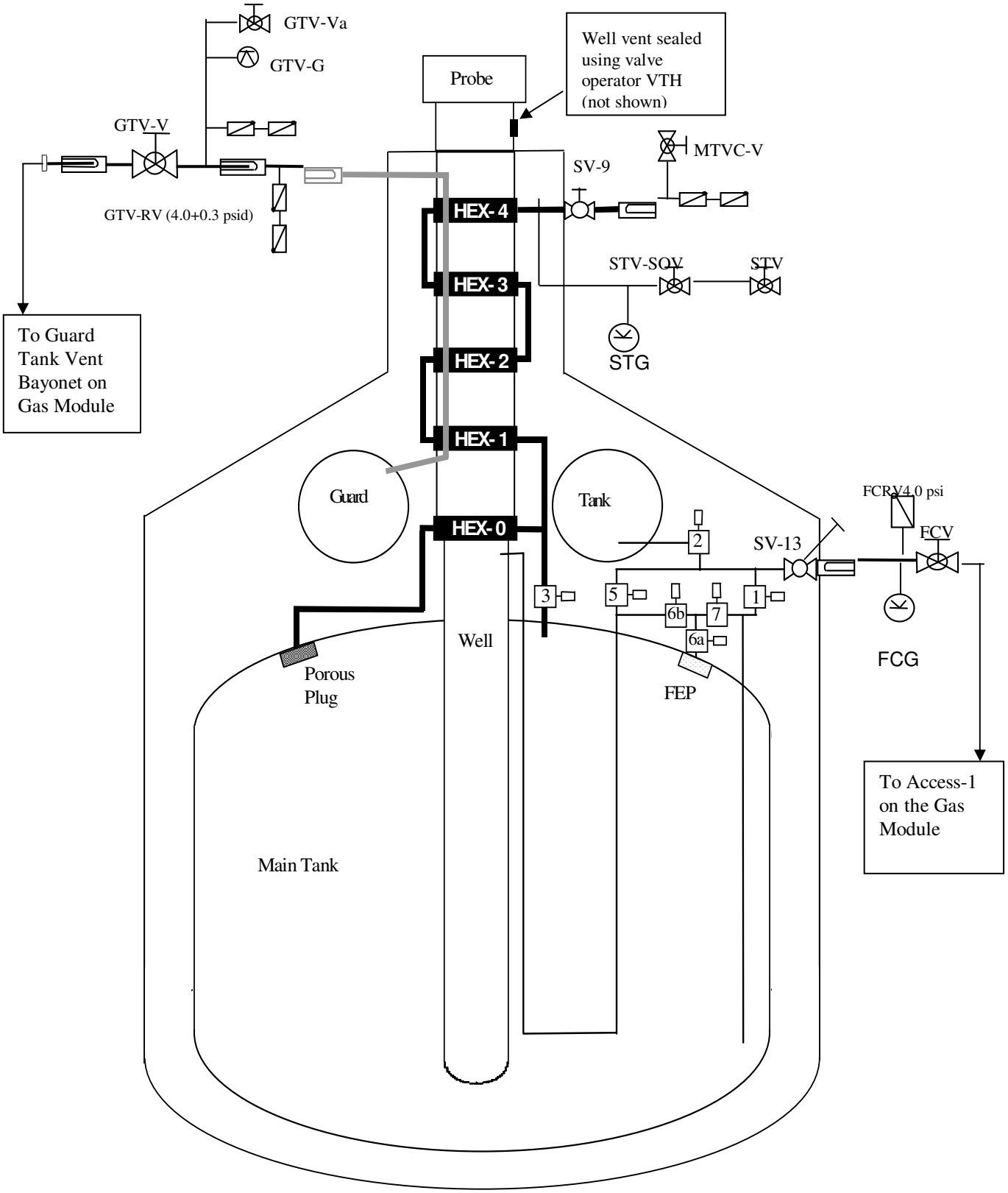

Figure 4 Schematic representation of SMD showing interfaces with Gas module.

SV-9

I. 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/safety high bay walkdown. 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: _____		

J. 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. 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: _____		

K. APPENDIX 3– CONTINGENCY/EMERGENCY RESPONSES

Condition	Circumstance	Response
Power Failure	Anytime	Wait for power restoration and resume procedure
Liquid nitrogen spill	Anytime	Clear area until all spilled liquid has evaporated
Temperature limits (CN 29 or 28) exceeded	Any time	Increase Main Tank venting
Burst disk rupture (MT/GT)	Any time	Evacuate room
Pressure in Main Tank exceeds limit	Anytime	Increase Main Tank venting to relieve pressure in Main Tank
Oxygen Monitor Alarm	Anytime	Evacuate building