# GRAVITY PROBE B
# PROCEDURE FOR
# SCIENCE MISSION DEWAR

## DISCONTINUE PUMPING ON PROBE-C WITH UTS

**To be performed at Vandenberg Air Force Base building 1610**

**WARNING: This document contains hazardous operations**

**P1019**

November 13, 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 procedure describes the steps necessary to pause pumping of the Probe by the Utility Turbo Station (UTS) and provides the option of terminating pumping and removing the UTS and associated plumbing from the Probe.

The hazardous operation in this procedure is the use of liquid nitrogen to service the leak detector.

## 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 and VAFB 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

All 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 requiring emergency medical treatment **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 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

| 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. A calibrated continuity checker is provided to verify any wrist strap prior to use.

### E.2. Lifting Operation Requirements

There are no lifting operations in this procedure

### E.3. Hardware/Software Requirements

E.3.1. Commercial Test Equipment

1. Helium leak detector

   Record Cal Due Date:_____ S/N#_____

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. HEPA down-flow booth

E.3.5. Additional Hardware

1. 4 liter liquid nitrogen thermos
2. Wrist strap continuity checker

E.3.6. Tools

| ***Description*** |
|---|
| N/A |

E.3.7. Personal Protective Equipment

1. Cryogenic Safety Gloves
2. Cryogenic safety apron
3. Goggles/glasses
4. Face shield
5. Non-porous shoes

E.3.8. Expendables

| ***Description*** | ***Quantity*** | ***Mfr./Part No.*** |
|---|---|---|
| N/A | 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 | - |
| 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 | - |

| *No.* | *Location* | *Description* | *Name* | *Serial No.* | *Cal Required* | *Status Cal due date* |
|---|---|---|---|---|---|---|
| 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 $\Delta P \geq 10$ 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

- Ensure Space Craft powered up and prepared to operate Vatterfly valve.
- Verify availability and functioning of emergency shower.

Section Complete QA Witness:_____

**NOTE**

Shutting the Vatterfly requires the Spacecraft. Ensure that the spacecraft operators are standing by and ready to operate the appropriate Vatterfly Valve.

G.2. **Shut-down UTS Turbo Pump**

G.2.1. Specify Vatterfly Valve in use LV1 (-X, -Y quadrant) or LV2 (-X, +Y quandrant)_____

G.2.2. Request Spacecraft team close Vatterfly valve

G.2.3. Verify telemetry indicates that the valve is closed

G.2.4. Record TG-1:_____torr

G.2.5. Turn off TG-1

G.2.6. Verify TV-4 and RGA-V are closed

G.2.7. Close UTS TV-1

G.2.8. Record TG-2:_____torr

G.2.9. Starting recording data from TG-2, TG-3 inn Table 1

G.2.10. Power off Converter and Vane Pump

G.2.11. Record TG-2:_____torr Time/Date:___

G.2.12. After five minutes record TG-2:_____torr Time/Date:___

G.2.13. Verify no rapid rise in TG-2

G.3. **Planned Configuration**

- UTS and plumbing are to be disconnected and removed, proceed to G.5
- This is a temporary shutdown with the intention of restarting pumping in the same configuration, proceed to section G.4

G.4. **Restart Pumping**

G.4.1. Place Valve Interlock switch in 'over-ride' position

G.4.2. Turn on Vane Pump and Converter

G.4.3. Push the red 'reset' button to reset the interlock circuit

G.4.4. Push the sensor button on the vacuum gauge display so that the 'Pir' annunciator displays

G.4.5. Slowly open TV-4

G.4.6. When the "Normalbetrieb" light illuminates, close TV-4 and open TV-1

G.4.7. Switch the valve interlock switch to the "protected" position

G.4.8. Push the sensor button on the vacuum gauge readout so that the "Hi-Vac" annunciator illuminates and the push the Emis botton to turn on the cold cathode gauge, TG-1

G.4.9. Verify TV-4 closed

G.4.10. When the pressure at TG-1 <1*E-4torr record:

1. TG-1:_____torr
2. TG-2:_____torr
3. P-9:_____counts/torr

G.4.11. Close TV-1

G.4.12. Verify UTS interlock switch in protected position

G.4.13. Request Spacecraft team open appropriate Vattefly Valve and record

1. TG-1:_____torr
2. TG-2:_____torr
3. P-9:_____counts/torr

G.4.14. If pressure >500mtorr at TG-2, push Stop on the turbo controller

G.4.15. Slowly open TV-4

G.4.16. When pressure at TG-2< 500 mtorr press Start button on the turbo controller

G.4.17. When TG-2 <100 mtorr, open TV-1

G.4.18. Record TG-1:_____torr

G.4.19. Close TV-4

G.4.20. Continue recording data as often as desired

G.4.21. Skip to G.9 to sign off procedure

QA Witness:_____

G.5. **Prepare/ Verify Prepared HEPA Down Flow Booth**

G.5.1. Ensure HEPA down flow booth installed over Vatterfly Valve and has been running for 30 minutes

G.5.2. Using particle counter, ensure particle count < .5microns

1. Record Particle Counter S/N#:_____ and Cal Due Date:_____
2. Record particle count:_____

QA Witness:_____

G.6. **Perfom Leak Back Test on Vatterfly Valve**

G.6.1. Install certified helium source to TV-5

G.6.2. Record TG-2 or TG-3:_____torr

G.6.3. Open TV-5 slowly until TG-2 reaches between 2-5 torr

G.6.4. Record TG-2:_____

G.6.5. Monitor TG-2 for 30 minutes

1. Time: _____ _____ _____ _____
2. TG-2: _____ _____ _____ _____
3. P-9: _____ _____ _____ _____

G.6.6. Verify pressure change at TG-2< 1mtorr/minute

Section Complete QA Witness:_____

| Note: |
| --- |
| Any individual entering the flow booth must be dressed in clean coveralls, hat and gloves. |

G.7. **Remove Probe Pumping Line**

G.7.1. Open TV-5 until TG-3 read ~760 torr

G.7.2. Close TV-5

G.7.3. Remove pumping line from KF-50 adapter

G.7.4. Verify Vatterfly ISO 200 protective cover has been stored in clean room compatible double bag

G.7.5. Remove Vatterfly adapter flange, bag and stow in clean room compatible double bag

G.7.6. Install Vatterfly ISO 200 protective cover

G.7.7. Connect UTS to Vatterfly ISO 200 protective closeout cover

G.7.8. Push the red 'reset' button to reset the interlock circuit

G.7.9. Push the sensor button on the vacuum gauge display so that the 'Pir' annunciator displays

G.7.10. Slowly open TV-4

G.7.11. When the "Normalbetrieb" light illuminates, close TV-4 and open TV-1

G.7.12. Switch the valve interlock switch to the "protected" position

G.7.13. Push the sensor button on the vacuum gauge readout so that the "Hi-Vac" annunciator illuminates and the push the Emis botton to turn on the cold cathode gauge, TG-1

| **WARNING:** |
| --- |
| **The following steps contain hazardous operations. The individual performing the following steps must wear cryogenic safety gloves, cryogenic apron, goggles/glasses, face shield, and non-porous shoes. Failure to comply may result in personal injury.** |

G.7.14. Ensure 6 foot clear area around vehicle

G.7.15. Make PA announcement stating a hazardous operation is about to commence

G.7.16. Turn on amber warning light.

G.7.17. Ensure all nonessential personnel are clear of controlled area.

G.7.18. 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.7.19. Disband control area

G.7.20. Make PA announcement stating that the hazardous operation is now complete

G.7.21. Turn off amber warning light

G.7.22. Connect leak detector to TV-3

G.7.23. Slowly open TV-3 and close TV-2

G.7.24. Ensure background < 1*E-7 scc/s He

G.7.25. Record initial leak rate:_____scc/s He

G.7.26. Spray all joints on closeout cover with helium

G.7.27. Record final leak rate:_____scc/s He

G.7.28. Verify no rise

G.7.29. Open TV-2 and close TV-3

G.7.30. Close Vatterfly cover valve

G.7.31. Close TV-1 and TV-2

G.7.32. Press Stop on turbo pump controller

G.7.33. Slowly open TV-5 until TG-2 reads between 2 and 5 torr

G.7.34. Perform 30 minute leak back test on Vatterfly cover vavle

1. Time: _____ _____ _____ _____
2. TG-2:_____ _____ _____ _____

G.7.35. Verify no rise detected in last 20 minutes

G.7.36. Open TV-5 until TG-2 reads ~760 torr

G.7.37. Remove UTS from Vatterfly cover valve and install plug in cover valve

QA Witness:_____

## G.8. Establish Final Configuration

G.8.1. Verify DAS alarm system enabled and record set points.

1. ***Top of lead bag temperature*** – verify CN [175] on DAS alarm list and set to alarm at T ≤ 6.0 K. Record set point. _____K

2. ***Top of lead bag temperature*** – verify CN [178] on DAS alarm list and set to alarm at T ≤ 6.0 K. Record set point. _____K

3. ***Relative Guard Tank Pressure*** – verify CN [46] on DAS alarm list and set to alarm at ΔP ≥ 10 torr. Record set point. _____torr

G.8.2. Verify liquid-level alarms set, as appropriate, and record set points.

1. ***Main Tank*** – verify liquid-level alarm set ≥20%. Record set point. _____%

2. ***Guard Tank*** – verify liquid level alarm set ≥ 10% (if liquid in GT). Record set point. _____%

G.8.3. Ensure Guard Tank pressure on DAS alarm list and set to alarm at 10 torr differential.

G.8.4. Ensure Watch Dog Timer is armed.

**G.8.5.** Verify performance of post-operations checklist (Appendix 2)

Section G7 completed. QA Witness:_____

H. **PROCEDURE COMPLETION**

**Completed by:**_____

**Witnessed by:**_____

**Date:** _____

**Time:**_____

**Quality Manager**_____**Date**_____

**Payload Test Director**_____**Date**_____

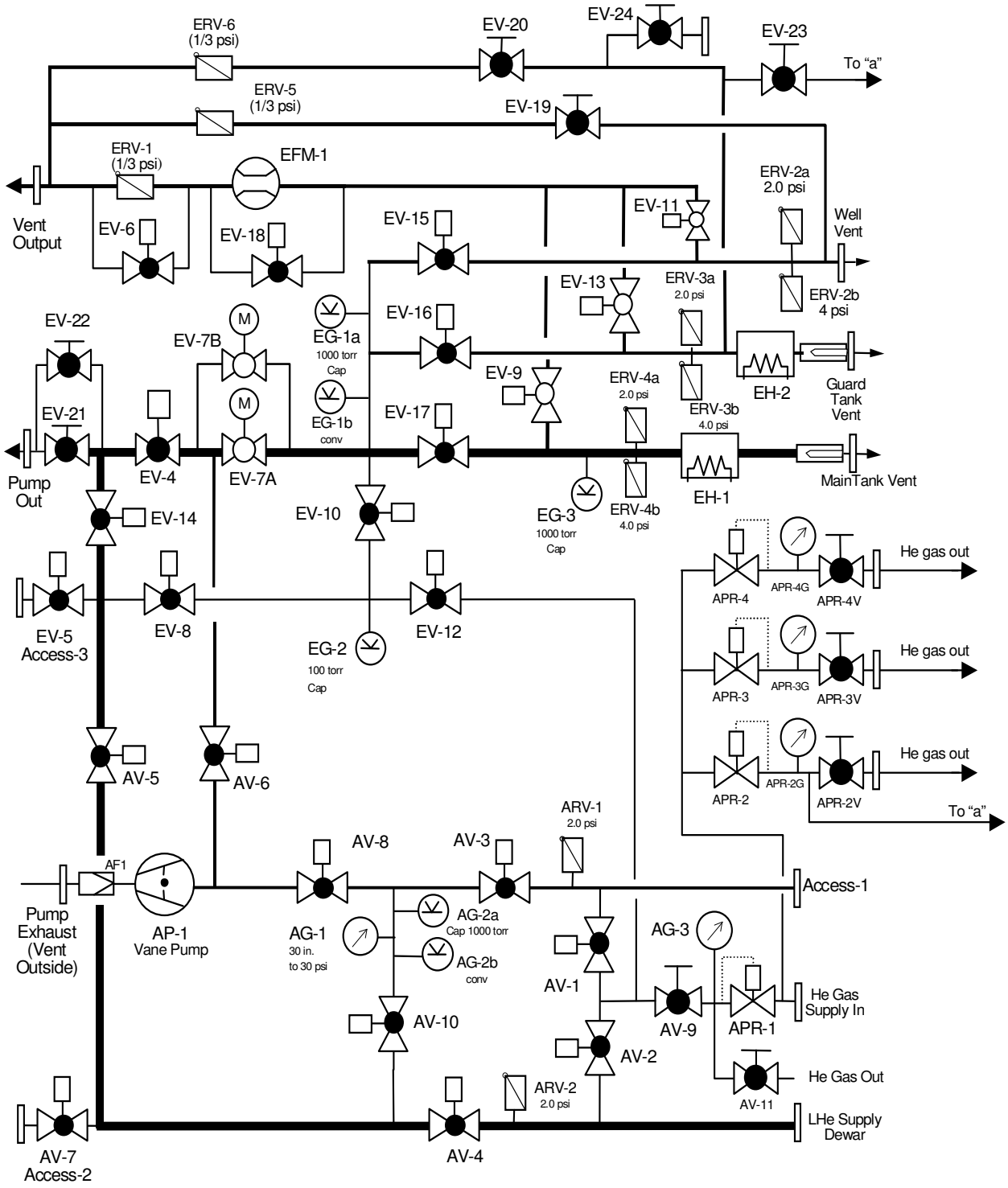


Figure 1. Gas Module

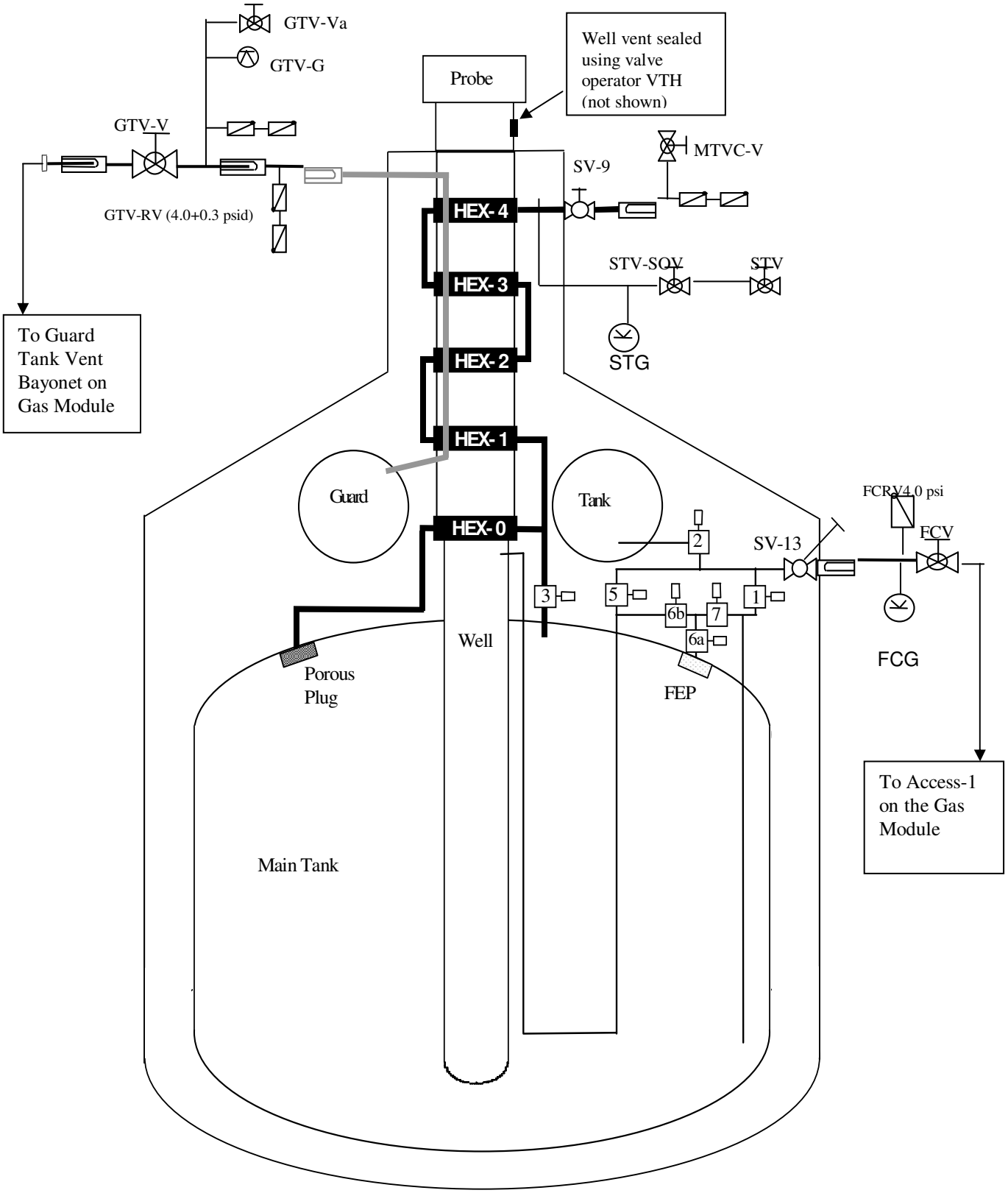


**Figure 4** Schematic representation of SMD showing interfaces with Gas module.



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 and 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. Verify/Perform an Engineering and Safety high-bay walk down. Ensure all discrepancies are corrected prior to start of operation. | | |
| | 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 |