GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

DISCONNECT MAIN TANK VENT LINE FROM GAS MODULE – MAIN TANK AT NBP

To be performed in Vandenberg Air Force Base building 1610

WARNING : This document contains hazardous operations

Aug 9, 2002

P1007

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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.
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.
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
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 provides the steps necessary to disconnect the Main Tank vent line from the Gas Module and install the Main Tank Vent Cap assembly, when the Main Tank liquid is at NBP. The steps include:

Set up Main Tank in slightly pressurized mode to ensure adequate pressure for purging

Leak check Main Tank Vent Cap

Close SMD vent valve

Remove vent line

Install vent cap and leak check

Open SMD vent valve

The procedure is applicable when the Guard Tank contains liquid or when it is depleted. In either case the Guard Tank may be connected to or disconnected from the Gas Module.

The hazardous operation contained in this procedure is the handling of cryogenic 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, there may be an oxygen deficiency monitor that alarms when the oxygen level is reduced to 19.5%. In addition, the GP-B cryogenic team provides an oxygen deficiency monitor that alarms when the oxygen level is reduced to 19.5%. Appropriate action(s) to be taken in the event of oxygen deficiency monitor alarming at 19.5% (evacuation, safety verification of acceptable O2, etc) 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 life support apparatus ELSA) 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 room and proceed to designated fallback area Bldg 1605, 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 and full-face shields with goggles/glasses 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 SMD or Probe shall be tethered.

B.3. Mishap Notification

B.3.1. Injury

In case of illness/injury 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 (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 PTD 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 PTD 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 Test Director is the designated signer for the “witnessed by” sign-off located at the end of each procedure. The person in charge of the operation (Test Director or Test Engineer) is to sign the “completed 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.

E. REQUIREMENTS

E.1. Electrostatic Discharge Requirements

When working on the space vehicle, proper ESD protection is required. The wrist-strap will be checked using an appropriate calibrated checker 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

No commercial test equipment is required for this operation.

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

Description

Helium leak detector: Calibrated. Leak:____ Cal Due Date:_____

E.3.5. Additional Hardware

Description
Main Tank vent cap assembly – See Figure 2
4 liter thermos

E.3.6. Tools

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

E.3.7. Personnel Protective Equipment

1. Cryogenic safety gloves and apron
2. Face Shield
3. Goggles/Glasses
4. Non-absorbent shoes

E.3.8. Expendables

WARNING
Ethanol is highly flammable and vapor/air mixtures are Explosive.
Exposure hazards include: Inhalation (headache/fatigue),
skin (dryness, eyes (redness/pain/burning)

Description	***Quantity***	***Mfr./Part No.***
Ethanol	AR	N/A
99.999% pure gaseous helium	AR	N/A
Vacuum Grease	AR	Apeizon N Dow Corning High Vacuum Grease

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*	*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, 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).

E.5.2. Guard Tank
The Guard-Tank may contain liquid, or be depleted.

E.5.3. Well
The Well is evacuated.

E.5.4. Vacuum Shell

The Vacuum Shell pressure shall be less that 5*10^-5 torr.

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 40 and CN 41) at T ≤ 6.0 K.

    b. Relative Guard Tank Pressure (CN 46) set at □P ≥ 0.3 torr.

E.5.6. GSE

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 Main Tank Vent Cap (Figure 5).

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 SMD is installed in its transportation and test fixture.
2. The ion-pump magnet is installed.
3. 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 with the Vacuum Module actively pumping the vacuum shell.
4. The thruster vent port is flanged to a shut-off valve.
5. The Fill Cap Assembly is installed at SV-13.

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 171.2 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 Main Tank Vent Line connected-if Main Tank Vent Line is not connected terminate procedure.
- Verify availability and functioning of emergency shower

QA Witness:_____

G.2. Verify Purity of All Sources of Helium Gas

G.2.1. Record serial number on helium bottle/s.

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

G.2.2. Verify helium bottle/s have been tested for purity and record Op. Number.
Op. Number:_____

QA Witness:_____

WARNING
This is a hazardous operation. When filling the nitrogen trap in the leak detector, wear cryogenic safety apron, gloves, face shield with goggles/glasses, and non-absorbent shoes. Failure to comply may result in personal injury.

G.3. **Leak Check Main Tank Vent Cap.**

G.3.1. Ensure the area warning light is changed to Amber

G.3.2. Ensure a controlled area of 15 feet is established

G.3.3. Ensure all nonessential personnel are clear of controlled area.

G.3.4. Request NASA safety to make a PA announcement that a hazardous task is about to begin

G.3.5. Record calibrated leak:_____scc/s

G.3.6. Record measured leak:_____scc/s

G.3.7. Connect Leak Detector to MTVC-V.

G.3.8. Cap all other access ports.

G.3.9. Bag the entire Main Tank Vent Cap Assembly.

G.3.10. Open/Verify open MTVC-V.

G.3.11. Record Leak detector background:_____ scc/s

G.3.12. Verify background less than $5x10^{-7}$ scc/s.

G.3.13. Record leak rate after one minute exposure:_____ scc/s

G.3.14. Verify no rise detected during this test.\

Note:

The hazardous operation is now complete. Make PA announcement that the hazardous operation is now complete. Ensure area warning light turned to green and disband controlled area.

QA Witness:_____

G.4. **Verify Configuration Requirements**

G.4.1. Verify liquid in Main Tank at NBP (4.2<T<4.3) and record temperature at bottom of tank CN [9] _____K.

G.4.2. Ensure DAS alarm system enabled and record set points.

1. ***Top of lead bag temperature*** – ensure CN [40] and CN[41] on DAS alarm list with alarm limit at $T \leq 6.0$ K. Record set point. _____K
2. ***Relative Guard Tank Pressure*** – ensure CN [46] on DAS alarm list with alarm limit at $\Delta P \geq 0.3$ torr. Record set point. _____torr

G.4.3. Ensure liquid-level alarms enabled, as appropriate, and record set points.

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

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

QA Witness:_____

G.5. **Record Initial Configuration and Conditions**

G.5.1. Record Guard Tank Configuration.

- o Guard Tank contains liquid, is connected to the GM and is venting in bypass mode (EV-20 open and EV-13 closed).
- o Guard Tank contains liquid, is connected to the GM and is venting in common manifold mode (EV-13 open and EV-20 closed).
- o Guard Tank contains liquid and is disconnected from Gas Module.
- o Guard Tank is depleted and is connected to Gas Module.
- o Guard Tank is depleted and is disconnected from Gas Module.

G.5.2. Record initial liquid helium levels as appropriate.

1. Main Tank (LL-1D or LL-2D) _____%
2. Guard Tank (LL-5D or LL-6D) _____%

G.5.3. Record initial pressures, as appropriate.

1. Main Tank (EG-3):_____ torr.
2. Guard Tank (EG-1a) _____ torr.
3. Guard Tank (GTV-G, relative to atm.) _____ torr.

QA Witness:_____

G.6. Set Up Main Tank in Non-vented, Slightly Pressurized Mode

CAUTION
During the period of Main Tank vent closure, the temperature at the top of the lead bag is to be continuously monitored. Failure to comply may result in equipment damage.

G.6.1. Close EV-9 and record:

1. Date/time : _____/_____.
2. Main Tank Pressure (EG-3):_____ torr
3. Input comment to DAS, "Main Tank Vent"

G.6.2. Monitor Main Tank pressure at EG-3 for 3 minutes. Record data in Table 1.

Table 1

Time	Pressure EG-3 (Torr)	Lead Bag temp [28] (K)

G.6.3. If Main Tank pressure (EG-3) remains constant or rises at a rate less than 1.5 torr per minute, build pressure in Main Tank as follows:

1. Turn on Tank Heater (H-8D or H-9D) power supply and adjust current limit to 1.25 amps.
2. Increase heater voltage slowly to 15 V maximum to build pressure in Main Tank.
3. Monitor Main Tank pressure at EG-3 and record data in Table 2.

Table 2

Time	Heater Voltage (V)	Pressure EG-3 (Torr)	Lead Bag temp [28] (K)	GT temp [24] (K)

G.6.4. When Main Tank pressure (EG-3) reaches 780 torr,

1. Turn off Main Tank heater, if on.
2. Record time of day: _____
3. Record Main Tank Pressure (EG-3):_____ torr

QA Witness:_____

G.7. **Disconnect Main Tank Bayonet and Install Vent Cap**

G.7.1. Close Main Tank Vent valve SV-9 and torque to 60 in-lbs.

Record Tool Cal Due Date:_____. Record Tool Serial Number:_____

QA Witness:_____

G.7.2. Remove vent line from Main Tank exhaust at one of the following locations (see Figure 2):

- Bayonet (at SV-9) **or**
- Bayonet at end of short vent line opposite from SV-9.

G.7.3. Cover open end of vent line.

G.7.4. Inspect o-ring on appropriate bayonet receptacle; clean and lightly lubricate with Apiezon N vacuum grease.

G.7.5. Install Vent Cap with MTVC-V open.

G.7.6. Leak check bayonet seal at Vent Cap:

1. Turn on leak detector
2. Check calibration
    a. Standard leak rate _____ sccs
    b. Calibrated leak rate _____ sccs
3. Connect leak detector to Vent Cap at MTVC-V.
4. Record background leak rate _____sccs
5. Leak check all joints up to SV-9
6. Verify all joins leak tight:
    a. Record highest leak rate _____ sccs
    b. Verify highest leak rate less than $5*10^{-6}$ sccs
7. Close MTVC-V
8. Remove leak detector

G.7.7. Open SV-9 to establish Main Tank venting.

QA Witness:_____

G.8. **Establish Final Configuration**

G.8.1. Close/verify closed EV-9 and EV-17.

G.8.2. **(Option)** Remove Main Tank vent line from inlet to heat exchanger at Gas Module, install blankoff, and cover open end of vent line.

G.8.3. Record Main Tank pressure STG_____ torr.

G.8.4. Ensure DAS alarm enabled and record set points if changed

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

    a. Top of Lead Bag set point [CN 40vand CN 41] _____ K (≤ 6.0 K)

G.8.5. Ensure liquid level sensor alarms enabled, as appropriate, and record set points if changed.

1. Main Tank Level Set Point _____%
2. Guard Tank Set Point _____%

G.8.6. Ensure Guard Tank pressure on DAS alarm list and set to alarm at > 0.3 torr above atmospheric pressure.

G.8.7. Verify Completion of Post Operations Checklist.

QA Witness:_____

H. **PROCEDURE COMPLETION**

Completed by:_____

Witnessed by:_____

Date: _____

Time:_____

Quality Manager_____**Date**_____

Payload Test Director_____**Date**_____

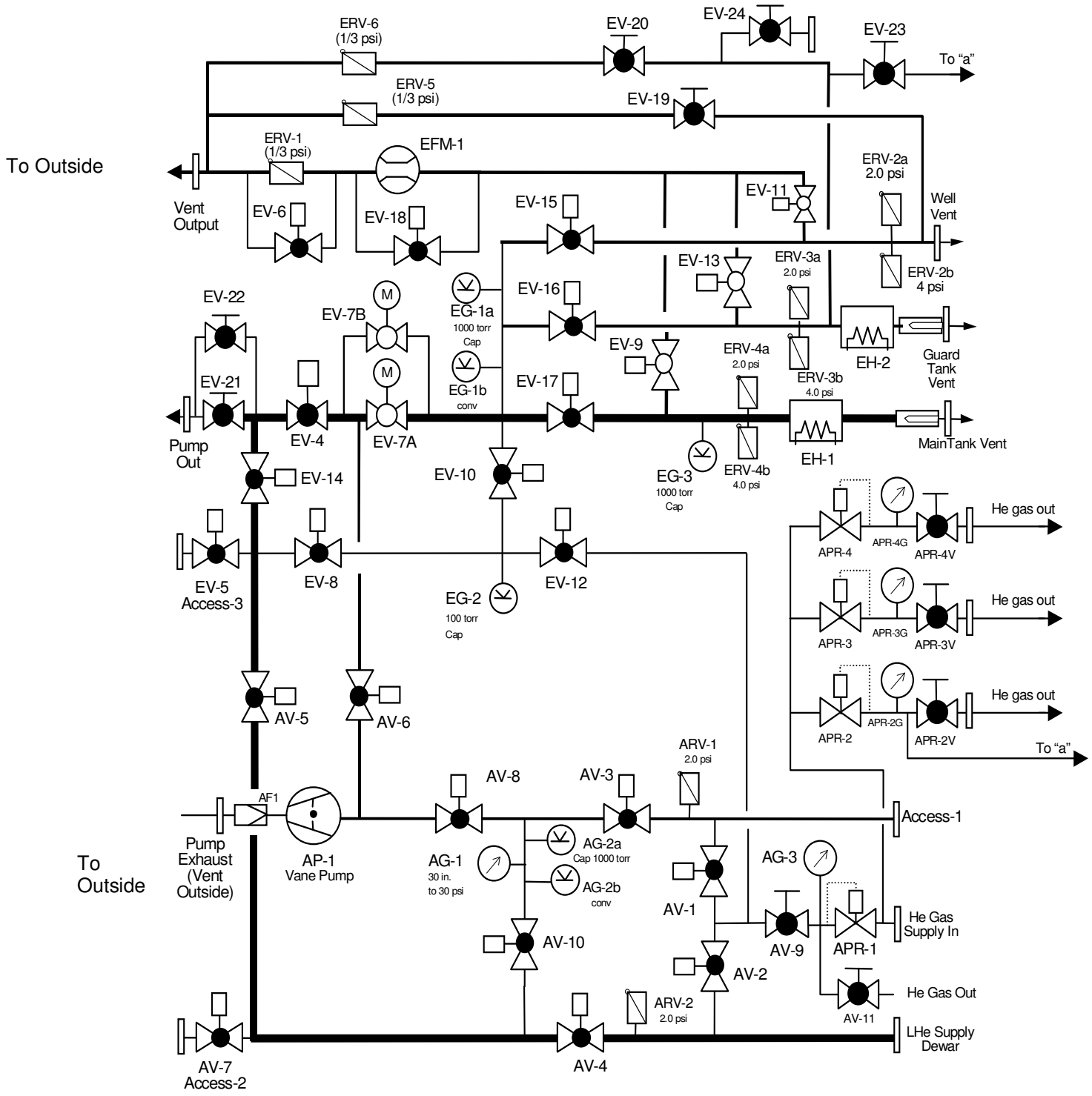
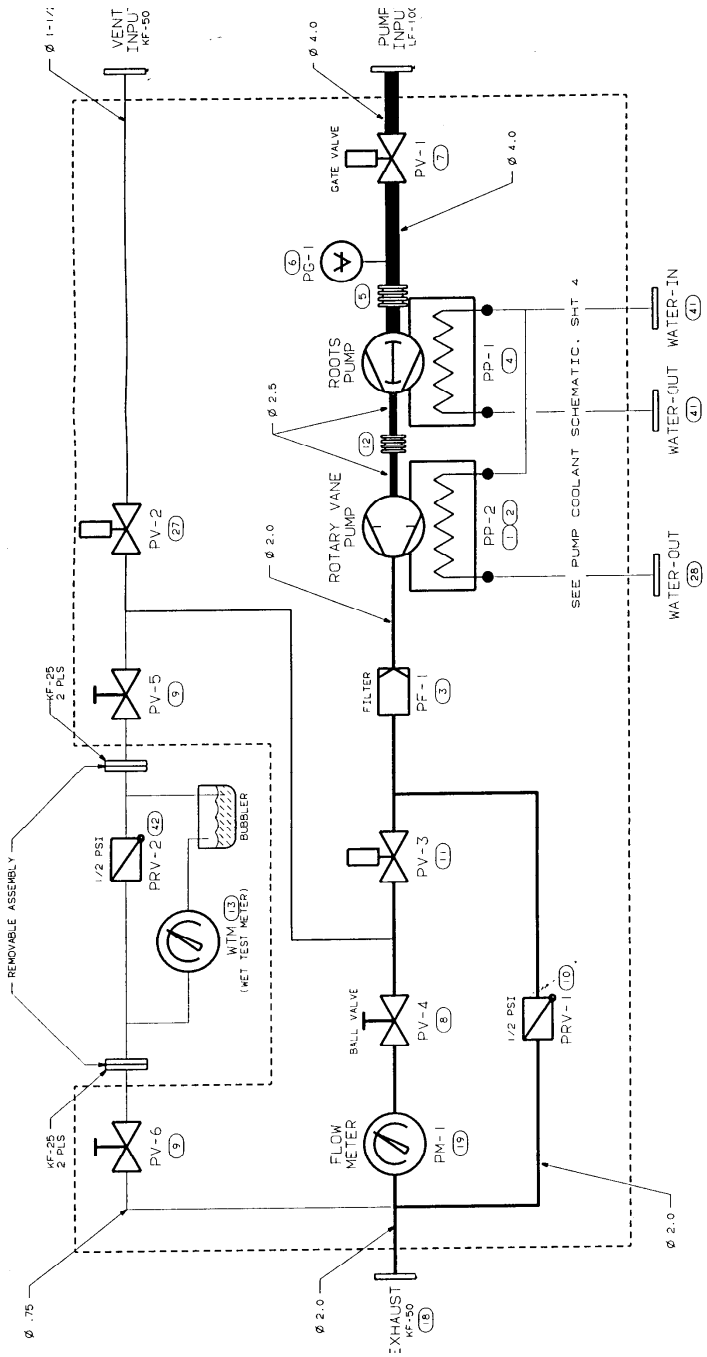


Figure 1. Gas Module

Figure 2-Schematic diagram of the Pump Module



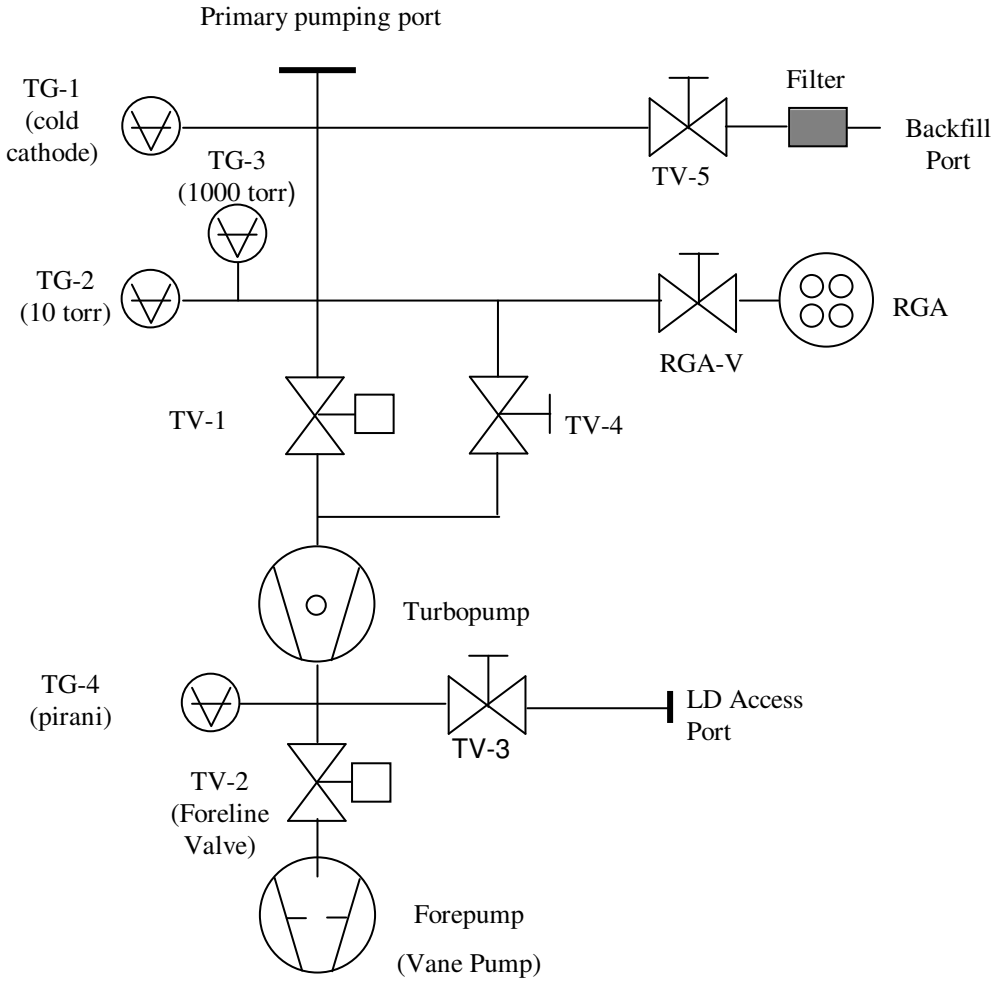


Figure 3. Schematic diagram of Utility Pumping System (UTS)

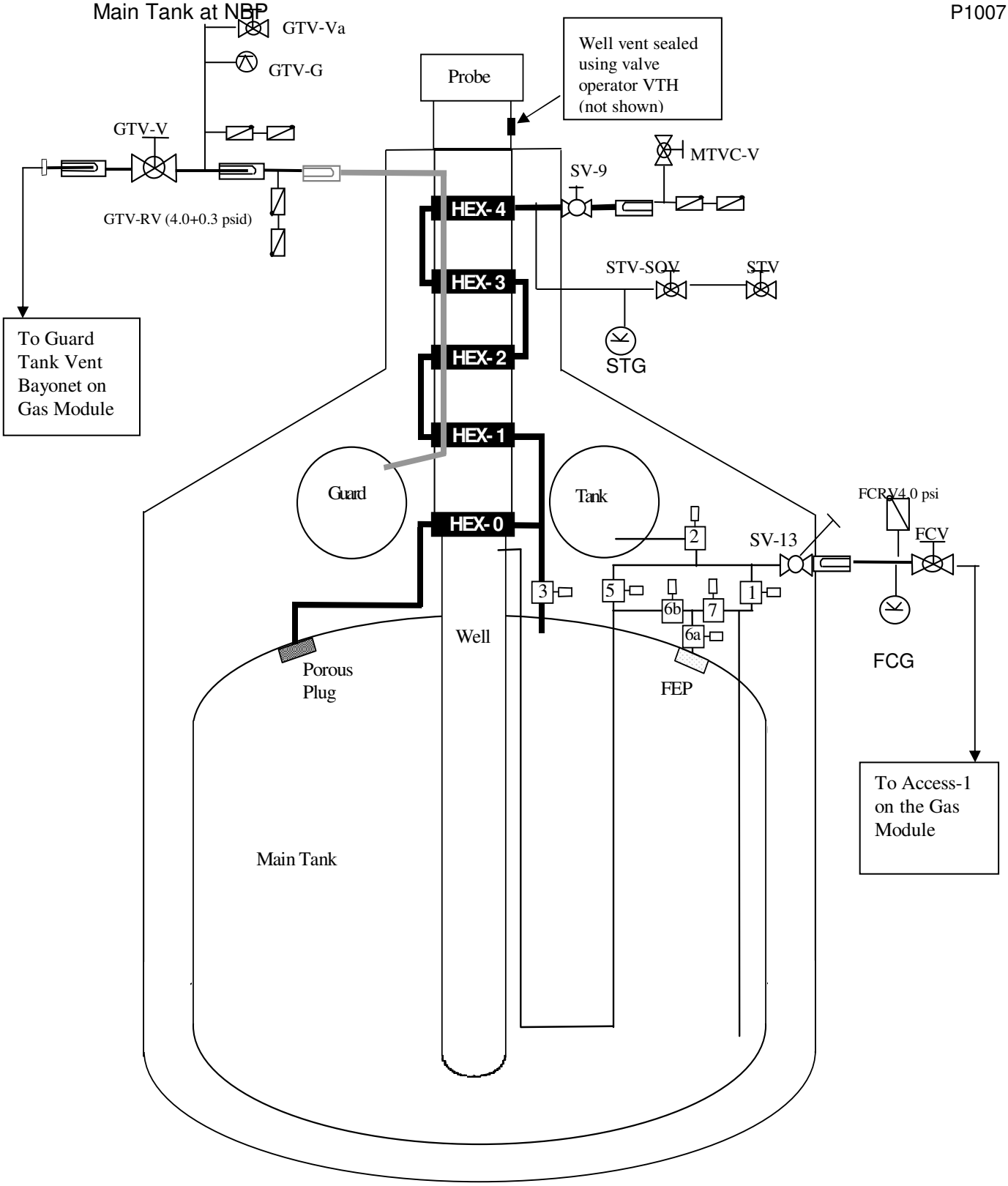


Figure 4 Schematic representation of SMD showing interfaces with Gas module.

Figure 5- Possible Main Tank and Guard Tank Vent Configurations

***note-dashed arrows indicated an option**

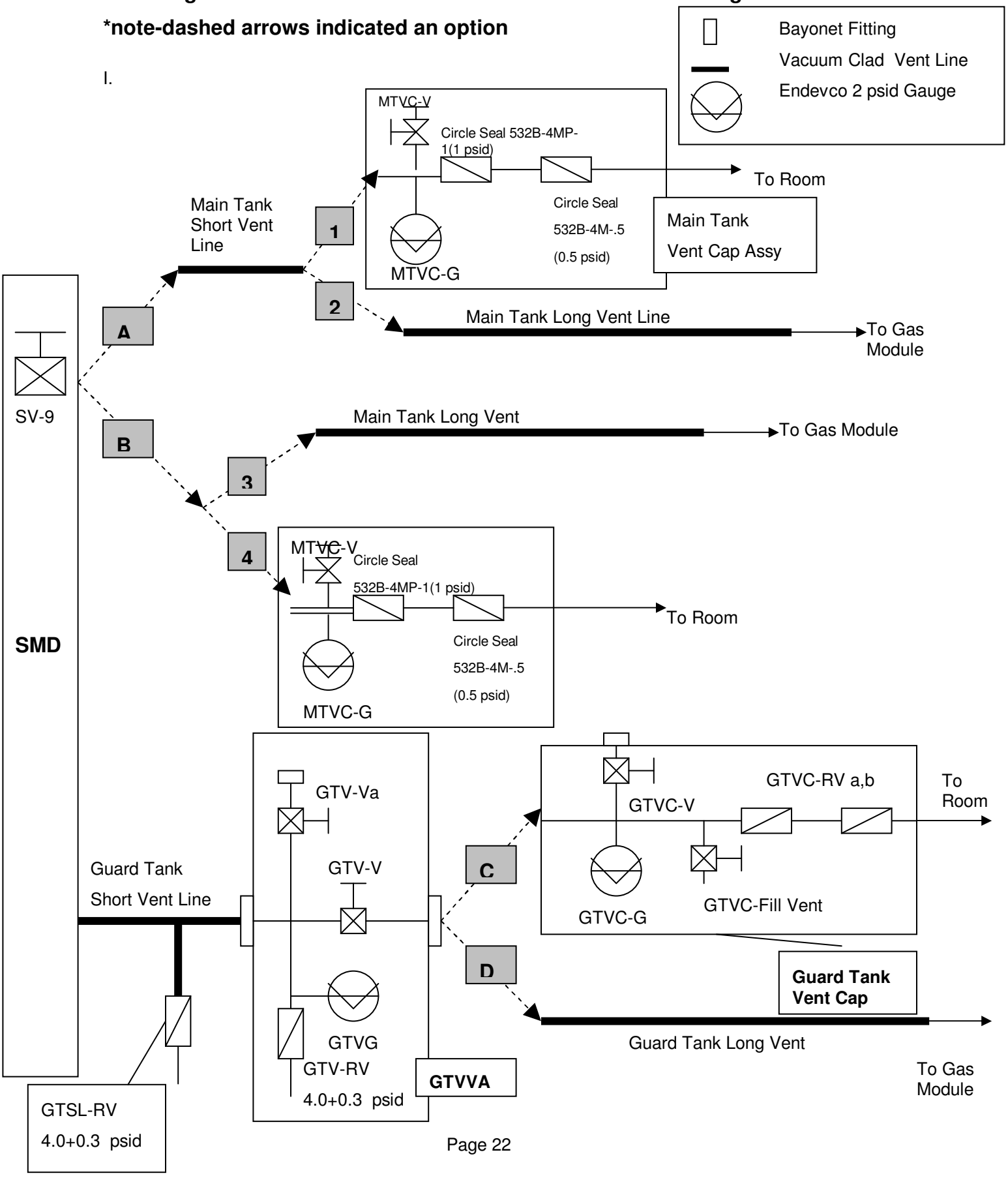
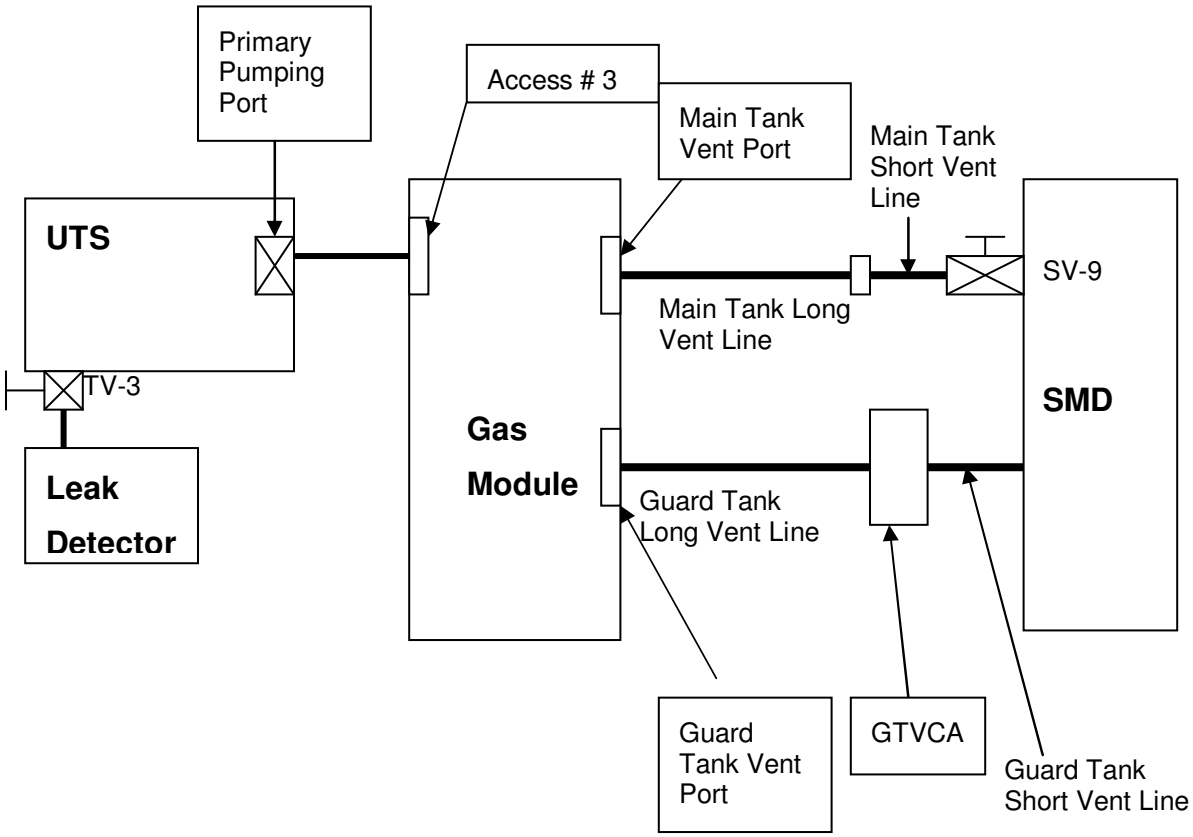


FIGURE 6: BLOCK DIAGRAM OF GSE AND SMD-SEE INDIVIDUAL DIAGRAMS FOR MORE DETAIL



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. Perform an Engineering and Safety High-Bay walk down. Verify all discrepancies are 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. Request NASA Safety concurrence for normal operations		
	Team Lead Signature: _____		

K. **APPENDIX 3–** CONTINGENCY RESPONSES

Condition	Circumstance	Response
Temperature limits (CN 1 or 28) exceeded	Anytime	Close EV-17 (if open) and open EV-9. Crack open SV-9 to allow MT to vent. Adjust SV-9 as necessary to restore temperature(s) below alarm limits. Open EV-6 and EV-18 if higher flow rate is needed.
Burst disk rupture (MT/GT)	Anytime	Evacuate room, Instruct HPF Site Monitor to activate emergency purge
Main Tank or Guard Tank liquid level falls below alarm limit	Anytime	Configure Dewar and Fill as appropriate
Oxygen Monitor Alarm	Anytime	Evacuate Room
Liquid Nitrogen Spill	Anytime	Clear area until all spilled liquid has evaporated