GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

Evacuate and Backfill Vatterfly Valve Covers

THIS DOCUMENT CONTAINS HAZARDOUS OPERATIONS

May 6, 2001

P0914

Written by:

_____Date_____
Ned Calder
Cryogenic Test

Checked by:

_____Date_____
Dave Murray
Cryogenic Test

Approvals:

_____Date_____
Dorrene Ross
Quality Assurance

_____Date_____
Harv Moskowitz
LMMS Safety

_____Date_____
Rob Brumley
Payload Technical Manager

_____Date_____
Mike Taber
Test Director

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
AR	As required
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

A. SCOPE

This procedure describes the steps necessary to evacuate any or all of the Probe Vatterfly valve covers. The procedure allows for the covers to either be left evacuated or backfilled with Helium gas.

Appendix 4 provides the steps to install an Endevco pressure sensor on any vatterfly valve cover if one is not already present.

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. Fall hazard training requirement; Lockheed Martin fall training Is required for any individual performing operations that pose a fall hazard

B.2.2. Cryogenic Hazards

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.

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 as follows
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

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.

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. 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	Jim Maddocks
Ned Calder	Ken Bower

E. REQUIREMENTS

E.1. Electrostatic Discharge Requirements

Grounding wrist straps are to be used for any work on the Space Vehicle per LM requirements.

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

E.3.2. Ground Support Equipment

Utility Turbopump System (UTS) (Figure 3)

E.3.3. Computers and Software:

The Data Acquisition System (DAS) is not 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

E.3.5. Additional Hardware

Description

E.3.6. Tools

Description
None

E.3.7. Expendables

Description	***Quantity***	***Mfr./Part No.***
Isopropyl Alcohol	AR	N/A
99.999% pure gaseous helium	AR	N/A
Vacuum Grease	AR	Apiezon N

E.4. Instrument Pretest Requirements

None required.

E.5. Configuration Requirements

E.5.1. Main Tank
There are no special requirements for the Main Tank

E.5.2. Guard Tank
There are no special requirements for the Guard-Tank.

E.5.3. Well
The Well is always evacuated.

E.5.4. Vacuum Shell

There is no requirement for the vacuum shell pressure.

E.5.5. Alarm System

1. The DAS alarm system must be enabled and contain the following alarm set-points:
    a. Top of the lead bad temperature set (CN 29) set at $T \leq 6.0K$.
    b. Top of lead bag temperature set (CN 28) at $T \leq 6.0$ K.
    c. Relative Guard Tank Pressure (CN 46) set at $P \geq 0.3$ 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. Leak-tight covers are installed on the six Vatterfly valves, V1 – V4 and LV1, LV2.

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
LMSC-P088357	Science Mission Dewar Critical Design Review
SU/GP-B P0108	Quality Plan
EM SYS229	Accident/Mishap/Incident Notification Process
LMMS GP-B-100333	Science Mission Dewar Failure Effects and Causes Plan
SU/GP-B	GP-B Contamination Control Plan
SU/GP-B	GP-B Maintenance and Testing at all Facilities
SU/GP-B P0879	Accident/ Incident/Mishap Notification Process

F.3. Additional Procedures

No additional procedures are indicated.

Operation Number:_____

Date Initiated:_____

Time Initiated:_____

G. OPERATIONS

G.1. Pre-Operations Verifications

- Verify SU QA notified.

  Record: Individual notified _____,

  Date/time _____/_____.

- Verify NASA representative notified.

  Record: Individual notified _____,

  Date/time _____/_____.

- Persons actually performing this procedure should initial their names in Sec D.3 and the name of the Test Director should be circled.

- Verify completion of the Pre-Operations Checklist (Appendix 1).

QA Witness:_____

G.2. Initial Operations

G.2.1. Record serial number on helium bottle/s to be tested.

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

G.2.2. Verify Helium cylinder content has been tested and record operation number.

Opt Number:_____

QA Witnesss:_____

G.3. Attach Pumping Line to Vatterfly Valve Cover and Start UTS

G.3.1. Attach vatterfly pumpout manifold to UTS as indicated in figure 1

1. Verify manifold ends are covered as it is in a clean room bag

G.3.2. Place UTS Valve Interlock switch in the "over-ride" position.

G.3.3. Turn on Vane Pump and Converter

G.3.4. Push the red reset button

G.3.5. Open the foreline valve TV-2.

G.3.6. Slowly open TV-4

G.3.7. Push the sensor button on the vacuum gauge display so that the "Pir" annunciator shows.

G.3.8. When the pressure on the Piriani gauge reads $<1\times10^{-2}$ torr, push the start button on the turbo controller.

G.3.9. When the "Normalbetrieb" light comes on, close TV-4 and open the UTS Gate Valve TV-1

G.3.10. Switch the Valve Interlock switch to the "protected" position.

G.3.11. Push the button on the vacuum gauge readout so that the "Hi-Vac" annunciator shows, and push the emis button to turn on the cold cathode guage, TG-1

G.4. **Leak Check Pumping Line**

G.4.1. Verify operation of leak detector

1. Record calibrated leak S/N #:_____ and Cal due date:_____
2. Record calibrated leak rate:_____
3. Record measured leak rate:_____
4. Verify G.4.1.2 and G.4.1.3 are within 10% of each other.

G.4.2. Attach leak detector to UTS TV-3

G.4.3. Leak check all plumbing up to closed TV-3

G.4.4. Slowly open TV-3 and then close TV-2

G.4.5. When leak detector is on the 10^{-6} range, leak check all plumbing and connections between UTS and vatterfly valve covers

G.4.6. Record initial leak rate:_____

G.4.7. Record final leak rate:_____

G.4.8. Verify no leaks detected

G.4.9. Open TV-2

G.4.10. Close TV-3

G.5. **Verify Endevco Pressure Gauges are Installed**

- Endevco Pressure gauges already installed on valve covers - Proceed to section G.6
- Endevco Pressure gauges not installed on valve covers - Follow instructions in appendix 4.

QA Witness:_____

G.6. **Verify Vatterfly Valve is Closed and Not Leaking**

G.6.1. Record pressure in valve cover:_____

G.6.2. Record last recorded pressure:_____

Note source:_____

G.6.3. Verify no change in pressure.

If there has been a pressure change in the vatterfly valve, consult with the Payload Test Director..

QA Witness:_____

G.7. **Evacuate Vatterfly Valve Cover/s**

G.7.1. Close gate valve TV-1

G.7.2. Press Stop on the turbo controller.

G.7.3. Press the emis button on the vacuum gauge to turn off the cold cathode gauge, TG-1

G.7.4. Open TV-6 to spin down turbo

G.7.5. When turbo spun down completely, open TV-4

G.7.6. Open all Vatterfly Valve cover valves

- LV-1
- LV-2
- VV-1
- VV-2
- VV-3
- VV-4

G.7.7. When the pressure as read on UTS pirani gauge is $<1\times10^{-2}$ torr, press the Start button on the turbo controller.

G.7.8. Push the button on the vacuum gauge readout so that the "Hi-Vac" annunciator shows, and push the emis button to turn on the cold cathode guage, TG-1

G.7.9. When the "Normalbetrieb" light comes on, close TV-4 and open the gate valve TV-1.

G.7.10. Verify that the Valve Interlock switch is in the protected position.

G.8. **Establish Final Configuration**

G.8.1. If it desired to operate the vatterfly valves (open and close) as a part of a test of the space vehicle, pump for one hour before proceeding.

G.8.2. Record Date and Time of commencement of vatterfly valve operation:

1. Date:_____ Time:_____

G.8.3. Verify that telemetry confirms that all valves that have been opened are now closed.

QA Witness:_____

G.8.4. Verify closure of all vatterfly valves with leak back test

1. Close UTS gate valve TV-1
2. Attach Helium supply to TV-5
3. Open TV-5 and backfill caps and manifold to 9 torr as read on TG-2
4. Record TG-2:_____ Time:_____
5. Wait one half hour and record TG-2:_____ Time:_____
6. Verify no decrease in pressure

7.

G.8.5. Select final configuration

o Leave vatterfly valve covers evacuated	1. Press Stop on Turbo controller 2. When Turbo has spun down, slowly open TV-4 3. When pirani gauge $<1\times10^{-2}$ torr, press Start of turbo controller 4. When the "Normalbetrieb" light comes on, close TV-4 and open the gate valve TV-1. 5. Push the button on the vacuum gauge readout so that the "Hi-Vac" annunciator shows, and push the emis button to turn on the cold cathode guage, TG-1 6. Pump for 1 hour: Record start time:_____ 7. Close all vatterfly valve cover valves and record pressure after the valve is closed. o LV-1 _____torr o LV-2 _____torr o VV-1 _____torr o VV-2 _____torr o VV-3 _____torr o VV-4 _____torr 8. Close UTS Gate valve, TV-1 9. Press Stop on UTS turbo controller 10. Turn off Vane Pump and Converter 11. Attach helium gas source to TV-5 12. While monitoring pressure in all vatterfly valves, backfill pumping line to 760 torr 13. Verify no rise in pressure in any of the covers after half hour. 14. Remove pumping line from all vatterfly valve covers 15. Proceed to section G.9

o Backfill vatterfly valve covers with helium	1. Verify UTS gate valve TV-1 closed. 2. Turn off cold cathode gauge, TG-1. 3. Press Stop on UTS turbo controller 4. Ensure TV-2 is closed. 5. Turn off Vane Pump and Converter 6. Verify helium gas source attached to TV-5 7. Open TV-5 and backfill all covers to desired pressure 8. Record pressure as read on TG-3 TG-3: _____torr 9. Close all vatterfly valve cover valves and record pressure on Endevco gauges after the valve is closed. o LV-1 _____torr o LV-2 _____torr o VV-1 _____torr o VV-2 _____torr o VV-3 _____torr o VV-4 _____|torr 10. While monitoring all of the vatterfly valve covers, backfill pumping line to 760 torr 11. Verify no increase in pressure in any of the covers after one half hour 12. Remove vatterfly pumpout manifold 13. Proceed to section G.9

G.9. **Final Verifications**

G.9.1. Verify completion of post-operations checklist.

Completed by:_____

Completed by:_____

Witnessed by:_____

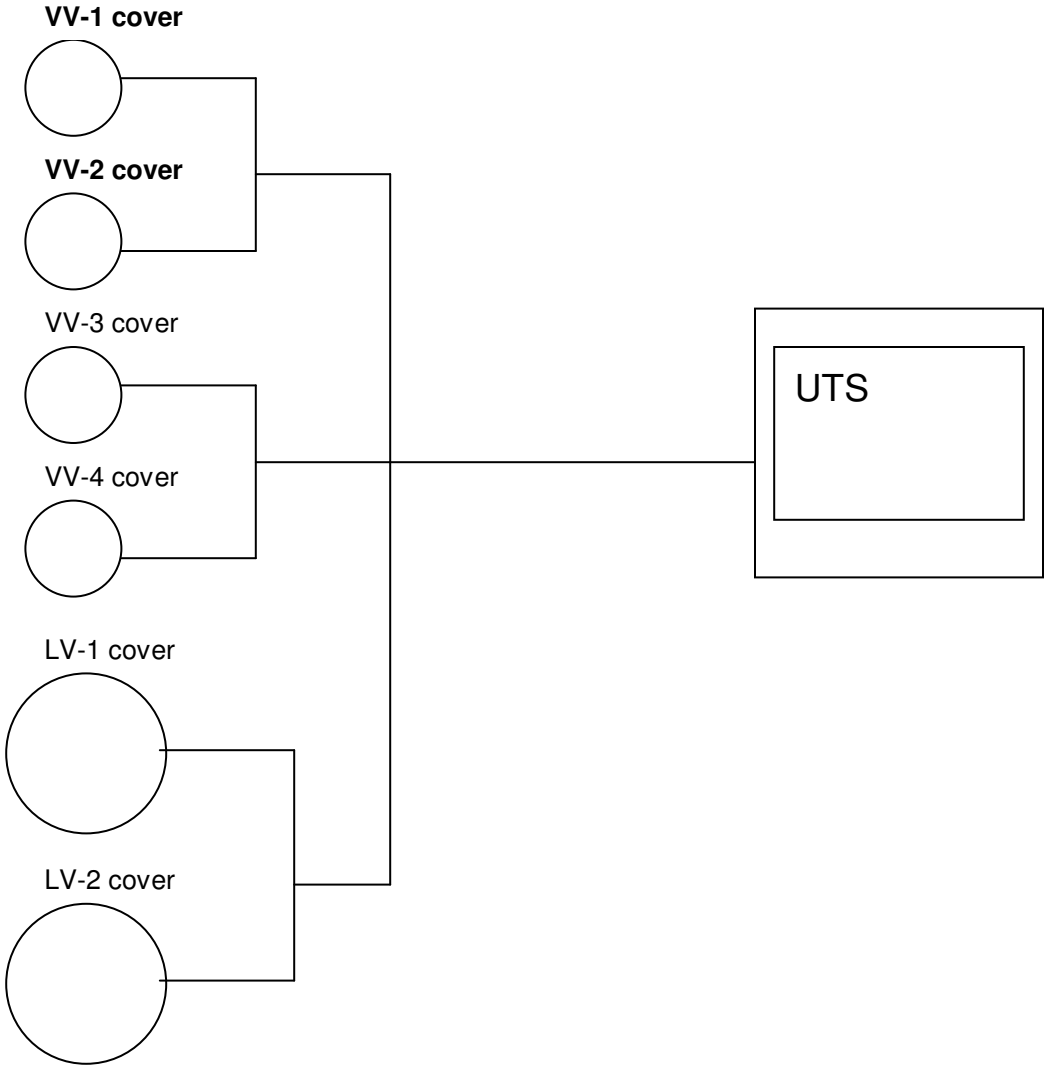
Date: _____

Time:_____

Quality Manager_____Date_____

Payload Test Director_____Date_____

Figure 1


VV-1 cover
VV-2 cover
VV-3 cover
VV-4 cover
LV-1 cover
LV-2 cover
UTS

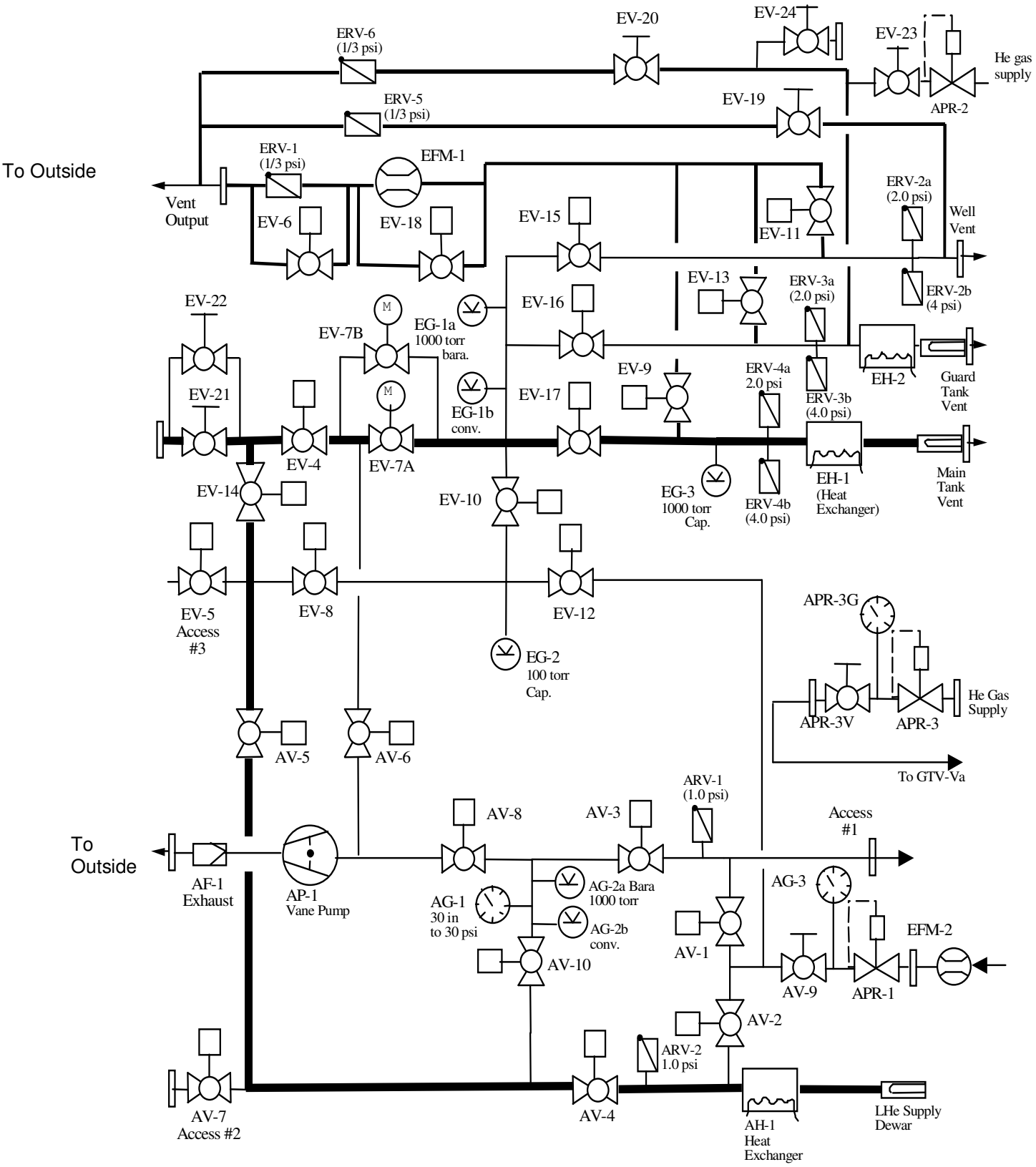
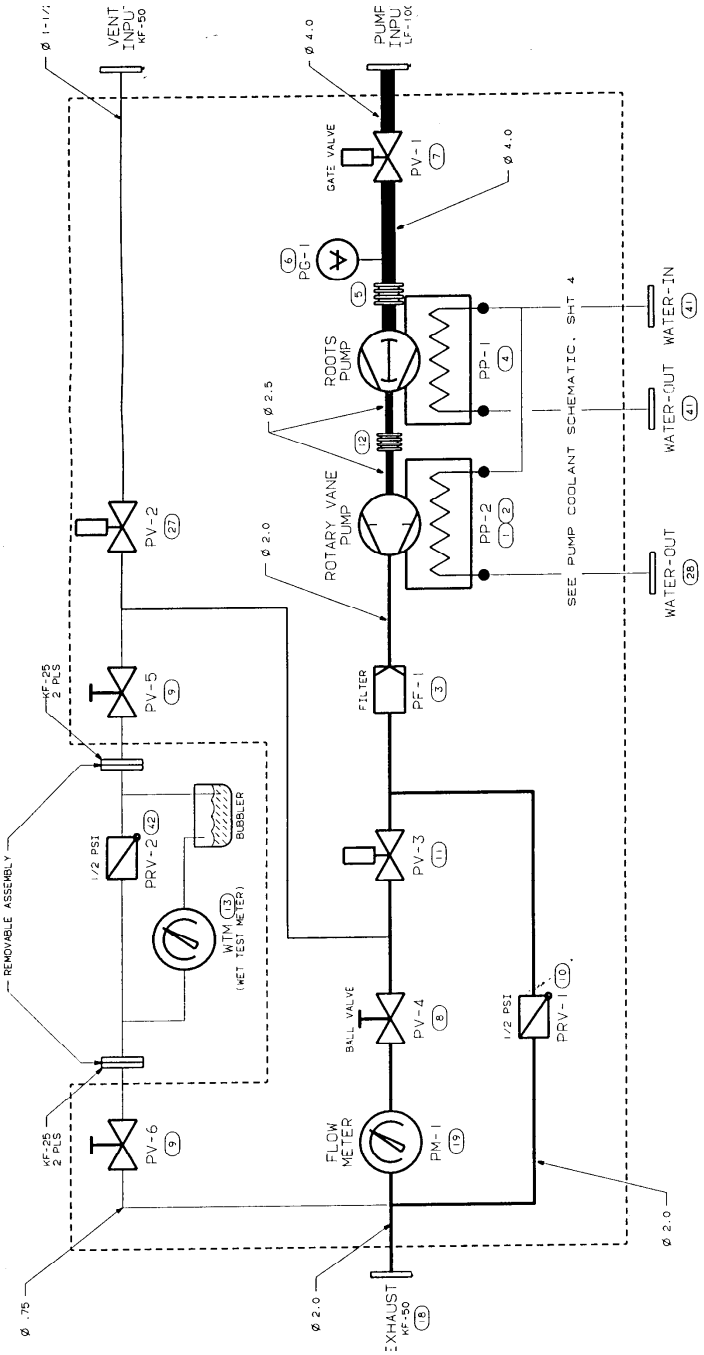


Figure 2. Gas Module

Figure 3-Schematic diagram of the Pump Module



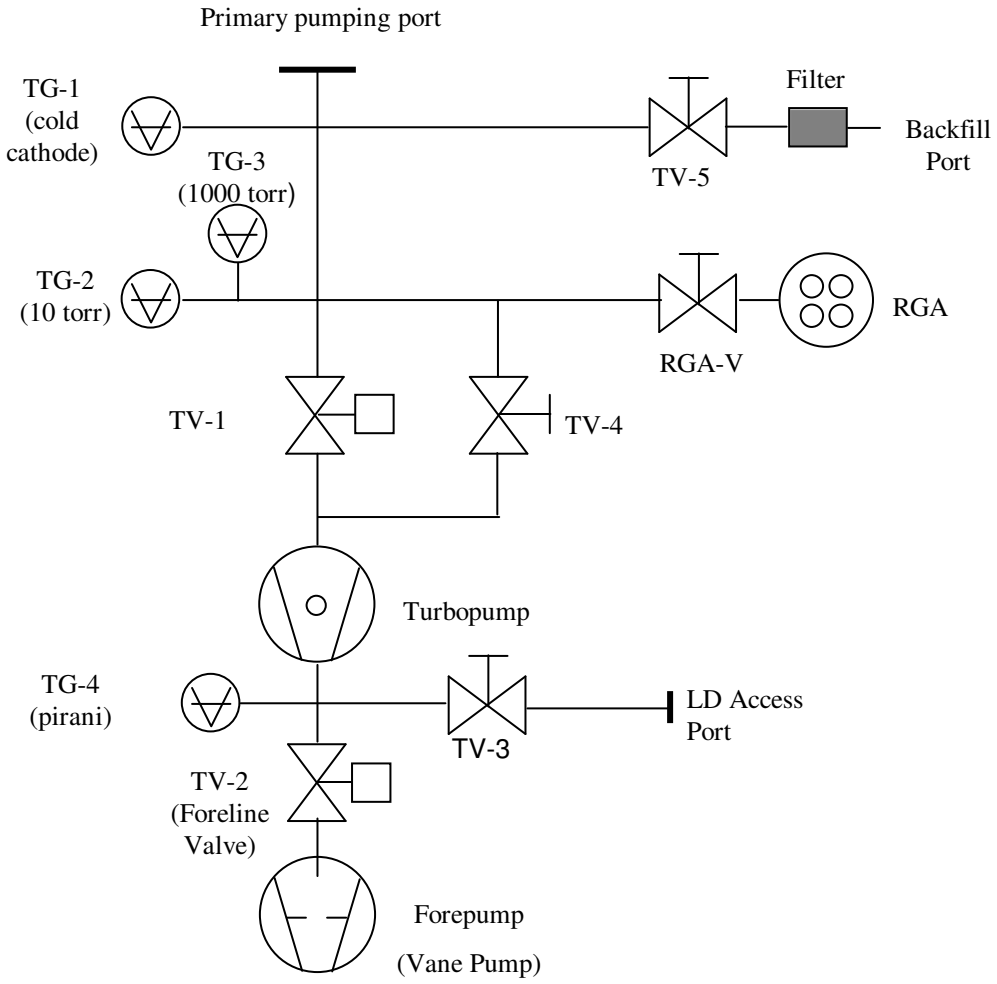


Figure 4. Schematic diagram of Utility Pumping System (UTS)

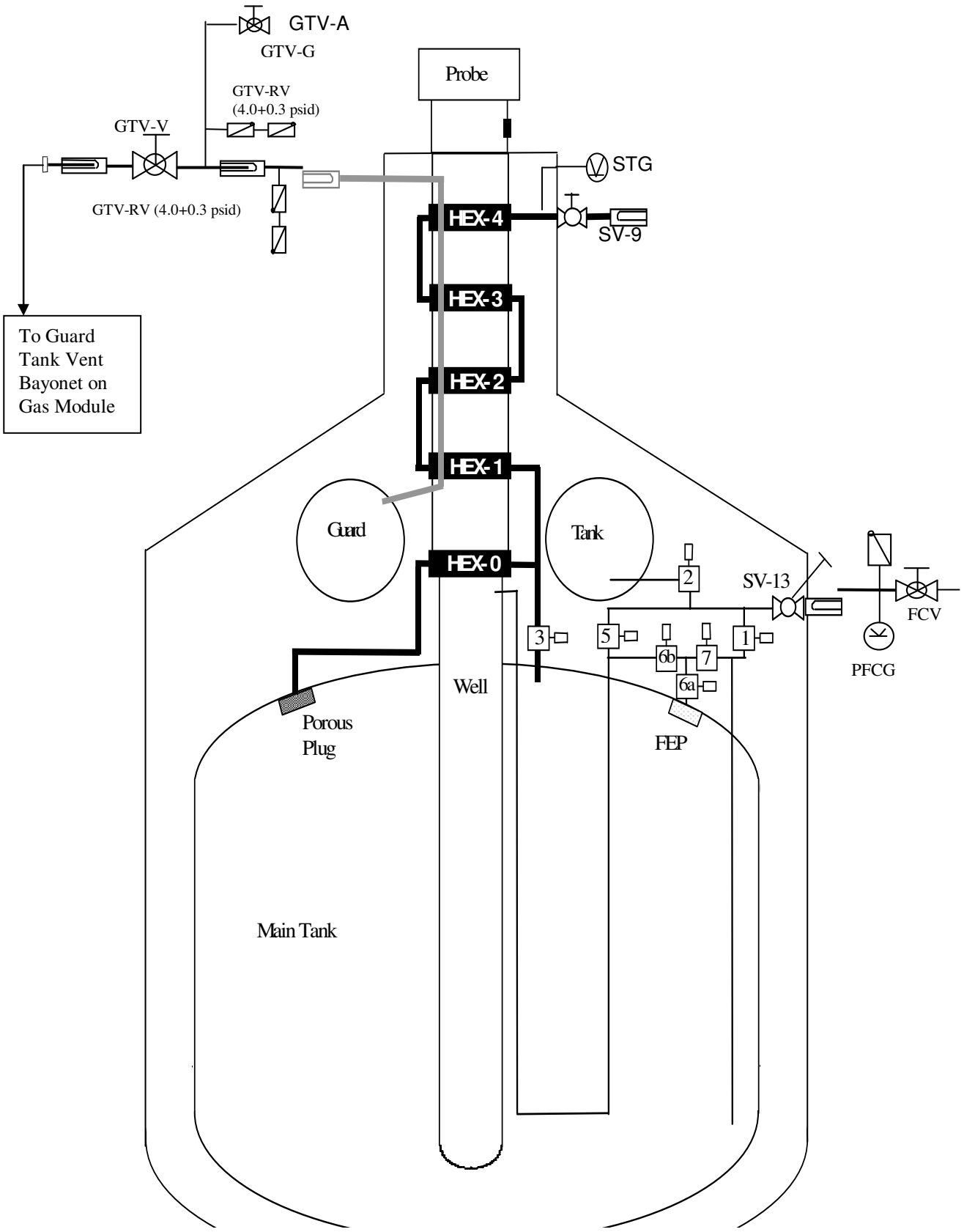


Figure 5. Schematic of Science Mission Dewar plumbing.

Figure 6- Possible Main Tank and Guard Tank Vent Configurations

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

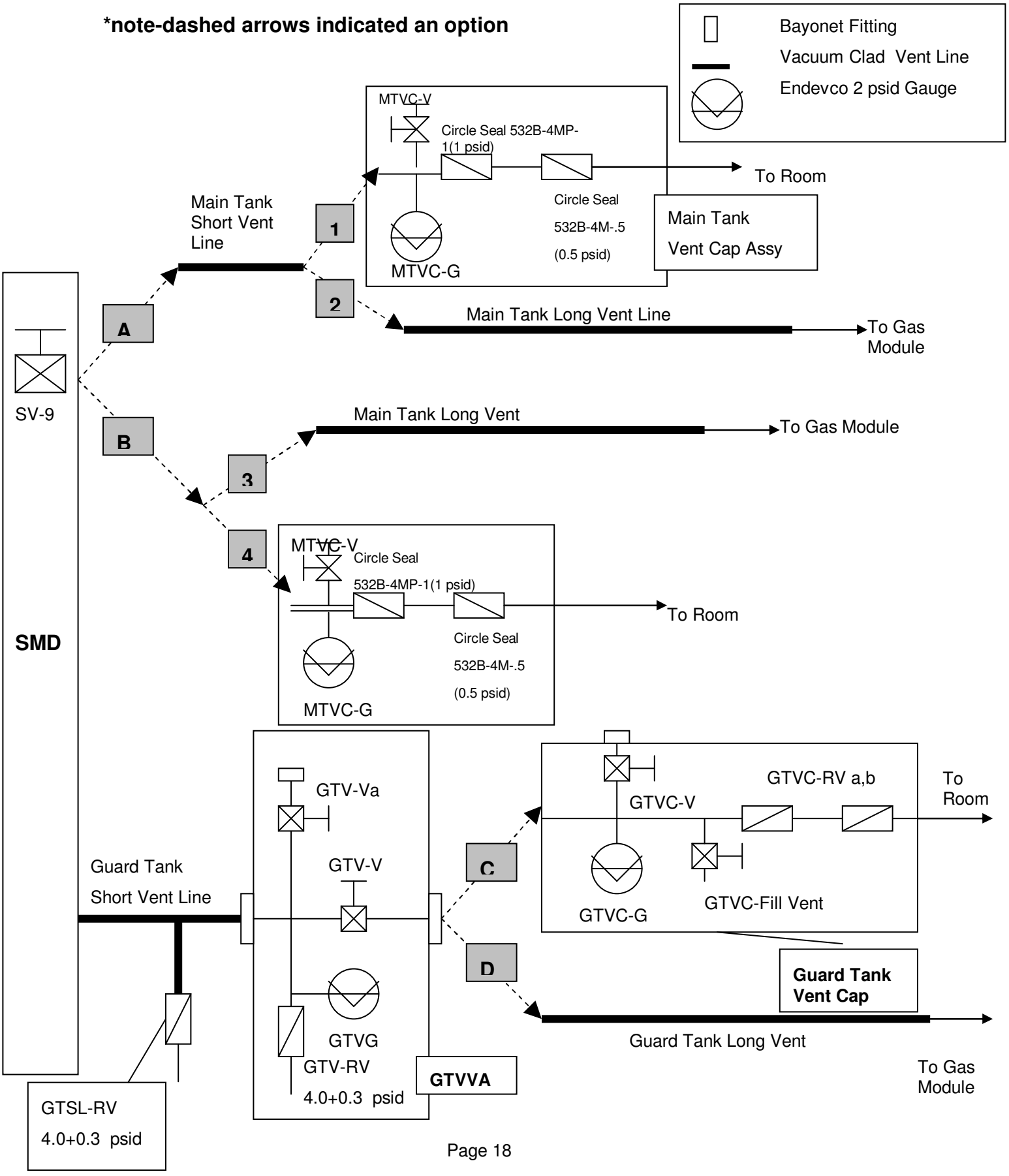
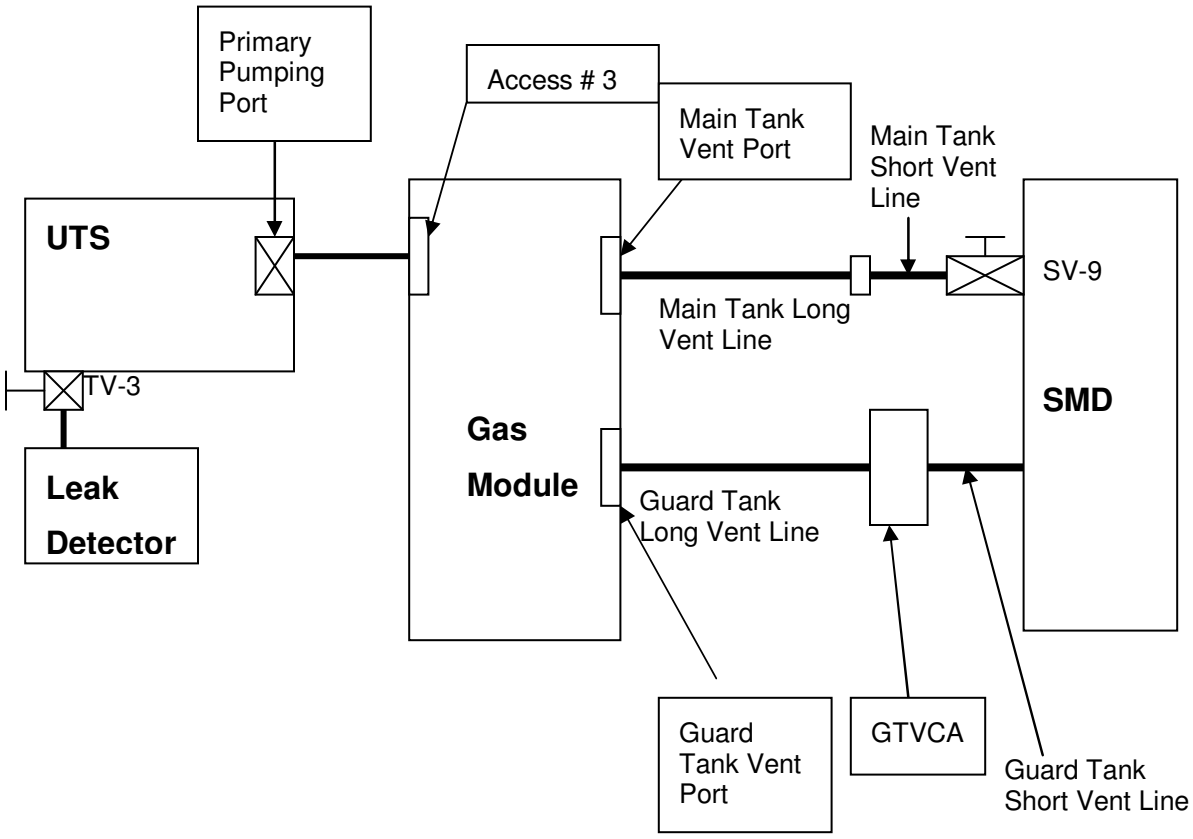


Figure 7: Block Diagram of GSE and SMD-See individual diagrams for more detail



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 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 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.		
	Team Lead Signature: _____		

Appendix 3– **Contingency Responses**

Condition	Circumstance	Response
Temperature limits (CN 1 or 28) exceeded	Any time	Promote MT venting: Open SV-9 and/ or EV-9 as appropriate to increase MT venting Reduce pressure in vatterfly caps: Adjust UTS valving so as to begin pumping on caps
Burst disk rupture (MT/GT)	Any time	Evacuate room
Vatterfly valve cover below atmospheric	Any time	Consult Payload Test Director and Payload Technical Manager
Main Tank or Guard Tank liquid level falls below alarm limit	Any time	Configure Dewar and Fill as appropriate

Appendix 4

H. INSTALLATION OF ENDEVCO PRESSURE GAUGES ON VATTERFLY VALVE COVERS.

H.1. Verify Configuration

H.1.1. Verify steps G.1 through G.4 of this procedure have been successfully completed

H.2. Install Endevco Gauges on Vatterfly Valve Covers

H.2.1. Verify all vatterfly valve cover valves are closed.

H.2.2. Install Endevco gauge on LV1

1. Close gate valve TV-1 and verify TV-4 is closed.
2. Close TV-2.
3. Press Stop on the turbo controller.
4. Press the emis button on the vacuum gauge to turn off the cold cathode gauge, TG-1
5. Open TV-6 to spin down turbo
6. Close TV-6 when turbo completely spun down.
7. Attach helium source to TV-5
8. Open TV-5 to backfill pumping line to 10 torr as read on TG-2 and then close TV-5.
9. Open LV-1 cover valve
10. After ten minutes record TG-2:_____torr, verify no decrease in pressure at TG-2
11. Set regulator supplying TV-5 helium source to 1 psig
12. Open TV-5 to set up helium purge
13. Remove VCR plug from LV-1 cover
14. Install 15psia Endevco pressure sensor with new VCR gasket.
15. Record serial number of gauge S/N#:_____
16. Close TV-5
17. Open TV-2
18. Slowly open TV-4
19. When pirani guage read 50mtorr, close TV-4 and TV-2
20. Close LV-1 cover valve

H.2.3. Install Endevco gauge on LV2

1. Verify pressure at TG-2 reads 0.0
2. Open TV-5 to backfill pumping line to 10 torr as read on TG-2 and then close TV-5.

3. Open LV-2 cover valve
4. Verify no decrease in pressure at TG-2
5. Open TV-5.
6. Verify regulator supplying TV-5 helium source set at 2 psig
7. Remove VCR plug from LV-2 cover
8. Install 15psia Endevco pressure sensor with new VCR gasket.
9. Record serial number S/N#:_____
10. Close TV-5
11. Open TV-2
12. Open TV-4
13. When pirani gauge reads less than 50mtorr, close TV-4 and TV-2
14. Close LV-2 cover valve

H.2.4. Install Endevco gauge on V1

1. Verify pressure at TG-2 reads 0.0
2. Open TV-5 to backfill pumping line to 10 torr as read on TG-2and then close TV-5.
3. Open V1 cover valve
4. Verify no decrease in pressure at TG-2.
5. Open TV-5.
6. Verify regulator supplying TV-5 helium source set at 2 psig
7. Remove VCR plug from V1 cover
8. Install 15psia Endevco pressure sensor with new VCR gasket.
9. Record serial number S/N#:_____
10. Close TV-5
11. Open TV-2
12. Open TV-4
13. When pirani gauge reads less than 50mtorr, close TV-4 and TV-2
14. Close V1 cover valve

H.2.5. Install Endevco gauge on V2

1. Verify pressure at TG-2 reads 0.0 close TV-4 and TV-2.
2. Open TV-5 to backfill pumping line to 10 torr as read on TG-2 and then close TV-5.
3. Open V2 cover valve
4. Verify no decrease in pressure at TG-2
5. Open TV-5.

6. Verify regulator supplying TV-5 helium source set at 2 psig
7. Remove VCR plug from V2 cover
8. Install 15psia Endevco pressure sensor with new VCR gasket.
9. Record serial number S/N#:_____
10. Close TV-5
11. Open TV-2
12. Open TV-4
13. When pirani gauge reads less than 50mtorr, close TV-4 and TV-2
14. Close V2 cover valve

H.2.6. Install Endevco gauge on V3

1. Verify pressure at TG-2 reads 0.0
2. Open TV-5 to backfill pumping line to 10 torr as read on TG-2 and then close TV-5.
3. Open V3 cover valve
4. Verify no decrease in pressure at TG-2
5. Open TV-5.
6. Verify regulator supplying TV-5 helium source to 2 psig
7. Remove VCR plug from V3 cover
8. Install 15psia Endevco pressure sensor with new VCR gasket.
9. Record serial number S/N#:_____
10. Close TV-5
11. Open TV-2
12. Open TV-4
13. When pirani gauge reads less than 50mtorr, close TV-4 and TV-2
14. Close V3 cover valve

H.2.7. Install Endevco gauge on LV-4

1. Verify pressure at TG-2 reads 0.0
2. Open TV-5 to backfill pumping line to 10 torr as read on TG-2 and then close TV-5.
3. Open V4 cover valve
4. Verify no decrease in pressure at TG-2.
5. Open TV-5.
6. Verify regulator supplying TV-5 helium source to 2 psig
7. Remove VCR plug from V4 cover
8. Install 15psia Endevco pressure sensor with new VCR gasket.
9. Record serial number S/N#:_____
10. Close TV-5
11. Open TV-2
12. Open TV-4
13. When pirani gauge reads less than 50mtorr, close TV-4 and TV-2
14. Close V4 cover valve

H.3. **Leak Check all newly installed gauges**

H.3.1. Open TV-2.

H.3.2. Open TV-4

H.3.3. Open all vatterfly valve cover valves

- LV1
- LV2
- V1
- V2
- V3
- V4

H.3.4. Push the sensor button on the vacuum gauge display so that the "Pir" annunciator shows.

H.3.5. When the pressure on the Piriani gauge reads $<1\times10^{-2}$ torr, push the start button on the turbo controller.

H.3.6. When the "Normalbetrieb" light comes on, close TV-4 and open the gate valve TV-1

H.3.7. Ensure the Valve Interlock switch to the "protected" position.

H.3.8. Push the button on the vacuum gauge readout so that the "Hi-Vac"

annunciator shows, and push the emis button to turn on the cold cathode gauge, TG-1

H.3.9. Slowly open TV-3

H.3.10. Close TV-2

H.3.11. Leak check all Endevco pressure gauges

1. Ensure background on the 10^{-7} sccs range
2. Record initial background: _____sccs
3. Record leak rate at LV-1: _____sccs
4. Record leak rate at LV-2: _____sccs
5. Record leak rate at VV-1: _____sccs
6. Record leak rate at VV-2: _____sccs
7. Record leak rate at VV-3: _____sccs
8. Record leak rate at VV-4: _____sccs

H.3.12. Verify no rise at any of the Endevco pressure gauges

H.3.13. Close all vatterfly valve cover valves

- LV-1
- LV-2
- VV-1
- VV-2
- VV-3
- VV-4

H.4. **Proceed to section G.8**

QA Witness: _____