Operations No. ___________

GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

(PTP) Un-vented Rate of Rise of Main Tank w/ Gas in Well

P0840 Rev-

May 22, 2001

Prepared by
______________________Date_______
Dave Murray
Cryogenic Test

Checked by
______________________Date_______
Jim Maddocks
Cryogenic Test

Approvals:

______________________Date_______
Dorrene Ross
Quality Assurance

______________________Date_______
Mike Taber
Payload Test Director

______________________Date_______
Rich Whelan
Systems Engineering

______________________Date_______
Robert Brumley
Payload Technical Manager

Revision Record

Rev	ECO	Pages	Date
-	-		May 22, 2001

Table of Contents

List of Abbreviations and Acronyms

AG-x	Gauge x of Gas Module auxiliary section
AMI	American Magnetics Inc.
ATC	Advanced Technology Center
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	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
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
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 verifies the pre-launch hold time required for which the main tank is valved-off and the guard tank is kept at a level >20%. The hold time is defined as the time for the main tank to warm from its starting temperature, nominally 1.7 K, to 1.85 K. The required hold time is greater than 90 days. temperature, nominally 1.7 K, to 1.85 K. The required hold time is greater than 90 days. This procedure applies to the case where there is residual gas in the Well as would be the case after the performance of a number of guard tank fill operations. The measurement of the hold time with the Well evacuated is covered in P0515.

B. SAFETY

B.1. Potential Hazards

Personal injury and hardware damage can result during normal positioning, assembly and disassembly of hardware. Examples include: positioning Dewar in tilt stand; integrating probe with airlock; positioning airlock on Dewar; removing airlock from Dewar; removing probe from Dewar; and positioning support equipment such as pressurized gas cylinders and supply dewars.

A number of undesired events may be associated with these operations. For example, personnel or equipment can be struck when hardware is being moved (e.g. by forklift or crane load). Personnel are subject to entrapment while positioning hardware, such as hands or feet caught between objects as hardware is moved into place. Suspended hardware may be dropped. Personnel can be caught between objects such as forklifts and walls or loads and building support columns.

In addition, liquid helium used in the SMD represents a hazardous material for the personnel involved in the operations. Cryogenic burns can be caused by contact with the cold liquid or gas, high pressures can result if boiling liquid or cold gas is confined without a vent path, and asphyxiation can result if the vent gas is allowed to accumulate.

The SMD Safety Compliance Assessment, document GPB-100153C discusses the safety design, operating requirements and the hazard analysis of the SMD.

B.2. Mitigation of Hazards

B.2.1 Lifting hazards

There are no lifting operations in this procedure

B.2.2 Cryogenic Hazards

The FIST OPS laboratory has an oxygen deficiency monitor that alarms when the oxygen level is reduced to 19.5%. Prior to beginning this procedure in any facility other than the FIST OPS Lab, the presence of a similar oxygen monitor must be verified by safety and operations personnel. Additional temperature and pressure alarms, provided by the DAS, warn of potential over-pressure conditions. Emergency vent line deflectors are installed over the four burst disks on the SMD vacuum shell, and oxygen collection pans are on the floor beneath them.

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

The FIST Emergency Procedures document, SU/GP-B P0141, discusses emergency procedures. These documents should be reviewed for applicability at any facility where the hardware is operated.

A.1.1. Other Hazards

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

B.3. Injuries

In case of any injury obtain medical treatment as follows
LM **Call 117;** Stanford University **Call 9-911**

C. QUALITY ASSURANCE

C.1. QA Notification

The ONR 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 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.

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

Test Director	Test Engineer
Mike Taber	Tom Welsh
Dave Murray	Chris Gray
Jim Maddocks	Bruce Clarke
Dave Frank	

E. REQUIREMENTS

E.1. Electrostatic Discharge Requirements

This procedure does not involve operations with any equipment sensitive to electrostatic discharge.

E.2. Lifting Operation Requirements

There are no lifting operations in this procedure

E.3. Hardware/Software Requirements

E.3.1 Commercial Test Equipment

No commercial test equipment is required for this operation.

E.3.2 Ground Support Equipment

The Ground Support Equipment includes the Gas Module, the Pump Module, the Electrical Module, and the Vacuum Module. The Gas Module provides the capability to configure vent paths, read pressures and flow rates, and pump and backfill vent lines. The Pump Module provides greater pumping capacity than the Gas Module, together with additional flow metering capabilities. The vent output of the Gas Module flows through the Pump Module. The Electrical Module contains the instruments listed in Table 1 (see the *Electrical Module Manual* for details) and provides remote control of valves in the Gas Module, Pump Module, and SMD. The Vacuum Module contains a turbo pump, backed by a vane pump and provides the capability to pump out the SMD vacuum shell.

This procedure calls for use of hardware located in the Gas Module (Figure 1), the Pump Module (Figure 2), the Vacuum Module (Figure 3), and the Electrical Module (Table 1).

E.3.3 Computers and Software

The Data Acquisition System (DAS) and data acquisition software are required for this procedure. The DAS reads and displays pressures, temperatures, and flow rates and monitors critical parameters. No additional computers or software are required.

E.3.4 Additional Test Equipment

No additional test equipment is required.

E.3.5 Additional Hardware

No additional hardware is required

E.3.6 Tools

No tools are required for this operation.

E.3.7 Expendables

Liquid helium for Guard Tank fillings is required for this operation.

E.4. Instrument Pretest Requirements

The GSE instruments required to perform this procedure are listed in Table 1, together with their serial numbers, where available. Instruments that are required to have current calibrations are indicated in the Cal-Required column. Instruments that do not require calibration are those not used to verify performance requirements and are not connected to flight instrumentation. The status column is to be filled in with the due date of the instrument calibration sticker and verified to be in calibration by QE or QE designee. Serial numbers are to be updated as appropriate.

Table 1. Required Instrumentation and Calibration Status

No.	***Location***	***Description***	***User Name***	***Serial No.***	***Cal Required***	***Status Cal due date***
1	DAS	Power Supply, H-P 6627A	-	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,	VG-1, VG-2	96021521	No	-

No.	Location	Description	User Name	Serial No.	Cal Required	Status Cal due date
		Granville-Phillips 360	VG-5			

E.5. **Configuration Requirements**

E.5.1 Main Tank

The Main Tank liquid must start at SFHe temperatures of 1.7 K or less and be filled to a liquid level ≥ 95%. The actuator control valve for the Gas Module valve, EV-9, should be in the "Subatm He" position.

E.5.2 Guard Tank

The Guard Tank must contain liquid, and the level must be maintained ≥ 20% at all times.

E.5.3 Well

The Well pressure must be measured with the UTS attached to the Well VTH pump-out valve.

E.5.4 SMD Vacuum Shell

The Vacuum Shell pressure must be less than 5 x 10^{-5} torr. Procedure P0213, contains the steps for connecting to and pumping on the SMD vacuum shell and should be used if the pressure criterion is not met.

E.5.5 Alarm System

E.5.5.1 The DAS alarm system must be enabled and contain the following alarm set-points:

a. Station 200 temperature (CN 01) set at T ≤ 2.2 K.

b. Top of lead bag temperature set (CN 28) at T ≤ 2.2 K.

c. Relative Guard Tank Pressure (CN 46) set at ΔP ≥ 0.3 torr.

E.5.5.2 The Facility Main Alarm System must be armed.

E.5.6 GSE and Non-flight Hardware

E.5.6.1 The ion-pump magnet is installed.

E.5.6.2 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).

E.5.6.3 The Main Tank vent line must be connected to the Gas Module with a vacuum insulated line (P/N 5833806). Procedures P0674, and P0672 contain the procedures for connecting Main Tank vent lines.

E.5.6.4 The Guard Tank vent line must be connected to the Gas Module with a vacuum insulated line (P/N 5833813). Procedure No. P0676 contains the steps for connecting the Guard Tank vent line.

E.5.6.5 The high-vacuum pumping line may be connected between the SMD at SV-14 and the inlet port of the Vacuum Module and be pumping up to a closed valve SV-14. Procedure No. P0213 contains the procedure for connecting to and pumping on the SMD vacuum shell.

E.5.6.6 A relief valve assembly (FLRV) or flight-like burst disk is installed in place of the flight SMD fill-line burst disk (BD3).

E.5.6.7 The Fill Cap Assembly must be installed at SV-13.

E.5.6.8 The thruster vent port is flanged to a flight thruster vent manifold or equivalent mockup manifold. This assembly includes a Endevco pressure transducer..

E.5.6.9 The heaters on the SMD top plate, SV-9, and Main Tank vent bayonet must be installed and operational.

E.5.6.10 The Pump Module must be connected to the Gas module at EV-21/22.

E.5.6.11 The probe pressure measurement system (PPMS) is installed and operational.

E.5.6.12 The Well pump out port has the VTH valve operator installed which is connected to PW-2 and VW-3.

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. A foreign object and debris shield may cover the upper cone of the SMD and is required whenever work is being performed above the SMD such that hard objects could be dropped and impact the SMD or Probe.

E.7. Verification/Success Criteria

This procedure demonstrates the prelaunch hold time of the Main Tank and Guard Tank.

Paragraph No.(PLSE-12)	Specification/Requirement Title	Criterion
3.2.1.9.2	Main Helium Tank	With the main tank filled with SFHe and the guard tank maintained with NBPHe, a period of >= 90 days shall elapse before the temperature of the SFHe rises above 1.85 K. This period may include up to 2 launch aborts at intervals >=24 hours and a subsequent successful launch. Success: Performance as shown in para. G.6
3.2.1.9.1	Guard Helium Tank	The guard tank shall have adequate liquid helium capability so that it does nor have to be refilled for a period of >= 7 days. Success: Performance as shown in para. G.7

E.8. Payload Constraints and Restrictions

E.8.1 No Payload operations which result in substantial heat dissipation in the Probe/SMD, e.g., temperature control operations, may be performed during this procedure.

E.8.2 Vacuum integrity of Probe must be maintained <5 E-6 torr level.

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
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
LMMC F277277v4.2	Science Payload Specification CDRL/PLSE-12

F.3. Additional Procedures

Document No.	Title
SU/GP-B P0674	Connect Main Tank Vent Line to Gas Module – Main Tank at NBP
SU/GP-B P0672	Connect Main Tank Vent Line to Gas Module – Main Tank Subatmospheric
SU/GP-B P0676	Connect Guard Tank Vent Line to Gas Module
SU/GP-B P0213	Connect Vacuum Module / Pump on SMD Vacuum Shell
SU/GP-B P0209	External Guard Tank Fill – Main Tank Subatmospheric
SU/GP-B P0613B	Repump Well with Probe Installed

Operation Number:___________

Date Initiated:___________

Time Initiated:___________

G. OPERATIONS

G.1. Verify Appropriate QA Notification

- Verify SU QA notified.
  Record: Individual notified __________________,

  Date/time ________/________.
- Verify ONR representative notified.

  Record: Individual notified __________________,
  Date/time ________/________.

G.2. Verify Preliminary SMD and GSE Preparations Complete

G.2.1 Record Guard Tank liquid level ________ %; temperature[CN24]_____.

Ensure level ≥ 20 %. If necessary, perform procedure P0209B, "External Guard Tank Fill – Main Tank Subatmospheric" to raise level and record:

Date ________ Procedure No. ________ and Op. No. ________

Liquid level ________ %

G.2.2 Record Main Tank liquid level ________ %; temperature[CN24]_____.

G.2.3 Verify relief assembly (FLRV-a,b) or flight-like burst disk installed on SMD fill line.

G.3. Verify Configuration Requirements

G.3.1 Verify ion-pump magnet installed.

G.3.2 Verify GSE cabling connected between SMD and Electrical Module and between SMD and Data Acquisition System.

G.3.3 Verify Main Tank vent line connected to Gas Module.

G.3.4 Verify Guard Tank vent line connected to Gas Module.

G.3.5 Verify actuator control valve for EV-9, located on Gas Module, set to "Subatm He" position.

G.3.6 Verify Pump Module connected to Gas Module at EV-21/22.

G.3.7 Ensure DAS alarm system enabled and record set points.

G.3.7.1 ***Station 200 temperature*** – ensure CN [01] on DAS alarm list and set to alarm at T ≤ 2.2 K. Record set point. __________K

G.3.7.2 ***Top of lead bag temperature*** – ensure CN [28] on DAS alarm list and set to alarm at T ≤ 2.2 K. Record set point. __________K

G.3.7.3 ***Relative Guard Tank Pressure*** – ensure CN [46] on DAS alarm list and set to alarm at ΔP ≥ 0.3 torr. Record set point. _________torr

G.3.8 Ensure DAS watchdog timer and alarm enabled.

G.3.9 Ensure liquid-level alarms enabled and record set points.

G.3.9.1 ***Main Tank*** – ensure liquid-level alarm set ≥ 20%. Record set point. _______%

G.3.9.2 ***Guard Tank*** – ensure liquid-level alarm set ≥ 20%. Record set point. _______%

G.3.10 Ensure Facility Main Alarm System enabled.

G.3.11 Ensure Top-plate heaters on SMD are connected and on.

Verify Initial Valve States		
	Verify Open	Verify Closed
o Main Tank connected to GM	EV-4, -10, -17, -21, -7a, -7b PV-1, -2, -3, -4	EV-9 . PV-5, -6
o Guard Tank connected to GM – liquid level ≥ 20%	EV-13 . GTV-V	Ev-16, EV-20, EV-23, EV-24 GTV-Va
o Well evacuated and disconnected from GM		VW-3 and VTH
o Remaining EV valves		EV-5, EV-6, EV-8, EV-11, EV-12, EV-14, EV-15, EV-18, EV-22, EV-19
o AV valves		All

G.3.12 Record Initial Conditions

G.3.12.1 Record initial SMD vacuum shell pressure as follows:

a. Turn on Vac-ion pump and record date/time ______/______

b. Use DAS [Monitor Data] for CN 99.

c. When value is steady, record pressure (IP) _______ torr.

d. Verify Vacuum Shell Pressure < 5 x 10^{-6} torr. If not, turn off Vac-ion pump and perform procedure P0213, *Pump SMD Vacuum Space with Vacuum Module*, to pump out SMD vacuum shell. Record Op No. _______.

e. Exit [Monitor Data] and collect data with [Set Data Interval] to 5 TO 15 min.

f. When data cycle is complete, turn off Vac-ion pump.

G.3.12.2 Record data in Table 3.

G.3.13 Set up Data Acquisition System

Note: Refer to Operating Instructions for mechanics of DAS keyboard/mouse operations.

G.3.13.1 Verify DAS set to configuration 4m

G.3.13.2 Set the Main Tank liquid-level sampling interval to 10 minute.

G.3.13.3 Set the Guard Tank liquid-level sampling interval to 10 minute.

G.3.13.4 Verify plotter is set up to display the guard tank and main tank temperatures and temperature rate of change.

G.3.13.5 Record the DAS software and version in use:

____

G.3.13.6 Record the DAS data file in use:

____

G.3.13.7 Take a PODs data set.

G.3.13.8 Take a “All Data” (data configuration 1) data set.

G.3.13.9 Return DAS to configuration “4m”.

G.3.14 Verify that the probe pressure measurement system is installed. If not, perform P0558A, “Probe Pressure Measurement System Installation And Leak Check Procedure”, and record Op. No.:_____________.

G.4. Prepare to Close off Main Tank Vent

CAUTION

In the following steps, do not let the guard tank liquid level fall below 20% before refilling. Failure to do so may result in aborting the test.

G.4.1 Monitor the guard tank level and maintain it above 20 % using the indicated procedure to raise level. Record time of performance in Table 2 below:

Table 2 Record of Guard Tank Fillings using P0209B

Date/Time	Elapsed Days	Op. No.	Start GT LLS %	End GT LLS %	LLS Used %	%/day
				AVE=		

Note: Use procedure P0209B ,"External Guard Tank Fill – Main Tank Subatmospheric".

G.4.2 Verify Probe helium pressure as measured by the RGA is <5E-5, record: RGA helium partial press _______ torr; PMG1 ________ torr.

G.4.3 Measure Well Pressure

G.4.3.1 Connect the UTS to the Well manifold using P0613B, "Repump Well with Probe Installed" completing steps up to but not including G.4.5, i.e., Well manifold with PW-2 is connected to Well via VTH and the UTS turbo is pumping up to a closed VW-3.

G.4.3.2 Record Operation No. ___________.

G.4.3.3 Record TG-1 ___________.

G.4.3.4 Record PW-2 ___________.

G.4.4 Evaluate Well pressure:

G.4.4.1 Evaluate fill line > one atmosphere exposure time by determining the total transfer time since last Well pump-out (See Appendix A)

a. Last Well pump-out _____________ .

b. Cumulative time of transfers ___________ .

c. Worst expected pressure for 90 days of hold: (1hr*15 xfers/cumulative time)*PW2 (from G.4.3.4) = ___________

G.4.5 Cross-Calibrate Thruster Vent Endevco with EG-2 100 torr Baratron

G.4.5.1 Close EV-17 and adjust EG-2 zero setting to read 0.01-0.00 torr, record zero value _________ torr.

G.4.5.2 Open EV-17 and close EV-4.

G.4.5.3 Record EG-2 ________ torr.

G.4.5.4 At DAS adjust offset of Thruster Vent pressure sensor, CN49, so that "Monitor Data" function of DAS gives agreement with that given by EG-2. Record offset used, Datcon(49,5), _________torr.

G.4.6 Instruct all experimenters that no Payload power dissipative tasks can be performed during this test.

G.4.7 Close RAV-3 (flight configuration)

G.4.7.1 **Verify all** RAV selection switches are in the OFF position.

G.4.7.2 Turn on RAV power supply and adjust current limit to 1.85 amps.

G.4.7.3 Adjust power supply to 28 VDC.

G.4.7.4 Power up RAV controller No. 3.

G.4.7.5 Position selection switch to RAV-3.

G.4.7.6 Record initial switch status: Open: θ θ Closed: θ θ

G.4.7.7 Activate controller No. 1 and record:

a) run time: ______ seconds
b) current draw: _______ amp
c) Time of day: ______ .

G.4.7.8 Record final switch status: Open: θ θ Closed: θ θ

G.4.7.9 Turn RAV-3 selection switch to OFF.

G.4.7.10 Power off controller No 3.

G.4.7.11 Turn off RAV power supply.

G.4.7.12 Record operation in RAV log book.

G.5. Start Main Tank Hold Test:

G.5.1 Close SV-9, record time/date __________/_________ .

G.5.2 Enter comment to DAS "Start Main Tank hold test".

G.5.3 Close EV-4 and EV21, verify EV22 closed.

G.5.4 Close PV-1and PV-3.

G.5.5 Shut down PP-1 and PP-2.

G.5.6 Record data in Table 3 periodically.

G.6. Main Tank Hold Time Measurement

G.6.1 Observe temperatures CN09, CN28, CN29, CN40 and CN41 and use these to calculate temperature rate of rise of Main Tank liquid helium.

G.6.2 When the temperature slope is changing less than 5%/day (approximately 0.1 mK/day/day), a final extrapolation to a 90 day time period can be made to verify the temperature will remain below 1.85 K for a 90 day period.

G.6.3 When the above criterion is met, record:

G.6.4 Time/date _____________ CN28 ___________ Calculate K/day ____

Calculate K/day/day ______

Calculate %/day _________

Calculated temperature at 90 days:

Elapsed No. of days______ + (Cal K/day)/(1.85-CN28present)= _____

G.6.5 Verify Main Tank unvented hold time is >90 days.

G.7. Guard Tank Hold Time Measurement

G.7.1 From the data record of Table 2 average and enter the results:
Average Guard Tank loss rate ________ %/day
Calculated hold time (80%/Average Loss Rate = _________ days).

G.7.2 Verify the Guard Tank hold time is >7 days.

G.8. Establish Final Configuration

G.8.1 Choose the final configuration:

G.8.2 π Prepare for P0818, "Un-vented Rate of Temperature Rise with Guard Tank Full

G.8.2.1 Allow UTS hook up to remain and close out this procedure and then proceed to continue performance of P0818 starting at para. G.4.6.

G.8.3 π Terminate test to steady state temperatures

G.8.3.1 Verify EV-7a/b, EV-10, EV-13 open.

G.8.3.2 Verify all other EV-valves closed.

G.8.3.3 Verify all AV valves are closed.

G.8.3.4 Pump Main Tank with Gas Module:

G.8.3.5 Turn on AP-1.

G.8.3.6 Open AV-6.

G.8.3.7 Open EV-17.

G.8.3.8 Adjust EV-7a/7b to reach steady state Main Tank pressure and temperature.

G.8.3.9 Record valve positions EV-7a ________ % EV-7b ________ %.

G.8.4 Input comment to DAS "End of Main Tank Hold Test with gas in Well".

G.8.5 Verify/set the DAS data cycle to 15 minutes.

G.8.6 Verify liquid level sensor sampling intervals are all 10 minutes.

G.8.7 Ensure DAS alarm enabled and record set points if changed

- o Thermal conditions substantially unchanged, alarm set points for Station 200 and lead bag unchanged
- o Thermal conditions substantially changed, temperature alarm points reset as follows:

  a. Station 200 set point [CN 1] _________ K (≤ 6.5 K)

  b. Top of Lead Bag set point [CN 28] _________ K (≤ 6.0 K)

  c. Guard Tank, GTVG _________ torr (>0.0 torr)

G.8.8 Ensure DAS watchdog timer and alarm enabled.

G.8.9 Continue to monitor Guard Tank pressure until HEX-1 temperature CN [05] reaches steady state. Be prepared to add heat as necessary.

G.8.10 Ensure Guard Tank pressure on DAS alarm list and set to alarm at 0.3 torr differential.

G.8.11 Ensure Facility Main Alarm System enabled.

H. PROCEDURE COMPLETION

Completed by:______________________

Witnessed by:______________________

Date: __________

Time:__________

Quality Manager____**Date**________

Payload Test Director____**Date**________

Appendix A

Determine Fill Line Exposure Time

Find the time for which the fill line has been exposed to =>atmospheric pressure. Enter data in Table below.

Event	Date	Operations Order	Time Open RAV-2	Time Close RAV-1	Exposure Hours
Pump Well					
Fill Main Tank	5/10	1683	1023	2101	10.6
Fill Main Tank	5/11	1684	0920	1619	7.0
Fill Main Tank	5/14	1686	1016	1552	5.6
Fill Main Tank	5/15	1687	1420	1755	4.6
Fill Main Tank	5/18	1688	1338	1615	2.6
Fill Main Tank	5/21	1689	0959	1235	2.6
Total					33.0

Table 3a Hold Time Data

Date/ Time	Comments	RGA He part. Press	Main Tank LHe level CN101 (%)	Main Tank Pres EG-2 CN114 (torr)	Thruster Vent CN49 (torr)	Vac Ion Pump press CN99 (torr)	GT press GTV_G CN46 (torr)	Flowrate PFM-1 CN110 (ll/hr)
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		
						/		

Table 3b Hold Time Data

Date/ Time	MT Bot T09D [CN09] K	Sta. 200 T01D [CN 01] K	Main Tank Top [CN 20] K	Top of lead bag [CN 28] K	GT Bot [CN 24] K	HX-4 T08D [CN 08] K	Slope of MT Bot [CN 141] K	Calc Slope CN28 K	EV-7a/7b Position %/%			
									/			
									/			
									/			
									/			
									/			
									/			
									/			
									/			
									/			
									/			
									/			
									/			
									/			
									/			
									/			
									/			
									/			
									/			

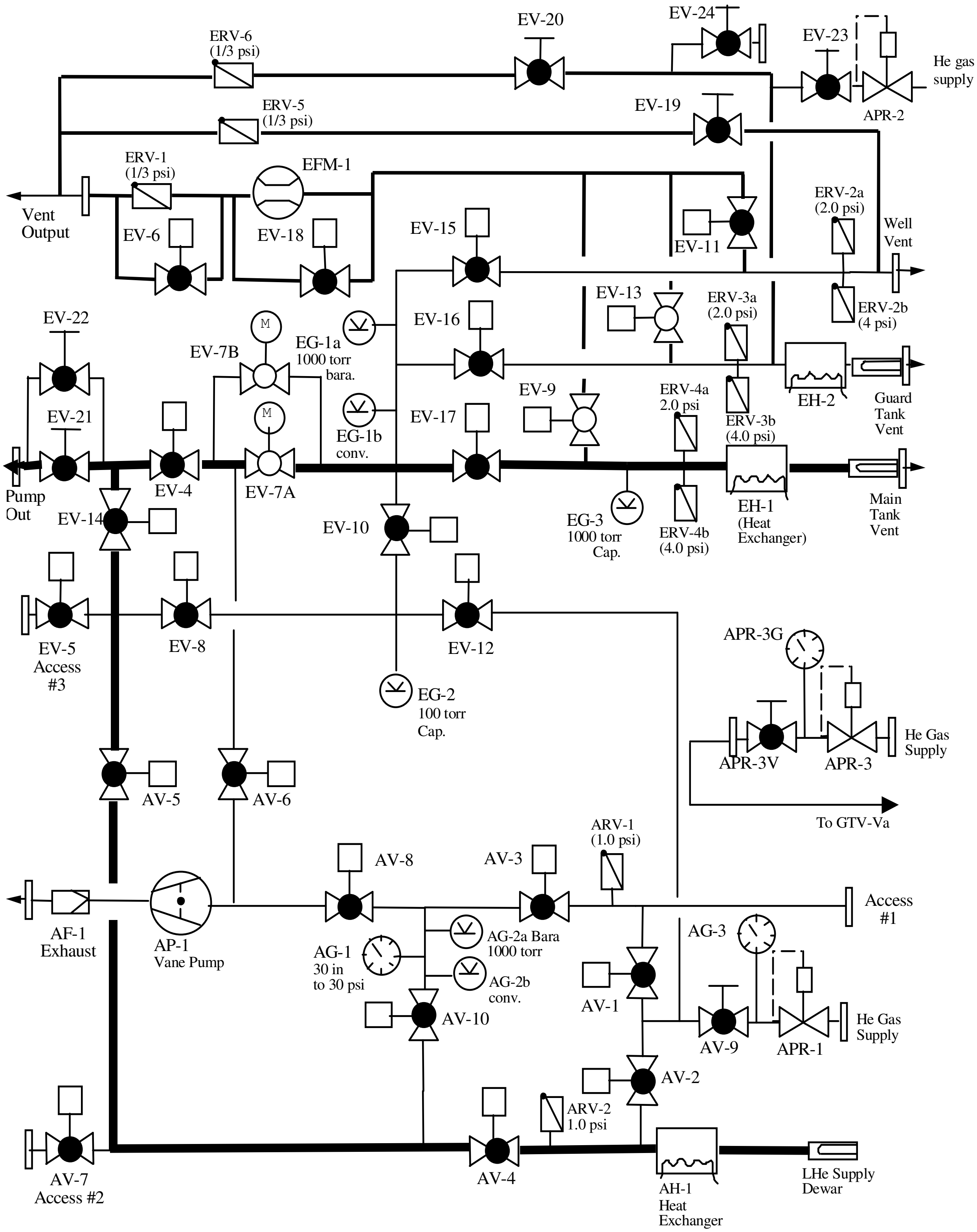

Figure 1. Schematic of Gas Module Plumbing.

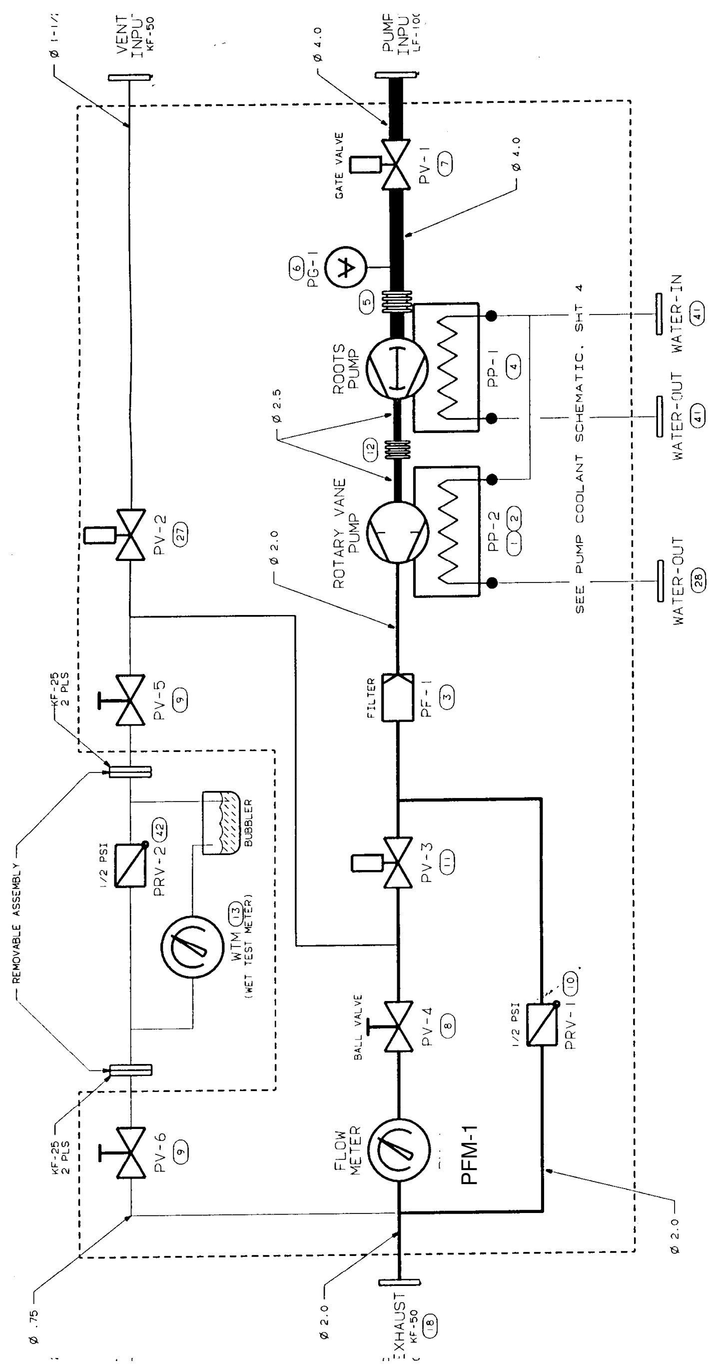

Figure 2. Schematic diagram of Pump Module plumbing.

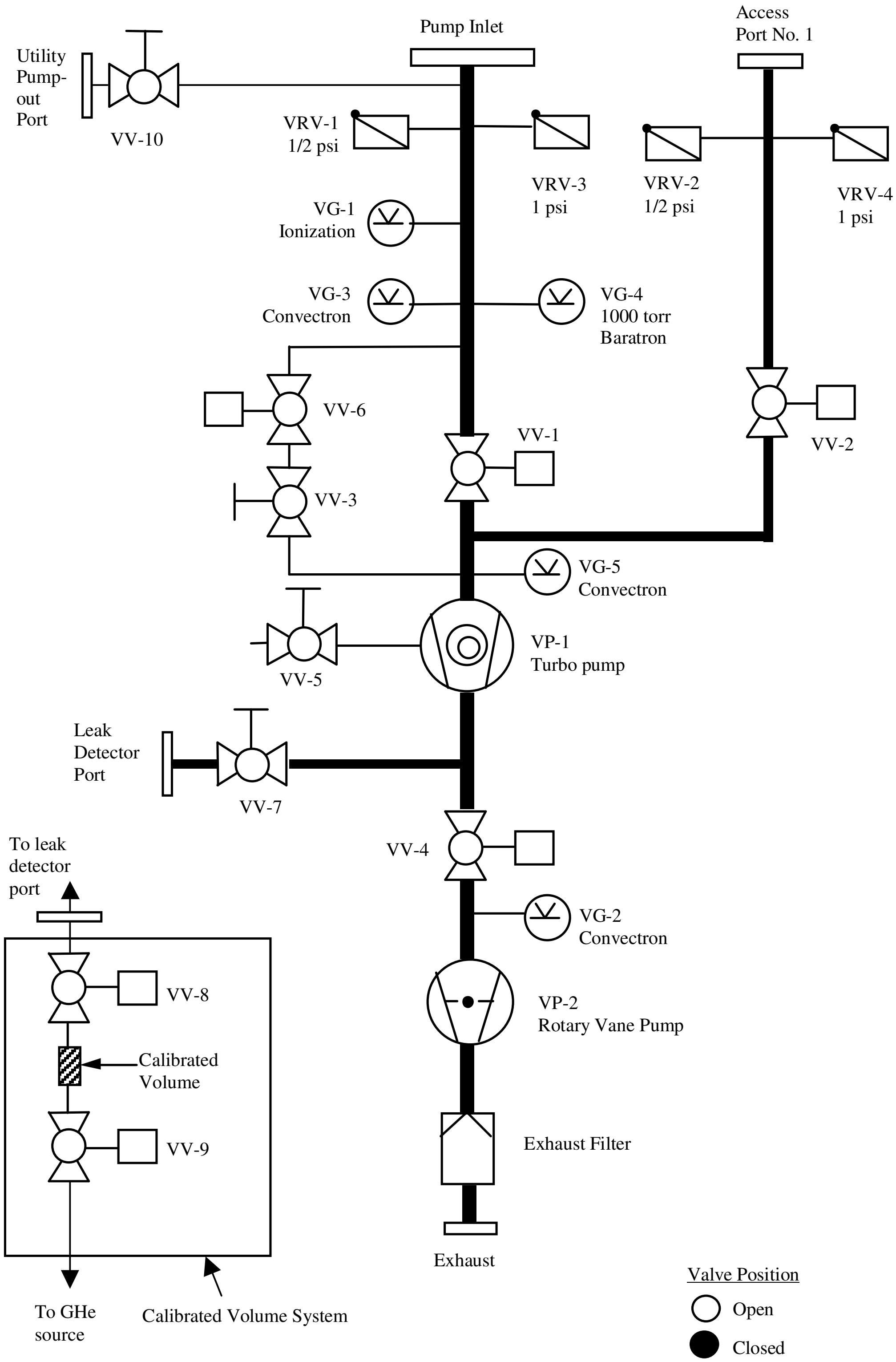

Figure 3 Schematic diagram of Vacuum Module

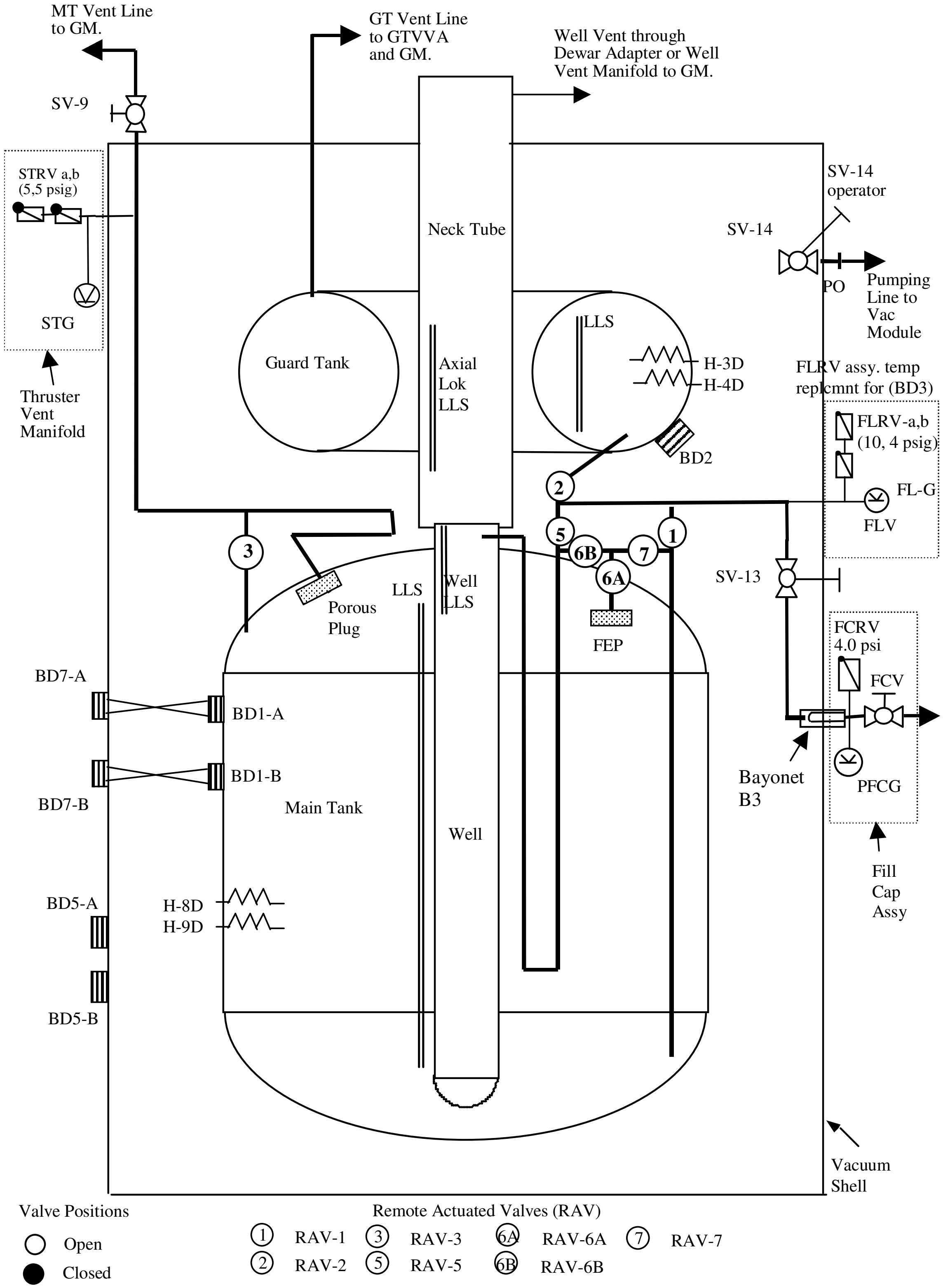

Figure 4. Schematic of Science Mission Dewar plumbing.

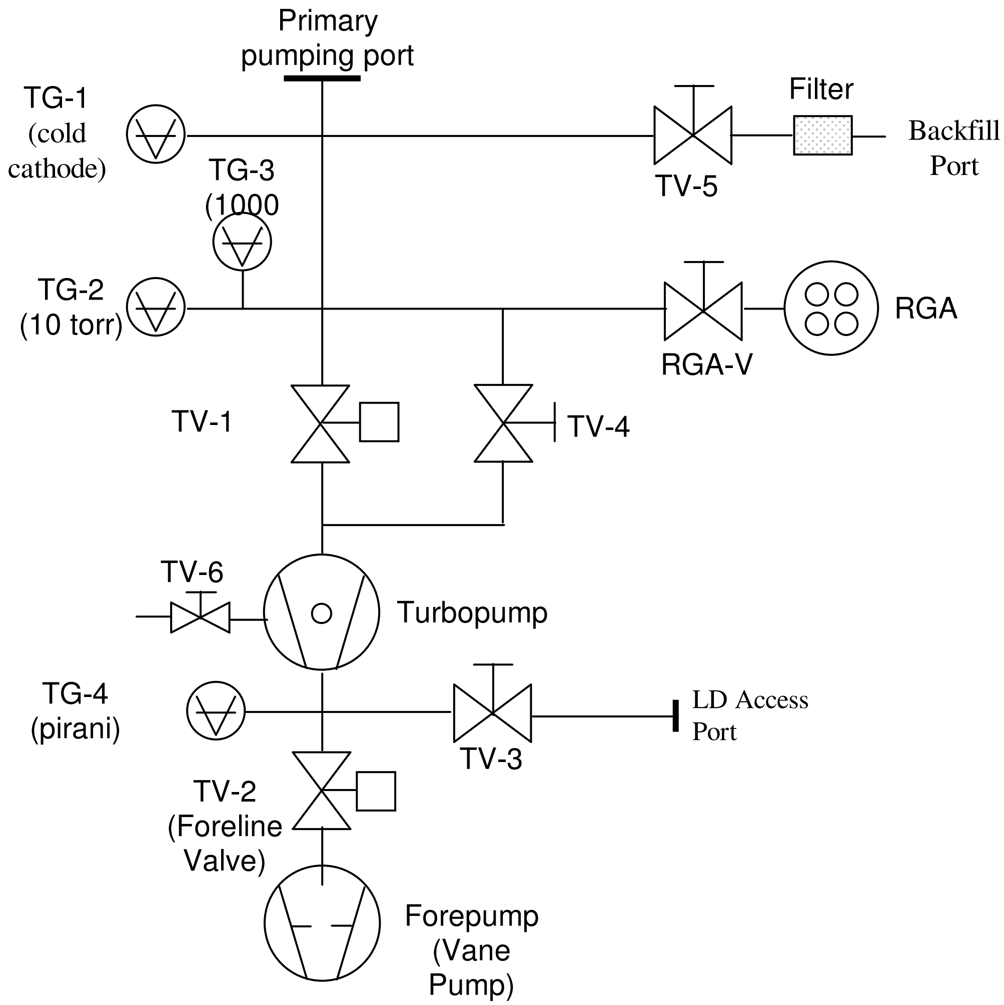

Figure 5. Schematic diagram of Utility Pumping System (UTS)