GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

NBP MAIN TANK FILL –
GUARD TANK INITIALLY DEPLETED
AND CONNECTED TO GAS MODULE

To be performed at Vandenberg Air Force Base building 1610

WARNING: THIS DOCUMENT CONTAINS HAZARDOUS OPERATIONS

P1034 Rev. -

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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	LM	Lockheed Martin Co.
AMI	American Magnetics Inc.	MT	Main Tank
ATC	Advanced Technology Center	MTVC	Main Tank Vent Cap
APR-x	Pressure regulator x of Gas Module	MTVC-G	Main Tank Vent Cap pressure gauge
AV-x	Valve x of Gas Module auxiliary section	MTVC-RV	Main Tank Vent Cap relief valve
CG-x	Gauge x of portable helium pressurization source	MTVC-V	Main Tank Vent Cap valve
CPR-x	Pressure regulator x of portable helium pressurization source	NBP	Normal boiling point
CV-x	Valve x of portable helium pressurization source	ONR	Office of Naval Research
CN [xx]	Data acquisition channel number	PFCG	Fill Cap assembly pressure Gauge
DAS	Data Acquisition System	PFM	Pump equipment Flow Meter
ECU	Experiment Control Unit	PG-x	Gauge x of Pump equipment
EFM	Exhaust gas Flow Meter	PM	Pump Module
EG-x	Gauge x of Gas Module exhaust section	psi	pounds per square inch
EH-x	Vent line heat exchanger in Gas Module	psig	pounds per square inch gauge
EM	Electrical Module	PV-x	Valve x of the Pump equipment
ERV-x	Relief valve of Gas Module exhaust section	QA	Quality Assurance
EV-x	Valve number x of Gas Module exhaust section	RAV-x	Remote Actuated Valve-x
FCV	Fill Cap Valve	RGA	Residual Gas Analyzer
FIST	Full Integrated System Test	SMD	Science Mission Dewar
GHe	Gaseous Helium	STV	SMD Thruster vent Valve
GM	Gas Module	SU	Stanford University
GP-B	Gravity Probe-B	SV-x	SMD Valve number x
GSE	Ground Support Equipment	TD	Test Director
GT	Guard Tank	TG-x	Gauge x of Utility Turbo System
GTVC	Guard Tank Vent Cap	TV-x	Valve x of Utility Turbo System
GTVC-G	Guard Tank Vent Cap pressure gauge	UTS	Utility Turbo System
GTVC-RV	Guard Tank Vent Cap relief valve	Vac	Vacuum
GTVC-V	Guard Tank Vent Cap valve	VCP-x	Vent cap pressure gauge
GTV-G	Guard Tank vent pressure gauge	VCRV-x	Vent cap relief valve
GTV-RV	Guard Tank vent relief valve	VCV-x	Vent cap valve
GTV-V	Guard Tank vent valve	VDC	Volts Direct Current
KFxx	Quick connect o-ring vacuum flange (xx mm diameter)	VF-x	Liquid helium Fill line valve
LHe	Liquid Helium	VG-x	Gauge x of Vacuum Module
LHSD	Liquid Helium Supply Dewar	VM	Vacuum Module
LHV-x	Liquid Helium Supply Dewar valves	VV-x	Valve x of Vacuum Module
LLS	Liquid level sensor	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

Note:
Used to indicate an operating procedure of such importance that it must be emphasized.

CAUTION:
Used to identify hazards to equipment.

WARNING:
Used to identify hazards to personnel.

A. Scope

This procedure describes the steps necessary to perform an external fill of the SMD Main Tank with normal boiling point liquid helium with the Guard Tank initially depleted of liquid helium. (For Guard Tank initially with liquid helium, see P1032.)

The steps include:

Fill Guard Tank to at least 15% from Main Tank

Pre-cool SMD internal fill line from Guard Tank

Pre-cool external transfer line from storage dewar

Fill Guard Tank

Switch from Guard Tank fill to Main Tank fill

Terminate transfer

This procedure is classified as hazardous because it involves the use of liquid helium, which is a cryogenic asphyxiant (see Sec. B.1, below).

B. Safety

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.

Mitigation of Hazards

Lifting hazards

There are no lifting operations in this procedure

Cryogenic Hazards

A rupture of the main tank burst disk(s) will be obvious due to the plume of cold gas. Emergency vent lines are installed over the burst disks on the SMD vacuum shell to eliminate the possibility of direct plume impingement on personnel. Orderly evacuation shall be performed in the event one or more of these burst disks rupture. The GP-B cryogenic team provides an oxygen deficiency monitor that alarms when the oxygen level is reduced to 19.5% will be utilized as an added precaution. Temperature and pressure alarms, provided by the DAS, warn of potential over-pressure conditions.

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 a ladder. In the unlikely event of a large LHe spill all employees have been instructed to evacuate the room and contact NASA and VAFB safety. The following additional requirements apply to all personnel involved directly in cryogenic operations: Insulated gloves when handling equipment that has been cooled to cryogenic temperatures. A protective apron, gloves impervious to liquid cryogens, impermeable shoes, and full-face shields with goggles/glasses are to be worn whenever the possibility of splashing or impingement of high velocity cryogens exists.

Other Hazards

All tools or other items used with the potential to damage the SV shall be tethered.

Mishap Notification

Injury

In case of any injury or illness requiring emergency medical treatment **Dial 911.**

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.

Contingency Response

Contingency responses to possible equipment troubles or irregularities (e.g., power failure) are listed in Appendix 3.

C. Quality Assurance

QA Notification

The NASA program and 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.

Red-line Authority

Authority to red-line (make minor changes during execution) this procedure is given solely to the Test Director or his designate and shall be approved by the QA Representative. Additionally, approval by the Payload Technical Manager shall be required, if in the judgment of the test director or QA Representative, mission functionality may be affected. Within hazardous portions of the procedure all steps shall be worked in sequence. Out-of-sequence work or redlines shall be approved by NASA Safety prior to their performance.

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.

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.

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 Test Director and approved by the QA representative.

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

Personnel Responsibilities

The performance of this procedure requires a minimum complement of personnel as determined by the Test Director. However, during the startup of the transfer (Sec. G.14), there are to be a minimum of two qualified persons (Sec. D.3) in attendance. 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.

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.

Required Personnel

The following personnel are essential to the accomplishment of this procedure:

FUNCTIONAL TITLE	NUMBER	AFFILIATION
Test Director/Test Engineer	1	Stanford
GP-B Quality Assurance	1	Stanford
NASA Safety Rep	1	SFAO or ANALEX

E. Requirements

Electrostatic Discharge Requirements

When working on the space vehicle, proper ESD protection is required. Wrist Straps will be checked on a appropriate calibrated checker prior to use.

Lifting Operation Requirements

There are no lifting operations in this procedure

Hardware/Software Requirements

Commercial Test Equipment

No commercial test equipment is required for this operation.

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 uses hardware located in the Gas Module (Figure 1), the Pump Module (Figure 2) and the Electrical Module (Table 1). However, the Pump Module may be omitted if a stand-alone gas meter (a substitute for PFM-1) is connected at the Gas Module Vent Output. The primary helium vent and all vane pump exhausts must be connected to an outside vent.

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.

Spacecraft Support:

If connector J802 is connected to flight electronics, operation of RAV-2 must be commanded through the spacecraft instead of the RAV controller in the Electrical Module.

Additional Test Equipment

Description	Manufacturer	Model
AMI Level Sensor Readout for LHSD	***AMI***	***110***
O_2 Monitor and Alarm	***Alpha-Omega Instruments***	***1000***

Additional Hardware

Description	Manufacturer	Model
Filter Line assembly	***LM***	***5833827***
Liquid He Transfer Line	***LM***	***5833804***
Liquid He Stinger	***LM***	***5833803***
GHe supply fittings to LHSD	***N/A***	***N/A***
500 or 1000 Liter Liquid Helium Supply Dewar	*Cryofab*	*CMSH-500, -1000*

Protective Clothing

Cryogenic safety gloves and apron

Face shield

Goggles/glasses

Non-absorbent shoes

Tools

Description
Torque Wrench, 1-1/4-in socket, 60 +/- 5 in-lb ***Cal Due Date: _____S/N: _____***

Expendables

WARNING

Alcohol is a skin irritant, potentially toxic if skin absorbed, and flammable. All hazardous waste will be placed into approved waste containers.

Description	Quantity	Mfr./Part No.
Ethyl alcohol	***AR***	***N/A***
99.999% pure gaseous helium	***AR***	***N/A***
Vacuum Grease	***AR***	***Dow Corning High Vacuum or Apiezon N***
Tie wraps – large size	***AR***	***N/A***
Liquid helium	***AR***	***N/A***

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	A1, A2, A3, A4	3452A01975	Yes	
2	DAS	Power Supply, H-P 6627A	B1, B2, B3, B4	3452A01956	Yes	
3	DAS	Data Acquisition/Control Unit H-P 3497A	-	2936A24553 9	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	EH-1	C-19950	No	-
24	GM	Guard Tank Heat Exchanger: a) Thermocouple, b) Current meter, c) Temperature set point controller	EH-2	C-09920	No	-

No.	*Location*	*Description*	*User 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***	***-***

Configuration Requirements

Main Tank

Liquid in the Main Tank must be at its normal boiling point (NBP), 4.2 K. The SMD is vertical with the +z axis up. The actuator control valve for EV-9 switches the state that EV-9 defaults to, should a power failure occur. It should be placed in the "NBP" position for this procedure, ensuring that EV-9 remains open in the event of power failure.

Guard Tank

The Guard Tank is depleted and regulated to a pressure > 0.3 torr above atmosphere. Care must be taken at all times to keep its pressure above atmospheric.

Well

The Well is evacuated.

SMD Vacuum Shell

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

Alarm System

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

Top of lead bag temperature set (CN 40) at $T \leq 6.0$ K.

Top of lead bag temperature set (CN 41) at $T \leq 6.0$ K.

Relative Guard Tank Pressure (CN 46) set at $\Delta P \geq 0.3$ torr.

The Watch Dog alarm must be armed.

GSE and Non-flight Hardware

The ion-pump magnet must be installed.

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).

The Main Tank vent line must be connected to the Gas Module with a vacuum insulated line. Document No. P1006, *Connect Main*

Tank Vent Line to Gas Module – Main Tank at NBP, contains the procedures for connecting the Main Tank vent line.

The Guard Tank vent line must be connected to the Gas Module with a vacuum insulated line (P/N 5833813). Document No. P1008, *Connect Guard Tank Vent Line to Gas Module*, contains the procedures for connecting the Guard Tank vent line.

The Fill Cap Assembly must be installed at SV-13 (Figure 3)

The SMD External Temperature Control Unit must be connected and operational.

Optional Non-flight Configurations

The following non-flight modifications of the basic SMD and optional GSE configurations are incidental to the performance of this procedure. Any combination represents an acceptable configuration.

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-14, or actively pumping the vacuum shell

F. Reference Documents

Drawings

Drawing No.	***Title***
LMMS-5833394	**Instrumentation Installation**

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
EM SYS229	Accident/Mishap/Incident Notification Process
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
EWR 127-	Eastern and Western Range Safety Requirements
KHB 1710.2 rev E	Kennedy Space Center Safety Practices Handbook

Additional Procedures

Document No.	Title
SU/GP-B P1015	Connect Vacuum Module/ Pump on SMD Vacuum Shell
SU/GP-B P1006	Connect Main Tank Vent Line to Gas Module – Main Tank at NBP

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

G. Operations

Verify Preparations

- Verify SU QA notified.
  Record: Individual notified _____,
  Date/time _____/_____.
- Verify NASA Program representative notified.
  Record: Individual notified _____,
  Date/time _____/_____.
- Verify NASA Safety representative has been notified and has given concurrence to proceed.
  Record: Individual notified _____,
  Date/time _____/_____.
- Verify that the Spacecraft is powered up, arming plug P222 is installed, and control personnel are prepared to command RAV-2 when requested.
- Record calibration information in Table 1 (Sec. E.4) and Sec. E.3.8.
- Verify that the persons performing this procedure, the test director, and safety engineer are identified in Sec. D.3.
- Verify performance of pre-operations checklist (Appendix 1).
- Verify availability of equipment, hardware, tools, and expendables listed in sections E.3.5 through E.3.9.
- Verify proper operation of the GP-B Cryogenic Group oxygen monitor
- Verify availability and functioning of emergency shower.

Section G.1 complete _____ QA.

Verify Purity of All Sources of Helium Gas

Record serial number on helium bottle/s.

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

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

Date/time _____/_____.

Section G.2 complete _____ QA.

Verify Configuration Requirements

Verify that the SMD is vertical (+z up). This procedure may be performed only in the vertical orientation.

Ensure DAS Watch Dog Alarm enabled.

Verify electrical cabling between SMD and GSE is as indicated in figure 6.

Verify DAS configuration is set to 4Z

Ensure that the SMD External Temperature Control Unit is operational.

Record MT pressure (EG-3 and/ or STG) _____ torr _____ torr.

Comment: If allowing pressure to build passively, Main Tank pressure must be greater than 15 torr above atmospheric before proceeding with initial Guard Tank fill (see G.9.4).

Verify Guard Tank vent line connected to the Gas Module. If not, perform P1008, *Connect Guard Tank Vent Line to Gas Module*, to connect the Guard Tank vent line. Completion of this procedure will leave the Guard Tank pressurized via APR-2 and GTV-Va.

Verify Main Tank vent line connected to Gas Module. If not perform procedure P1006, *Connect Main Tank Vent Line to Gas Module – Main Tank at NBP,* to connect Main Tank vent. Complete P1006 through paragraph G.6.6 step 1 only (i.e., open SV-9 but **do not** reestablish Main Tank venting by opening EV-9).

Verify that the primary helium vent and the AP-1 vane pump exhaust of the Gas Module are vented to the outside.

Verify that the actuator control valve for EV-9 is in the "NBP" position.

CAUTION

The Main Tank vent path is closed at EV-9 during the initial stages of this procedure to allow pressure for the transfer to build. During this period of closure the temperature at the top of the lead bag is appropriately alarmed and continuously monitored to detect trends prior to alarm. Corrective action for over temperature is given in Appendix 3. Failure to comply may result in equipment damage.

Close /Verify closed EV-9 Date/Time _____/_____

Verify DAS alarm system enabled and record set points.

Top of lead bag temperature – verify [CN 40] on DAS alarm list and set to alarm at $T \leq 6.0$ K. Record set point _____K

Top of lead bag temperature – verify [CN 41] on DAS alarm list and set to alarm at $T \leq 6.0$ K. Record set point _____K

Relative Guard Tank Pressure – verify [CN 46] on DAS alarm list and set to alarm at $\Delta P \geq 0.3$ torr. Record set point _____torr

Ensure Main Tank liquid-level alarm set ≥ 20%: Record. _____%

Verify Fill Cap Assembly installed at SV-13.

Ensure ion-pump magnet installed.

Record Vacuum Shell Pressure.

Turn on Vac-ion pump and record time of day _____

Use DAS [Monitor Data] for CN 99.

When value is steady, record pressure (IP) _____ torr. If pressure is above $5x10^{-5}$ torr, perform procedure P1015, *Connect of Vacuum Module / Pump on SMD Vacuum Shell*, to connect Vacuum Module and pump out SMD vacuum shell.

Comment: If the Main Tank level is < 30%, fill the MT first and then pump on the vacuum shell.

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

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

Verify liquid in Main Tank is at NBP (4.2<T<4.4) and record temperature at bottom of tank CN [9] _____K.

Section G.3 Complete Quality _____

Verify Valve Configuration and Record Initial Conditions

Verify valve states as indicated in following Table. Record configuration in left-hand column, then verify corresponding valve states.

Verify Initial Valve States		
	Verify Open	**Verify Closed**
1. Main Tank vent Connected to GM		EV-9, EV-17
Guard Tank vent Connected to GM; depleted of LHe and pressure regulated at GTV-Va (verify source of He gas at APR-2)	EV-16, GTV-V, GTV-Va, APR-2	EV-13, EV-20, EV-23, EV-24
2. Remaining EV valves	EV-7a/b	EV-4, EV-5, EV-6, EV-8, EV-10, EV-11, EV-12, EV-14, EV-15, EV-18, EV-19, EV-21/22
3. AV valves		All
4. Dewar Valves	SV-9	SV-12, SV-13, FCV

Record initial temperatures

Top of Lead Bag CN [40] _____ K.

Top of Lead Bag CN [41] _____ K.

Temperature at bottom of Main Tank CN [9] _____K.

Record pressures.

Guard Tank (GTV-G) CN [46]:_____ torr (relative to atm.).

Main Tank (STG) CN [49]:_____ torr. (Endevco on Thruster Vent Manifold)

Record liquid level in Main Tank _____ %.

Record Fill Cap Assembly pressure and verify that it reads >760 torr. If not, enter in D-log and consult Payload Test Director.

Fill Cap Assembly (PFCG): _____ torr.

Section G.4 complete. Quality_____

Verify RAVs in Standard Configuration

Using the RAV log book verify that the dewar's internal valves are in the following positions. If not, investigate to ensure previous RAV operations properly recorded. If necessary, note resolution in D-log.

Open: RAV-3, and RAV-6B.

Closed: RAV-1, RAV-2, RAV-5, RAV-6A, and RAV-7.

Section G.5 complete. Quality_____

Set Up Data Acquisition System

Note: refer to DAS operating instructions for information on configurations and mechanics of keyboard/mouse operation.

Verify DAS set to configuration 4AA.

Set DAS to fast scan mode using [other menus], [data config], [fast scan]

Record directory and data file name _____ .

Start "Special Data Cycle" by using [Other Menus] + [Special Data Col] + [Use Pre-Selected], and from menu select "1 = Main Tank fill with Guard Tank empty", + [Init. Collectn] + [Enter] (=use default file). Use 0.1 minute cycle time.

Record directory and special data file name _____ .

Set Main Tank and Guard Tank Liquid Level Sensor sampling intervals to 1 min.

Ensure printer is displaying special Data Cycle data.

Section G.6 complete. Quality_____

Check Initial Pressure in Fill Line

Install a pumping line between valve FCV on the Fill Cap Assembly and the Access Port #1 of the Auxiliary gas section.

Turn on pump AP-1.

Open AV-8 and AV-3.

Open valve FCV and evacuate to 20 mtorr as measured at AG-2.

Close AV-8 and FCV.

Once the pressure in the Fill Cap Assembly has stabilized, record

Fill Cap Assembly pressure (PFCG): _____ torr.

Open valve SV-13 to bring Fill Cap Assembly up to SMD Fill line pressure and record

Fill line pressure (PFCG): _____ torr.

`

Section G.7 complete. Quality_____

Raise Pressure in Fill Line to Main Tank Pressure

CAUTION:
Opening RAV-1 in the following steps may cause heating of the top of the Main Tank. Be prepared to proceed to the opening of RAV-2 to start the transfer without undue delay. The rate of temperature rise at the top of the lead bag (CN [40], CN [41]) should be monitored by the test director. If the temperature limit at the top of the lead bag is reached, be prepared to undertake Contingency Response #2 in Appendix 3. Failure to comply may result in equipment damage.

Discontinue normal data cycles by using [D.C. off]

Verify that the Special Data Cycle is rolling over at 0.5 minute intervals.

Open RAV-1 using:

Ensure all RAV controller selection switches in OFF position.

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

Adjust power supply to 28 VDC.

Power up controller #1.

Position selection switch for controller #1 to RAV-1.

Record initial status lights(4) on: Open: θ θ Closed: θ θ

Activate controller #1 to open RAV-1 and record:

Run time:_____ seconds.

Current draw:_____ amps.

Time of day: _____.

Record final status lights(4) on: θ θ Closed: θ θ

When convenient, record operation in RAV log book.

Verify that the Fill Cap Assembly pressure (PFCG) rises to Main Tank pressure

Record Main Tank pressure (EG-3) _____ torr

Record Fill line pressure (PFCG): _____ torr.

Close SV-13 and torque to 60 in-lbs ± 5 in-lbs.

Section G.8 complete. Quality_____

Prepare for Internal Transfer to Guard Tank

Verify that the arming plug, P222, is installed and that the operations personnel are prepared to operate RAV-2 on request.

CAUTION

Use of the Main Tank heater in the following will heat the MT ullage as well as the liquid. Continue to carefully monitor the temperature at the top of the lead bag and be prepared to undertake Contingency Response #2 in Appendix 3. Failure to comply may result in equipment damage.

Turn on Main Tank heater power supply, (H-8D or H-9D) and adjust current limit to 1.25 A.

Set the power supply voltage in the range 10 to 40 V and record:

V:_____ Vdc, and I:_____A

Wait until Main Tank pressure (STG) > 15 torr above atmospheric pressure and record STG: _____ torr diff.

Valve configuration:

	Open	Closed
EV valves	EV-7a/-b, EV-16	All other
AV valves	AV-3, APR-2	All other
Dewar valves	GTV-V, GTV-Va, SV-9	SV-12, SV-13, FCV
RAV valves	RAV-1, RAV-3, RAV-6B	All other
VF valves	N/A	N/A

Section G.9 complete. Quality_____

Initiate Transfer to Guard Tank

CAUTION
The test director is to monitor the top of the lead bag temperatures as opening RAV-2 may further increase the rate of rise. Prepare to open EV-9 briefly (see contingency 2 of Appendix 3) if this happens. Failure to comply may result in equipment damage

Input comment to DAS "Start Internal transfer to Guard Tank".

Establish Guard Tank vent path.

Close GTV-Va

Open EV-13 and record time _____.

When Guard Tank pressure as read at CN [46] ≤ 5 torr diff.:

Record Guard Tank pressure (GTV-G), CN [46] _____torr diff.

Immediately request operations personnel to open RAV-2 and record time of day: _____.

When convenient, record operation in RAV log book.

When RAV-2 operation is completed, immediately open EV-6 and EV-18.

Confirm transfer by noting Guard Tank vent gas flow and, ultimately, an increase in the Guard Tank liquid level. Adjust the Main Tank heater voltage with a maximum of 50V as needed to produce an adequate transfer rate.

Record data in the following table.

Time	*MT Pressure EG-3 (torr)*	*GT Pressure GTV-G (torr)*	*GT Temp CN [24]*	*MT Heater Voltage (V)*	*MT LLS (%)*	*GT LLS (%)*	*Comments*

When the Guard Tank liquid level reaches 15%:

Turn off Main Tank heater

Terminate transfer (perform following section).

Section G.10 complete. Quality_____

Terminate Transfer to Guard Tank

Close RAV-1 as follows:

Verify controller #1 powered up and selection switch set to RAV-1.

1. Controller #1 powered up and set to RAV-1.
2. Controller #1 not powered up — perform the following steps:

Ensure selection switch for controller #1 in off position

Power up controller #1.

Position selection switch for controller #1 to RAV-1.

Record initial status lights(4) on: Open: θ θ Closed: θ θ

Activate controller #1 to close RAV-1 and record:

Run time:_____ seconds

Current draw:_____ amp

Time of day:_____

Record final status lights(4) on: θ θ Closed: θ θ

Turn selection switch for controller #1 to OFF.

Power off controller #1.

When convenient, record operation in RAV log book.

Configure Guard Tank vent valves as follows

Close EV-6, and EV-18.

Close EV-13.

Open EV-20.

Open EV-9 and record time _____

Enter comment to DAS "Open EV-9 - end internal GT transfer."

Once conditions have stabilized, record:

Guard Tank Pressure (GTV-G):_____ torr (relative to atm.).

Main Tank pressure (EG-3):_____ torr.

Flow rate EFM-1 _____slpm.

Record liquid levels:

Main Tank level	("A" or "B"):	_____%
Guard Tank Level	("A" or "B"):	_____%

Install Stinger in LHSD

WARNING:
A Hazardous Operation is about to begin. In the following steps cold helium gas will be expelled from the stinger and transfer lines. The operator performing the operation must wear a face shield with goggles/glasses, apron, non-absorbent shoes, and cryogenic gloves. Failure to comply may result in personal injury.

Note:
Use appropriate extension for the LHSD being used and clean all O-rings and mating surfaces. See Fig. 4 for transfer plumbing configuration.

Ensure an adequate safety controlled area (15 feet) is properly designated.

Ensure all nonessential personnel are out of the area.

Turn on the amber warning light and make a PA announcement stating, "Attention all personnel, the GP-B program is now performing a hazardous cryogenic operation".

Reduce LHSD pressure to < 1.0 psig by temporarily opening the vent valve on the LHSD (LHV-1).

Open valve VF-1 (Liquid withdrawal valve) on the stinger.

Slowly insert stinger into LHSD while purging. Position stinger withdrawal end approx. 1-in. above bottom of LHSD and tighten quick disconnect.

Close valve VF-1 just as cold gas is expelled from stinger.

Close the primary (low-pressure) relief valve, LHV-2, on the LHSD.

Increase LHSD ullage pressure builder to 8 to 10 psig by performing the following steps:

Attach a GHe hose to the VENT outlet (LHV-1) of the LHSD while purging the hose and the VENT outlet.

Adjust pressure regulator to obtain 8 to 10 psig in LHSD.

Record LHSD data:

Date / time: _____ / _____
Liquid level _____ %
LHSD serial number: _____

LHSD valve positions:

Open: LHV-1; Closed: all others

Note
The hazardous task is now completed. Request PA announcement that hazardous activities are completed. Request area operation light is returned to green. Disband controlled area.

Section G.12 complete. Quality_____

Install Fill Line Assembly

Comment: Two transfer lines are available for use. One has an integrated filter and connects directly to bayonet B3 at the dewar. The other has a separate filter that is first installed at bayonet B3 (the latter case is shown in Fig. 5), after which the fill line is connected to the filter.

Record fill line used:

- o Fill line with integrated filter
- o Fill line and separate filter

Backfill Pumping line and Fill Cap Assembly as follows:

Ensure AV-8 closed.

Open AV-1

Open AV-9 until pressure reaches 0 psig at AG-1, then close AV-9.

Close AV-1.

Remove the pumping line from the fill cap assembly.

Remove fill cap assembly from bayonet B3.

Install Filter Line Assembly (P/N 5833827) to Dewar Fill Bayonet B3 if used.

Install Fill Line Assembly as follows:

CAUTION:
Be sure to provide adequate support to the Fill Line by the use of support stands or other means so as to not apply excessive load on the Filter Assembly and Stinger. Failure to comply may result in equipment damage.

Mate the Fill Line (P/N 5833804) with the LHSD Stinger at VF-1.

Mate VF-2 end of transfer line with Filter Line Assembly or B3 as appropriate.

Ensure VF-2 and relief valve stems pointed upwards.

Ensure VF-3 closed.

Connect a low-impedance facility vent line to the KF fitting at VF-3.

Valve configuration:

	Open	Closed
EV valves	EV-7a/-b, EV-9, EV-16, EV-20	All other
AV valves	AV-3, APR-1	All other
Dewar valves	GTV-V, SV-9	GTV-Va, SV-12, SV-13
RAV valves	RAV-2, RAV-3, RAV-6B	All other
VF/LH valves	LHV-1	VF-1, VF-2, VF-3, LHV-2, LHV-3

Section G.13 complete. Quality_____

Condition Transfer Line/Filter/Stinger Assembly

Configure Pumping Line as follows:

Connect a flexible pumping line mated to Access-1 of Gas Module to VF-3.

Evacuate Transfer Line:

Open valve VF-2.

Open/verify open AV-3.

Open AV-8.

Close AV-8 when pressure reaches less than 50 mtorr as read on gauge AG-2.

Backfill Transfer Line:

Open AV-1.

Open AV-9 until pressure reaches 0.5 psig as read on gauge AG-1 and then Close AV-9.

Close AV-1.

Evacuate Transfer Line (second time):

Open AV-8.

Close AV-8 when pressure reaches less than 50 mtorr as read on gauge AG-2.

Backfill Transfer Line (second time):

Open AV-1.

Open AV-9 until pressure reaches 0.5 psig as read on gauge AG-1 and then Close AV-9.

Close AV-1

Valve configuration

	Open	Closed
EV valves	EV-7a/-b, EV-9, EV-16, EV-20	All other
AV valves	AV-3, APR-1	All other
Dewar valves	GTV-V, SV-9	GTV-Va, SV-12, SV-13
RAV valves	RAV-2, RAV-3, RAV-6B	All other
VF/LH valves	VF-2, LHV-1	VF-1, VF-3, LHV-2, LHV-3

Section G.14 complete. Quality_____

Start Guard Tank Transfer

Comment: This section starts the transfer by precooling the SMD internal Fill Line by pushing liquid up from the Guard Tank.

CAUTION
Transfer startup is a critical operation. All potentially interfering operations must be suspended. A qualified test director/engineer must be assigned to monitor temperatures at the top of the lead bag during pre-cool and initial startup of transfer. Failure to comply may result in equipment damage.

Turn on Main and Guard Tank vent line heat exchangers (EH-1, EH-2).

Ensure VF-3 closed

Open/verify open VF-2.

Open SV-13.

Ensure Guard Tank pressure is greater than atmospheric pressure and Record Guard Tank pressure CN[46] (GTV-G): _____ torr diff.

Verify EV-17 closed.

Verify EV-9 open.

Close EV-20.

Turn on power supply for Guard Tank heater (H-3D or H-4D).

Set power supply current limit to 0.07 amps.

Set power supply voltage to 50 volts.

Record voltage _____ vdc, and current _____ amps.

Open VF-3 to start precool of fill line.

When Fill Valve (SV-13) temperature T-24D [CN 42] is < 75 K:

Power off Guard Tank heaters.

Close SV-13.

Immediately open VF-1 to start pre-cooling of transfer line.

Configure Guard Tank venting

Close EV-9. (This prevents hot gas from being dumped into the Main Tank when EV-13 is opened in the next step).

Open EV-13.

When the facility vent line connected to VF-3 indicates adequate cooling of the transfer line, initiate transfer to Guard Tank as follows:

Close VF-2 and immediately.

Open SV-13.

Record time of day _____.

Open EV-6 and EV-18.

When Guard Tank pressure (EG-1a) drops to less than 3 torr above the Main Tank pressure (EG-3), open EV-9.

Verify start of transfer by observing an increasing flow rate at PFM-1 and record PFM-1 Liquid liters/hr.

Input comment to DAS “Starting external fill of GT”.

Record all fill data on the attached data sheets every 15 minutes.

Adjust LHSD pressure:

Close pressurization valve, LHV-1, at the LHSD.

Adjust the gas supply pressure regulator, APR-3, to the desired pressure (as high as possible without exceeding 10 psig at the LHSD).

Reopen pressurization valve at LHSD.

Note:
Do not exceed 100 LL/hr transfer rate as read on PFM-1 (scale B) as this exceeds the capacity of the vent line heat exchangers (EH-1 and EH-2) in the Gas Module.

Close VF-3 when it thaws out.

When Guard Tank is filled to desired level:

Record Guard Tank level (circle unit used “A” or “B”) _____ %

Verify that operations personnel are prepared to operate RAV-2 on request.

Switch to Main Tank fill: perform following section.

Valve configuration:

	Open	Closed
EV valves	EV-6, EV-7a/-b, EV-9, EV-13, EV-16, EV-18	All other
AV valves	AV-3, APR-1	All other
Dewar valves	GTV-V, SV-9, SV-13	GTV-Va, SV-12
RAV valves	RAV-2, RAV-3, RAV-6B	All other
VF valves	VF-1, VF-3	VF-2

Section G.15 complete. Quality_____

Switch from Guard Tank to Main Tank Fill

Open RAV-1 (MT fill valve) by performing the following steps:

Ensure selection switch for controller #1 is in OFF position.

Power up controller #1.

Position selection switch for controller #1 to RAV-1.

Record initial switch status: Open: π π Closed: π π

Activate controller #1 to open RAV-1 and record:

Run time: _____ seconds

Current draw: _____ amps

Time of day: _____ .

Record status lights(4) Open: π π Closed: π π

When convenient, record operation in RAV log book.

Close RAV-2 (GT fill valve) by performing the following steps:

Request operations personnel to close RAV-2 and record time of day: _____.

When convenient, record operation in RAV log book.

Input comment to DAS “Switch from GT to MT fill”.

Valve configuration:

	Open	Closed
EV valves	EV-6, EV-7a/-b, EV-9, EV-13, EV-16, EV-18	All other
AV valves	AV-3, APR-1	All other
Dewar valves	GTV-V, SV-9, SV-13	GTV-Va, SV-12
RAV valves	RAV-1, RAV-3, RAV-6B	All other
VF valves	VF-1	VF-2, VF-3 (if possible)

Section G.16 complete. Quality_____

Monitor Main Tank Fill

Continue recording data in Data Sheets.

Maintain LHSD ullage pressure between 6 and 10 psig.

Verify the transfer is complete, LHSD empty, when the LHSD level is zero and a rapid and consistent increase in the flow rate is observed.

Proceed immediately to the next section.

Terminate Transfer

Stop the flow of liquid helium

Close VF-1.

Close SV-13 and torque to 60 ± 5 in-lbs and immediately open VF-2.

Close EV-6 and EV-18.

Establish Guard Tank vent configuration.

Verify GTV-V open.

Verify EV-9, EV-13 and EV-16 open.

Record CN [46] (GTV-G) _____ torr (relative to atm.)

Remove the pumping line and vent line at valve VF-3.

Remove the Transfer/ Filter Lines from the Dewar fill bayonet B3.

Immediately install the Fill Cap Assembly with FCV closed.

Valve configuration:

	Open	Closed
EV valves	EV-7a/-b, EV-9, EV-13, EV-16	All other
AV valves	AV-3, APR-1	All other
Dewar valves	GTV-V, SV-9	GTV-Va, SV-12, SV-13, FCV
RAV valves	RAV-1, RAV-3, RAV-6B	All other
VF valves	N/A	N/A

Sections G.17, G.18 complete. Quality_____

Condition Dewar Fill Line

Connect a pumping line between the Fill Cap Assembly at valve FCV and the Auxiliary Gas Section access port no. 1.

Ensure valves AV-1 and AV-9 closed.

Ensure AP-1 on.

Open AV-8 and AV-3.

Open valve FCV and evacuate Fill Cap Assembly to <25 mtorr measured at AG-2B.

Close FCV.

Open SV-13.

Close RAV-1:

(**Comment:** At this time, relief of fill line is through Fill Cap Assembly)

Verify that RAV controller #1 is already on and that controller #1 selection switch is already set to RAV-1:

- Controller #1 powered up and set to RAV-1.
- Controller #1 not powered up — perform the following steps:

Ensure selection switch for controller #1 in off position

Power up controller #1.

Position selection switch for controller #1 to RAV-1.

Record initial status lights (4) on: Open: θ θ Closed: θ θ

Activate controller #1 to close RAV-1 and record:

Run time: _____ seconds

Current draw: _____ amp

Time of day: _____

Record final status lights (4) on: Open: θ θ Closed: θ θ

When convenient, record operation in RAV log book.

Turn OFF all RAV controllers as follows:

Turn all RAV selection switches to OFF.

Power off all controllers.

Turn off RAV power supply.

Open FCV and evacuate the Dewar fill line to < 25 mtorr as measured at AG-2b.

Close SV-13 and torque to 60 +/- 5 in-lbs.

Close FCV

Close AV-8.

Open AV-1.

Open AV-9 until pressure reaches 1.5 psig on AG-1, then close AV-9.

Close AV-1.

Monitor the pressure in the Fill Cap Assembly for 15 minutes to be sure it maintains vacuum and record:

Initial PFCG pressure: _____ torr Date/Time: _____/_____

Final PFCG pressure: _____ torr Date/Time: _____/_____

Comment: If PFCG rises by more than 2.0 torr in 30 minutes, open FCV and AV-8 and pump until AG-2b is less than 25 mtorr then repeat steps G.19.12 through G.19.17.

Section G.19 complete. Quality_____

Record Configuration of Dewar and GSE

Verify valve states are as indicated in following Table

	Open	Closed
EV valves	EV-7a/-b, EV-9, EV-13, EV-16	All other
AV valves	AV-3, APR-1	All other
Dewar valves	GTV-V, SV-9	GTV-Va, SV-12, SV-13, FCV
RAV valves	RAV-3, RAV-6B	All other
VF valves	N/A	N/A

Record the final liquid levels as appropriate:

Main Tank level ("A" or "B"): _____ %

Guard Tank Level ("A" or "B"): _____ %

Record Main Tank pressure (EG-3): _____ torr:

Turn off Main and Guard Tank vent-line heat exchangers (EH-1, EH-2).

Ensure all RAV operations recorded in log book.

Section G.20 complete. Quality_____

Place Data Acquisition System in Standard Configuration

Comment: refer to DAS operating instructions for information on configurations and mechanics of keyboard/mouse operation.

Input comment to DAS "Completed External NBP fill of Main Tank".

Stop Special Data Cycle by using [Other Menus] + [Special Data Col] + [Stop Data Col].

Record Vacuum Shell Pressure.

Turn on Vac-ion pump and record time of day _____ .

Use DAS [Monitor Data] for CN 99.

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

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

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

Set DAS to normal scan mode using [other menus], [data config], [normal scan]

Set Main Tank liquid level sampling interval to 10 minutes.

Set Guard Tank liquid level sampling interval to 10 minutes.

Ensure that Vac-ion pump is off.

Ensure DAS alarm enabled and record set points if changed

3. Thermal conditions substantially unchanged, alarm set points for Station 200 and lead bag are unchanged and set to alarm.
4. Thermal conditions substantially changed, temperature alarm points reset as follows:

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

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

Ensure liquid level sensor alarms enabled on Main Tank and Guard Tank and record set points if changed.

Main Tank Level Set Point_____%

Guard Tank Level Set Point _____%

CAUTION
The Guard Tank may tend to subcool following the completion of this procedure. Establish continuous monitoring of the Guard Tank pressure by placing it on the DAS alarm list. Failure to comply may result in equipment damage.

Ensure Guard Tank pressure on DAS alarm list and set to alarm at 0.3 torr diff. or higher.

Ensure Facility Main Alarm System enabled.

Ensure DAS watchdog timer and alarm enabled.

Section G.21 complete. _____

Secure LHSD

WARNING:
A Hazardous operation is about to begin. In the following steps cold helium gas will be expelled from the LHSD vent (LHV-1). In addition, removal of the stinger involves handling of a cold surface. Both the cold gas and the stinger surface are capable of quickly causing severe frostbite. The operator performing the operation must ensure that the cold gas is directed away from all personnel and must wear a face shield with goggles/glasses, apron, non-absorbent shoes, and cryogenic gloves. Failure to comply may result in personal injury.

Verify safety clear area (15 feet)and amber light in operation

Turn on the amber warning light and make a PA announcement stating, "Attention all

personnel, the GP-B program is now performing a hazardous cryogenic operation

Ensure all nonessential personnel are clear of area.

Shut off the GHe supply used to pressurize the LHSD.

Close LHV-1 (VENT outlet valve of the LHSD), and disconnect the pressurization line.

Crack open LHV-1 and LHV-2, the primary (low-pressure) relief valve, to allow the LHSD to depressurize.

When the primary relief valve at LHV-2 stops venting, completely open LHV-1 and carefully remove the stinger from the LHSD and close the stinger access ball valve.

Close LHV-1 (the VENT outlet valve).

Ensure that LHV-2, the primary (low-pressure) relief valve, is fully open

Note
The hazardous task is now completed. Request PA announcement that hazardous activities are completed. Request area operation light be returned to green. Disband controlled area.

Section G.22 complete. _____

Perform Final Closure of SV-13 and Conditioning the Dewar Fill Cap Assembly

Once SV-13 has warmed sufficiently to try final closure perform the following steps. **Comment**: The time required required to warm up until the valve seals correctly may be a few hours.

Verify that the Fill Cap Assembly is still evacuated and record:

Date:_____ Time of day _____

PFCG pressure:_____

Retorque SV-13 to 60 ± 5 in-lbs.

Open FCV.

Open/Verify open AV-3.

Open AV-8 and evacuate to < 25 mtorr as measured at AG-2b.

Close AV-8.

Ensure EV-12 closed.

Open AV-1.

Open AV-9 until pressure reaches 1.5 psig as read on gauge AG-1 and then close AV-9.

Close FCV.

Close AV-1 and record:

Time of day:_____

Initial PFCG pressure:_____

Open AV-8 and evacuate to < 25 mtorr as measured at AG-2b.

Close AV-8.

Verify closure of SV-13 and FCV by verifying the pressure in the Fill Cap Assembly (PFCG) does not drop by more than 1.0 torr over 30 minutes.. After 30 minutes record:

Time of day:_____

Final PFCG pressure:_____

Note: If PFCG drops by more than 1.0 torr in 30 minutes, repeat steps G.23.2 through G.23.14.

Open AV-1.

Open AV-9 until pressure reaches 0 psig as read on gauge AG-1 and close AV-9.

Close AV-1.

Close AV-3.

Turn off pump AP-1

(Optional) Remove pumping line from Fill Cap Assembly.

(Optional) Install KF-25 blank-off cap on valve FCV.

Valve configuration:

	Open	Closed
EV valves	EV-7a/-b, EV-9, EV-13, EV-16	All other
AV valves	None	All other
Dewar valves	GTV-V, SV-9	GTV-Va, SV-12, SV-13, FCV
RAV valves	RAV-3, RAV-6B	All other
VF valves	N/A	N/A

Perform Post-Operations Checklist (Appendix 2)

Section G.23 complete. Quality_____

H. Procedure Completion

Completed by: _____

Witnessed by: _____

Date: _____

Time: _____

Quality Manager	**Date**
Payload Test Director	**Date**

Data Sheet 1

Date/Time	LHSD Level (%)	LHSD press (psig)	Main Tank pressure EG-3 (Torr)	Guard Tank pressure EG-1a (Torr)	LHe Flow PFM-1 [B] (l/hr)	Main Tank Liquid He Level (%)	Guard Tank Liquid He Level (%)	

Data Sheet 2

Date Time	Lead bag top T-22D [40] (K)	Lead bag top T-23D [41] (K)	G.T. bottom T-15D [24] (K)	HX-4 T-08D[8] (K)	M.T. bottom T-09D [9] (K)	Vac-Ion Pump (torr)	Gas Mod HX GT/MT (^{o}C/ ^{o}C)	MT Vent Bayonet/ Baynt Nut (^{o}C/ ^{o}C)	SV-9 Valve/ Top Plate (^{o}C/ ^{o}C)	Top-Plate Cyl(2) (^{o}C/ ^{o}C)

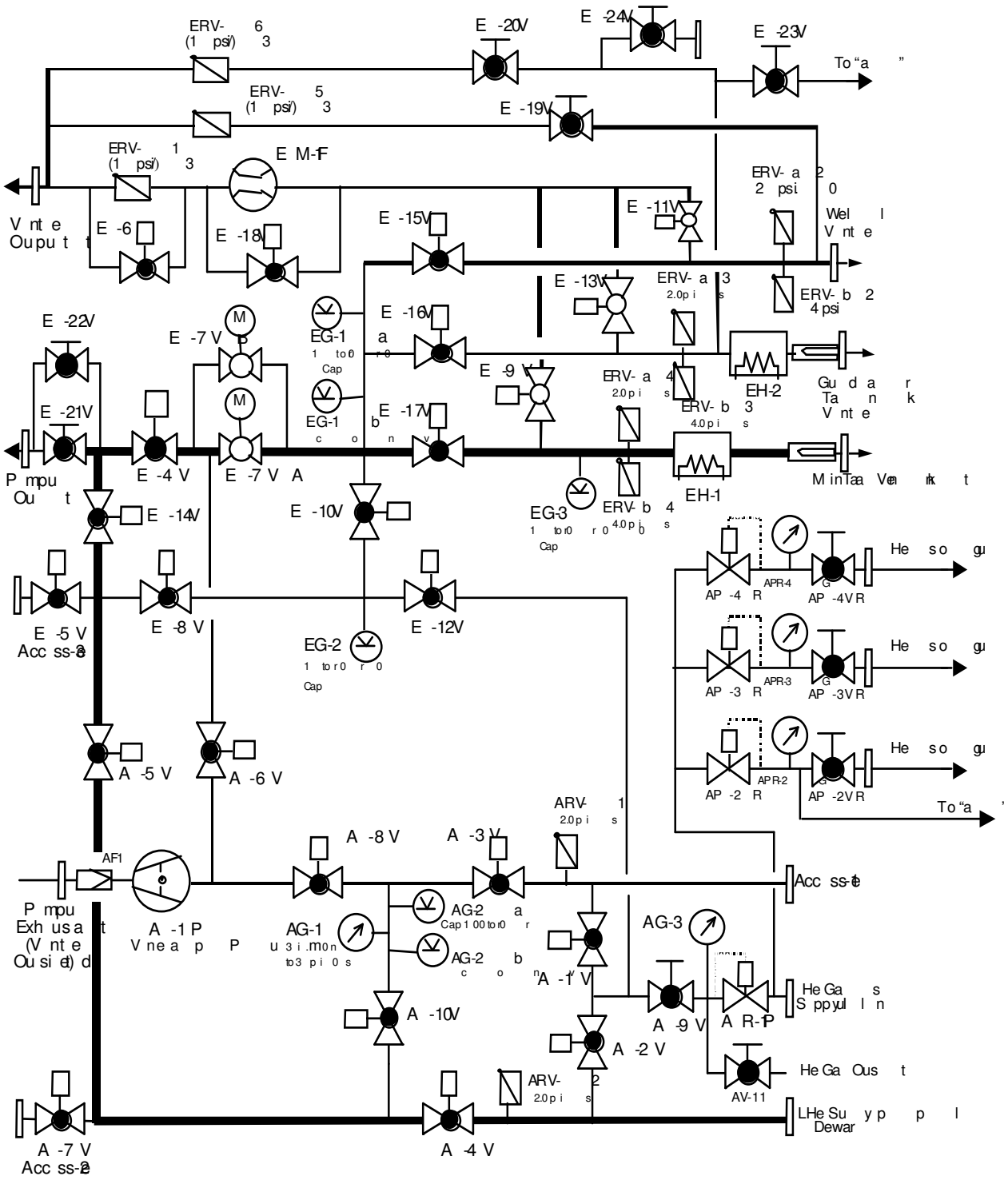

Figure 1. Schematic of Gas Module Plumbing.

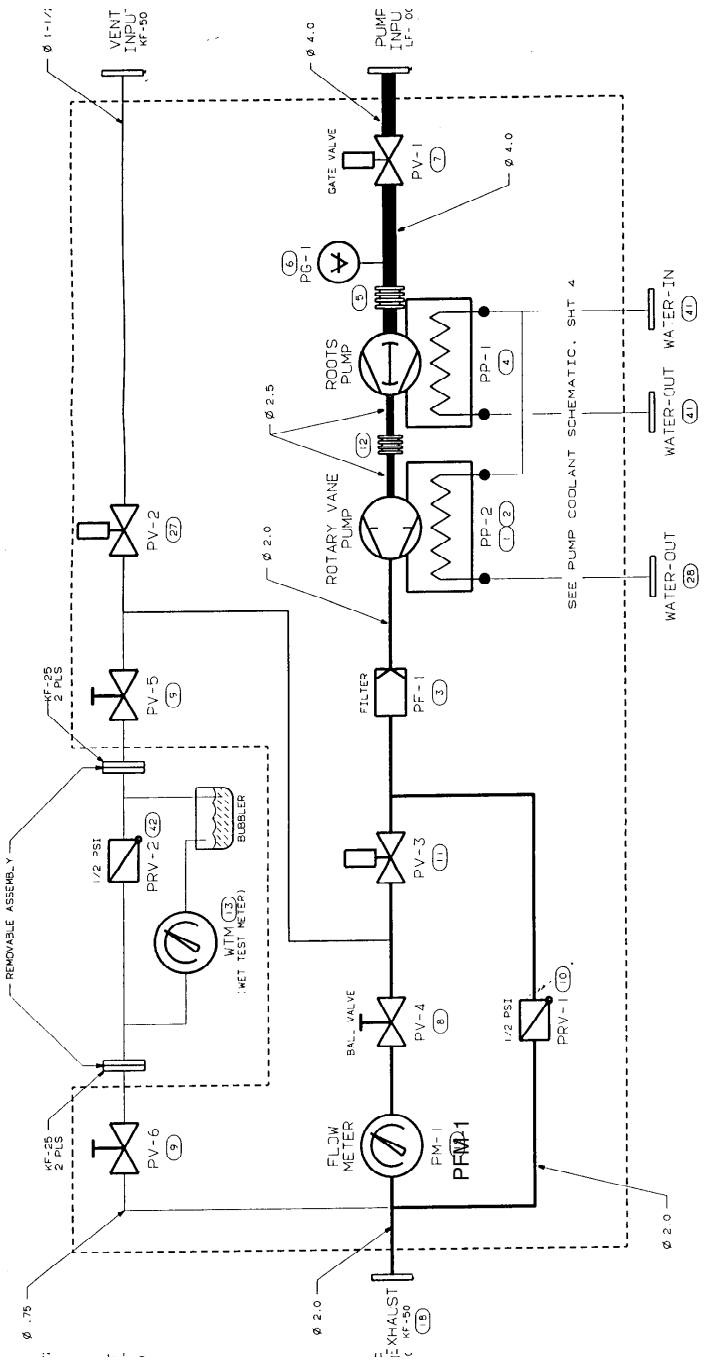

Figure 2. Schematic of Pump Module plumbing.

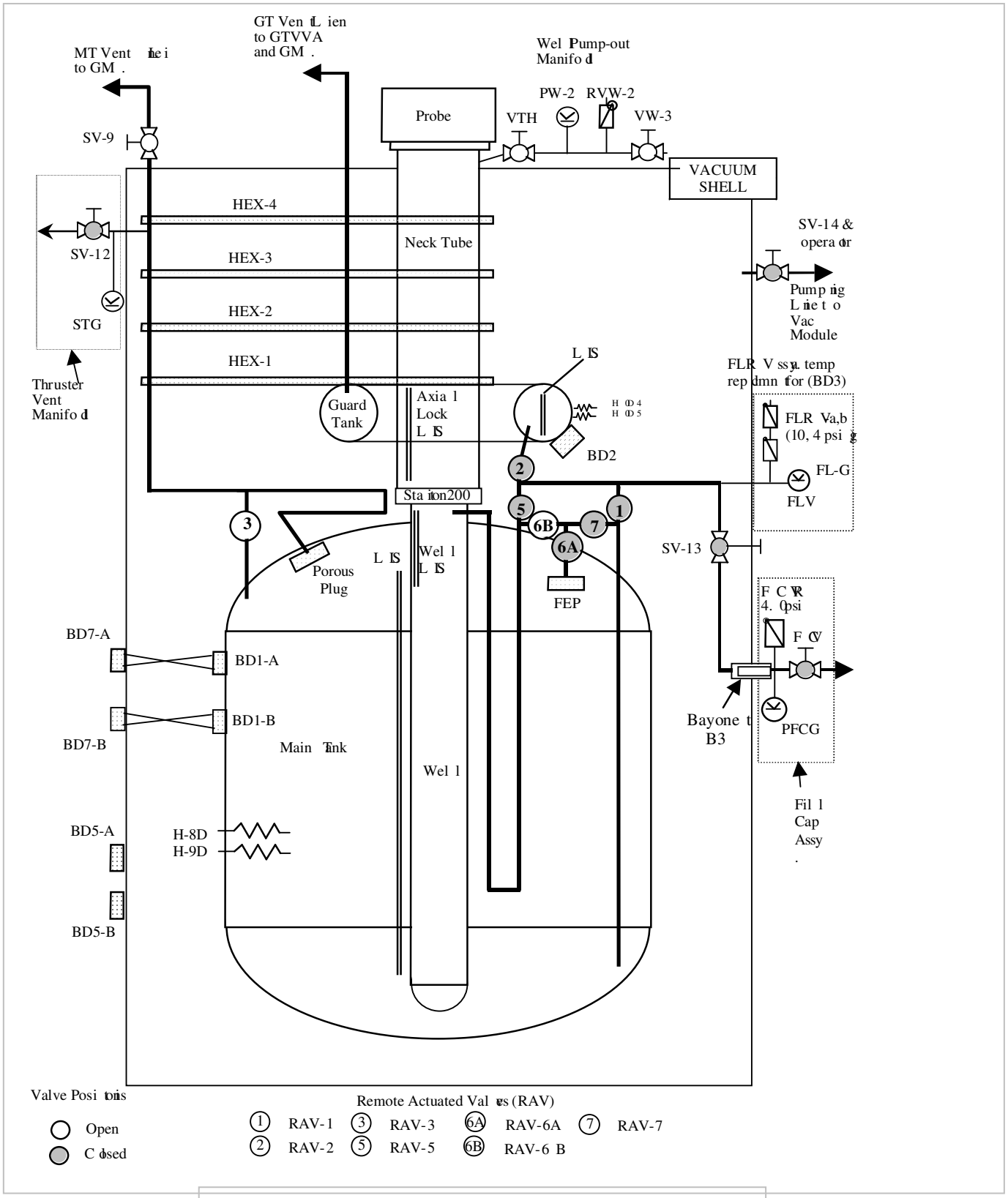

Figure 3. Schematic of Science Mission Dewar plumbing

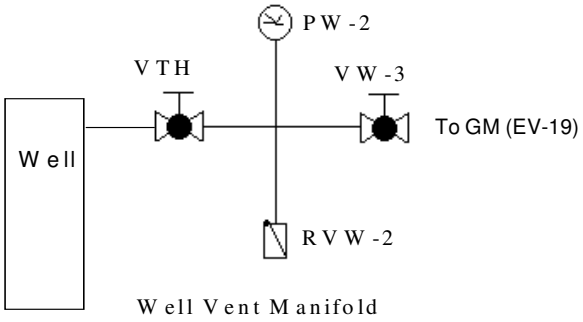

Figure 4 Well vent manifold.

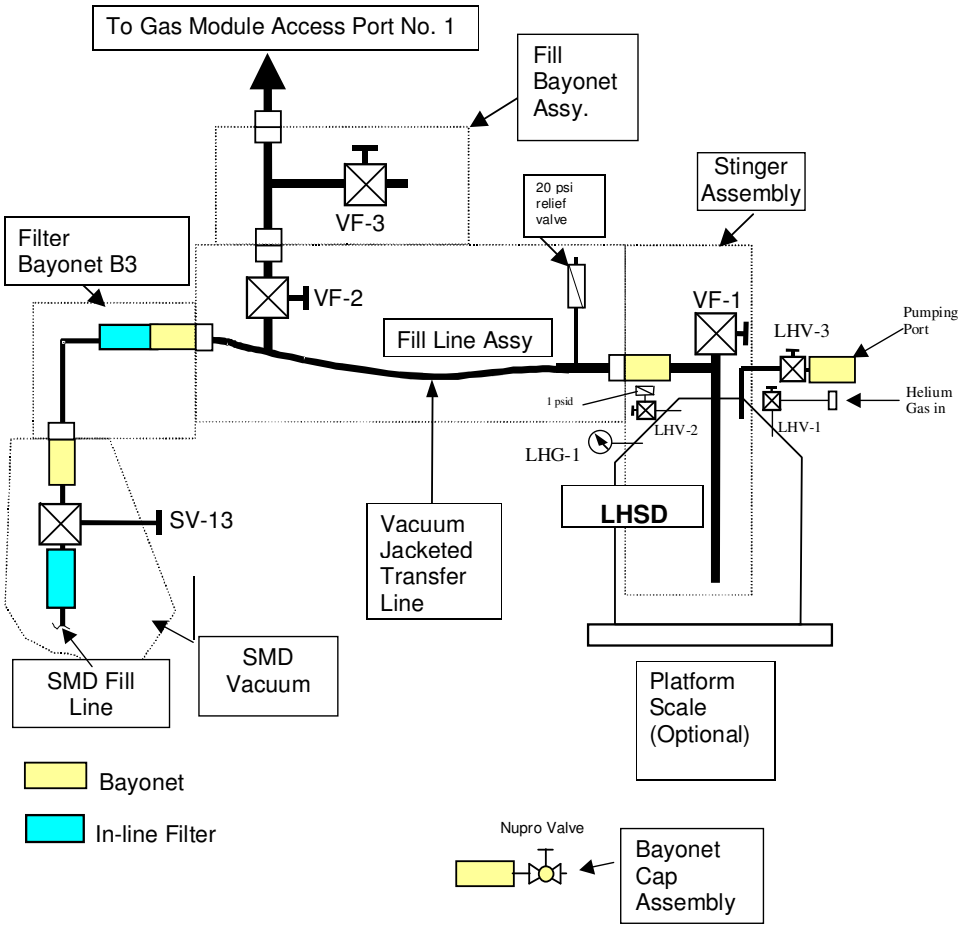

Figure 5. Schematic of liquid helium transfer plumbing

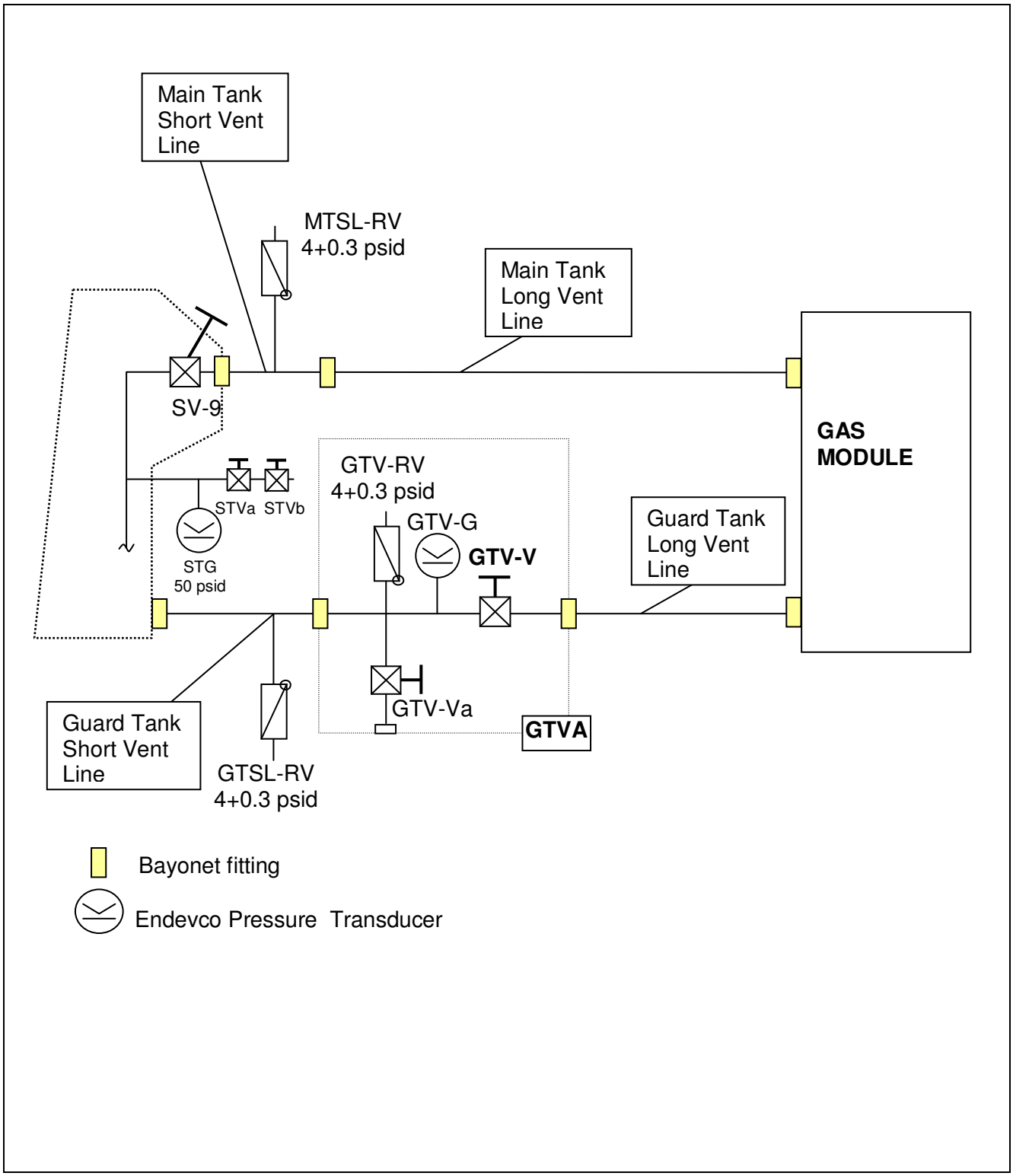

Figure 6. Main Tank and Guard Tank venting to Gas Module with Guard Tank Vent Assembly (GTVA) in place.

I. Appendix 1 – Pre-Procedure 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 a high-bay engineering/safety walk down. Ensure all discrepancies are corrected prior to procedure performance.		
	11. Confirm that each test team member understands that there will be a post-test team meeting.		

	Team Lead Signature: _____		

J. Appendix 2 – Post-Procedure 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 Responses

	Condition	Circumstance	Response
1	Power Failure	Before. G.12 (start of transfer)	**Wait for power restoration:** Re-establish valve configuration, and resume procedure
		Section G.12 through G.16	**Go to Safemode:** Close VF-1, SV-13, if open; Immediately open VF-2; Open EV-20; Close VF-3, when possible.
		After G.16	**Wait for power restoration:** Re-establish valve configuration , and resume procedure
		Any time	**Wait for power restoration** **Note**: the DAS computer will continue to function for several hours, however no data will be collected DAS computer still operating: Reset GM valving per the last configuration in procedure and resume procedure DAS computer not operating: Reboot computer and launch DRP_SMD and select auto startup option Reset GM valving per the last configuration in procedure and resume procedure
2	Temperature limits (CN 40) exceeded	MAIN TANK IS NOT VENTING	**ALLOW MAIN TANK TO VENT** **If SV-9 is closed:** Close EV-17 (if open) and verify EV-9 open, 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. **If SV-9 open and EV-9 closed:** Open EV-9 for short periods (~15 sec) and allow increased flow from Main tank; in addition, Open EV-6 and EV-18 if higher flow rate is needed. **If SV-9 and EV-9 open** Open EV-6 and EV-18 for higher flow If problem persists see item 3

	Condition	Circumstance	Response
3	Temperature limits (CN 40) exceeded	MAIN TANK IS VENTING	**PROMOTE INCREASE IN MAIN TANK VENTING** Power up heater at H08D or H0-9D and starting at 15 vdc input increase power until increased flow has cooled the problem area
4	Burst disk rupture (MT/GT)	ANY TIME	Evacuate room
5	Oxygen monitor alarm	ANYTIME	Evacuate room.
6	Liquid Nitrogen Spill	ANYTIME	Clear area until all spilled liquid has evaporated.