GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

Repressurize Guard Tank in Thermal Vacuum Test

THIS DOCUMENT CONTAINS THE USE OF HAZARDOUS MATERIALS

P0958A

ECO No.1407

April 22, 2003

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REVISION RECORD

REVISION	ECO	Description	DATE
A	1407	1) Sec. G.2: Clarify that the verification of gas content applies to the BIP helium only. 2) Sec. G.4: Added caution about not allowing the main tank to blow down and cool Viton seals. 3) Sec. G.4.6: Added verification that the SV is in a powered-down state. 4) Sec. G.6.4: Deleted reference to ECU data (also in Data Sheet 1) since the SV is not powered. 5) Sec. G.8.4: Corrected GT pressure alarm spec. (was 790, is 30 torr). 6) Appendix 3: Corrected response to over-temperature situation to warn of consequences of blowing down the main tank.	4/22/03

Table of Contents

List of Abbreviations and Acronyms

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

A. SCOPE

This procedure provides the steps necessary to repressurize the Guard Tank of the SMD subsequent to its evacuation during Thermal Vacuum Test in the SEP III chamber located in Lockheed Martin building 156. This is to be performed prior to the venting of the thermal vacuum chamber. The steps include

1. Verify configuration;
2. Connect source of high purity helium;
3. Repressurize the Guard Tank at a controlled rate while monitoring key parameters;
4. (Option) Disconnect Vacuum Module and return to standard pressurization configuration.

B. SAFETY

B.1. Potential Hazards

Personal injury and hardware damage can result during normal positioning, assembly and disassembly of hardware

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

When working inside the SEP III chamber and in the area outside of the SEP III chamber in LM Building 156, an oxygen deficiency monitor that alarms when the oxygen level is reduced to 19.5% will be utilized. 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.

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.

The following additional requirements apply to all personnel involved directly in cryogenic operations. Gloves that are impervious to liquid

helium and liquid nitrogen are to be worn whenever the possibility of splashing or impingement of high-velocity cryogens exists or when handling equipment that has been cooled to cryogenic temperatures. Protective clothing and full-face shields are to be worn whenever the possibility of splashing cryogens exists.

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 judgment 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

Test Director	***Test Engineer***
Ned Calder Mike Taber Dave Murray	Tom Welsh

E. REQUIREMENTS

E.1. Electrostatic Discharge Requirements

This procedure does not include 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 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 Electrical Module contains the instruments listed in Table 1, 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, the Electrical Module (Table 1), and the Vacuum Module.

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. Test Equipment: N/A

E.3.5. Additional Hardware

Description	*Quantity*	*Mfr./Part No.*
Flowmeter	1	Dwyer VFA-4 (10 scfh air) or VFA-23 (5 slpm air) or similar with built-in flow control valve
1/4” stainless flex hose	A/R	
2-stage regulator with 30 psig output pressure gauge for BIP helium cylinder	1	

E.3.6. Tools

No additional tools are required.

E.3.7. Expendables

Description	*Quantity*	*Mfr./Part No.*
BIP+ grade compressed He gas	1.5 m^3 (~550 psig in a K cylinder)	Air Products

E.4. Instrument Pretest Requirements

The GSE instruments required to perform this procedure are listed in Table 1, together with their serial numbers, where available. Instruments that are required to have current calibrations are indicated in the Cal-Required column. Instruments that do not require calibration are those not used to verify performance requirements and are not connected to flight instrumentation. The

status column is to be filled in with the due date of the instrument calibration sticker and verified to be in calibration by QE or QE designee.

Table 1. Required Instrumentation and Calibration Status

No.	*Location*	*Description*	*Name*	*Serial No.*	*Cal Required*	*Status Cal due date*
1	DAS	Power Supply, H-P 6627A	-	3452A01975	Yes	
2	DAS	Power Supply, H-P 6627A	-	3452A01956	Yes	
3	DAS	Data Acquisition/Control Unit H-P 3497A	-	2936A245539	No	-
4	DAS	Digital Multimeter H-P 3458A	-	2823A15047	Yes	
5	EM	Vacuum Gauge Controller Granville-Phillips Model 316	EG-1a, -1b	2827	No	-
6	EM	Vacuum Gauge Controller Granville-Phillips Model 316	AG-2a, -2b	2826	No	-
7	EM	Vacuum Gauge Controller Granville-Phillips Model 316	EG-3	2828	No	-
8	EM	MKS PDR-C-2C	EG-2, FCG	92022108A	No	-
9	EM	Flow meter – Matheson 8170	EFM-1	96186	No	-
10	EM	Flow meter totalizer Matheson 8124	EFM-1	96174	No	-
11	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Main Tank	96-409-11	No	-
12	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Guard Tank	96-409-10	No	-
13	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Well	96-409-9	No	-
14	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Axial Lock	96-409-12	No	-
15	EM	Pressure Controller – MKS 152F-92	EV-7a, -7b	96203410A	No	-
16	EM	Power Supply HP 6038A	H08D Tank Heater	96023407A	Yes	
17	EM	Power Supply HP 6038A	H09D Tank Heater	3511A-13332	Yes	
18	EM	Power Supply HP 6038A	RAV Power Supply	3329A-12486	Yes	
19	EM	Vac Ion Pump power supply Varian 929-0910, Minivac	SIP	5004N	No	-
20	EM	Flow meter totalizer Veeder-Root	PFM-1	576013-716	No	-
21	GM	Pressure Gauge, Heise	AG-1	CC-122077	No	-
22	GM	Pressure Gauge, Marshall Town	AG-3	N/A	No	-
23	GM	Main Tank Heat Exchanger: a) Thermocouple, b) Current meter, c) Temperature set point controller	-	C-19950	No	-
24	GM	Guard Tank Heat Exchanger: a) Thermocouple, b) Current meter, c) Temperature set point controller	-	C-09920	No	-

No.	*Location*	*Description*	*Name*	*Serial No.*	*Cal Required*	*Status Cal due date*
25	VM	Vacuum Gauge readout, Granville-Phillips 316	VG-3 VG-4	2878	No	-
26	VM	Vacuum Gauge readout, Granville-Phillips 360	VG-1, VG-2 VG-5	96021521	No	-

E.5. Configuration Requirements

E.5.1. Space Vehicle

The SV is horizontal in the SEP III thermal vacuum chamber and configured for the thermal vacuum test.

E.5.2. Main Tank

Liquid in the Main Tank is at normal boiling point (NBP). The MT is vented through a port plate to the Gas Module for flow metering. (See Figure 2 for the Main Tank vent plumbing, Figure 1 for the GM, and Figure 4 for the SMD.)

E.5.3. Guard Tank

The Guard Tank is evacuated and being pumped by the Vacuum Module (See Fig. 3a for the Guard Tank pressurization / pumping line and Fig. 5 for the Vacuum Module.)

E.5.4. Well

The Well is evacuated. This procedure places no requirement on the Well pressure.

E.5.5. SMD Vacuum Shell

The Vacuum Shell is evacuated. This procedure places no requirement on the vacuum shell pressure.

E.5.6. Alarm System

1. The DAS alarm system must be enabled and contain the following alarm set-points:
   a. Top of lead bag temperature (CN 175) set at $T \leq 6.0$ K.
   b. Top of lead bag temperature set (CN 178) at $T \leq 6.0$ K.

E.5.7. GSE and Non-flight Hardware

1. GSE cabling must be connected between the SMD and the Electrical Module (P/N 5833812) and between the SMD and the Data Acquisition System (P/N 5833811).
2. The Guard Tank Vent Valve Assembly is installed as depicted in Fig. 4.
3. The flight equivalent Fill Cap is installed at SV-13.

E.6. Optional Non-flight Configurations

None

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*
EM SYS229	*Accident/Mishap/Incident Notification Process*
SU/GPB P0879	*Accident/Mishap Notification Process*
SU/GPB P0875	*GP-B Maintenance and Testing at All Facilities*

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 _____/_____.

- Record calibration due dates in Table 1 (Section E.4)
- 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).
- Verify that the spacecraft operations personnel have been informed of the need for ECU support for this procedure.

G.2. Verify Content of Source of Helium Gas

G.2.1. Record serial number(s) of BIP helium bottle(s):

_____.

Verify helium bottle(s) have been tested for contents and record Op. Number. : _____

QA Witness:_____

G.3. Verify Configuration Requirements

G.3.1. Ensure DAS alarm system enabled and record set points.

1. ***Top of lead bag temperature*** – ensure CN [175] on DAS alarm list with alarm limit at T ≤ 6.0 K. Record set point. _____K
2. ***Top of lead bag temperature*** – ensure CN [178] on DAS alarm list with alarm limit at T ≤ 6.0 K. Record set point. _____K

Section Complete QA Witness:_____

G.4. **Record Initial Configuration and Conditions**

G.4.1. Based on last main tank liquid level measurement and an estimate of the average boiloff rate, estimate the current main tank liquid level: _____%. Record date / time: _____/_____

G.4.2. Verify Main Tank vent configuration:

1. Main Tank vent connected to the Gas Module at EH-1
2. Valve EV-9 open, all other EVs and AVs, closed.
3. Gas meter connected to GM "Vent Out" port and the pulser is connected to the DAS with the flow rate (EFM-1) reading on channel 110.

Caution
Do not allow the Main Tank to blow down during this procedure. The cooling caused by doing this could cause the Viton seals at SV-9 and the Main Tank bayonet to leak helium into the T/V chamber causing possible damage to the SV and/or chamber equipment.

G.4.3. Verify that the Vacuum Module is pumping on the Guard Tank as depicted in Figure 3a with valve HPLV-2 open

G.4.4. Record initial pressures, as appropriate.

1. Main Tank – NBP (EG-3):_____ torr.
2. Vacuum Module (VG-1): _____ torr

G.4.5. Record initial temperatures

1. Top of Lead Bag (CN 175) _____K
2. Top of Lead Bag (CN 178) _____K
3. Guard Tank (CN 170) _____K
4. Bottom of the Main Tank (CN 171) _____K

G.4.6. Verify that the SV is powered down.

Section Complete QA Witness:_____

G.5. **Connect He Supply to Guard Tank Pressurization Line**

G.5.1. Close valve HPLV-2 (Fig. 3a) on the line to the Guard Tank.

G.5.2. Turn off VG-1 and close valves VV-10 and VV-4.

G.5.3. Turn off the turbopump, VP-1, and forepump, VP-2..

G.5.4. Open VV-5 to bring turbopump to 1 atm.

G.5.5. Disconnect HPLV-2 from the Vacuum Module at VV-10 and insert a tee between HPLV-2 and VV-10.

G.5.6. Purge the BIP helium by opening HPL-SOV and increasing the output pressure to ~5 psig. Close HPL-SOV.

G.5.7. Using 1/4" stainless flex hose, connect the BIP He supply (with regulator and shut-off valve) to the input of the Dwyer flowmeter and connect the output to the flow control valve HPL-FCV (Fig. 3b). Purge this assembly with He gas by opening HPL-SOV, HPL-FMV, and HPL-FCV. (Note: Do not open HPL-FMV by more than six turns; the valve stem is not captured.) Close these valves except HPL-FMV. Connect the other end of JPL-FCV to the tee between HPLV-2 and VV-10.

G.5.8. Leak check modified pressurization plumbing:

1. Record calibrated leak:_____scc/s
2. Record measured leak:_____scc/s
3. Connect Leak Detector to leak check port on VM (at VV-7).
4. Start leak checker and open VV-7 and VV-10 to pump up to HPL-FCV with leak detector.
5. Record Leak detector background:_____ scc/s
6. Verify background less than 10^{-6} scc/s.
7. Bag new joints downstream of HPL-FCV
8. Record maximum leak indication after two minutes exposure:_____ scc/s
9. Spray leak check all remaining joints up to HPL-SOV.
10. Verify no rise detected during this test.

G.5.9. Close VV-10, VV-7, and VV-1.

G.5.10. Shut down leak detector.

Section Complete QA Witness:_____

G.6. **Set Up Data Acquisition**

G.6.1. The DAS should be set up in configuration 4z.

G.6.2. Set DAS to 5-minute data cycles.

G.6.3. Start a Special Data Collection for channels numbers 175, 170, 46, 47, 110.

Section Complete QA Witness: _____

CAUTION:
The next section will start flowing warm He gas into the Guard Tank. It is critical that the temperature at the top of the lead bag (CNs 175, 178) not be allowed to go above 6.5 K. (Alarms are set at 6 K.) These temperatures should be monitored by onsite personnel until the end of this procedure. Contingency response is included in Appendix 3.

G.7. **Repressurize the Guard Tank**

G.7.1. Commence recording data every fifteen minutes on the attached data sheet.

G.7.2. Enter a comment in the DAS: "Starting to repressurize GT".

G.7.3. Record date / time: _____ / _____

G.7.4. Open HPLV-2.

G.7.5. Verify HPL-FMV is open. (Note: Do not open this valve more than six turns as the valve stem is not captured.)

G.7.6. While monitoring the flow meter HPL-FM, open HPL-SOV and slowly start opening HPL-FCV. Establish an initial flow rate of 2 slpm (4 scfh). Guard Tank flow rate may be increased within the constraint of the above caution and the following guidelines:

1. Maintain the Main Tank vent rate below 20 slpm.
2. Maintain the HEX-1 temperature (T-3D on the ECU) below 60 K (50 – 60 K is desirable).

Note: It will take approximately 1 standard m^3 of He to completely repressurize the Guard Tank. At 2 slpm this would nominally take 8 hours to complete, ignoring thermal relaxation time.

G.7.7. When the Guard Tank pressure reaches 860 – 910 torr (nom. 2 – 3 psig) as read by CN 46 with HPLV-2 momentarily closed, reset the He supply regulator (HPL-R) as follows:

1. Completely back off the regulator;
2. While monitoring the flow meter HPL-FM, slowly increase the regulator setting until the flow meter just starts to show some flow.

Note: The Guard Tank will continue to take gas as it cools back to its steady-state temperature. The GT pressure will consequently drop back below 860 torr due to pressure drop along the supply line and to pressure regulator insensitivity. Wait until the GT temperature has nearly stabilized to reset the regulator, if needed.

Section Complete QA Witness:_____

G.8. **Establish Final Configuration**

G.8.1. When temperatures and pressures have stabilized, enter a comment in the DAS: "Completed repressurization of GT".

G.8.2. If the He supply is marginal, switch to a standard six-pack source as follows:

1. Record serial number of helium bottle/s.

   1. _____ 2. _____ 3. _____

   4. _____ 5. _____ 6. _____

2. Verify helium bottle/s have been tested for purity and record Op. Number: _____.
3. Close HPL-SOV and HPLV-2.
4. Disconnect HPLV-2 at the tee to the VM and the flow meter.
5. Set the six-pack regulator to the same pressure as the BIP regulator.
6. Crack HPLV-2 and the shut-off valve at the six-pack and connect the two while gas is flowing from both directions.

G.8.3. Restore DAS to it original configuration

G.8.4. Ensure DAS alarm system enabled and record set points.

1. ***Top of lead bag temperature*** – ensure CN [175] on DAS alarm list with alarm limit at $T \leq 6.0$ K. Record set point. _____K
2. ***Top of lead bag temperature*** – ensure CN [178] on DAS alarm list with alarm limit at $T \leq 6.0$ K. Record set point. _____K
3. ***Relative Guard Tank Pressure*** – ensure CN [46] on DAS alarm list with alarm limit at $\Delta P \geq 30$ torr. Record set point. _____torr

Section Complete QA Witness:_____

H. **Procedure Complete**

Completed by:_____

Witnessed by:_____

Date: _____

Time:_____

Quality Manager_____ **Date**_____

Test Director_____ **Date**_____

Data Sheet 1

Date / Time	Top of lead bag temp. (K) CN 175	Top of lead bag temp. (K) CN 175	Bottom of MT temp. (K) CN 171	Guard Tank temp. (K) CN 170	GT press. (GTV-G, torr) CN 46	MT press. (EG-3, torr) CN 47	MT flow rate (PFM-1, slpm) CN 110	GT flow rate (HPL-FM, slpm)

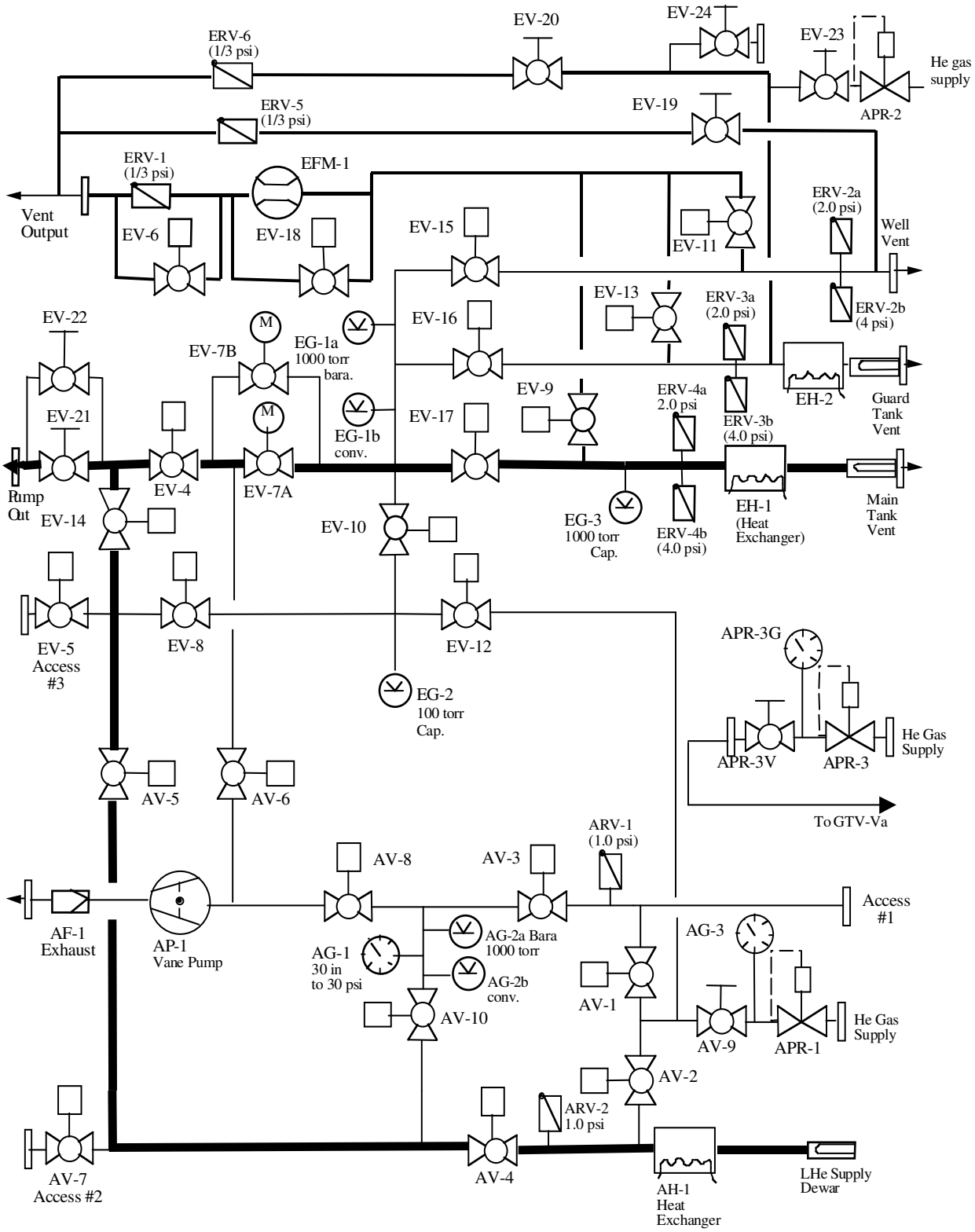


Figure 1 Schematic of Gas Module

Figure 2 Main Tank Vent Configuration

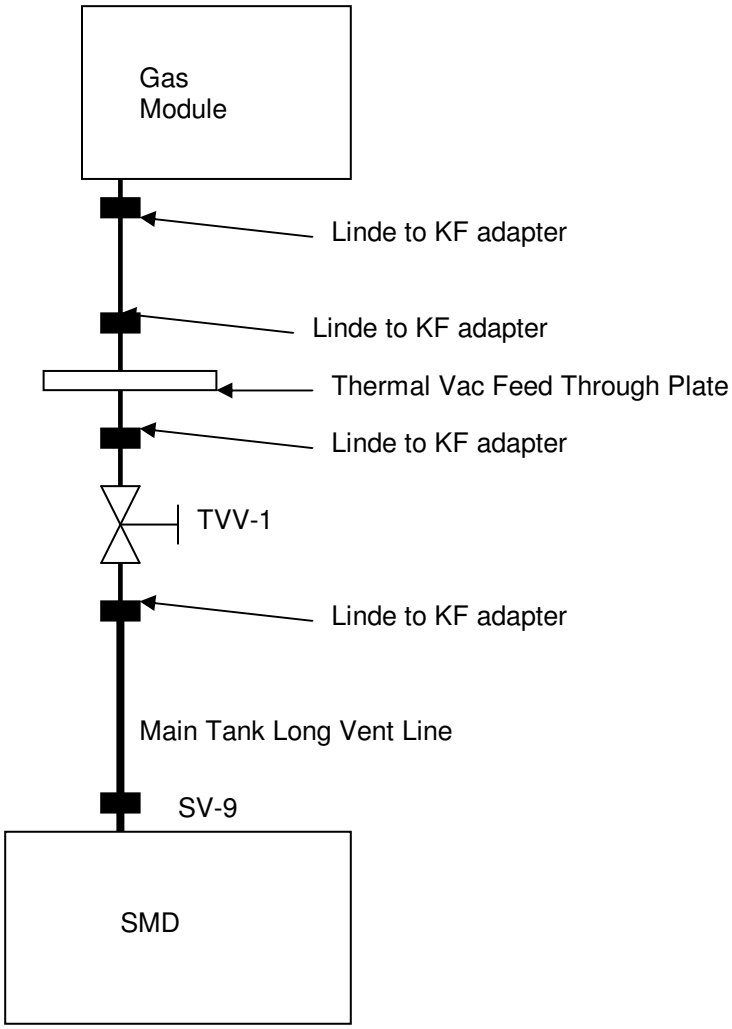


Figure 3a: Guard Tank Pressurization Line Assembly

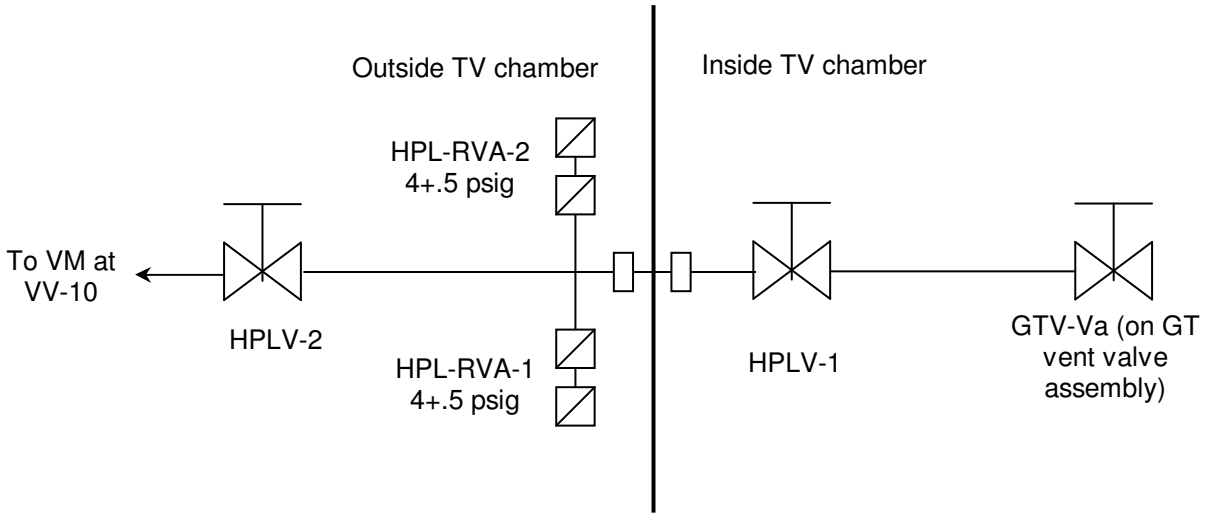


Figure 3b: Guard Tank Pressurization Line Assembly as Modified for This Procedure

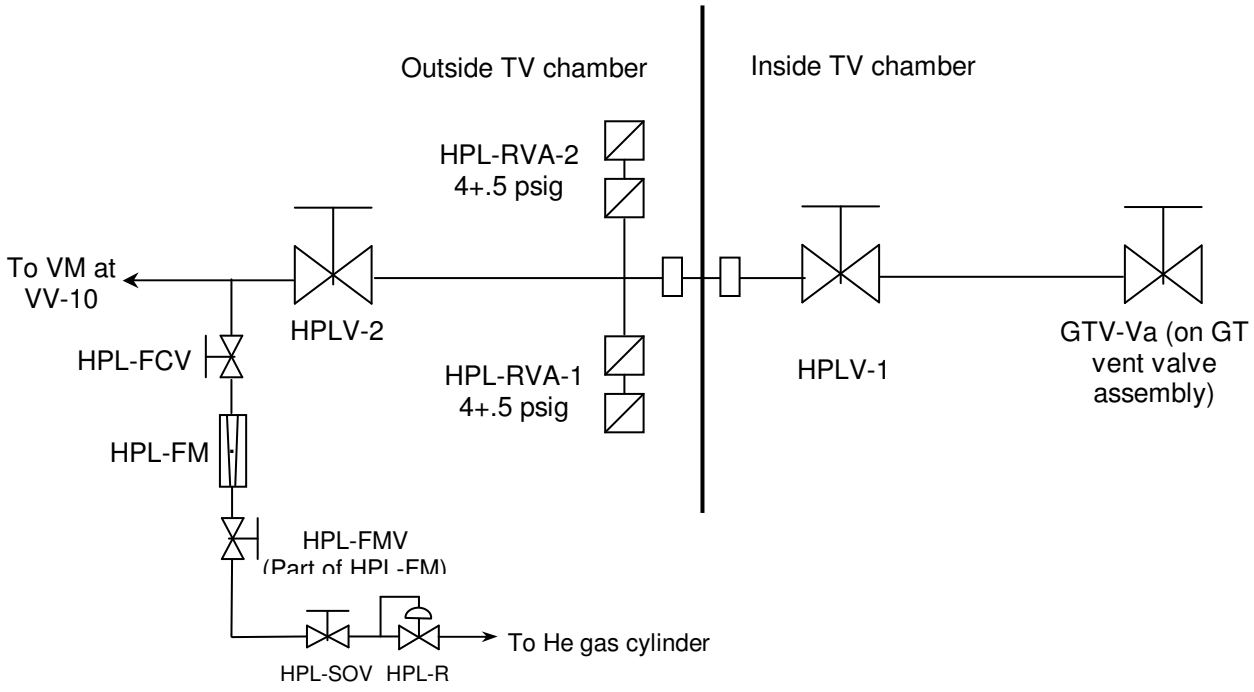


Figure 4 Science Mission Dewar with ancillary plumbing.

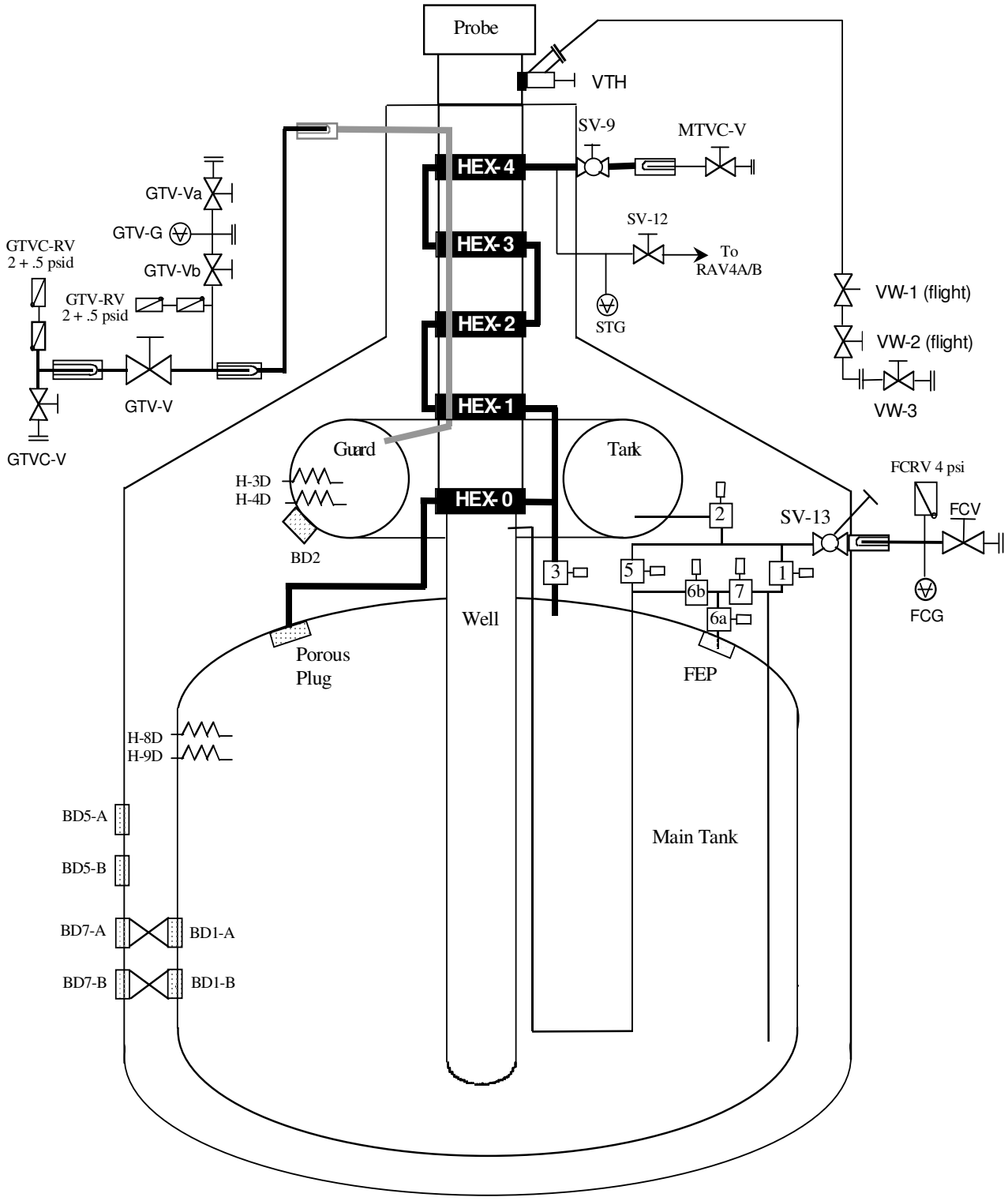
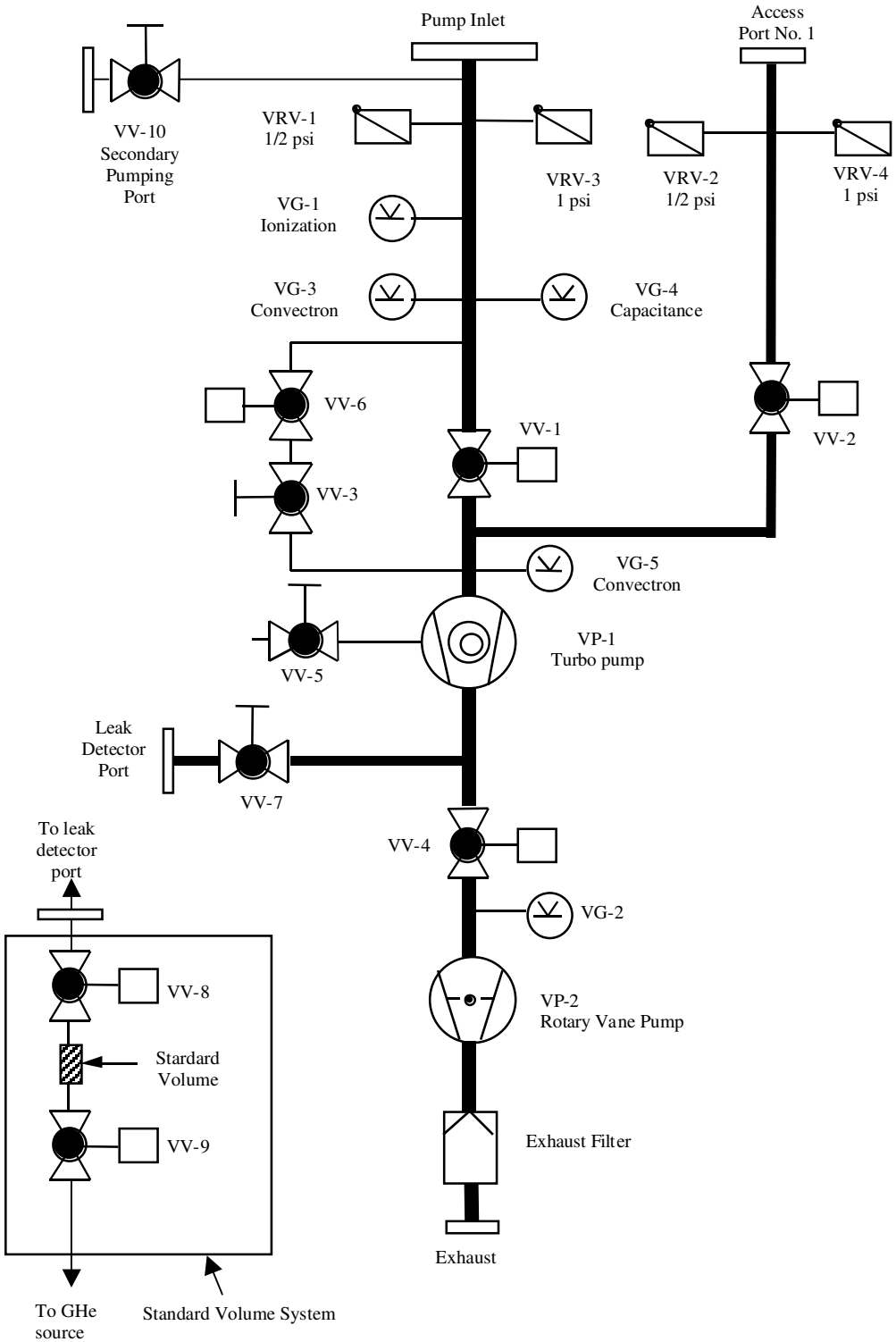


Figure 5 Vacuum Module



I.

APPENDIX 1 – Pre Operations Checklist

DATE	CHECKLIST ITEM	COMPLETED	REMARKS
	1. Verify the test procedure being used is the latest revision.		
	2. Verify all critical items in the test are identified and discussed with the test team.		
	3. Verify all required materials and tools are available in the test area.		
	4. Verify all hazardous materials involved in the test are identified to the test team.		
	5. Verify all hazardous steps to be performed are identified to the test team.		
	6. Verify each team member 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: _____		

J. APPENDIX 2 – Post Operations Checklist

DATE	CHECKLIST ITEM	COMPLETED	REMARKS
	1. Verify all steps in the procedure were successfully completed.		
	2. Verify all anomalies discovered during testing are properly documented.		
	3. Ensure management has been notified of all major or minor discrepancies.		
	4. Ensure that all steps that were not required to be performed are properly identified.		
	5. If applicable sign-off test completion.		
	Team Lead Signature: _____		

K. APPENDIX 3 – Contingency Responses

Condition	Circumstance	Response
Temperature limits (CN 175 or 178) exceeded	Any time	1) Reduce or stop flow into GT with HLP-FCV 2) Only if necessary, open EV-6 and EV-18 to increase MT vent flow. Excessive MT vent flow may cause cooling of the Viton seals at SV-9 and the MT bayonet. This may cause the seals to leak and flood the T/V chamber with He.