GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

Inspect and Reconfigure Payload following Thermal Vacuum Test

THIS DOCUMENT CONTAINS THE USE OF HAZARDOUS MATERIALS

P0957

December 3, 2002

Written by:

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REVISION RECORD

REVISION	ECO	PAGES	DATE

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List of Abbreviations and Acronyms

AG-x	Gauge x of Gas Module auxiliary section
AMI	American Magnetics Inc.
ATC	Advanced Technology Center
Aux	Auxiliary
AV-x	Valve x of Gas Module auxiliary section
Bot	Bottom
CN [xx]	Data acquisition channel number
DAS	Data Acquisition System
EFM	Exhaust gas Flow Meter
EG-x	Gauge x of Gas Module exhaust section
EM	Electrical Module
ERV-x	Relief valve of Gas Module exhaust section
EV-x	Valve number x of Gas Module exhaust section
FCV	Fill Cap Valve
FIST	Full Integrated System Test
GHe	Gaseous Helium
GM	Gas Module
GP-B	Gravity Probe-B
GSE	Ground Support Equipment
GT	Guard Tank
GTVC	Guard Tank Vent Cap
GTVC-G	Guard Tank Vent Cap pressure gauge
GTVC-RV	Guard Tank Vent Cap relief valve
GTVC-V	Guard Tank Vent Cap valve
GTV-G	Guard Tank vent pressure gauge
GTV-RV	Guard Tank vent relief valve
GTV-V	Guard Tank vent valve
HX-x	Vent line heat exchanger in Gas Module
KFxx	Quick connect o-ring vacuum flange (xx mm diameter)
LHe	Liquid Helium
LHSD	Liquid Helium Supply Dewar
Liq	Liquid
LL	Liquid level
LLS	Liquid level sensor
LMMS	Lockheed Martin Missiles and Space
LMSC	Lockheed Missiles and Space Co.
MT	Main Tank
MTVC	Main Tank Vent Cap
MTVC-G	Main Tank Vent Cap pressure gauge
MTVC-RV	Main Tank Vent Cap relief valve
MTVC-V	Main Tank Vent Cap valve
NBP	Normal boiling point
ONR	Office of Naval Research
PFCG	Fill Cap assembly pressure Gauge
PFM	Pump equipment Flow Meter
PG-x	Gauge x of Pump equipment
PM	Pump Module
psi	pounds per square inch
psig	pounds per square inch gauge
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
TD	Test Director
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 provides the necessary steps to inspect and reconfigure the payload following the completion of the Thermal Vacuum Test in Lockheed Martin building 156. The steps include

The following activities after the door to the TVAC chamber is opened

1. Disconnect Main Tank Vent Line from TVAC feedthrough plate and install vent cap assembly

2. Disconnect Guard Tank Vent Line from TVAC feedthrough plate and reconnect outside of chamber

The following activities occur after the vehicle is in the tilt dolly or assembly stand

1. Inspect and reconfigure misc payload items (fill cap assembly, ion pump, burst disk covers, relief valves, etc.)

2. Connect Main Tank Vent Line to GM

3. Connect Guard Tank Vent Line to GM

4. Perform Main Tank Fill Operation

5. Connect Vacuum Module to SMD and perform leak check of SMD

6. Connect UTS to the Well and perform leak check of the Well seals

7. Remove Vacuum Module from Vacuum Shell and UTS from the Well

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 deflectors are installed over the four burst disks on the SMD vacuum shell except during test operations.

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 TD 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 TD 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 TD 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 in charge of the operation (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

Any person who comes in contact with the SV must use a grounding wrist strap that has been tested that day. Appropriate attachment points are positioned around the SV.

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 Pump Module provides greater pumping capacity than the Gas Module, together with additional flow metering capabilities. The vent output of the Gas Module flows through the Pump Module. The Electrical Module contains the instruments listed in Table 1, and provides remote control of valves in the Gas Module, Pump Module, and SMD. 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, 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. Test Equipment

Description
Utility Turbo System (UTS, see Figure 3)
Helium leak detector
Helium leak detector calibrated leak; Calibrated leak S/N#:_____ Cal. due date:

E.3.5. Additional Hardware

No additional hardware is required.

E.3.6. Tools

No additional tools are required.

E.3.7. Expendables

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

E.4. Instrument Pretest Requirements

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

Table 1. Required Instrumentation and Calibration Status

No.	*Location*	*Description*	*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	-

No.	*Location*	*Description*	*Name*	*Serial No.*	*Cal Required*	*Status Cal due date*
16	EM	Power Supply HP 6038A	H08D Tank Heater	96023407A	Yes	
17	EM	Power Supply HP 6038A	H09D Tank Heater	3511A-13332	Yes	
18	EM	Power Supply HP 6038A	RAV Power Supply	3329A-12486	Yes	
19	EM	Vac Ion Pump power supply Varian 929-0910, Minivac	SIP	5004N	No	-
20	EM	Flow meter totalizer Veeder-Root	PFM-1	576013-716	No	-
21	GM	Pressure Gauge, Heise	AG-1	CC-122077	No	-
22	GM	Pressure Gauge, Marshall Town	AG-3	N/A	No	-
23	GM	Main Tank Heat Exchanger: a) Thermocouple, b) Current meter, c) Temperature set point controller	-	C-19950	No	-
24	GM	Guard Tank Heat Exchanger: a) Thermocouple, b) Current meter, c) Temperature set point controller	-	C-09920	No	-
25	VM	Vacuum Gauge readout, Granville-Phillips 316	VG-3 VG-4	2878	No	-
26	VM	Vacuum Gauge readout, Granville-Phillips 360	VG-1, VG-2 VG-5	96021521	No	-

E.5. Configuration Requirements

E.5.1. Main Tank

Liquid in the Main Tank is at normal boiling point (NBP).

E.5.2. Guard Tank

The Guard-Tank must be depleted and maintained above atmospheric pressure by an external source of GHe.

E.5.3. Well

The Well is evacuated.

E.5.4. SMD Vacuum Shell

This procedure places no requirement on the vacuum shell pressure.

E.5.5. Alarm System

1. The DAS alarm system must be enabled and contain the following alarm set-points:
    a. Top of 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.
    c. Relative Guard Tank Pressure (CN 46) set at $\Delta P \geq 10$torr.

E.5.6. 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).

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 flight-equivalent Fill Cap Assembly is installed at SV-13.

F. REFERENCE DOCUMENTS

F.1. Drawings

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

F.2. Supporting documentation

Document No.	***Title***
LMMC-5835031	*GP-B Magnetic Control Plan*
GPB-100153C	*SMD Safety Compliance Assessment*
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*
EM SYS229	Accident/Mishap/Incident Notification Process
SU/GP-B P059	*GP-B Contamination Control Plan*
SU/GP-B P0875	*GP-B Maintenance and Testing at all Facilities*

F.3. Additional Procedures

SU/GP-B P0879	Accident/Incident/Mishap Notification Process

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 (Sections. E.3.4, 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).

Section Complete QA Witness:_____

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

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

1. _____ 2. _____ 3. _____

4. _____ 5. _____ 6. _____

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

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
3. ***Relative Guard Tank Pressure*** – ensure CN [46] on DAS alarm list with alarm limit at ΔP ≥ 30 torr. Record set point. _____torr

G.3.2. Record initial pressures, as appropriate.

1. Main Tank – NBP (STG):_____ torr.
2. Guard Tank – (GTV-G) _____ torr relative to 1 atm.

G.3.3. Record initial temperatures

1. Top of Lead Bag _____K
2. Top of Lead Bag _____K
3. Guard Tank _____K
4. Bottom of the Main Tank _____K

Note:
Sections G.4 and G.5 are to be performed while the SV is in the thermal vacuum chamber

G.4. **Disconnect from TVAC Feed-through Plate and Reconfigure Guard Tank Pressurization Assembly**

G.4.1. Close GTPV-1 and GTPV-2 (Fig. 3)

G.4.2. Break connections at TVAC feedthrough plate and reconnect the halves of the GTPA outside of TVAC chamber

G.4.3. Leak check GTPA

1. Calibrate leak detector
    a. Record standard leak rate:_____scc/s He
    b. Record measured leak rate:_____scc/s He
2. Valve off the gas supply and disconnect GTPV-2
3. Open GTPV-2
4. Connect leak detector to GTPV-2
5. Verify background on the E-7 scc/s He range

6. Record background leak rate:_____scc/s He
7. Leak check all new connections
8. Record final leak rate:_____scc/s He
9. Verify no rise detected
10. Close GTPV-2
11. Vent and disconnect leak detector

G.4.4. Ensure Guard Tank Pressure >100 torr

G.4.5. Open GTPV-1

G.4.6. Crack open GTPV-2 and while purging from both directions connect GTPA to the certified helium source

G.4.7. Fully open GTPV-2

G.4.8. Adjust regulator to achieve desired Guard Tank pressure

Section Complete QA Witness:_____

G.5. **Disconnect Main Tank Vent Line from TVAC Feedthrough Plate and Install Modified Vent Cap**

G.5.1. Close TVV-1 (Fig. 2)

G.5.2. Input comment to DAS, "Close Main Tank Vent Valve, TVV-1"

G.5.3. Disconnect Main Tank vent line from TVAC feedthrough plate

G.5.4. Install KF-25 Tee with a GSE relief valve (~ .3psid)and nupro valve (referred to as MMTVC-V) onto TVV-1

G.5.5. Leak check Main Tank Vent Cap

1. Ensure leak detector calibrated
2. Ensure open MMTVC-V
3. Connect leak detector to MMTVC-V
4. Ensure background on the 10^{-6} scc/s He range
5. Record initial background:_____ scc/s He
6. Bag and leak check Main Tank vent cap assembly
7. Record final leak rate:_____ scc/s He
8. Verify no rise detected
9. Close MMTVC-V
10. Vent and disconnect leak detector

G.5.6. Open TVV-1

G.5.7. Enter comment to DAS, "Open TVV-1, Main Tank vent valve"

Section Complete QA Witness:_____

Note:
The following operations are to be performed when the SV is outside the Thermal Vacuum chamber.

G.6. **Configure Miscellaneous Items**

Note:
Step G.6.1 requires the removal of the LED Sun Shade Cover

G.6.1. View the telescope optical path through the Mylar on the top of the sunshade. Note any visible debris or obscuration of the optical path due to frozen air:

_____
_____
_____

G.6.2. Inspect and configure GTVA

1. Visually inspect GTVA
2. Remove kapton tape from GTVA-RV and GTVC-RV
3. Reinstall handles on GTV-Va and GTV-Vb

G.6.3. Visually inspect Main Tank and vacuum shell burst disks

G.6.4. Install burst disk deflectors and protective covers

G.6.5. Inspect and configure Probe burst disk

1. Install aluminum foil over Probe burst disk

G.6.6. **Option**: Install plastic bags containing wood blocks to brace Vatterfly Valve Cover Valves on all 6 valves

G.6.7. Install Vac Ion Pump (VIP) magnet and measure SMD Vacuum Shell pressure

1. Install ion pump magnet and protective cover onto vehicle exercising extreme care to avoid damaging the ceramic feed-through
2. Connect high voltage line to vac ion pump
3. Turn on VIP and record time of day:_____
4. Use CN 99 to monitor VIP and after reading is steady record VIP pressure:_____torr
5. Verify VIP < 5*E-5 torr
6. Begin new data cycle
7. After data cycle complete, turn off VIP

G.6.8. Remove Mock Flight Fill Cap Assembly and Install Fill Cap Assembly

1. Open MFCA-V to let the the fill cap up to air
2. Remove Mock Flight Fill Cap Assembly and install GSE Fill Cap

Assembly

3. Attach UTS to FCV
4. Ensure FCV open
5. Turn on Vane Pump and Converter
6. Open TV-2 and TV-4
7. When TG-4 reads < 500mtorr Press Start on turbo controller
8. When turbo fully up to speed close TV-4 and open TV-1
9. Leak check fill cap assembly
    a. Connect leak detector to TV-3
    b. Open TV-3 and close TV-2
    c. Record Initial background:_____scc/s He
    d. Leak check FCA
    e. Record final background:_____scc/s He
    f. Verify no rise $>10^{-5}$ sccs
    g. Close TV-3 and open TV-2
    h. Vent and disconnect leak detector
10. Close TV-1
11. Connect source of He gas to TV-5
12. Open TV-5 and backfill fill cap to 760 torr as read on PFCG
13. Close TV-5
14. Close FCV
15. Perform leak back test on FCV
16. Open TV-4 and evacuate pumping line to 25mtorr as read on TG-4
17. Close TV-4 and TV-2
18. Record TG-2:_____torr
19. Record PFCG:_____torr
20. Monitor TG-2 for half an hour and verify no significant rise in pressure at TG-2 and no decrease in pressure at PFCG
21. Record TG-2:_____torr
22. Record PFCG:_____torr
23. Disconnect UTS from FCA and install KF-25 cap

G.6.9. Install plastic pump-out port cap on flight Guard Tank vent line

Section Complete QA Witness:_____

Note:

The Space Vehicle should be rotated to the vertical orientation before the following operations are performed

G.7. **Connect Main Tank Vent Line to Gas Module**

G.7.1. Perform procedure P0674 to connect the Main Tank vent line to the Gas Module

G.7.2. Record Op. Number:_____

G.8. **Connect Guard Tank Vent Line to Gas Module**

G.8.1. Perform procedure P0676 to connect the Guard Tank vent line to the Gas Module

G.8.2. Record Op. Number:_____

G.9. **Perform Main Tank Fill**

G.9.1. Perform procedure P0648 to fill the Main Tank and Guard Tank

G.9.2. Record Op. Number/s and Date

1. Op Number: _____ Date:_____
2. Op Number: _____ Date:_____
3. Op Number: _____ Date:_____

Note:

The following operation can begin at any time before or the during the fill operation, however the leak check of the SMD must be performed after the fill operation is complete.

G.10. **Connect Vacuum Module to SMD Vacuum Shell and Leak Check SMD**

G.10.1. Perform P0213C, *Connect Vacuum Module / Pump on SMD Vacuum Shell* (Op. No._____) with the following modifications and options:

1. Select Initial Configuration 1 (pumping line disconnected), and Final Configuration 3 (actively pumping on SMD vacuum)
2. Skip steps F.7.11 through F.7.17, leaving the leak detector connected to VM and running, and perform F.8.11 (configuration 3) through the remainder of the procedure.
3. To perform a leak check of critical seals on the dewar, open VV-7 and close VV-4 to make the leak checker the backing pump for the Vacuum Module.

WARNING:

Lethal voltage may be present at the Ion Pump when connected to the power supply. Turn off the High Voltage power supply and

disconnect the HV cable before performing any leak checks of the Ion Pump.

4. Flood each of the seals listed below with helium for one minute and verify that no response is observed on the 10^{-7} sccs range. If a response is seen, a bag leak check of sufficient duration to reach steady state value should be performed to verify that the total leak does not exceed 5 x 10^{-6} sccs. Record below:

Location	Date/time	Background (sccs)	Leak after 1 min. (sccs)	Saturation leak (optional)
BD5B*				
BD7B*				
BD7A*				
BD5A*				
Ion Pump				
Main tank bayonet				
Guard tank bayonet				
+Y ARP post				
-Y ARP post				

*Note: The "A" units are on the right side of the +X axis (in the +Y direction). The Main Tank burst disks (BD7A/B) are adjacent to the +X axis.

Section Complete QA Witness:_____

G.11. **Connect UTS to Well and Leak Check Well Seals**

G.11.1. Perform P0613B, Repump Well with Probe Installed

1. Record Op. Number:_____
2. After completion of step G.4.7 perform the following steps
   a. Ensure Vent Disable switch enabled (Verify no potential RF interference present)
   b. Open TV-3 and close TV-2
   c. Ensure background on the E-5 scc/s He range
   d. Record initial background:_____scc/s He
   e. Leak check the Well seal
   f. Record final leak rate:_____scc/s He

g. Verify no rise detected

h. Close TV-3 and open TV-2

i. Proceed to section G.4.8

Section Complete QA Witness:_____

G.12. **Disconnect Vacuum Module from SMD Vacuum Shell**

G.12.1. When it is desired to discontinue pumping on the SMD vacuum shell, perform P0214C, *Stop Pumping on SMD Vacuum Shell / Disconnect Vacuum Module*, (Op. No._____) with the following modifications and options:

1. Use Initial Configuration 1 (actively pumping on SMD vacuum) and Final Configuration 3 (pumping line disconnected)
2. Use options G.5.19, G.5.20, and G.5.27 to perform complete disconnection and shut down.

G.13. **Establish Final Configuration**

G.13.1. Ensure DAS alarm enabled and record set points if changed

- Thermal conditions substantially unchanged, alarm set points for lead bags unchanged
- Thermal conditions substantially changed, temperature alarm points reset as follows:

a. Top of Lead Bag set point [CN 175] _____ K (≤ 6.0 K)

b. Top of Lead Bag set point [CN 178] _____ K (≤ 6.0 K)

G.13.2. Ensure liquid level sensor alarms enabled, as appropriate, and record set points if changed.

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

G.13.3. Ensure Guard Tank pressure on DAS alarm list and set to alarm at 10 torr differential.

G.13.4. Ensure Watch Dog Timer is armed.

G.13.5. Perform Post-Operations Checklist (Appendix 2)

Section Complete QA Witness:_____

H. **PROCEDURE COMPLETE**

Completed by:_____

Witnessed by:_____

Date: _____

Time:_____

Quality Manager_____**Date**_____

Payload Test Director_____**Date**_____

Gas Module

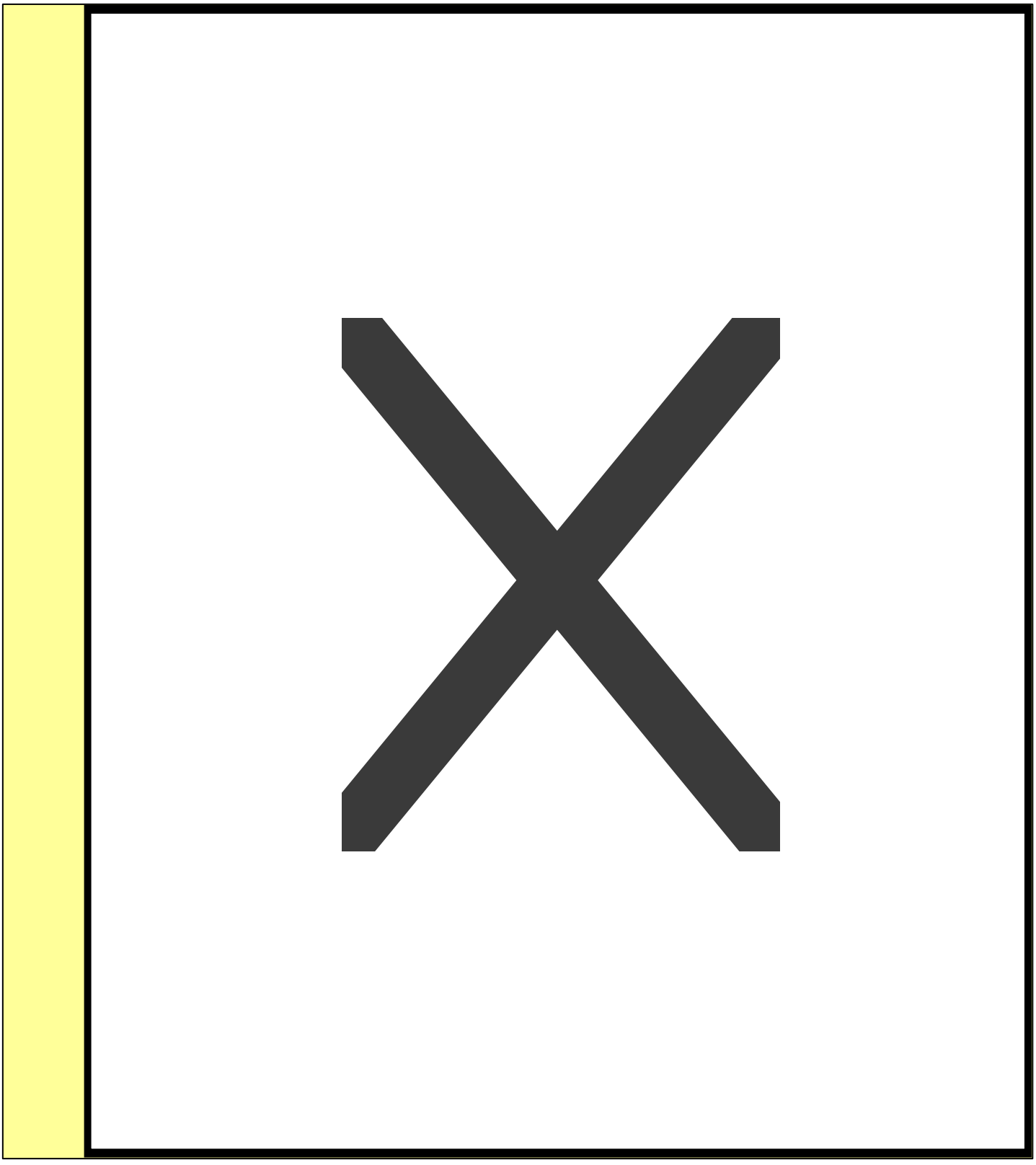


Figure 2 Main Tank Vent Configurations

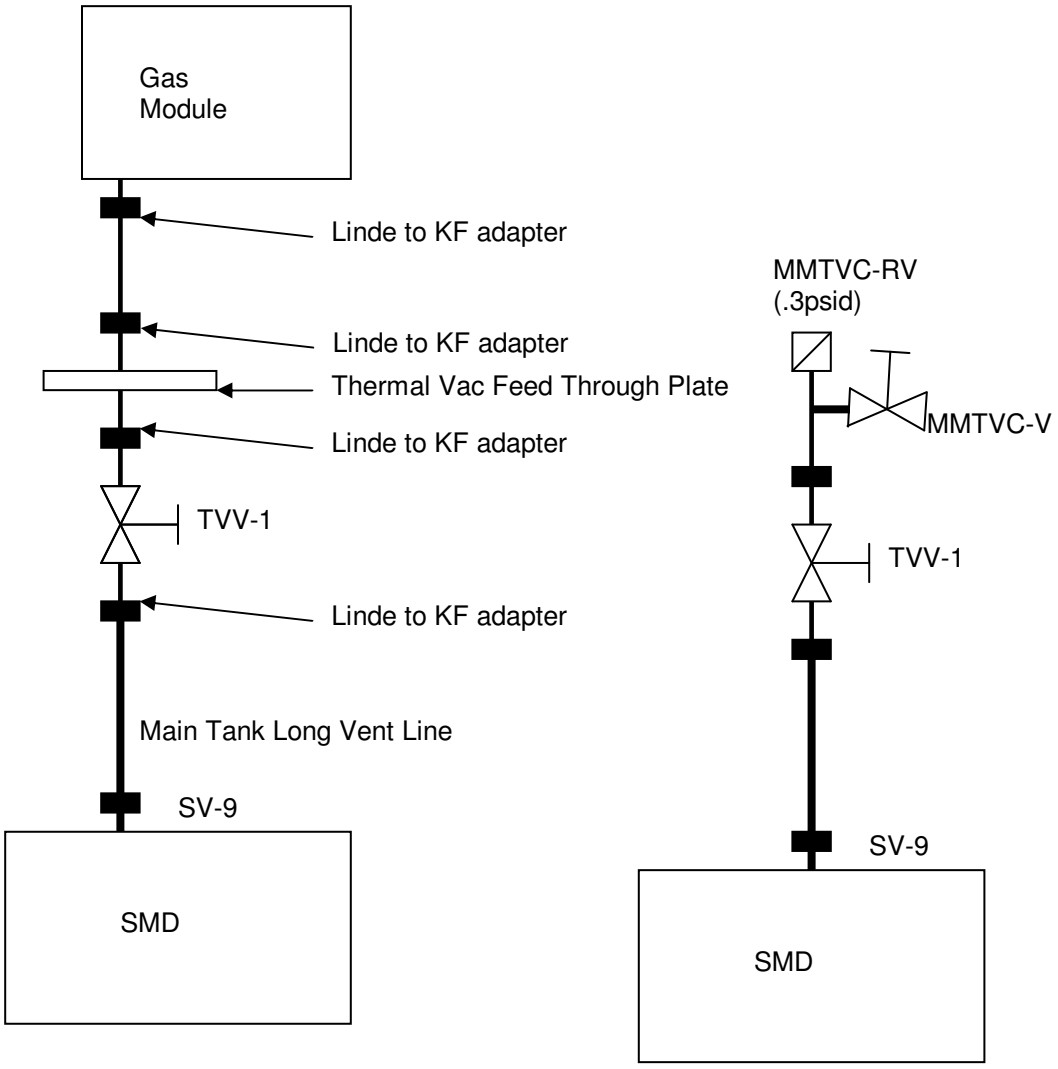
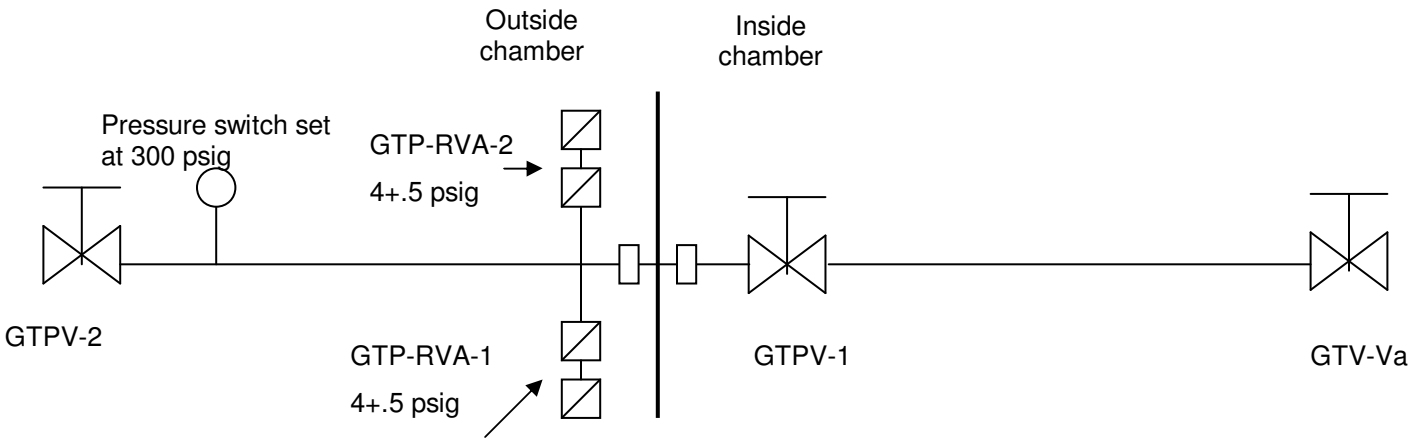
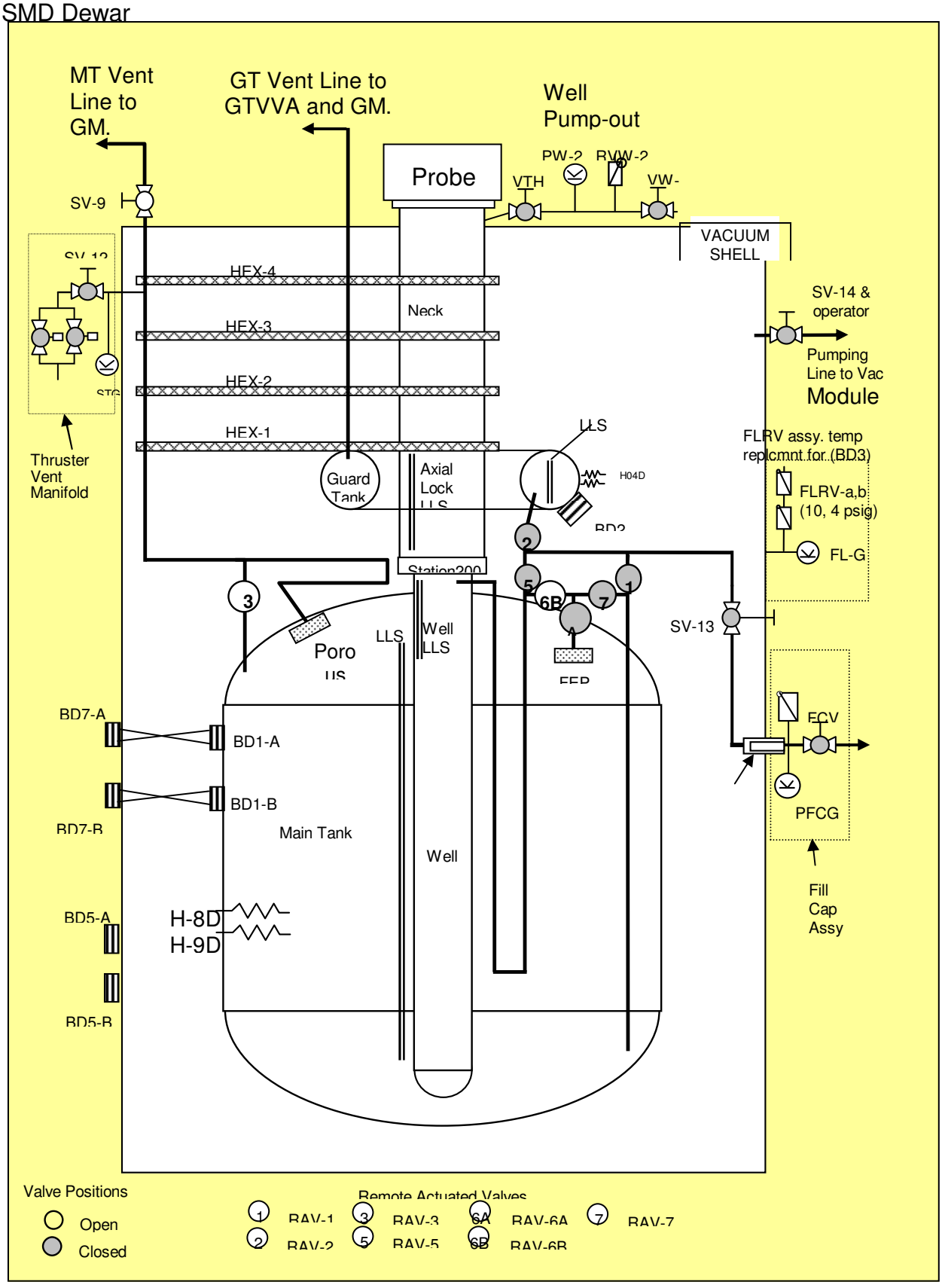


Figure 3: Guard Tank Pressurization Assembly



SMD Dewar


MT Vent Line to GM.
GT Vent Line to GTVVA and GM.
Well Pump-out
Probe
PW-2
RVW-2
VTH
VW-
SV-9
VACUUM SHELL
HEX-4
HEX-3
HEX-2
HEX-1
Neck
SV-14 & operator
Pumping Line to Vac Module
Thruster Vent Manifold
Guard Tank
Axial Lock
LLS
H04D
BD2
FLRV assy. temp replcmnt for (BD3)
FLRV-a,b (10, 4 psig)
FL-G
Station200
Poro
Well LLS
SV-13
FCV
PFCG
Fill Cap Assy
BD7-A
BD1-A
BD1-B
BD7-B
Main Tank
Well
BD5-A
H-8D
H-9D
BD5-B
Valve Positions
Open
Closed
Remote Actuated Valves
RAV-1
RAV-2
RAV-3
RAV-5
RAV-6A
RAV-6B
RAV-7

Appendix 1 **Pre Operations Checklist**

DATE	CHECKLIST ITEM	COMPLETED	REMARKS
	1. Verify the test procedure being used is the latest revision.		
	2. Verify all critical items in the test are identified and discussed with the test team.		
	3. Verify all required materials and tools are available in the test area.		
	4. Verify all hazardous materials involved in the test are identified to the test team.		
	5. Verify all hazardous steps to be performed are identified to the test team.		
	6. Verify each team member knows their individual responsibilities.		
	7. Confirm that each test team member clearly understands that he/she has the authority to stop the test if an item in the procedure is not clear.		
	8. Confirm that each test team member clearly understands that he/she must stop the test if there is any anomaly or suspected anomaly.		
	9. Notify management of all discrepancy reports or d-log items identified during procedure performance. In the event an incident or major discrepancy occurs during procedure performance management will be notified immediately.		
	10**.** Confirm that each test team member understands that there will be a post-test team meeting.		
	Team Lead Signature: _____		

Appendix 2 **Post Operations Checklist**

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

Appendix 3– **Contingency Responses**

Condition	Circumstance	Response
Temperature limits (CN 1 or 28) exceeded	Any time	Open EV-9 to Vent Main Tank
Burst disk rupture (MT/GT)	Any time	Evacuate room