GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

Thrust Nullifier Heater Verification

This operation to be performed in VAFB building 1610

THIS DOCUMENT CONTAINS NON-HAZARDOUS OPERATIONS

July 14, 2003

P1051 Rev-

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Revision Record

REVISION	ECO	PAGES	DATE

Table of Contents

List of Abbreviations and Acronyms

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

A. SCOPE

This procedure describes the steps necessary to install the Thrust Nullifer on the end of the Guard Tank Short Vent Line and perform a verification test of the Thrust Nullifier heaters. After the heater checkout is complete, the Guard Tank Vent Line is reinstalled per procedure P1008.

This procedure will be accomplished in Building 1610.

B. SAFETY

B.1. 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.

B.2. Mitigation of Hazards

B.2.1. Lifting hazards

There are no lifting operations in this procedure

B.2.2. Cryogenic Hazards

In VAFB building 1610, there may be an oxygen deficiency monitor that alarms when the oxygen level is reduced to 19.5%. In addition, the GP-B cryogenic team provides an oxygen deficiency monitor that alarms when the oxygen level is reduced to 19.5%. Appropriate action(s) to be taken in the event of oxygen deficiency monitor alarming at 19.5% (evacuation, safety verification of acceptable O2, etc) Additional temperature and pressure alarms, provided by the DAS, warn of potential over-pressure conditions. Emergency vent lines are installed over the four burst disks to direct any flow to an outside area.

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 life support apparatus ELSA) within easy reach. Note that tank need not be kept available when working from ladder. In the unlikely event of a large Lhe spill all employees have been instructed to evacuate the room and proceed to designated fallback area Bldg 1605, and contact NASA 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, non-absorbent shoes and full-face shields with goggles/glasses are to be worn whenever the possibility of splashing cryogens exists.

B.2.3. Other Hazards

All 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 illness/injury requiring EMERGENCY medical treatment, **DIAL 911.**

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 and Stanford University GP-B P0879. Additionally, VAFB NASA Safety and 30th Space Wing Safety will be notified as required.

B.3.3. Contingency Response

Responses to contingencies (e.g., power failure) are listed in Appendix 3.

C. QUALITY ASSURANCE

C.1. QA Notification

The NASA representative and SU QA shall be notified 24 hours prior to the start of this procedure. Upon completion of this procedure, the QE Manager will certify his/her concurrence that the effort was performed and accomplished in accordance with the prescribed instructions by signing and dating in the designated place(s) in this document.

C.2. Red-line Authority

Authority to red-line (make minor changes during execution) this procedure is given solely to the PTD or his designate and shall be approved by the QA Representative. Additionally, approval by the Payload Technical Manager shall be required, if in the judgement of the PTD or QA Representative, experiment functionality may be affected. Within hazardous portions of this procedure, all

steps shall be worked in sequence. Out-of-sequence work or redlines shall be approved by NASA Safety prior to their performance.

C.3. Discrepancies

A Quality Assurance Representative designated by D. Ross shall review any discrepancy noted during this procedure, and approve its disposition. Discrepancies will be recorded in a D-log or a DR per Quality Plan P0108. Any time a procedure calls for verification of a specific configuration and that configuration is not the current configuration, it represents a discrepancy of one of three types. These types are to be dealt with as described below.

1. If the discrepancy has minimal effect on procedure functionality (such as the state of a valve that is irrelevant to performance of the procedure) it shall be documented in the procedure, together with the resolution. Redlines to procedures are included in this category.
2. If the discrepancy is minor and affects procedure functionality but not flight hardware fit or function, it shall be recorded in the D-log. Resolution shall be in consultation with the PTD and approved by the QA representative.
3. All critical and major discrepancies, those that effect flight hardware fit or functions, shall be documented in a D-log and also in a Discrepancy Report, per P0108.

D. TEST PERSONNEL

D.1. Personnel Responsibilities

The performance of this procedure requires a minimum complement of personnel as determined by the Test Director. The Test Director is the designated signer for the “witnessed by” sign-off located at the end of each procedure. The person in charge of the operation (Test Director or Test Engineer) is to sign the “completed by” sign-off. 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. 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

There are no lifting operations in this procedure

E.1. Hardware/Software Requirements

E.1.1. Commercial Test Equipment

No commercial test equipment is required for this operation.

E.1.2. Ground Support Equipment

The Ground Support Equipment includes the Gas Module, the Electrical 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.

E.1.3. Computers and Software:

The Data Acquisition System (DAS) is 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.1.4. Additional Test Equipment

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

E.1.5. Flight Hardware

Description
Two Guard Tank Thrust Nullifier (LM P/N 8A03510-101, S/N 001 and 002) and associated o-rings (Parker 2-027).

E.1.6. Tools

Description
N/A

E.1.7. Personnel Protective Equipment

1. N/A

E.1.8. Expendables

Description	***Quantity***	***Mfr./Part No.***
Isopropyl	AR	N/A

99.999% pure gaseous helium	AR	N/A
Vacuum Grease	AR	Apeizon N Dow Corning High Vacuum Grease

E.2. **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*	*User Name*	*Serial No.*	*Cal Required*	*Status Cal due date*
1	DAS	Power Supply, H-P 6627A	-	3452A01975	Yes	
2	DAS	Power Supply, H-P 6627A	-	3452A01956	Yes	
3	DAS	Data Acquisition/Control Unit H-P 3497A	-	2936A245539	No	-
4	DAS	Digital Multimeter H-P 3458A	-	2823A15047	Yes	
5	EM	Vacuum Gauge Controller Granville-Phillips Model 316	EG-1a, -1b	2827	No	-
6	EM	Vacuum Gauge Controller Granville-Phillips Model 316	AG-2a, -2b	2826	No	-
7	EM	Vacuum Gauge Controller Granville-Phillips Model 316	EG-3	2828	No	-
8	EM	MKS PDR-C-2C	EG-2, FCG	92022108A	No	-
9	EM	Flow meter – Matheson 8170	EFM-1	96186	No	-
10	EM	Flow meter totalizer Matheson 8124	EFM-1	96174	No	-
11	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Main Tank	96-409-11	No	-
12	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Guard Tank	96-409-10	No	-
13	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Well	96-409-9	No	-
14	EM	Liquid Helium Level Controller American Magnetics, Inc. 136	LLS Axial Lock	96-409-12	No	-
15	EM	Pressure Controller – MKS 152F-92	EV-7a, -7b	96203410A	No	-
16	EM	Power Supply HP 6038A	H08D Tank Heater	96023407A	Yes	
17	EM	Power Supply HP 6038A	H09D Tank Heater	3511A-13332	Yes	
18	EM	Power Supply HP 6038A	RAV Power Supply	3329A-12486	Yes	

No.	*Location*	*Description*	*User Name*	*Serial No.*	*Cal Required*	*Status Cal due date*
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.3. Configuration Requirements

E.3.1. Main Tank
There are no special requirements for the Main Tank

E.3.2. Guard Tank
The Guard Tank liquid level must be greater than 80%

E.3.3. Well
The Well is always evacuated.

E.3.4. Vacuum Shell

There is no requirement for the vacuum shell pressure.

E.3.5. Alarm System

1. The DAS alarm system must be enabled and contain the following alarm set-points:
    a. Top of the lead bad temperature set (CN 29) set at $T \leq 6.0K$.
    b. Top of lead bag temperature set (CN 28) at $T \leq 6.0$ K.
    c. Relative Guard Tank Pressure (CN 46) set at $P \geq 30$ torr.

E.3.6. GSE

1. GSE cabling must be connected between the SMD and the Electrical Module (P/N 5833812) and between the SMD and the Data Acquisition System (P/N 5833811).
2. Leak-tight covers are installed on the six Vatterfly valves, V1 – V4 and LV1, LV2.

F. REFERENCE DOCUMENTS

F.1. Drawings

Drawing No.	*Title*
LMMS-5833394	Instrumentation Installation

F.2. Supporting documentation

Document No.	*Title*
LMMC-5835031	GP-B Magnetic Control Plan
GPB-100153C	SMD Safety Compliance Assessment
LM/P479945	Missile System Prelaunch Safety Package
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
EWR 127-1	Eastern and Western Range Safety Requirements
KHB 1710.2 rev E	Kennedy Space Center Safety Practices Handbook

F.3. Additional Procedures

Document No.	*Title*
SU/GP-B P0879	Accident/Incident/Mishap Notification Process
SU/GP-B P1015	Connect Vacuum Module to SMD
SU/GP-B P0875	GP-B Maintenance and Testing at all Facilities

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 _____/_____.
- Verify NASA safety representative notified.

  Record: Individual notified _____,

  Date/time _____/_____.
- Verify completion of the Pre-Operations Checklist (Appendix 1).
- Verify proper operation of GP-B Cryogenic Team oxygen monitor
- Record calibration due dates in sections. E.1.4, E.2

QA Witness:_____

G.2. Initial Operations

G.2.1. Record serial number on helium bottle/s used in this procedure.

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

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

Opt Number:_____

QA Witnesss:_____

G.3. Verify Configuration Requirements

G.3.1. Ensure Guard Tank Vent Line connected to Gas Module

G.3.2. 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. _____K
   Record set point.
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

G.3.3. Record initial pressures, as appropriate.

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

G.3.4. Record initial temperatures

1. Top of Lead Bag CN40 _____K
2. Top of Lead Bag CN41 _____K
3. Guard Tank _____K
4. Bottom of the Main Tank _____K

G.3.5. Ensure Guard Tank liquid level >80%

1. If Guard Tank liquid level <80%, perform procedure, P1029 “Internal Guard Tank Fill”
   a. Record Opt Number:_____
2. Record final Guard Tank liquid helium level:_____

G.4. Set Up Data Acquisition System

G.4.1. Set DAS to fast scan mode using [other menus], [data config], [fast scan] and [Remove MultScan]

G.4.2. Start “Special Data Cycle” by using [Other Menus] + [Special Data Col].

G.4.3. Enter CNs: 175, 171, 64, 46 (GTV-G) and 49 (ST-G, Thruster Vent)

G.4.4. [Init. Collectn]

G.4.5. [Enter] use default file name.

G.4.6. Ensure printer is displaying special Data Cycle data.

G.4.7. Connect/verify connected power supply A3 and A4 to Guard Tank heaters H03D and H-04D via Umbilical.

G.4.8. Turn on power supply A and set outputs A3 and A4 to 0.08 amp current limit.

Quality_____

G.5. **Install Thrust Nullifier S/N#001 onto Space Vehicle**

G.5.1. Close GTV-V

G.5.2. Ensure closed/close EV-20, EV-16 and EV-13

G.5.3. Remove Guard Tank Long Vent Line and install Guard Tank Short Vent Line

G.5.4. Lightly grease a Parker 2-027 o-ring with Apiezon N grease and install onto Guard Tank Short Vent Line

G.5.5. Install Thrust Nullifier S/N#001 onto end of Short Vent Line and secure as necessary

G.5.6. Connect Thrust Nullifier heaters to Space Vehicle and the external temperature control unit.

G.5.7. Verify Thrust Nullifier heaters and the associated controllers are functioning nominally

G.5.8. Set current limit on Guard Tank Heaters to .07A

Note:
In the following step, there will be cooling of the Thrust Nullifier. If external temperature controller fails, maintain the Nullifier at room temperature with a heat gun if necessary, exercising sufficient care not to damage any of the heaters, PRT's or o-rings in the Nullifier

G.5.9. Once Guard Tank pressure, as read on GTV-G, reaches ~150 torr (it may be necessary to temporarily tape closed GTV-RV), open GTV-V and ensure that the Guard Tank Short Vent Line and the Thrust Nullifier are sufficiently purged. If necessary, adjust internal Guard Tank heater voltage A3 or A4, to a maximum of 50V, to obtain a sufficient purge

G.6. **Thrust Nullifier S/N#001 Heater Verification**

G.6.1. Set current limit on Guard Tank Heaters A3 and A4 to .07A

G.6.2. Adjust voltage as necessary, to a maximum of 50V, to reduce the liquid level in the Guard Tank, while regulating the temperature of the Thrust Nullifier with the external temperature controller.

G.6.3. When satisfied that the heaters on Thrust Nullifier are working appropriately, shut off Guard Tank heaters

G.6.4. Proceed to section G.7

QA Witness:_____

G.7. **Installation of Thrust Nullifier S/N#002**

G.7.1. Close GTV-V

G.7.2. Remove Thrust Nullifier S/N#001

G.7.3. Install Thrust Nullifier S/N#002 onto end of Short Vent Line and secure as necessary

G.7.4. Connect Thrust Nullifier heaters to Space Vehicle and the external temperature control unit.

G.7.5. Verify Thrust Nullifier heaters and the associated controllers are functioning nominally

G.7.6. Set current limit on Guard Tank Heaters to .07A

Note:
In the following step, there will be cooling of the Thrust Nullifier. If external temperature controller fails, maintain the Nullifier at room temperature with a heat gun if necessary, exercising sufficient care not to damage any of the heaters, PRT's or o-rings in the Nullifier

G.7.7. Once Guard Tank pressure, as read on GTV-G, reaches ~200 torr (it may be necessary to temporarily tape closed GTV-RV), open GTV-V and ensure that the Guard Tank Short Vent Line and the Thrust Nullifier are sufficiently purged. If necessary, adjust internal Guard Tank heater voltage A3 or A4, to a maximum of 50V, to obtain a sufficient purge.

G.8. **Thrust Nullifier S/N#002 Heater Verification**

G.8.1. Verify current limit on Guard Tank Heaters A3 and A4 to .07A

G.8.2. Adjust voltage as necessary, to a maximum of 50V, to reduce the liquid level in the Guard Tank, while regulating the temperature of the Thrust Nullifier with the external temperature controller.

G.8.3. When satisfied that the heaters on Thrust Nullifier are working appropriately, shut off Guard Tank heaters

G.8.4. Proceed to section G.9

QA Witness:_____

G.9. **TAO Measurement**

G.9.1. Ensure Thrust Nullifier installed on end of Guard Tank short Vent Line, otherwise record configuration:_____

G.9.2. Record Guard Tank Initial Liquid Level

1. Date/Time:_____
2. Guard Tank Liquid Level:_____

G.9.3. Monitor TAO with signal analyzer and record results below and in attached
table:_____
_____
_____

_____
_____
_____
_____

G.9.4. Continue to monitor TAO and signal analyzer for ~24 hours

G.9.5. Record Guard Tank final Liquid Level

1. Date/Time:_____
2. Guard Tank Liquid Level:_____

G.9.6. Monitor TAO with signal analyzer and record results below:_____
_____
_____
_____
_____
_____
_____

G.9.7. Proceed to section G.10

G.10. **Installation of Guard Tank Long Vent Line**

G.10.1. Close GTV-V

G.10.2. Remove Thrust Nullifier S/N# 002

G.10.3. Remove Guard Tank Short Vent Line

G.10.4. Perform Procedure P1008, “Connect Guard Tank Vent Line to Gas Module”

1. Record Opt Number:_____

G.11. **Final Verifications**

G.11.1. Verify completion of post-operations checklist.

Completed by:_____

Completed by:_____

Witnessed by:_____

Date: _____

Time:_____

Quality Manager_____**Date**_____

Payload Test Director_____**Date**_____

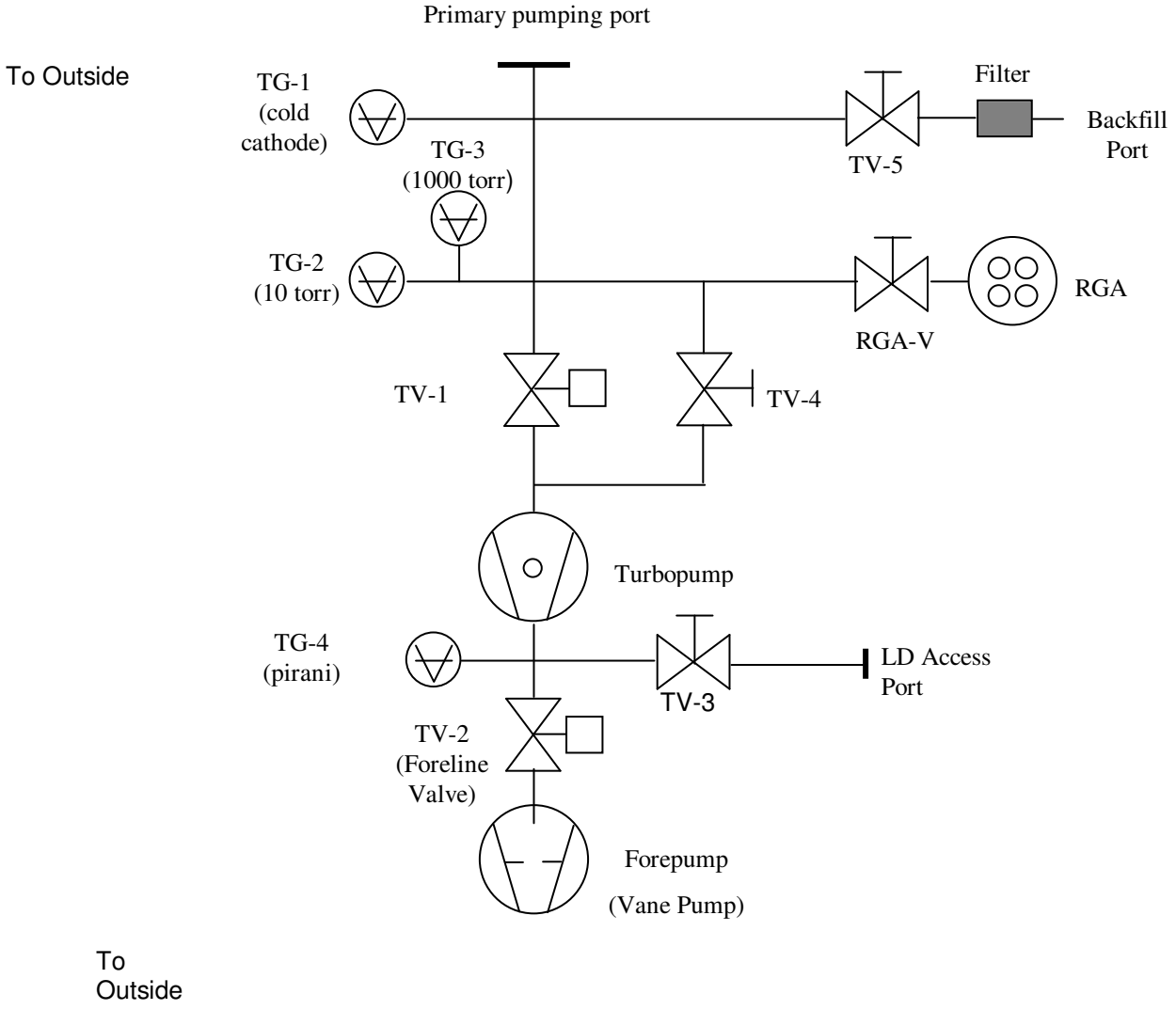

Figure 4. Schematic diagram of Utility Pumping System (UTS)

Figure 2. Gas Module

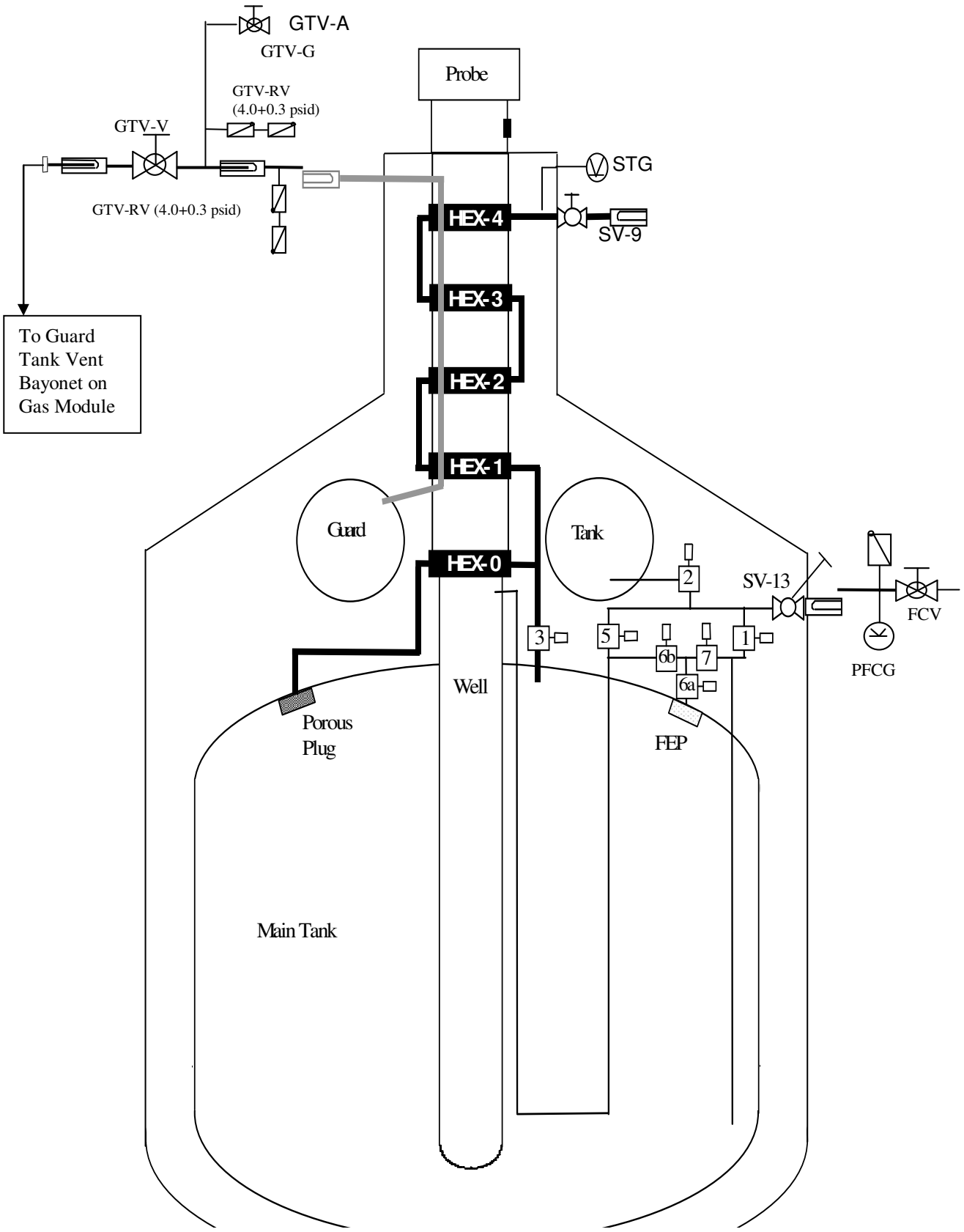

Figure 5. Schematic of Science Mission Dewar plumbing.

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 is certified and knows their individual responsibilities.		
	7. Confirm that each test team member clearly understands that he/she has the authority to stop the test if an item in the procedure is not clear.		
	8. Confirm that each test team member clearly understands that he/she must stop the test if there is any anomaly or suspected anomaly.		
	9. Notify management of all discrepancy reports or d-log items identified during procedure performance. In the event an incident or major discrepancy occurs during procedure performance management will be notified immediately.		
	10. Confirm that each test team member understands that there will be a post-test team meeting.		
	Team Lead Signature: _____		

Appendix 2 **Post Operations Checklist**

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

Appendix 3– **Contingency Responses**

Condition	Circumstance	Response
Temperature limits (CN 1 or 28) exceeded	Any time	Promote MT venting: Open SV-9 and/ or EV-9 as appropriate to increase MT venting Reduce pressure in vatterfly caps: Adjust UTS valving so as to begin pumping on caps
Burst disk rupture (MT/GT)	Any time	Evacuate room
Main Tank or Guard Tank liquid level falls below alarm limit	Any time	Configure Dewar and Fill as appropriate
Oxygen Monitor Alarm	Anytime	Evacuate Room
Liquid Nitrogen Spill	Anytime	Clear area until all spilled liquid has evaporated

Data Sheet

Date/Time	CN 46	CN 40	CN 46	CN 49	PRT A	PRT B	Voltage on Thrust Nullifier Heaters