GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

GUARD TANK
VENT LINE IMPEDANCE

P0891

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Revised by:
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REVISION RECORD

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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
APR-x	Pressure regulator x of Gas Module
AV-x	Valve x of Gas Module auxiliary section
CG-x	Gauge x of portable helium pressurization source
CPR-x	Pressure regulator x of portable helium pressurization source
CV-x	Valve x of portable helium pressurization source
CN [xx]	Data acquisition channel number
DAS	Data Acquisition System
EFM	Exhaust gas Flow Meter
EG-x	Gauge x of Gas Module exhaust section
EH-x	Vent line heat exchanger in Gas Module
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
KFxx	Quick connect o-ring vacuum flange (xx mm diameter)
LHe	Liquid Helium
LHSD	Liquid Helium Supply Dewar
LHV-x	Liquid Helium Supply Dewar valves
LLS	Liquid level sensor
LM	Lockheed Martin Co.
MT	Main Tank
MTVC	Main Tank Vent Cap
MTVC-G	Main Tank Vent Cap pressure gauge
MTVC-RV	Main Tank Vent Cap relief valve
MTVC-V	Main Tank Vent Cap valve
NBP	Normal boiling point
ONR	Office of Naval Research
PFCG	Fill Cap assembly pressure Gauge
PFM	Pump equipment Flow Meter
PG-x	Gauge x of Pump equipment
PM	Pump Module
psi	pounds per square inch
psig	pounds per square inch gauge
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 to perform an evaluation of the flow impedance of the SMD internal Guard Tank vent line. This process does not produce an qualitative result but is intended to serve as a qualitative evaluation of the condition of the Guard Tank vent line which can be used to detect an incipient plugging of the vent line.

B. Safety

B.1. Potential Hazards

Personal injury and hardware damage can result during normal positioning, assembly and disassembly of hardware. Examples include: positioning Dewar in tilt stand; integrating probe with airlock; positioning airlock on Dewar; removing airlock from Dewar; removing probe from Dewar; and positioning support equipment such as pressurized gas cylinders and supply dewars.
A number of undesired events may be associated with these operations. For example, personnel or equipment can be struck when hardware is being moved (e.g. by forklift or crane load). Personnel are subject to entrapment while positioning hardware, such as hands or feet caught between objects as hardware is moved into place. Suspended hardware may be dropped. Personnel can be caught between objects such as forklifts and walls or loads and building support columns.
In addition, liquid helium used in the SMD represents a hazardous material for the personnel involved in the operations. Cryogenic burns can be caused by contact with the cold liquid or gas, high pressures can result if boiling liquid or cold gas is confined without a vent path, and asphyxiation can result if the vent gas is allowed to accumulate.
The SMD Safety Compliance Assessment, document GPB-100153C discusses the safety design, operating requirements and the hazard analysis of the SMD.

B.2. Mitigation of Hazards

B.2.1. Lifting hazards

There are no lifting operations in this procedure

B.2.2. Cryogenic Hazards

The high bay, LM Building 205, has an oxygen deficiency monitor that alarms when the oxygen level is reduced to 19.5%. 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 by immediately calling 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

Contingency responses to possible equipment troubles or irregularities (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 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 judgement of the test director 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.

C.3.1. 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.

C.3.2. 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 Test Director and approved by the QA representative.

C.3.3. 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. 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.

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

The names of those actually performing this procedure are to be initialed and the name of the person acting as Test Director should be circled.

Test Director	Test Engineer
Mike Taber Dave Murray	Tom Welsh Dave Hipkins Bruce Clarke Ned Calder

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 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.

E.3.3. Computers and Software:

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

E.3.4. Additional Test Equipment

Description	Manufacturer	Model
AMI Level Sensor Readout for LHSD	AMI	110

E.3.5. Additional Hardware

Description	Manufacturer	Model
None		

E.3.6. Tools

Description	Serial No.	Cal Due
Torque Wrench, 1-1/4-in socket, 60 in-lb		N/A
1-1/4 adjustable wrench		N/A

E.3.7. Expendables

Description	Quantity	Mfr./Part No.
Ethyl alcohol	AR	N/A
99.99% pure gaseous helium	AR	N/A
Vacuum Grease	AR	Braycote Micronic 601
Tie wraps – large size	AR	N/A

E.4. Instrument Pretest Requirements

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

Table 1. Required Instrumentation and Calibration Status

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

No.	Location	Description	User Name	Serial No.	Cal Required	Status Cal due date
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	-
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 must be at its normal boiling point (NBP), 4.2 K. The SMD may be vertical or horizontal. 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.

E.5.2. Guard Tank

The Guard Tank is depleted of liquid helium and regulated to a pressure > 0.3 torr above atmosphere via an external gaseous helium source. In this mode care must be taken at all times to keep its pressure above atmospheric to avoid contamination of the Guard Tank vent line.

E.5.3. Well

The Well is evacuated and the Well pump-out at VTH may be in one of the following configurations:

1) closed with the VTH operator removed;
2) have the Well manifold connected to a closed VTH; or
3) have an open VTH with a pumpout valve, VW-3, and convectron, PW-2, making up the Well manifold.

E.5.4. SMD Vacuum Shell

The Vacuum Shell pressure should be less than 1 x 10-4 torr. If this is not the case use procedure P0213 to condition the vacuum shell pressure to a safe condition. However, if this procedure is being used in conjunction with up-righting the dewar (P0633) and the Main Tank liquid level is very low (< 30%), priority should be given to filling the Main Tank. The fill operation will result in cooling the vapor cooled shields and thereby lower the vacuum shell pressure to less than the required 1 x 10-4 torr. And pumping on the vacuum shell can be deferred to a later date.

E.5.5. Alarm System

1. The DAS alarm system must be enabled and contain the following alarm set-points:
    a. Station 200 temperature (CN 01) set at $T < 6.5$ K.
    b. Top of lead bag temperature set (CN 28) at $T \leq 6.0$ K.
    c. Relative Guard Tank Pressure (CN 46) set at $\Delta P \geq 0.3$ torr.
2. The Watch Dog alarm must be armed.

E.5.6. GSE and Non-flight Hardware

1. A relief valve or flight-like burst disk may be installed in place of the SMD fill-line burst disk.
2. The ion-pump magnet must be installed.
3. 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).
4. The Main Tank vent line must be connected to the Gas Module with a vacuum insulated line, use procedure P0674, Connect Main Tank Vent Line to Gas Module – Main Tank at NBP if this is not the case.
5. The Guard Tank vent line is connected to the Gas Module.
6. The thruster vent port may be opened to an Endevco pressure transducer, STG.
7. The Fill Cap Assembly must be installed at SV-13 (Figure 3)
8. Top Plate heaters must be installed on SMD and be operational.

E.6. 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.

1. The SMD (with Probe) is installed in: the SMD transportation and test fixture or in the space vehicle assembly fixture; or the space vehicle tilt dolly.
2. A foreign object and debris shield may cover the upper cone of the SMD. If it is not present, any object that could cause damage to the payload, if dropped, must be tethered.
3. 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

E.7. Verification/ Success Criteria

N/A

E.8. Payload Constraints and Restrictions

N/A

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
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

F.3. Additional Procedures

Document No.	Title
SU/GP-B P0213	Connect Vacuum Module/ Pump on SMD Vacuum Shell
SU/GP-B P0674	Connect Main Tank Vent Line to Gas Module – Main Tank at NBP
SU/GP-B P0875	GP-B Maintenance and Testing at all Facilities
SU/GP-B P0879	Accident/Incident/Mishap Notification Process

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

G. Operations

G.1. Verify Appropriate QA Notification

G.1.1. Verify SU QA notified.

Record: Individual notified _____,
Date/time _____/_____.

G.1.2. Verify NASA representative notified.

Record: Individual notified _____,

G.1.3. Record calibration due dates in Table 1 (Sec. E.4).

G.1.4. Verify that persons actually performing this procedure have initialed their names in Sec. D.3 and the name of the Test Director is circled.

G.1.5. Verify Pre-ops meeting with operations group has been conducted.

G.1.6. Verify Purity of All Sources of Helium Gas

Record serial number on helium bottle/s.
1. _____ 2._____ 3. _____
4. _____ 5 _____ 6. _____

G.1.7. Verify helium bottle/s have been tested for purity and record Op. Number:_____

Date/time _____/_____.

Quality _____

G.2. Verify Configuration Requirements

G.2.1. Ensure DAS Watch Dog Alarm enabled.

G.2.2. Ensure that Top Plate heaters on SMD are operational.

G.2.3. Verify GSE cabling connected between SMD and Electrical Module and between SMD and Data Acquisition System.

G.2.4. Record MT pressure (EG-3 and/ or STG) ____ torr ____ torr diff.

G.2.5. Verify DAS and, as appropriate, liquid level alarms enabled and record set points.

1. Main Tank level ("A" or "B"): Record set point _____%
2. Guard Tank Level ("A" or "B"): Record set point _____%
3. Station 200 temperature – verify [CN 01] on DAS alarm list and alarm setpoint at T ≤ 6.5 K. Record set point _____K
4. Top of lead bag temperature – verify [CN 28] on DAS alarm list and and alarm setpoint at T ≤ 6.0 K. Record set point _____K
5. Relative Guard Tank Pressure – verify [CN46] on DAS alarm list and and alarm setpoint at P ≥ 0.3 torr. Record set point _____torr

G.2.6. Verify Main Tank vent line connected to Gas Module. If not perform procedure P0674, Connect Main Tank Vent Line to Gas Module.

If P0674 used, enter Op Order Number_____ .

G.2.7. Verify Guard Tank vent line connected to Gas Module. If not, perform procedure P0676, Connect Guard Tank Vent Line to Gas Module , to connect Guard Tank vent.

If P0674 used, enter Op Order Number_____ .

G.2.8. Verify Fill Cap Assembly installed at SV-13.

G.2.9. Ensure ion-pump magnet installed.

G.2.10. Record Vacuum Shell Pressure.

1. Turn on Vac-ion pump and record time of day _____
2. Use DAS [Monitor Data] for CN 99.
3. When value is steady, record pressure (IP) _____ torr. If pressure is above $1x10^{-4}$ torr, perform procedure P0213, Connect of Vacuum Module / Pump on SMD Vacuum Shell, to connect Vacuum Module and pump out SMD vacuum shell.
4. Exit [Monitor Data] and collect data with [Set Data Interval] to 5 min.
5. When data cycle is complete, turn off Vac-ion pump.

G.2.11. Verify liquid in Main Tank is at NBP (4.2<T<4.3) and record temperature at bottom of tank CN [9] _____K.

G.2.12. Verify Actuator Control for EV-9 set to "NBP" position.

Section G.2 Complete Quality _____

G.2.13. If Guard Tank is not supplied with gaseous helium via APR-2 and EV-23, perform the following steps:

1. Adjust APR-2 to 1.5 psig
2. Close EV-13 (manifolded vent) or EV-20 (bypass vent)..
3. Open EV-23.
4. Verify flow meter, EFM-2 responds, showing inflow to Guard Tank.

G.3. **Verify Gas-Module and SMD Configuration and Record Initial Conditions**

G.3.1. 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
2. Guard Tank vent Connected to GM; depleted of LHe and Pressure regulated at EV-23 (verify source of He gas at APR-2)		
	EV-16, EV-23 GTV-V, APR-2	EV-13, EV-20, EV-24 GTV-Va
3. 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
4. AV valves		All

G.3.2. Record initial temperatures

1. Station 200 CN [01] _____ K.
2. Top of Lead Bag CN [28] _____ K.
3. Temperature at bottom of Main Tank CN 09] _____K.

G.3.3. Record pressures.

1. Guard Tank (GTV-G) [CN46]:_____ torr (relative to atm.).
2. Main Tank (STG) [CN49]:_____ torr diff.. (Endevco on Thruster Vent Manifold)

G.3.4. Record liquid level in Main Tank _____ %.

G.3.5. 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.

G.3.6. Record status of Well pump-out:

- o VTH closed and Well manifold not installed.
- o Well manifold installed, record valve positions and pressure:

  VTH ____ , VW-3 _____ , PW-1 _____ torr.

G.3.7. Verify SMD internal valving is in Standard Configuration

1. 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.
    a. Open: RAV-3, and RAV-6B.
    b. Closed: RAV-1, RAV-2, RAV-5, RAV-6A, and RAV-7.
2. Verify SV-9 open.

Section G.3 complete. Quality_____

G.4. Set Up Data Acquisition System

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

G.4.1. Set up WTM (Wet Test Meter) to measure flow from EV-24, verify data is being acquired at DAS.

G.4.2. Verify DAS set to configuration 4M.

G.4.3. Set DAS to fast scan mode using [other menus], [data config], [fast scan]

G.4.4. Record directory and data file name _____ .

G.4.5. Start "Special Data Cycle" by using:

1. [Other Menus] + [Special Data Col] + [Input IDs]
2. Input CNs: 1, 5, 25, 8, 46, 120 for scan list.
3. And [Init. Collectn] + [Enter] (=use default file).

G.4.6. Record directory and special data file name _____ .

G.4.7. Set Main Tank Liquid Level Sensor sampling interval to 1 min.

G.4.8. Ensure printer is displaying special Data Cycle data.

G.4.9. Place normal Data Cycles to 5 minute intervals.

G.4.10. Valve configuration:

	Open	Closed
EV valves	EV-7a/-b, EV-9, EV-23, EV-16	All other
AV valves	APR-2	All other
Dewar valves	GTV-V, SV-9	GTV-Va, SV-13, ST-Va/Vb
RAV valves	RAV-3, RAV-6B	All other

Section G.4 complete. Quality_____

G.5. Set up for flow test

G.5.1. Verify DAS is cycling at 5 minute intervals.

G.5.2. Set up Guard Tank pressure.

1. Begin data entry every 15 minute in Table 1.

Note: In the following it is important to minimize perturbing internal temperatures as a good equilibrium temperature condition is important for high quality data.

2. Adjust APR-2 to slowly adjust pressure at GTVG (CN46) to between 100 torr to 140 torr (140 torr is maximum reading at CN46). Use EFM-2 reading to maintain low helium in flow rate.
3. When the pressure is attained and the flow is low, proceed with the next steps.

Note: The quality of the evaluation results are a strong function of establishment of good equilibrium temperature distribution in the Guard Tank-HEX1 through HEX4 regions.

G.5.3. Comment on condition of temperature equilibrium of Guard Tank, Main Tank and HEXs: _____

_____

_____

Section G.5 complete. Quality _____

G.6. Flow gas out of Guard Tank.

G.6.1. Comment to DAS, “Begin flow out of Guard Tank”.

G.6.2. Close EV-23: Guard Tank is now closed off; pressure relief is now at ERV-2a/-2b.

G.6.3. Verify DAS is set to fast scan mode using [other menus], [data config], [fast scan]

G.6.4. Suspend alarm cycles.

G.6.5. Place special Data Cycle cycle time to </= 0.25 minutes

G.6.6. At the conclusion of a normal data cycle, suspend normal data cycles.

G.6.7. At a point between special data cycles, perform the following steps and record exact time (from DAS clock) at which EV-24 is opened.

1. Open EV-24 Record time _____ .

G.6.8. Once the flow as indicated at CN120 has reached a relative constant value, initiate normal data cycles at 5 minute intervals.

G.6.9. Continue recording data in Table 1 every <=15 minutes.

Section G.6 complete. Quality _____

G.7. Completion of Guard Tank flow.

G.7.1. When:

1. the flow rate as measured by WTM is ~/< 1 slpm

Or,

2. the pressure at GTVG is <15 torr

proceed with the following steps to shut down the test.

G.7.2. Verify APR-2 is adjusted to ~ 1.5 psig.

G.7.3. Close EV-24.

G.7.4. Open EV-23.

G.7.5. Stop data entries to Table 1.

Section G.7 complete. Quality _____

G.8. Configuring Dewar and GSE

G.8.1. Verify Gas Module valving as follows:

	Open	Closed
EV valves	EV-7a/-b, EV-16, EV-9, EV-23	All other
AV valves	APR-2	All other
Dewar valves	GTV-V, SV-9	GTV-Va, ST-Va/Vb, SV-13, FCV
RAV valves	RAV-3, RAV-6B	All other

Section G.8 complete. Quality _____

G.9. Setting up Data Acquisition

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

G.9.1. Input comment to DAS "Completed Gurar Tank Vent Line Impedance Measurement".

G.9.2. Set DAS to configuration choice 4M.

G.9.3. Stop Special Data Cycle by using [Other Menus] + [Special Data Col] + [Stop Data Col].

G.9.4. Record Vacuum Shell Pressure.

1. Turn on Vac-ion pump and record time of day _____ .
2. Use DAS [Monitor Data] for CN 99.
3. When value is steady, record pressure (IP) _____ torr.
4. Exit [Monitor Data] and collect data with [Set Data Interval] to 15 min.
5. When data cycle is complete, turn off Vac-ion pump.

G.9.5. Set DAS to normal scan mode using [other menus], [data config], [normal scan]

G.9.6. Set DAS data cycle interval to 15 minutes.

G.9.7. Set Main Tank Liquid Level sampling interval to 10 minutes.

G.9.8. Confirm that the liquid level sensors are set at a sampling rate of 10 minutes or turned off.

G.9.9. Confirm that Vac-ion pump is off.

G.9.10. Enable/verify enabled the alarms on the Main Tank and Well Liquid Level Sensors.

G.9.11. Verify enabled the DAS alarm and record the set points:

a) CN ____, Level _____
b) CN ____, Level _____
c) CN ____, Level _____
d) Main Tank Level: _____ %
e) Well Level: _____ %

G.9.12. Ensure DAS watchdog timer and alarm enabled.

Section G.9 complete. Quality _____

G.10. **Data Documentation**

G.10.1. Attach to this procedure an Excel plot of the special data cycle output.

G.10.2. Record time elapsed to reach a flow of 1 slpm or a pressure of 15 torr-diff at GTVG _____ .
Flow rate CN121 _____ slpm
Pressure GTVG CN46 _____ torr

G.10.3. From the Excel spreadsheet calculate the integrated flow out of the Guard Tank and enter _____ liters.

Section G.10 complete. Quality _____

H. **Procedure Completion**

Completed by: _____

Witnessed by: _____

Date: _____
Time:_____

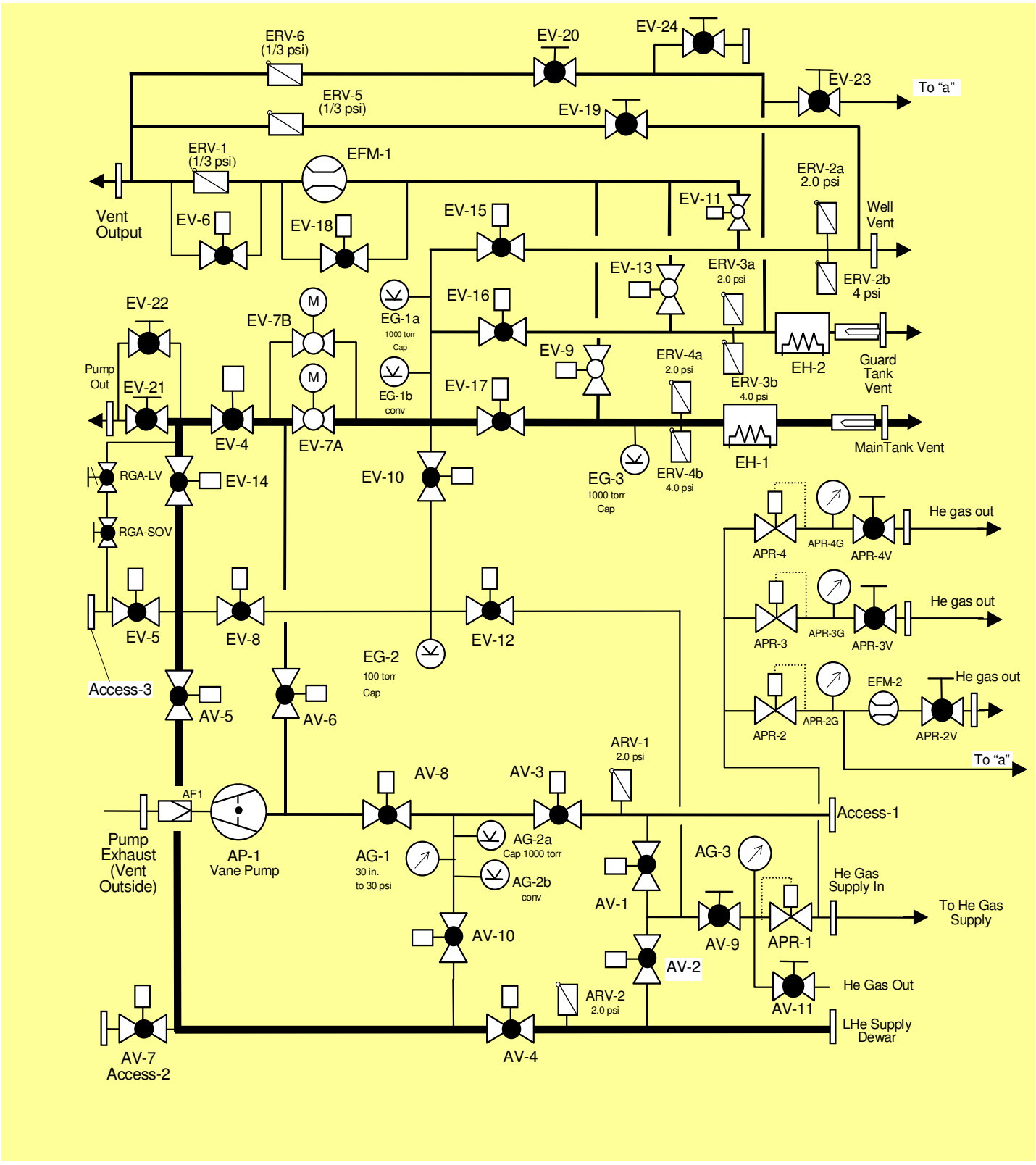
Quality Manager Date _____

Payload Test Director Date _____

Table 1

Date/Time	MT Press EG-3 CN47	GT Press EG-1a CN112	WTM Helium Gas flow CN121	Sta. 200 T-1D [1] CN01	Lead bag Top T-20D CN28	G.T.Bott T-15D CN24	HX-4 T-08D CN08	M.T. Bottom T-09D CN09
	Torr	Torr	Slpm	K	K	K	K	K

Figure 1 Gas Module Schematic



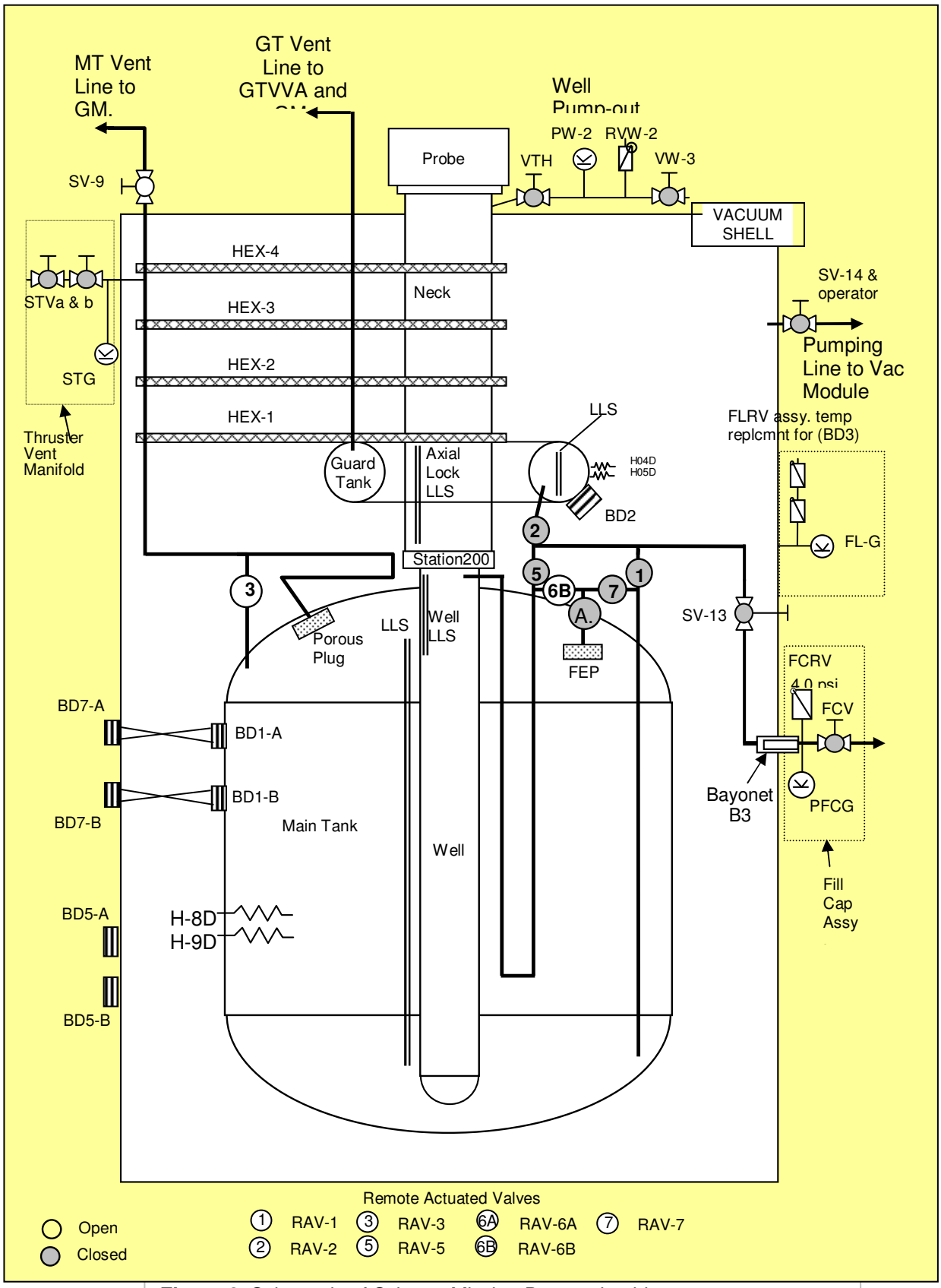


Figure 2. Schematic of Science Mission Dewar plumbing

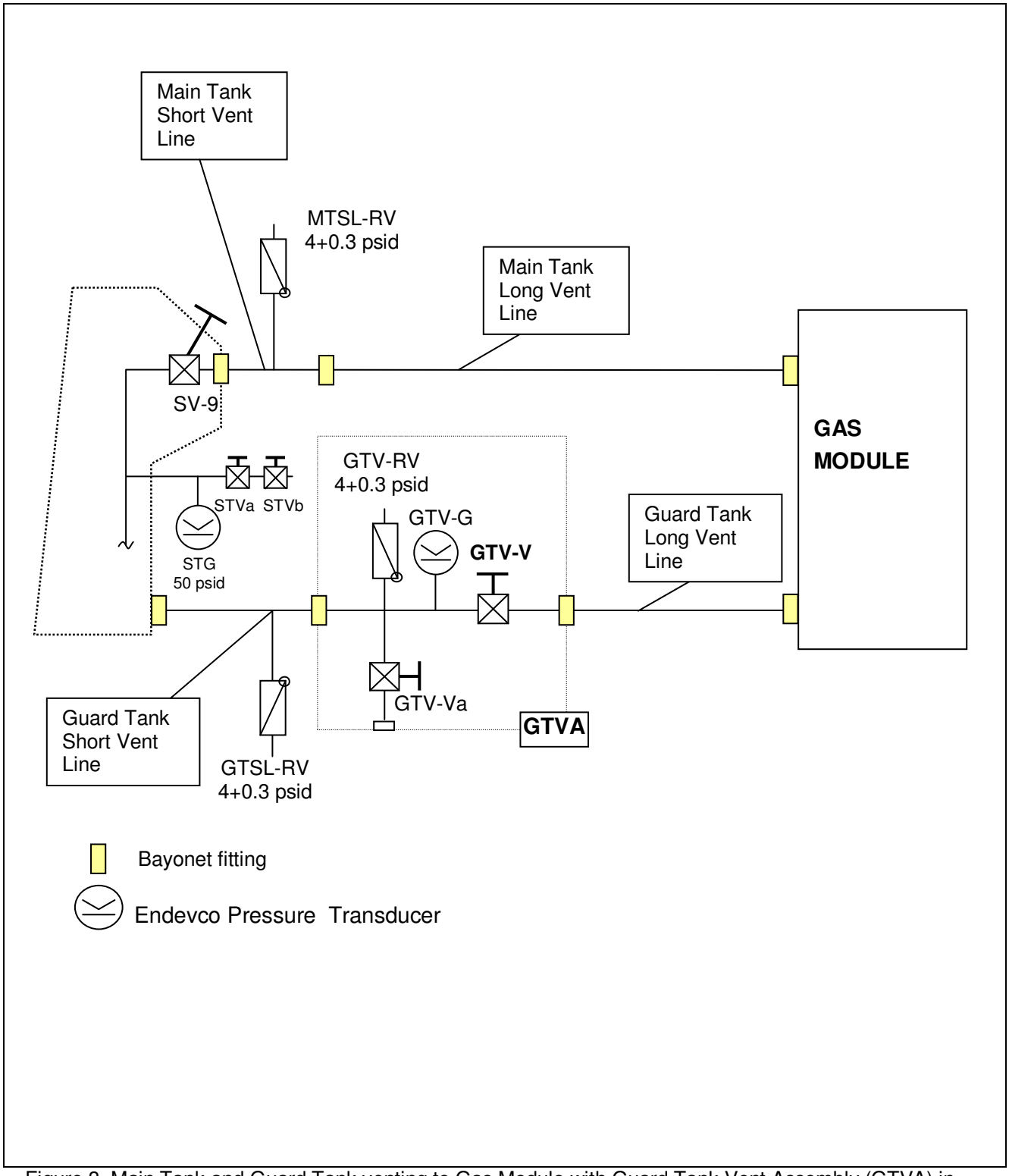


Figure 3. Main Tank and Guard Tank venting to Gas Module with Guard Tank Vent Assembly (GTVA) in place.
(MT&GT_toGM_dwg.doc)

I. APPENDICES

I.1. Appendix 1 Pre-Test 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: _____		

I.2. **Appendix 2 Post-Test 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: _____		

I.3. **Appendix 3– Contingency Responses**

	Condition	Circumstance	Response
1	Power Failure	Before. G.7 (start of transfer)	Wait for power restoration: Re-establish valve configuration, and resume procedure
		After Section G.7	Do Section 8 and wait for power restoration and then continue to close out procedure.
		After G.7	Wait for power restoration: Re-establish valve configuration , and resume procedure
		Any other 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
4	Burst disk rupture (MT/GT)	Any time	Evacuate room