GRAVITY PROBE B
PROCEDURE FOR
SCIENCE MISSION DEWAR

MAIN TANK
NORMAL BOILING POINT FILL
WITH PRE-COOL THROUGH THE GUARD TANK
WITH LHe in Well

December 11, 1998

Prepared by

_____Date_____
D. Frank
LMMS Cryogenic Test

Checked by

_____Date_____
Dave Murray
Cryogenic Test

Approvals:

_____Date_____
Ben Taller
Quality Assurance

_____Date_____
Albert Rodriguez
LMMS Safety

_____Date_____
Sasha Buchman

_____Date_____
Mike Taber

Hardware Manager

Test Director

REVISION RECORD

REVISION	ECO	PAGES	DATE
A	731	Modified procedure to include the following options 1. Filling and draining the Guard Tank. 2. Pre-cooling the internal fill line by pushing liquid up from the Main Tank. 3. Putting Guard Tank in locked-up or bypass mode (G.19.1).	1/27/98
B	768	Revision incorperates the new Guard Tank vent path through EV-20 (by-pass mode) and elimination of the Guard Tank locked-up mode and elimination of option to keeping Guard Tank pressurized with Gas Module. (G.2.1, G.5.3, G.10.13, G.11.2.5, G.15.20.6, added G.17.3, G.19.1, removed G.21.19, Data Sheet 2, figure 1). Added SV-13 temperature criteria during cool-down (G.10.10, G.14.29 Modified G.3. such that smaller volume is used in checking initial pressure in Fill Line. Expanded Alarm setting (G.20.10,.11,.12).	3/6/98
C	886	Remove reference to Case1/case2 (A.scope, G.2.15, G.9.5, G.10.17, G.11.2.6, G.13, G.14.32, G.14.38, G.15.20.7, G.15.29, G.17.2, G.19.1.1, G.19.1.2,G.20.7, G.20.10). Changed Vac-ion operation (G.1.4). Update “Special Data Cycle” (G.9.2). Update pressurization of Main Tank (G.10, G.14)	12/11/98

Table of Contents

List of Abbreviations and Acronyms

ATC	Advanced Technology Center
Aux	Auxiliary
AV-x	Valve x of the Auxiliary gas section of the Gas Module
AG-x	Gauge x of the Auxiliary gas section of the Gas Module
Bot	Bottom
DAS	Data Acquisition System
EFM	Exhaust gas Flow Meter
EM	Electrical Module
EV-x	Exhaust gas valve of Gas Module number x
EG-x	Gauge x of Exhaust gas section of Gas Module
FIST	Full Integrated System Test
FCG	Fill Cap assembly pressure Gauge
GHe	Gaseous Helium
GM	Gas Module
GP-B	Gravity Probe-B
GSE	Ground Support Equipment
KF25	Quick connect o-ring vacuum flange (25 mm diameter)
LHe	Liquid Helium
LHSD	Liquid Helium Supply Dewar
Liq	Liquid
LMMS	Lockheed Martin Missiles and Space
LMSC	Lockheed Missiles and Space Company
PFM	Pump equipment Flow Meter
PM	Pump Module
psi	pounds per square inch
psig	pounds per square inch gauge
PV-x	Valve x of the Pump equipment
PG-x	Gauge x of Pump equipment
RAV-x	Remote Actuated Valve-x
RGA	Residual Gas Analyzer
SMD	Science Mission Dewar
SU	Stanford University
SV-x	SMD Valve number x
TV-x	Valve x of Utility Turbo System
TG-x	Gauge x of Utility Turbo System
UTS	Utility Turbo System
Vac	Vacuum
VDC	Volts Direct Current
VF-x	Valve x of liquid helium Fill line
VM	Vacuum Module
VV-x	Valve x of Vacuum Module
VG-x	Gauge x of Vacuum Module
VW-x	Valve x of Dewar Adapter
STV	SMD Thruster vent Valve

FCV Fill Cap Valve

A. **SCOPE**

This procedures describes the steps necessary to perform an external fill of the Main Tank with normal boiling point liquid helium for the Science Mission Dewar. This procedure is to be used when the **Fill Line is to cooled through the Guard Tank** and when there is **liquid in the Well**. This procedure has the option for change-outs of liquid helium supply dewars during the fill. It also provides for options of filling the Guard Tank or Well.

For a Main Tank NBP fill and with **LHe in the Well** with a **pre-cool from the Main Tank,** use P0441.

For a Main Tank NBP fill and with **LHe in the Well** with a **pre-cool from the Guard Tank,** use P0442.

For a Main Tank NBP fill and with **the Well evacuated** use procedure P0421.

B. **GENERAL REQUIREMENTS**

B.1. **Electrostatic Discharge**

This procedure does not include any equipment sensitive to electrostatic discharge.

B.2. **Safety**

B.2.1. General

Personal injury and hardware damage can result during normal positioning, assembly and disassembly of hardware (e.g. positioning of Dewar in tilt stand; integration of probe into airlock; integration of airlock/probe onto Dewar; removal of airlock from Dewar; removal of probe from Dewar); and during positioning of support equipment (e.g. pressurized gas cylinders; supply dewars).

Undesired events associated with these operations include: (1) Personnel or other objects are struck (e.g. by forklift or crane load) when hardware is being moved . (2) Personnel are subject to entrapment while positioning hardware when their hands or feet are caught between objects as hardware is moved into place. (3) Suspended hardware is dropped. (4) Personnel who are present during hardware movements (e.g. by forklift; crane) are caught between objects (e.g. forklifts and walls; loads and building support columns).

B.3. **Lifting Operations**

There are no lifting operations in this procedure

B.4. **Injuries**

In case of any injuries adhere to the following:

B.4.1. Obtain medical treatment:

LMMS **Call 117;** Stanford University **Call 9-911**

B.5. **Safety Requirements**

The SMD Safety Compliance Assessment, document GPB-100153C discusses the safety design, operating requirements and the hazard

analysis of the SMD. The FIST Emergency Procedures, document SU/GP-B P0141 discusses emergency procedures. These documents should be reviewed for applicability at any facility where the hardware is operated.

B.6. **Test Personnel**

B.6.1. Personnel Qualifications:
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-offs located at the end of each procedure/task module. The person in charge of the operation (Test Director or Test Engineer) is to sign the "completed by" sign-off.

B.6.2. Qualification of Personnel:
The Test Director must have a detailed understanding of all procedures and facility operations and experience in all of the SMD operations and is the only personnel that has authority to approve redlines.
The 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.
The personnel who qualify for the above categories are:

Test Director:	Mike Taber
	Dave Murray
Test Engineer:	Tom Welsh
	David Frank

C. **CONFIGURATION REQUIREMENTS**

C.1. **General System Configuration Requirements and Test Conditions.**

C.1.1. Note that the following modifications or non-flight arrangement of the basic SMD configuration have been made:

1. The SMD is installed in its transportation and test fixture.
2. A relief valve is installed in place off the fill line burst disk.
3. Emergency vent line deflectors are installed over the four burst disk ports and an oxygen collection pan is installed on the floor below these.
4. A foreign object and debris shield covering the upper cone of the SMD is installed.
5. The ion pump magnet is installed.
6. The Airlock Support Plate may be installed on the SMD.
7. Dewar Adapter or Probe is mounted to the Well of the SMD.
8. The GSE cabling is connected between SMD and Electrical Module (P/N 5833812) and Data Acquisition System (P/N 5833811).
9. The Guard Tank vent is connected to the Gas Module (P/N 5833813) with a vacuum insulated line.
10. The Main Tank vent is connected to the Gas Module with a vacuum insulated line (P/N 5833806).
11. The Well is connected to the Gas Module via a pumping line attached to the Dewar Adapter interface flange at the Airlock Support Plate.
12. The Vacuum shell pump out port at SV-6 may be connected to the Vacuum Module (P/N 5833816) via a 2-in valve operator and pumping line.

13. The thruster vent port is flanged to a shut-off valve.

D. HARDWARE/SOFTWARE REQUIRED

D.1. Special Test Equipment

Item	Description	Manufacturer	Model
1	Filter Line assembly	LMMS	5833827
2	Liquid He Transfer Line	LMMS	5833804
3	Liquid He Siphon Tube	LMMS	5833803
4	AMI Level Sensor Readout for LHSD	AMI	110
5	GHe supply fittings to LHSD	N/A	N/A
6	Bayonet Cap with Nupro Valve	LMMS	N/A

D.2. Tools

Description
Torque Wrench
1-1/4-in socket, 60 in-lb

D.3. Expendables

Description	Quantity	Mfr./Part No.
Alcohol	AR	N/A
99.99% pure gaseous helium	AR	N/A
Vacuum Grease	AR	Braycote Micronic 601
500 Liter Dewars Liquid Helium	AR	SU or commercial
Tie wraps - large size	AR	N/A

D.4. Commercial Test Equipment

No commercial test equipment is required for this procedure.

D.5. Computers and Software:

No special computers and software are required in addition to the Data Acquisition System.

E. **EQUIPMENT PRETEST REQUIREMENTS**

Verify top plate heaters and Gas Module Heat Exchangers are operational.

The GSE instruments used to perform this procedure are listed in the following table together with their serial numbers were available. The instruments which are required to have current calibrations are so indicated in the Cal Required column. Instruments that do not require calibration are 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.

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	LLS Axial	96-409-12	No	-

		American Magnetics, Inc. 136	Lock			
15	EM	Pressure Controller, MKS 152F-92	EV-7a, -7b	96203410A 96023407A	No	-
16	EM	Power Supply HP 6038A	H08D Tank Heater	3511A-13356	Yes	

No.	Location	Description	User Name	Serial No.	Cal Required	Status Cal due date
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	-

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

Operation Number: _____.

Date Initiated: _____.

Time Initiated: _____.

G. **OPERATIONS**

G.1. **Record the Initial Condition:**

G.1.1. Dewar is: not tilted _____ tilted to _____ .

G.1.2. Record pressures:

Gas Module Manifold (EG-1a): _____ torr

Main Tank (EG-3): _____ torr

G.1.3. Record initial liquid helium levels (as appropriate):

a) Main Tank level (LL-1D or LL-2D): _____ %
b) Well level (LL-3LD or LL-4LD): _____ %
c) Guard Tank Level (LL-5D or LL-6D): _____ %
d) Axial Lock level (LL-7D or LL-8D): _____ %

G.1.4. Recording Vac-ion pump:

G.1.4.1. Turn on Vac-ion pump and record time of day : _____

G.1.4.2. Use DAS "Monitor Data" for CN 99.

G.1.4.3. When value is at equilibrium record pressure (IP): _____ torr

G.1.4.4. Exit "Monitor Data" and collect data using "Set Data Interval" to 5 minutes.

G.1.4.5. When data cycle is complete, **turn off** Vac-ion pump.

G.1.5. Option for filling Well: _____ (yes / no).

If yes, perform procedure P0210" Internal Main Tank to Well Tranfers" and record:

a) Operation number: _____
b) Main Tank level (LL-1D or LL-2D): _____ %
c) Well level (LL-3LD or LL-4LD): _____ %
d) Guard Tank Level (LL-5D or LL-6D): _____ %
e) Axial Lock level (LL-7D or LL-8D): _____ %

G.1.6. Record Fill Cap Assembly pressure and verify that it reads > 0.0 psig.

Fill Cap Assy (FCG): _____ psig / torr

G.2. **Initial Configuration of SMD and GSE**

G.2.1. Configuring the Gas Module

G.2.1.1. Close/verity closed EV-10, EV-12.

G.2.1.2. Close/verify closed AV-9.

G.2.1.3. Open/verify open EV-9 and EV-16.

G.2.1.4. Perform **one** of the following:

θ **(Only if Guard Tank in bypass mode):**

a. Verify open EV-20.

b. Verify closed EV-13.

θ **(Only if Guard Tank is not in bypass mode):**

c. Verify closed EV-20.

d. Verify open EV-13.

G.2.1.5. Open/verify open EV-19.

G.2.1.6. Verify that all other EV valves are closed.

G.2.1.7. Close/verify closed all AV valves.

G.2.1.8. Verify pump AP-1 is on.

G.2.1.9. Verify that Heat Exchangers are on.

G.2.2. Configuring the Dewar

G.2.2.1. Verify that Top Plate heaters on SMD are operational.

G.2.2.2. Using the RAV log book verify the dewar's internal valves are in the following positions:

Open: RAV-3, and RAV-6B.
Closed: RAV-1, RAV-2, RAV-5, RAV-6A, and RAV-7.

G.2.2.3. The dewar's external valves are in the following positions:

Open: SV-9.
Closed: SV-13, VW-1, STV and FCV.

G.3. **Checking initial pressure in Fill Line**

G.3.1. Install a pumping line between valve FCV on the Fill Cap Assembly and the Access Port #1 of the Auxiliary gas section.

G.3.2. Open AV-8.

G.3.3. Open AV-3.

G.3.4. Open valve FCV and evacuate to 20 mtorr as measured at AG-2.

G.3.5. Close AV-8 and FCV.

G.3.6. Once the pressure in the Fill Cap Assy. as measured at PFCG has stabilized, record:

Fill Cap Assy. pressure (PFCG): _____ torr.

G.3.7. Open valve SV-13 and bring the Fill Cap Assy. up to the pressure in the SMD Fill line and record:

Fill line pressure (PFCG): _____ torr.

G.4. **Raising pressure in Fill Line**

G.4.1. Verifying Guard Tank Pressure is above atmospheric condition.

G.4.1.1. Record Guard Tank pressure at EG-1a: _____ torr.

G.4.1.2. **If** EG-1a is below 760 torr perform the following to raise the pressure:

a. Set Guard Tank Heater power supply current limit to 0.07 amp.

b. Set voltage of heater H-3D to 50 vdc and record:

i) Time of Day: _____

ii) V: _____ vdc and I: _____ a

c. **(Optional)** Set voltage of heater H-4D to 50 vdc and record:

i) Time of Day: _____

ii) V: _____ vdc and I: _____ a

d. When pressure EG-1a is at least 760 torr, turn off heater(s).

G.4.2. Open RAV-2 to bring the Fill Line up to Guard Tank pressure as follows and record:

G.4.2.1. Verify all RAV selection switches are in the OFF position.

G.4.2.2. Turn on RAV power supply and adjust current limit to 1.95 amps.

G.4.2.3. Adjust power supply to 28 VDC.

G.4.2.4. Power up RAV controller No. 2.

G.4.2.5. Position selection switch to RAV-2.

G.4.2.6. Record initial switch status: Open: θ θ Closed: θ θ

G.4.2.7. Activate controller No. 2 and record:

a) run time: _____ seconds

b) current draw: _____ amp

c) time of day: _____

G.4.2.8. Record final switch status: Open: θ θ Closed: θ θ

G.4.2.9. Record operation in RAV log book.

G.4.3. Verify that the Fill Cap Assembly pressure rises to the Dewar Guard Tank pressure measured by PFC.

Fill line pressure (PFC): _____ psig/torr.

G.4.4. Close SV-13 and torque to 60 in-lbs ± 5 in-lbs.

G.4.5. Proceed to step G.5 if liquid in Guard Tank or G.6 if no liquid.

G.5. **(Option) Draining of Liquid in Guard Tank**

Note: This paragraph is **only** to be performed if there is liquid remaining in the Guard Tank

G.5.1. Record the Guard tank pressure EG-1a: _____ torr.

G.5.2. Record the Guard tank pressure desired for initiating transfer: _____ torr.

G.5.3. Close/verify closed Guard Tank vent valves EV-13 and EV-20 and record:

time of day: _____ .

G.5.4. Turn on Guard Tank Heater H-3D:

G.5.4.1. Set power supply current limit to 0.07 amp.

G.5.4.2. Set voltage of heater H-3D to 50 Vdc and record:

i) Time of Day: _____

ii) V: _____ Vdc and I: _____ a

G.5.5. **(Optional)** Turn on Guard Tank Heater H-4D:

G.5.5.1. Set power supply current limit to 0.07 amp.

G.5.5.2. Set voltage of heater H-4D to 50 Vdc and record:

i) Time of Day: _____

ii) V: _____ Vdc and I: _____ a

G.5.6. Setting up Data Acquisition

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

G.5.6.1. Input comment to DAS “Start Guard Tank Drain”.

G.5.6.2. Set DAS data cycle interval to 5 minutes.

G.5.6.3. Set Main Tank sampling interval to 1 minute.

G.5.6.4. Set Guard Tank sampling interval to 1 minutes.

G.5.7. Initiating the Transfer

G.5.7.1. When the Guard tank pressure (EG-1a) reaches the desired initial pressure do the next steps:

G.5.7.2. Open RAV-1:

a. **Verify** RAV-1 selection switch is in the OFF position.

b. Power up RAV controller No.1.

c. Position selection switch to RAV-1.

d. Record initial switch status: Open: θ θ Closed: θ θ

e. Activate controller No.1 and record:

a) run time: _____ seconds
b) current draw: _____ amp
c) Time of day: _____

f. Record final switch status: Open: θ θ Closed: θ θ

g. Record operation in RAV log book.

G.5.7.3. Open EV-18 and record time: _____.

G.5.7.4. Record pressures:

a) Time of day: _____
b) EG-3: _____ torr
c) EG-1a: _____ torr

G.5.7.5. Open EV-6 as required to keep Main Tank pressure from increasing too much.

G.5.8. Stopping the Flow of Liquid Helium

G.5.8.1. When Guard Tank liquid level sensors read zero record:

a) Time of day: _____

b) Guard Tank temp. (T-15D): _____ K

G.5.8.2. Close RAV-1:

a. Verify that controller No. 1 is already powered up and that RAV selection switch is already set to No.1.

b. Record initial switch status: Open: θ θ Closed: θ θ

c. Activate controller No. 1 and record:

a) run time: _____ seconds
b) current draw: _____ amp
c) Time of day: _____

d. Record final switch status: Open: θ θ Closed: θ θ

G.5.8.3. Close relief bypass valves EV-6 and EV-18.

G.5.8.4. Close EV-9 to isolate the Main Tank and record:

a) Guard Tank Pressure (EG-1a): _____ torr
b) Main Tank pressure (EG-3): _____ torr

G.5.8.5. Open Guard Tank vent valve EV-13.

G.5.8.6. Once EG-1a and EG-3 are within 3 torr of each other, open EV-9.

G.5.8.7. Record flowrate EFM-1: _____.

G.5.8.8. When Guard Tank temperature (T-15D) rises above 4.4K record:

a) Time of day: _____
b) Guard Tank temp. (T-15D): _____ K

G.5.8.9. Turn off power to the Guard Tank heater(s).

G.5.8.10. Once conditions have stabilized, record final transfer conditions:

a) Main Tank level (LL-1D or LL-2D): _____ %
b) Well level (LL-3LD or LL-4LD): _____ %
c) Guard Tank Level (LL-5D or LL-6D): _____ %
d) Axial Lock level (LL-7D or LL-8D): _____ %

G.5.8.11. Record Vacuum pressure (IP): _____ torr

G.5.9. Configuring the DAS

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

G.5.9.1. Input comment to DAS “End of Guard Tank Drain”.

G.5.9.2. Set DAS data cycle interval to 15 minutes.

G.5.9.3. Set all liquid level sampling intervals to 10 minute.

G.5.9.4. Verify Final Configurations

G.5.10. Verify open: EV-9, EV-13, EV-16, and EV-19.

G.5.11. Go to Section G.6

G.6. **Installing Stinger in LHSD**

Note: Use appropriate extension for the LHSD being used. and **clean** all O-rings and mating surfaces.

G.6.1. Reduce the pressure in the liquid helium supply to < 1.0 psig by opening the low pressure relief valve.

G.6.2. Open valve VF-1 (Liquid withdrawal valve) on the stinger

G.6.3. Slowly insert the stinger into the LHSD while allowing it to be purged.

G.6.4. Close valve VF-1 just as cold gas is expelled from stinger.

G.6.5. Close the primary (low pressure) relief valve on the LHSD.

G.6.6. Increase LHSD ullage pressure builder to 4 to 6 psig via:

_____ a) Power on the electric pressure builder **or,**

_____ b) Attach an external source of Ghe to the ullage inlet per following:

i) Attach a GHe hose to the VENT outlet of the LHSD while purging the hose and the VENT outlet.

ii) Adjust pressure regulator to required LHSD driving pressure.

G.6.7. Record LHSD data:

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

G.7. **Installing Fill Line Assembly**

G.7.1. Removal of Pumping line and the Fill Cap Assembly

G.7.1.1. Close/verify closed AV-8.

G.7.1.2. Open AV-1

G.7.1.3. Open AV-9 until pressure reaches 0 psig at AG-1 and then close AV-9.

G.7.1.4. Close AV-1.

G.7.1.5. Remove the pumping line from the fill cap assembly.

G.7.2. Install the Filter Line Assembly (P/N 5833827) to the Dewar Fill Bayonet B3.

G.7.3. Installing Fill Line Assembly

Note: Be sure to provide adequate support to the Fill Line such not to load the Filter Assembly and Stinger.

G.7.3.1. Mate the Fill Line (P/N 5833804) with the Stinger in the LHSD.

G.7.3.2. Mate the VF-2 end of the transfer line with the Filter Line Assembly.

G.7.3.3. Ensure that the valve stem of VF-2 and stem of relief valve are pointed upwards.

G.7.3.4. Close/verify closed VF-3.

G.8. **Condition the Transfer Line/Filter/Stinger Assembly**

G.8.1. Configure Pumping Line:

G.8.1.1. Verify mated, the 1-in flexible pumping line to Access Port #1 port of Auxiliary Gas section.

G.8.1.2. Mate other end to outlet of VF-2.

G.8.2. Evacuating Transfer Line:

G.8.2.1. Open valve VF-2.

G.8.2.2. Open/verify open AV-3.

G.8.2.3. Open AV-8.

G.8.2.4. Close AV-8 when pressure reaches less than 50 mtorr as read on gauge AG-2.

G.8.3. Backfilling Transfer Line:

G.8.3.1. Open AV-1.

G.8.3.2. Open AV-9 until pressure reaches 0.5 psig as read on gauge AG-1 and then Close AV-9.

G.8.3.3. Close AV-1.

G.8.4. Evacuating Transfer Line (second time):

G.8.4.1. Open AV-8.

G.8.4.2. Close AV-8 when pressure reaches less than 50 mtorr as read on gauge AG-2.

G.8.5. Backfilling Transfer Line (second time):

G.8.5.1. Open AV-1.

G.8.5.2. Open AV-9 until pressure reaches 0.5 psig as read on gauge AG-1 and then Close AV-9.

G.8.5.3. Close AV-1.

G.8.5.4. Close valve VF-2.

G.9. **Setting up Data Acquisition**

G.9.1. Set DAS to configuration choice 4P.

G.9.2. Start “Special Data Cycle” by using [Other Menus] + [Special Data Col] + [Use Pre-Selected] + [Init. Collectn] + [Enter] (=use default file).

G.9.3. Input comment to DAS “Start Main Tank NBP Fill”.

G.9.4. Set DAS data cycle interval to 5 minutes.

G.9.5. Setting up the appropriate Liquid Level Sensors sampling intervals to 1 min.

Axial Lock	(LL-7D or LL-8D)	1 min
Main Tank	(LL-1D or LL-2D)	1 min
Guard Tank	(LL-5D or LL-6D)	1 min

G.10. **Starting the Transfer and Pre-cool Through Guard Tank**

G.10.1. Record the following instrumentation and time of day:

Time of day: _____.

Main Tank vent pressure: EG-3 _____ torr

Temperatures: T-1D _____ K (channel 1)

T-15D _____ K (channel 24)

G.10.2. Precooling Fill lines and starting transfer:

G.10.2.1. Open VF-1.

G.10.2.2. Open VF-3.

G.10.2.3. Open VF-2.

WARNING

In the following steps cold helium gas and liquid will be expelled from a siphon tube and transfer lines. Personnel involved with the operation are to wear a face mask and cryogenic gloves

G.10.2.4. When a dense plume is evident from VF-2, close VF-2 and VF-3 and **immediately open** SV-13.

G.10.2.5. Open/verify open EV-13, EV-6, and EV-18.

G.10.2.6. Open EV-11.

G.10.2.7. Set the Guard Tank liquid level sensor (LL-5D or LL-6D) to 0 minutes.

G.10.2.8. Set data acquisition system to monitor data mode and monitor the Guard Tank temperature T-15D (channel 24).

G.10.2.9. When the temperature T-15D has cooled to below 10K, proceed immediately to the next step.

Time of day: _____

G.10.3. Open RAV-1:

G.10.3.1. Verify that controller No.1 is already powered up and that RAV selection switch is already set to RAV-1, if not perform the following:

a. Verify RAV-1 selection switch is in the OFF position.

b. Power up RAV controller No. 1.

c. Position selection switch to RAV-1.

G.10.3.2. Record initial switch status: Open: θ θ Closed: θ θ

G.10.3.3. Activate controller No. 1 and record:

a) run time: _____ seconds

b) current draw: _____ amp

c) time of day: _____

G.10.3.4. Record final switch status: Open: θ θ Closed: θ θ

G.10.3.5. Record operation in RAV log book.

G.10.4. Close RAV-2:

G.10.4.1. Verify that controller No.2 is already powered up and that RAV selection switch is already set to RAV-2.

G.10.4.2. Record initial switch status: Open: θ θ Closed: θ θ

G.10.4.3. Activate controller No.2 and record:

a) run time: _____ seconds

b) current draw: _____ amp

c) time of day: _____

G.10.4.4. Record final switch status: Open: θ θ Closed: θ θ

G.10.4.5. Record operation in RAV log book.

G.10.5. Set the Guard Tank liquid level sensor (LL-15D or LL-6D) to 1 minute or turn off if no liquid.

G.11. **Verify Start of Transfer**

G.11.1. Verify tank flow meter (PFM-1) of 50 to 100 liquid liters/hour.

CAUTION

Do not exceed 100 l/hr transfer rate as read on PFM-1(B) as this exceeds the capacity of the heat exchanger in the gas module.

PFM1 (B) reading: _____

Start Time: _____

G.11.2. Record LHe level of LHSD: _____ %

G.11.3. Record all fill data on the attached data sheets every 15 minutes.

G.11.4. Adjust LHSD pressure:

G.11.4.1. Close pressurization valve at the LHSD and adjust the gas supply pressure regulator to the desired pressure not to exceed 8 psig.

G.11.4.2. Reopen pressurization valve at the LHSD.

G.12. **Selection of options**

G.12.1. Select and perform one or more of the following options:

θ G.13 Simultaneous Well fill Date: _____ Time: _____

θ G.14 LHSD change-out Date: _____ Time: _____
Date: _____ Time: _____
Date: _____ Time: _____

θ G.15 Simultaneous Guard Tank fill Date: _____ Time: _____

Note: A Guard Tank fill is only to be performed prior to the termination of the transfer.

θ G.16 Termination of transfer Date: _____ Time: _____

G.13. **(Option) Perform simultaneous Well Fill**

This operation is performed near the end of the LHSD to raise the level in the Well.

G.13.1. Record level in LHSD: _____ %

G.13.2. Record the following levels:

a) Well level (LL-3LD or LL-4LD): _____ %
b) Axial Lock level (LL-7D or LL-8D): _____ %

G.13.3. Input comment to DAS "Start simultaneous Well Fill".

G.13.4. Open RAV-7 by performing the following operations:

G.13.4.1. Verify Controller RAV-7 selection switch is in the OFF position.

G.13.4.2. Power up RAV controller No.4.

G.13.4.3. Position selection switch to RAV-7.

G.13.4.4. Record initial switch status: Open: θ θ Closed: θ θ

G.13.4.5. Activate controller No. 4 and record:

a) run time: _____ seconds

b) current draw: _____ amp

c) time of day: _____

G.13.4.6. Record final switch status: Open: θ θ Closed: θ θ

G.13.4.7. Record operation in RAV log book.

G.13.5. Perform the following if Well Adapter is installed (i.e. no Probe), otherwise skip:

G.13.5.1. Close EV-11.

G.13.5.2. Partially open DEV-14 and manually control to maintain the Well at 0.5 oz / in^2 as measured at PW-1.

G.13.5.3. Close EV-6 and EV-18.

G.13.6. Perform the following if Probe is installed, otherwise skip:

G.13.6.1. Close EV-9 as required to slow the transfer into the tank.

Note: EV-9 should not be kept closed too long as this may cause a rise in the Main Tank temperature.

G.13.6.2. Open/verify open EV-9

G.13.7. When the Axial Lock level reaches 30 %, close RAV-7:

G.13.7.1. Verify that controller No.4 is already powered up and that RAV selection switch is already set to RAV-7.

G.13.7.2. Record initial switch status: Open: θ θ Closed: θ θ

G.13.7.3. Activate controller No.4 and record:

a) run time: _____ seconds

b) current draw: _____ amp

c) time of day: _____

G.13.7.4. Record final switch status: Open: θ θ Closed: θ θ

G.13.7.5. Record operation in RAV log book.

G.13.8. Input comment to DAS "End of Well Fill".

G.13.9. Perform the following if Well Adapter is installed (i.e. no Probe), otherwise skip:

G.13.9.1. Close DEV-14.

G.13.9.2. Open EV-11.

G.13.9.3. Open EV-6 and EV-18.

G.13.10. Record the following levels:

a) Well level (LL-3LD or LL-4LD): _____ %
b) Axial Lock level (LL-7D or LL-8D): _____ %

G.13.11. Return to G.12 to select another option.

G.14. **(Option) Liquid Helium Supply Dewar Change-Out**

WARNING

In the following steps cold helium gas and liquid will be expelled from a siphon tube and transfer lines. Personnel involved with the operation are to wear a face mask and cryogenic gloves

G.14.1. Installing Stinger

Note: Use appropriate extension for the LHSD being used.
Clean all O-rings and mating surfaces.

G.14.1.1. Reduce the pressure in the liquid helium supply to < 1.0 psig by opening the low pressure relief valve.

G.14.1.2. Open valve VF-1 (Liquid withdrawal valve) on the stinger.

G.14.1.3. Slowly insert the stinger into the LHSD while allowing it to be purged.

G.14.1.4. Close valve VF-1 just as cold gas is expelled from stinger.

G.14.1.5. Close the primary (low pressure) relief valve on the LHSD.

G.14.1.6. Increase LHSD ullage pressure builder to 4 to 8 psig via:

_____ a) Power on the electric pressure builder **or,**

_____ b) Attach an external source of Ghe to the ullage inlet per following:

i) Attach a GHe hose to the VENT outlet of the LHSD while purging the hose and the VENT outlet.

ii) Adjust pressure regulator to required LHSD driving pressure.

G.14.1.7. Record LHSD data:

	2st LHSD	3nd LHSD	4nd LHSD
Date:	_____	_____	_____
Time:	_____ %	_____ %	_____ %
LHe level:	_____	_____	_____
serial number:	_____ %	_____ %	_____ %

G.14.2. Discontinue the flow of liquid helium from the expended dewar as follows:

G.14.2.1. Record:

	1st LHSD	2nd LHSD	3nd LHSD
Time of day:	_____	_____	_____
Main Tank Liquid level:	_____ %	_____ %	_____ %

G.14.2.2. Close inlet valve SV-13 and torque to 60 +/- 5 in-lbs.

G.14.2.3. Close EV-6.

G.14.3. Open Nupro valve on the Bayonet Cap Assembly.

G.14.4. Close VF-1 and **immediately** remove transfer line from stinger and install Bayonet Cap Assembly.

Note: Be prepared to wipe frost from free bayonet. Cold gas will be expelled from the open line.

G.14.5. Close the Nupro valve on the Bayonet Cap Assembly.

G.14.6. Close/verify closed AV-1 and AV-9.

G.14.7. Close/verify closed VF-3.

G.14.8. Open VF-2, AV-3, and AV-8 and evacuate the transfer line.

G.14.9. Close valve AV-8 when pressure reaches less than 100 mtorr as read on gauge AG-2b.

G.14.10. Open AV-1.

G.14.11. Open AV-9 and pressurize the line to 0.5 psig as read at gauge AG-1 . Use APR-1 to control this pressure.

G.14.12. Open the Nupro valve on the Bayonet Cap Assembly , increase pressure at AG-1 to 2 psig by using APR-1.

G.14.13. Close the Nupro valve on the Bayonet Cap Assembly after purging for 10 minutes.

G.14.14. Remove the Bayonet Cap Assembly and connect transfer line to Stinger in the LHSD.

Note: Use music stands where required to afford support for the transfer line and siphon tube. Be prepared to wipe frost from free bayonet.

G.14.15. Close AV-9 and AV-1.

G.14.16. Evacuating Transfer Line:

G.14.16.1. Open AV-8.

G.14.16.2. Close AV-8 when pressure reaches less than 25 microns as read on gauge AG-2b.

G.14.17. Backfilling Transfer Line:

G.14.17.1. Open AV-1.

G.14.17.2. Open AV-9 until pressure reaches 0.5 psig as read on gauge AG-1 and close AV-9.

G.14.17.3. Close AV-1.

G.14.18. Open RAV-2:

G.14.18.1. Verify that controller No. 2 is already powered up and that RAV selection switch is already set to RAV-2.

G.14.18.2. Record initial switch status: Open: θ θ Closed: θ θ

G.14.18.3. Activate controller No. 2 and record:

a) run time: _____ seconds

b) current draw: _____ amp

c) time of day: _____

G.14.18.4. Record final switch status: Open: θ θ Closed: θ θ

G.14.18.5. Record operation in RAV log book.

G.14.19. Close RAV-1:

G.14.19.1. Verify that controller No.1 is already powered up and that RAV selection switch is already set to RAV-1.

G.14.19.2. Record initial switch status: Open: θ θ Closed: θ θ

G.14.19.3. Activate controller No.1 and record:

a) run time: _____ seconds

b) current draw: _____ amp

c) time of day: _____

G.14.19.4. Record final switch status: Open: θ θ Closed: θ θ

G.14.19.5. Record operation in RAV log book.

G.14.20. Precooling Fill lines and starting transfer:

G.14.20.1. Open VF-1.

G.14.20.2. Open VF-3.

G.14.20.3. Verify open VF-2.

WARNING

In the following steps cold helium gas and liquid will be expelled from a siphon tube and transfer lines. Personnel involved with the operation are to wear a face mask and cryogenic gloves

G.14.20.4. When a dense plume is evident from VF-2, close VF-2 and **immediately open** SV-13.

G.14.20.5. Close VF-3.

G.14.20.6. Open/verfiy open EV-13, EV-6, and EV-18.

G.14.20.7. Verify open: EV-11.

G.14.20.8. Set the Guard Tank liquid level sensor (LL-5D or LL-6D) to 0 minutes.

G.14.20.9. Set data acquisition system to monitor data mode and monitor the Guard Tank temperature T-15D (channel 24).

G.14.20.10. When the temperature T-15D has cooled to below 10K, proceed immediately to the next step.

Time of day: _____

G.14.21. Open RAV-1:

G.14.21.1. Verify that RAV controller No.1 is already on and that RAV selection switch is already set to RAV-1.

G.14.21.2. Record initial switch status: Open: θ θ Closed: θ θ

G.14.21.3. Activate controller No. 1 and record:

a) run time: _____ seconds

b) current draw: _____ amp

c) time of day: _____

G.14.21.4. Record final switch status: Open: θ θ Closed: θ θ

G.14.21.5. Record operation in RAV log book.

G.14.22. Close RAV-2:

G.14.22.1. Verify that controller No. 2 is already powered up and that RAV selection switch is already set to RAV-2.

G.14.22.2. Record initial switch status: Open: θ θ Closed: θ θ

G.14.22.3. Activate controller No. 2 and record:

a) run time: _____ seconds

b) current draw: _____ amp

c) time of day: _____

G.14.22.4. Record final switch status: Open: θ θ Closed: θ θ

G.14.22.5. Record operation in RAV log book.

G.14.23. Set the Guard Tank liquid level sensor (LL-15D or LL-6D) to 1 minute or turn off if no liquid.

G.14.24. Verify tank flow meter (PFM-1) of 50 to 100 liquid liters/hour.

CAUTION

Do not exceed 100 l/hr transfer rate as read on PFM1(B) as this exceeds the capacity of the heat exchanger in the gas module.

PFM1 (B) reading: _____

Start Time: _____

G.14.25. Record LHe level of LHSD: _____ %

G.14.26. Record all fill data on the attached data sheets every 15 minutes.

G.14.27. Adjust LHSD pressure:

G.14.27.1. Close pressurization valve at the LHSD and adjust the gas supply pressure regulator to the desired pressure **not to exceed** 8 psig.

G.14.27.2. Reopen pressurization valve at the LHSD.

G.14.28. **(Option)** Perform simultaneous Well Fill

This operation is performed near the depletion of the LHSD to raise the level in the Well.

G.14.28.1. Record level in LHSD: _____ %

G.14.28.2. Record the following levels:

a) Well level (LL-3LD or LL-4LD): _____ %

b) Axial Lock level (LL-7D or LL-8D): _____ %

G.14.28.3. Open RAV-7 by performing the following operations:

a. Verify that controller No. 4 is already powered up and that RAV selection switch is already set to RAV-7.

b. Record initial switch status: Open: θ θ Closed: θ θ

c. Activate controller No. 4 and record:

i) run time: _____ seconds

ii) current draw: _____ amp

iii) time of day: _____

d. Record final switch status: Open: θ θ Closed: θ θ

e. Record operation in RAV log book.

G.14.28.4. Input comment to DAS "Start of simultaneous Well Fill".

G.14.28.5. Perform the following if Well Adapter is installed (i.e. no Probe), otherwise skip:

a. Close EV-11.

b. Partially open DEV-14 and manually control to maintain the Well at 0.5 oz / in^2 as measured at PW-1.

c. Close EV-6 and EV-18.

G.14.28.6. Perform the following if Probe is installed, otherwise skip:

a. Close EV-9 as required to slow the transfer into the tank.

Note: EV-9 should not be kept closed too long as this may cause a rise in the Main Tank temperature.

b. Open/verify open EV-9

G.14.28.7. When the Axial Lock level reaches 30 %, close RAV-7:

a. Verify that controller No. 4 is already powered up and that RAV selection switch is already set to RAV-7.

b. Record initial switch status: Open: θ θ Closed: θ θ

c. Activate controller No. 4 and record:

i) run time: _____ seconds

ii) current draw: _____ amp

iii) time of day: _____

d. Record final switch status: Open: θ θ Closed: θ θ

e. Record operation in RAV log book.

G.14.28.8. Input comment to DAS "End of Well Fill".

G.14.28.9. Perform the following if Well Adapter is installed (i.e. no Probe), otherwise skip:

a. Close DEV-14.

b. Open EV-11.

c. Open EV-6 and EV-18.

G.14.28.10. Record the following levels:

a) Well level (LL-3LD or LL-4LD): _____ %
b) Axial Lock level (LL-7D or LL-8D): _____ %

G.14.28.11. Return to G.12 to select another option.

G.15. **(Option) Perform simultaneous Guard Tank Fill**

G.15.1. Open RAV-2 by performing the following operations:

G.15.1.1. Verify that controller No. 2 is already powered up and that RAV selection switch is already set to RAV-2. **If not, perform the following:**

a. Verify RAV2 selection switch is in the OFF position.

b. Power up RAV controller No. 2.

c. Position selection switch to RAV-2.

G.15.1.2. Record initial switch status: Open: θ θ Closed: θ θ

G.15.1.3. Activate controller No. 2 and record:

i) run time: _____ seconds

ii) current draw: _____ amp

iii) time of day: _____

G.15.1.4. Record final switch status: Open: θ θ Closed: θ θ

G.15.1.5. Record operation in RAV log book.

G.15.2. Close EV-9.

G.15.3. Input comment in DAS "Start simultaneous Guard Tank Fill".

G.15.4. Once the level in the Guard Tank has achieved the desired value, open EV-9.

G.15.5. Close RAV-2 by performing the following operations:

G.15.5.1. Verify that controller No. 2 is already powered up and that RAV selection switch is already set to RAV-2.

G.15.5.2. Record initial switch status: Open: θ θ Closed: θ θ

G.15.5.3. Activate controller No. 2 and record:

i) run time: _____ seconds

ii) current draw: _____ amp

iii) time of day: _____

G.15.5.4. Record final switch status: Open: θ θ Closed: θ θ

G.15.5.5. Record operation in RAV log book.

G.15.6. Input comment to DAS "End of Guard Tank Fill.

G.15.7. Go to section G.16.

G.16. **Termination of Transfer**

G.16.1. Stopping the flow of liquid helium:

Note: A full Dewar or empty LHSD is indicated by a rapid and consistent increase in the flow rate.

G.16.1.1. Close VF-1.

G.16.1.2. Close SV-13 and torque to 60 in-lbs ± 5 in-lbs and **immediately open** VF-2.

G.16.1.3. Close EV-6 and EV-18.

G.16.2. Place the Well in bypass mode:

G.16.2.1. Open/verify open EV-19.

G.16.2.2. Close EV-11.

G.16.3. θ Perform **only** if Guard Tank is to be put in bypass mode:

G.16.3.1. Open/verify open EV-20.

G.16.3.2. Close EV-13.

G.16.4. Remove the pumping line from the Gas Module at valve VF-3.

G.16.5. Remove the Transfer and Filter Lines from the Dewar fill bayonet B3.

G.17. **Conditioning the Dewar Fill Line**

G.17.1. Install the Fill Cap Assembly.

G.17.2. Connect a pumping line between the Fill Cap Assembly at valve FC and the Auxiliary Gas Section access port no. 1.

G.17.3. Close/verify closed valve AV-1 and AV-9.

G.17.4. Open AV-8 and AV-3.

G.17.5. Open/verify open valve FCV and evacuate Fill Cap Assembly to <25 mtorr measured at AG-2B.

G.17.6. Close FCV.

G.17.7. Open SV-13.

G.17.8. Close RAV-1:

Note: Relieving of the Dewar fill line will be thru the relief valve in the Fill Cap Assembly until the next operation.

G.17.8.1. Verify that RAV controller No.1 is already on and that RAV selection switch is already set to RAV-1.

G.17.8.2. Record initial switch status: Open: θ θ Closed: θ θ

G.17.8.3. Activate controller No.1 and record:

a) run time: _____ seconds

b) current draw: _____ amp

c) time of day: _____

G.17.8.4. Record final switch status: Open: θ θ Closed: θ θ

G.17.8.5. Record operation in RAV log book.

G.17.9. Turning OFF all RAV controllers:

G.17.9.1. Turn all RAV selection switches to OFF.

G.17.9.2. Power off all controllers.

G.17.9.3. Turn off RAV power supply.

G.17.10. Open FCV and evacuate the Dewar fill line to < 25 mtorr as measured at AG-2b.

G.17.11. Close SV-13 and torque to 60 +/- 5 in-lbs.

G.17.12. Close FCV.

G.17.13. Close AV-8.

G.17.14. Open AV-1.

G.17.15. Open AV-9 until pressure reaches 1.5 psig as read on gauge AG-1 and then close AV-9.

G.17.16. Close AV-1.

G.17.17. Monitor the pressure in the Fill Cap Assembly PFC for 15 minutes to be assured that no gas is leaking into the Fill Cap Assembly (i.e. it maintains vacuum) and record:

PFCG pressure: _____
Date/Time: _____

G.18. **Configuring of Dewar and GSE**

G.18.1. Verify that the valves in the exhaust section of the gas module are in the following positions:

G.18.1.1. Verify open EV-9, EV-16, and EV-19.

G.18.1.2. Perform **one** of the following:

θ **Only** for Guard Tank **IN** by-pass mode:

a. Open/verify open EV-20.

b. Close EV-13.

θ **Only** for Guard Tank **NOT** in by-pass mode:

c. Verify open EV-13.

d. Close/verify closed EV-20.

G.18.1.3. Verify all other valves in the **exhaust** section only are closed.

G.18.2. Record the reading on flowmeter EFM-1 and verify that helium is venting.

EFM-1 reading _____

G.18.3. Record the final liquid levels as appropriate:

a) Main Tank level (LL-1D or LL-2D): _____ %
b) Well level (LL-3LD or LL-4LD): _____ %
c) Guard Tank Level (LL-5D or LL-6D): _____ %
d) Axial Lock level (LL-7D or LL-8D): _____ %

G.18.4. Record the following pressures:

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

G.19. **Setting up Data Acquisition**

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

G.19.1. Input comment to DAS “Completed External NBP fill of Main Tank”.

G.19.2. Set DAS to configuration choice 4M.

G.19.3. Stop Special Data Cycle by using [Other Menus] + [Special Data Col] + [Stop Data Col].

G.19.4. Set DAS data cycle interval to 15 minutes.

G.19.5. Set Main Tank Liquid Level sampling interval to 10 minutes.

G.19.6. Set Guard Tank Liquid Level sampling interval to 10 minutes or turned off.

G.19.7. Set the Axial Lock liquid level sampling interval to 10 minutes.

G.19.8. **Confirm** that the liquid level sensors are set at a sampling rate of 10 minutes or turned off.

G.19.9. **Confirm** that Vac-ion pump is off.

G.19.10. Enable/verify enabled the alarms on the Main Tank and Well Liquid Level Sensors.

G.19.11. 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.19.12. Enable/verify enabled the Main Alarm System.

G.20. **Final Closure of SV-13 and Conditioning the Dewar Fill Cap Assembly**

G.20.1. Once SV-13 has warmed sufficiently to try final closure perform the following:

Note:

The time required to warm up untill the valve seals correctly may be few hours.

G.20.2. Verify that the Fill Cap Assembly is still evacuated and record:

PFCG pressure: _____
Date/Time: _____

G.20.3. Retorque SV-13 to 60 +/- 5 in-lbs.

G.20.4. Open AV-8.

G.20.5. Open FCV and evacuate to < 25 mtorr as measured at AG-2b.

G.20.6. Close AV-8.

G.20.7. Close/verify closed EV-12 and AV-9.

G.20.8. Open AV-1.

G.20.9. Open AV-9 until pressure reaches 1.5 psig as read on gauge AG-1 and then close AV-9.

G.20.10. Close AV-1.

G.20.11. Close FCV and record:

PFCG pressure: _____
Date/Time: _____

G.20.12. Open AV-8 and evacuate to < 25 mtorr as measured at AG-2b.

G.20.13. Close AV-8.

G.20.14. Verify closure of SV-13 by observing the pressure in the Fill Cap Assembly PFC until satisfied that no gas is leaking into the Dewar Fill line. After 30 minutes record:

PFCG pressure: _____
Date/Time: _____

G.20.15. Open AV-1.

G.20.16. Open AV-9 until pressure reaches 0 psig as read on gauge AG-1 and then close AV-9.

G.20.17. Close AV-1.

G.20.18. Close AV-3.

G.20.19. Remove the pumping line from the Fill Cap Assembly.

G.20.20. Install a KF-25 blank-off cap on valve FCV:

Witnessed by : _____.
Completed by : _____.
Date: _____.
Time: _____.

Data Sheet 1

Date/Time	LHSD Level (%)	LHSD press (psig)	Main Tank pressure EG-3 (Torr)	Guard Tank pressure EG-1a (Torr)	LHe Flow PFM-1 [B] (ll/hr)	Well press (oz/ in^2)	Main Tank Liquid He LL-1,2D (%)	Axial Lock Liquid He LL-7,8D (%)

Data Sheet 2

Date Time	Sta. 200 T-1D [1] (K)	Lead bag top T-20D [28] (K)	G.T. bottom T-15D [24] (K)	HX-4 T-08D[8] (K)	M.T. bottom T-9D [9] (K)	Vac-Ion Pump (torr)	Gas Module HX (^{o}C)	M.T. Vent Bayonet /O-ring (^{o}C/ ^{o}C)	Valve SV-9 /Top Plate (^{o}C/ ^{o}C)	Dewar Adapter (^{o}C)

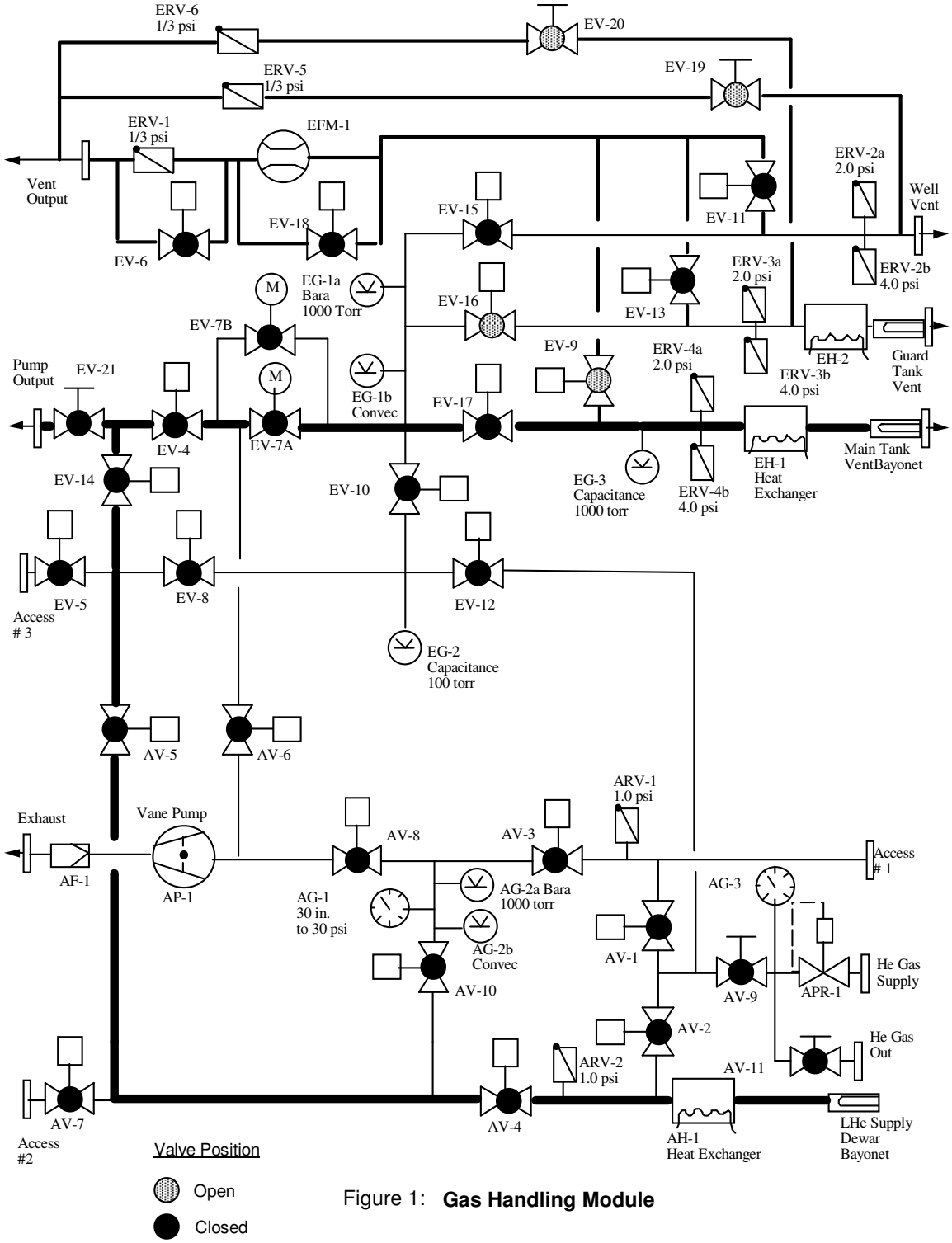

Figure 1: **Gas Handling Module**

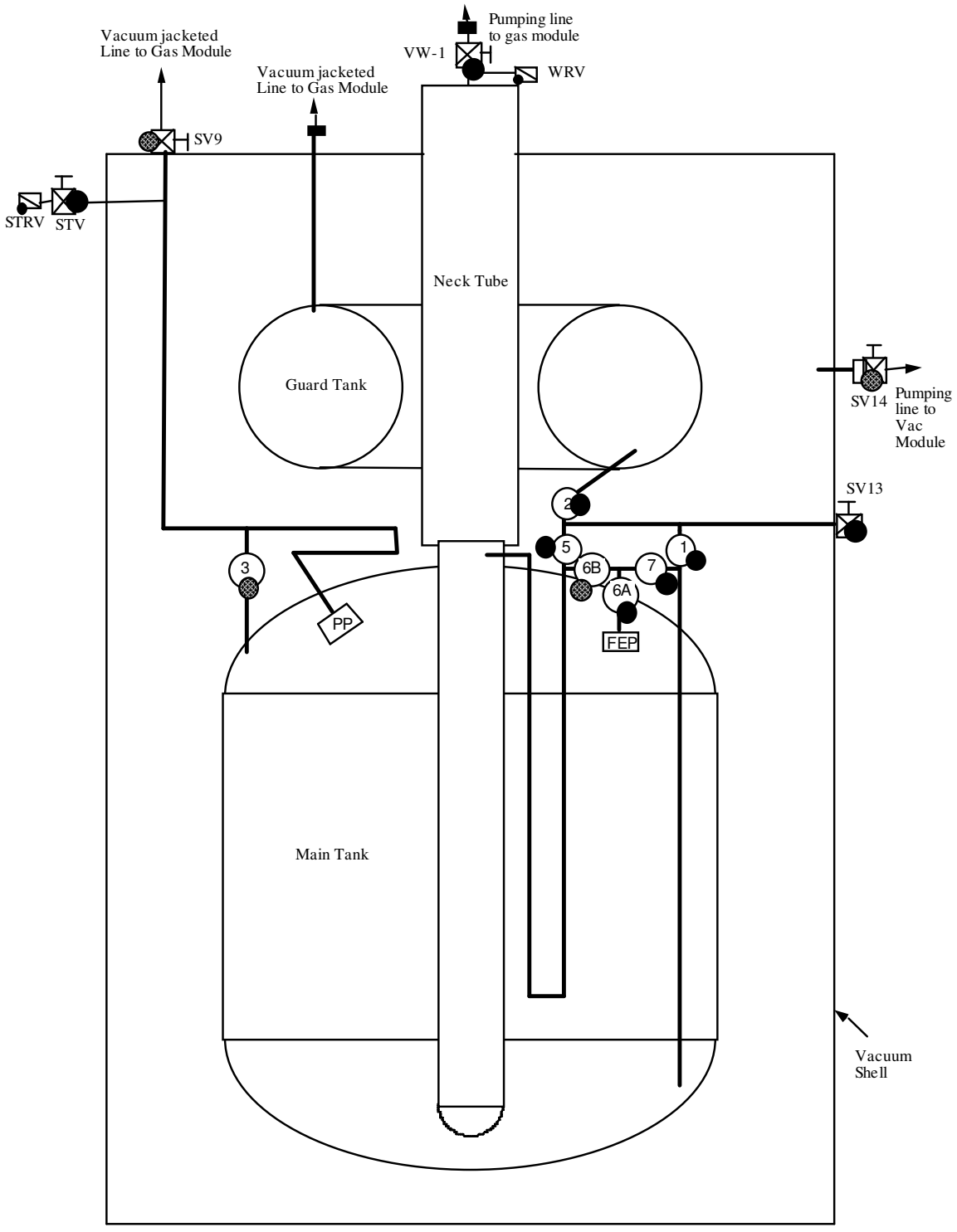

Figure 2: **Science Mission Dewar**

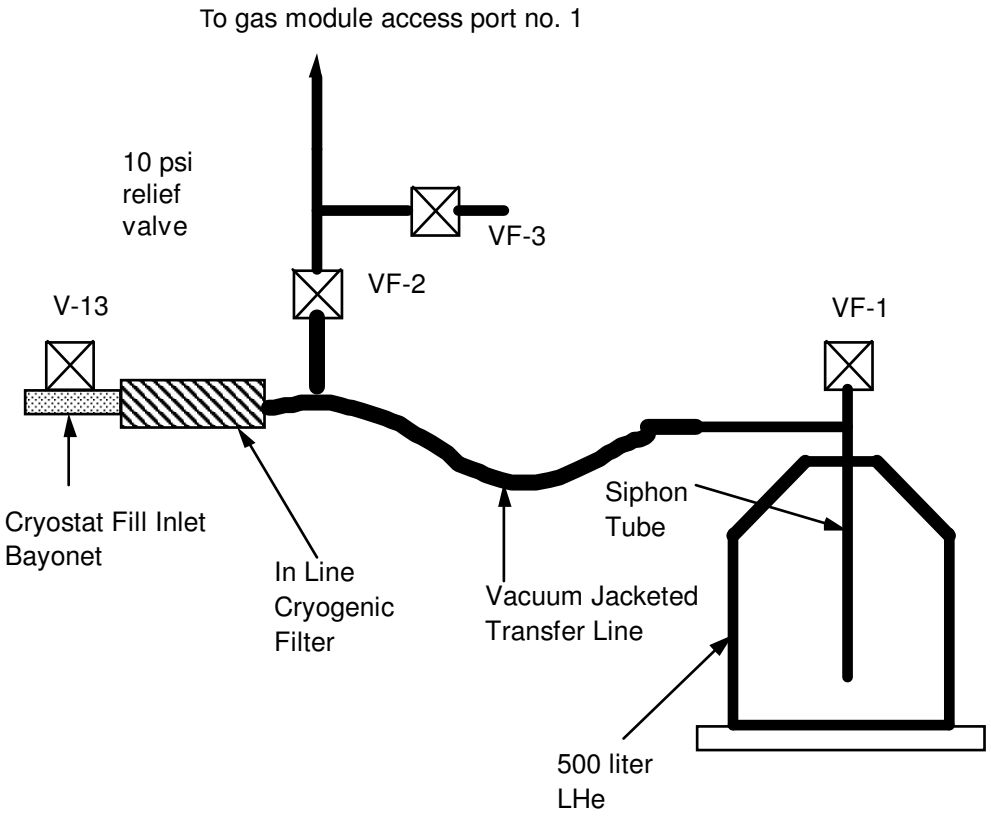

Figure 3: **Liquid Helium Transfer Schematic**