GRAVITY PROBE B

PROCEDURE FOR

PAYLOAD VERIFICATION

(PTP) REMOVE PROBE SPINUP GAS/VAC. LINES (HORIZ.)

P0647 Rev. A
11/9/00
ECO 1225

Prepared by: M. Taber

Approvals:

Program Responsibility	Signature	Date
C. Warren Gas/Vac. Engineer		
M. Taber Payload Test Director		
D. Ross GP-B Quality Assurance		
S. Buchman GP-B Hardware Manager		

NOTES:
Level of QA required during performance of this procedure:
_X_ Stanford QA Representative
___ Government QA Representative

All redlines must be approved by QA

Revision Record:

Rev	Rev Date	ECO #	Summary Description
A	11/7/00	1225	1) Title changed: was: "…(-Y Axis Up)", is: "…(Horiz.)" 2) Content revised to allow for disconnection of a P1a line, if connected. 3) Incorporated redlines from Payload Verif. I and other corrections.

Acronyms and Abbreviations:

Acronym / Abbreviation	**Meaning**
GSE	Ground Support Equipment
IG	Ionization Gauge
LD	Leak Detector
LGS	Leakage Gas System
LV-x	Probe Leakage Gas Valve #x (1 or 2)
PPMS	Probe Pressure Measurement System
RGA	Residual Gas Analyzer
SMD	Science Mission Dewar
UTS	Utility Turbopump System

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A **Scope**

This procedure effects the removal of gas/vacuum lines between the Probe and the Gyro Spinup Gas / Vac. GSE. These lines include the leakage gas pumping line, the spinup gas supply lines (including a gas supply line to P1a, if installed), and the spinup gas exhaust lines.

B **Requirements Verification** N/A

C **Configuration Requirements**

Probe-C is integrated into the SMD per drawing 65113-1C34292 and oriented horizontally with the +Z axis facing the LGS. The Leakage Gas pumping line is installed as depicted in Fig. 1. Installation of Spinup Supply and Exhaust lines is optional. (See Fig. 2 for an example of an exhaust line configuration.) The PPMS is installed per P0558. Pressure in the Probe is low enough for the RGA to function for the duration of this procedure. Installed Probe Gas/Vac. spinup lines to be removed are assumed to be evacuated with the Probe valves (S1-S4, P1a) being closed. It is assumed that Gamah-to-VCR "connector savers" with buffer valves are installed on the Gamah spinup gas fittings.

D **Hardware Required**

D.1 Flight hardware required

Description	No. Req'd
65113-1C34292 Probe-C / Science Mission Dewar Assembly	1

D.2 Commercial test equipment: N/A

D.3 Mechanical/Electrical special test equipment: N/A

D.4 GSE / hardware:

Description	No. Req'd
Leakage Valve (LV) cover assembly, cleaned for use	1
VCR cap(s) and gaskets for spinup connector savers and the spinup gas ports	A/R
Exhaust Valve cover assembly(s), cleaned for use	A/R
KF 50 caps for the exhaust gas ports on the leakage gas system	A/R
ISO 200 blankoff plate for the LGS pumping port with o-ring / centering ring	1
4' x 4' HEPA filter downflow unit with vinyl curtains mounted below gantry	1
Spinup line "connector savers" (1/4" female Gamah to 1/4" male VCR installed on Probe)	4
Probe Pressure Measurement System with RGA & IG readouts	1
Utility Turbopump System and flexible pumping line	1

D.5 Tools

Description	No. Req'd
misc. wrenches including 17 mm	A/R
Proto 6169A Torque wrench, 0-75 in.-lb. or equivalent	1

D.6 Expendables

Description	Quantity
aluminum foil	A/R

E **Software Required**: N/A

F **Procedures Required**: N/A

G **Equipment Pretest Requirements**: N/A

H **Personnel Requirements**

This test to be conducted only by certified personnel. Persons certified to perform this procedure are Mike Taber, Chuck Warren, Ken Bower, Mike Murray, and Tom Welsh with Mike Taber being the leader.

I **Safety Requirements**

These operations are to be performed in the vicinity of flight equipment. Two persons are required for manipulation of the 8" pumping line and care should be taken to prevent impacting of the flight equipment. Movement of the gantry used to support the HEPA downflow booth also requires two persons. Care should also be taken to prevent scratching or otherwise damaging vacuum sealing surfaces, particularly those which are on flight equipment and/or must be sealed with metal gaskets.

J **General Instructions**

J.1 Redlines can be initiated by Mike Taber and must be approved by QA.

J.2 Any nonconformance or test anomaly should be reported per Quality Plan, P0108. Do not alter or break test configuration if a test failure occurs; notify quality assurance.

J.3 Work done inside the HEPA filter downflow unit should with proper clean room garb consistent with Class 1000 conditions.

K **References and Applicable Documents:** N/A

Op. Order No._____
Date Initiated_____
Time Initiated_____

L Operations

L.1 Record the current configuration of spinup supply, exhaust and leakage gas lines between the Gas/Vac. GSE and the Probe:

L.1.1 Identify which Probe spinup supply valves are connected to which spinup supply valves:
S1_____ S2_____ S3_____ S4_____ P1a_____

L.1.2 Verify by physical examination that each of the connected spinup supply valves are closed and check off:
❑ S1 ❑ S2 ❑ S3 ❑ S4 ❑ P1a

L.1.3 Identify which spinup exhaust valves are connected to an exhaust line:
❑ V3 connected to _____ ❑ V4 connected to _____

L.1.4 Verify by reference to the appropriate procedure(s) that each of the connected exhaust valves is in a closed state and record the relevant Op. Nos.:

L.1.5 Identify which 6" Vatterfly valve is connected to the leakage gas pumping line
❑ LV1 (in -X, -Y quadrant) ❑ LV2 (in -X, +Y quadrant)

L.1.6 Verify by reference to the appropriate procedure that the connected 6" Vatterfly valve is in a closed state and record the relevant Op. No.:

L.2 Gas/Vac GSE preparation (see Fig. 3):

L.2.1 Verify that all GSV, AXV, SEV (except SEV-5) valves are closed.

L.2.2 Turn on SEP-1, -2 and verify that SEG-2 drops to less than 10 millitorr.

L.2.3 Open AXV-8, -5, -6 and pump spinup supply and exhaust manifolds until SEG-2 indicates less than 10 millitorr.

L.2.4 Place system in Interlock Defeat mode.

L.2.5 Open the GSV valves appropriate to the valves indicated in L.1.1; i.e., if S1 is connected, open GSV-7, if S2 is connected, open GSV-8, etc. and record which valves have been opened:_____

L.2.6 Open all buffer valves to which a supply line has been connected (including P1a, if connected).

L.2.7 Likewise, open SEV valve(s) appropriate to the valve(s) indicated in L.1.3, and record which valve(s) have been opened_____.

L.2.8 When SEG-2 indicates less than 10 millitorr, close the valves opened in L.2.5 and L.2.7. (Do not close the buffer valves.)

L.2.9 Close AXV-5, -6.

L.2.10 Verify that LGG-3 is less than 100 millitorr; if not, briefly open AXV-7 until it does.

L.2.11 Close AXV-8 and verify that AXV-7 is closed.

L.3 Set up RGA on the PPMS:

L.3.1 Power up RGA and verify connection to a computer equipped with TranspectorWare software.

L.3.2 Start up the TranspectorWare program using a recipe that includes He as a "selected peak" in the scan list and has an update interval of one minute or less. Record filename:_____.

L.3.3 Verify that the Probe temperatures are stable.

L.3.4 Determine the stability of the He partial pressure by measuring the partial pressure over a period of a half hour:

Date : _____/ time:				
He partial pressure (torr)				

L.4 Vent and disconnect spinup supply lines

L.4.1 Verify torque wrench calibration: Cal. due date:

L.4.2 Torque all Probe spinup valves specified in L.1.1 to 60 in-lbs. and check off:
❑ S1 ❑ S2 ❑ S3 ❑ S4 ❑ P1a

QA witness:

L.4.3 Perform leak-through check of Probe spinup valves:

L.4.3.1 Open / verify open spinup gas supply valves V5, V6 with LGR-1 set to 2-5 psig (see Fig. 3).

L.4.3.2 If not already the case, place KS-1 in Interlock Defeat mode.

L.4.3.3 Open all the GSV valves appropriate to the valves indicated in L.1.1; i.e., if S1 is connected, open GSV-7, if S2 is connected, open GSV-8, etc.

L.4.3.4 Verify that flow controller set point for GSV-4 is set to zero and the mode switch is "off".

L.4.3.5 Open GSV-1, -2.

L.4.3.6 Set the mode switch for GSV-4 to "auto" and start monitoring the He partial pressure with the RGA.

L.4.3.7 Slowly turn up the set point for GSV-4 until a flow rate of ~5 sccm is obtained. Verify that there is no change in the partial pressure of He in the Probe.

L.4.3.8 When the pressure read by GSG-4 reads ~9.5 torr, turn the GSV-4 set point down to zero, and change the mode switch to "off".

L.4.3.9 Measure the He partial pressure on the RGA and the pressure at GSG-4 for a period of at least half an hour and record:

Date : _____/ time:				
He partial pressure (torr)				
GSG-4 (torr)				

L.4.3.10 Verify that the rise in the He partial pressure over a period of half an hour is not more than 10% of the initial value over the rise that would be expected from L.3.4.

L.4.3.11 Verify that the pressure drop at GSG-4 does not exceed 0.03 torr over the last twenty minutes of the above measurements.

L.4.3.12 Set the mode switch for GSV-4 to "auto" and continue monitoring the He partial pressure with the RGA.

L.4.3.13 Bring GSG-4 up to 1 atm. by turning up the GSV-4 set point to ~50 sccm.

L.4.3.14 When GSG-4 reaches one atmosphere, turn the GSV-4 set point to zero and set the mode switch to "off".

L.4.3.15 Close GSV-2.

L.4.3.16 Measure the He partial pressure on the RGA and the pressure at GSG-4 for a period of at least half an hour and record:

Date : _____/ time:				
He partial pressure (torr)				
GSG-4 (torr)				

L.4.3.17 Verify that the rise in the He partial pressure over a period of half an hour is not more than 10% of the initial value over the rise that would be expected from L.3.4.

L.4.3.18 Verify that the pressure drop at GSG-4 does not exceed 1.0 torr over the last twenty minutes of the above measurements.

L.4.3.19 Open AXV-8, -5, and pump the spinup supply manifold until SEG-2 indicates less than 10 millitorr.

L.4.3.20 Close all the open buffer valves connected to the spinup valves or P1a. (This will leave the volume between the buffer valves and the spinup valves evacuated.)

L.4.3.21 Open GSV-2.

L.4.3.22 Set the mode switch for GSV-4 to "auto", and bring GSG-4 up to 1 atm. by turning up the GSV-4 set point to ~50 sccm.

L.4.3.23 When GSG-4 reaches one atmosphere, turn the GSV-4 set point to zero and set the mode switch to "off".

L.4.3.24 Close GSV-2.

L.4.3.25 Close GSV valves opened in L.4.3.3 (i.e., any of the valves GSV-7, -8, -9, -10 that were opened).

L.4.4 Locate the 4' x 4' HEPA filter downflow unit with vinyl curtains mounted below gantry over the top of the Probe and the LGS cone.

L.4.5 Turn on the HEPA downflow unit and allow to run at least an hour to clean up before performing operations under the downflow unit.

L.4.6 For each of the spinup lines, disconnect the spinup line VCR and install VCR caps on the connector savers on the Probe.

L.4.7 Disconnect the spinup lines from the VCR ports on the LGS and install VCR caps on the ports.

L.4.8 Wrap the open VCR glands on the ends of the spinup lines with a double layer of aluminum foil.

L.4.9 Unlash the spinup supply lines from the exhaust gas line and remove. Stow the spinup lines such that the ends are protected from contamination and the bellows are protected from damage.

L.5 Vent and disconnect spinup exhaust lines (see Fig. 2):

L.5.1 Perform leak-through check of Probe exhaust valves:

L.5.1.1 Open / verify open spinup gas supply valves V5, V6 with LGR-1 set to 2-5 psig (see Fig. 3).

L.5.1.2 If not already the case, place KS-1 in Interlock Defeat mode.

L.5.1.3 Open the SEV valves appropriate to the valves indicated in L.1.3.

L.5.1.4 Turn off SEP-1, -2 to close SEV-5.

L.5.1.5 Verify that flow controller set point for GSV-5 is set to zero and the mode switch is "off".

L.5.1.6 Open GSV-3, and open/verify open GSV-1.

L.5.1.7 Open AXV-5, -6.

L.5.1.8 Set the mode switch for GSV-5 to "auto" and start monitoring the He partial pressure with the RGA.

L.5.1.9 Slowly turn up the set point for GSV-5 until a flow rate of ~100 sccm is obtained. Verify that there is no change in the partial pressure of He in the Probe.

L.5.1.10 When the pressure read by GSG-4 reads ~9.5 torr, turn the GSV-5 set point down to zero, and change the mode switch to "off".

L.5.1.11 Measure the He partial pressure on the RGA and the pressure at GSG-4 for a period of at least half an hour and record:

Date : _____/ time:				
He partial pressure (torr)				
GSG-4 (torr)				

L.5.1.12 Verify that the rise in the He partial pressure over a period of half an hour is not more than 10% of the initial value over the rise that would be expected from L.3.4.

L.5.1.13 Verify that the pressure drop at GSG-4 does not exceed 0.03 torr over the last twenty minutes of the above measurements.

L.5.1.14 Set the mode switch for GSV-5 to "auto" and continue monitoring the He partial pressure with the RGA.

L.5.1.15 Bring GSG-4 up to 1 atm. by slowly turning up the GSV-5 set point to ~1000 sccm.

L.5.1.16 When GSG-4 reaches one atmosphere, turn the GSV-5 set point to zero and set the mode switch to "off".

L.5.1.17 Close GSV-1, -3

L.5.1.18 Measure the He partial pressure on the RGA and the pressure at GSG-4 for a period of at least half an hour and record:

Date : _____/ time:				
He partial pressure (torr)				
GSG-4 (torr)				

L.5.1.19 Verify that the rise in the He partial pressure over a period of half an hour is not more than 10% of the initial value over the rise that would be expected from L.3.4.

L.5.1.20 Verify that the pressure drop at GSG-4 does not exceed 1.0 torr over the last twenty minutes of the above measurements.

L.5.1.21 Close all AXV and SEV valves.

L.5.2 One at a time disconnect the exhaust line(s) from the KF/ISO adapter(s). Provide temporary support for the exhaust remaining portion of the lines as necessary. Disconnect the exhaust line(s) at the LGS. Cover the open KF fittings with a double layer of aluminum foil, and remove the exhaust line(s) from the clean environment.

L.5.3 Remove the KF/ISO adapter(s), and install an exhaust gas valve cover assembly on the 2.5" Vatterfly valve as each line is disconnected using the ISO clamps just removed.

L.5.4 Install KF caps and centering rings on the open exhaust gas port(s) on the LGS.

L.6 Vent and disconnect leakage gas line:

L.6.1 Turn off / verify off IG LGG-1.

L.6.2 Install / verify installed a blankoff plug at AUX.1.

L.6.3 Close / verify closed AXV-1.

L.6.4 Perform leak-through check of Probe 6” Vatterfly valve:

L.6.4.1 Turn on SEP-1, -2 and open AXV-8.

L.6.4.2 Open AXV-3 and pump out auxiliary manifold until AXG-1CON bottoms out.

L.6.4.3 Close AXV-8 and open AXV-7.

L.6.4.4 Slowly open AXV-1 and bleed in enough He to indicate ~900 millitorr on LGG-3.

L.6.4.5 Close AXV-3. Measure the He partial pressure on the RGA and the pressure at LGG-3 for a period of at least half an hour and record:

Date : _____/ time:				
He partial pressure (torr)				
LGG-3 (torr)				

L.6.4.6 Verify that the rise in the He partial pressure over a period of half an hour is not more than 10% of the initial value over the rise that would be expected from L.3.4.

L.6.4.7 Verify that the pressure drop at LGG-3 does not exceed 5 mtorr over the last twenty minutes of the above measurements.

L.6.4.8 Shut down turbopump system (skip if already shut down and vented):

L.6.4.8.1 Close valves LGV-6, -7.

L.6.4.8.2 Close valve LGV-10.

L.6.4.8.3 Flip off breakers Turbo 1 and Turbo 2 (on the Power Distribution Box).

L.6.4.8.4 Turn off LGP-3 at circuit breaker F15 on the TCS 120.

L.6.4.8.5 Turn off LGP-4 at circuit breaker F3 on the TCS 120.

L.6.4.8.6 Turn the TCS 120 Pumping Unit Control master switch off.

L.6.4.8.7 Open vent valve LGV-9 to vent blower and then reclose. (LGP-1, -2 stay evacuated unless manually

vented.)

L.6.4.8.8 Wait for 30 minutes and then vent the turbos with nitrogen by slowly opening LGV-4, -5.

L.6.4.8.9 Close LGV-4, -5 after venting is complete.

L.6.4.9 Open AXV-3 and continue monitoring the He partial pressure with the RGA. (Note: Gatevalves LGV-1, -3 do not support a full atmosphere differential towards the turbopumps; shutting down and venting the turbos prior to the next step avoids this problem.)

L.6.4.10 Bleed AXG-1CAP up to 1 atm. by slowly opening AXV-1.

L.6.4.11 When AXG-1CAP reaches one atmosphere, close AXV-1 and AXV-3.

L.6.4.12 Measure the He partial pressure on the RGA and the pressure at AXG-1CAP for a period of at least half an hour and record:

Date : _____/ time:				
He partial pressure (torr)				
AXG-1CAP (torr)				

L.6.4.13 Verify that the rise in the He partial pressure over a period of half an hour is not more than 10% of the initial value over the rise that would be expected from L.3.4.

L.6.4.14 Verify that the pressure drop at AXG-1CAP does not exceed 1 torr over the last twenty minutes of the above measurements.

L.6.4.15 Close AXV-7.

L.6.5 Loosen the spherical nuts on the threaded rods supporting the bellows. Disconnect the bellows from the 6”-8” adapter.

L.6.6 Support the leakage gas pumping line with a ladder or other suitable object.

L.6.7 While supporting the pumping line, unbolt the clamps holding the pumping line to the LGS cone and remove the pumping line. Cover exposed flanges on the pumping line, the LGS cone, and the adapter with a double layer of aluminum foil.

L.6.8 Remove the pumping line and the supporting hardware from the clean environment.

L.6.9 Remove the 6”-8” adapter and install the 6" Vatterfly cover using the ISO clamps just removed.

L.6.10 Install an ISO 200 blankoff plate on the LGS pumping port with a clean o-ring / centering ring.

L.7 Close, verify closed all LGS, AXV, SEV, GSV valves.

L.8 Secure the HEPA downflow system as required per engineering instruction.

L.9 Pump out and back fill Vatterfly cover assemblies:

L.9.1 Attach a pumping line from the UTS to the 6" Vatterfly cover access valve.

L.9.2 Start up the UTS forepump and pump out cap assembly to <25 millitorr as read at the UTS.

L.9.3 Backfill the 6" Vatterfly cover assembly with filtered He gas to a pressure of 1 psig as read on the gauge on the cover assembly and close access valve.

L.9.4 Disconnect the UTS from the cover assembly and cap the cover assembly access valve.

L.9.5 If an exhaust line has been removed, attach a pumping line from the UTS to the 2.5" Vatterfly cover access valve.

L.9.6 Pump out cap assembly to <25 millitorr as read at the UTS.

L.9.7 Backfill the 2.5" Vatterfly cover assembly with filtered He gas to a pressure of 1 psig as read on the gauge on the cover assembly and close access valve.

Operation completed.

Completed by: _____

QA witness: _____

Date: _____

Time: _____

PTD: _____

RQE: _____

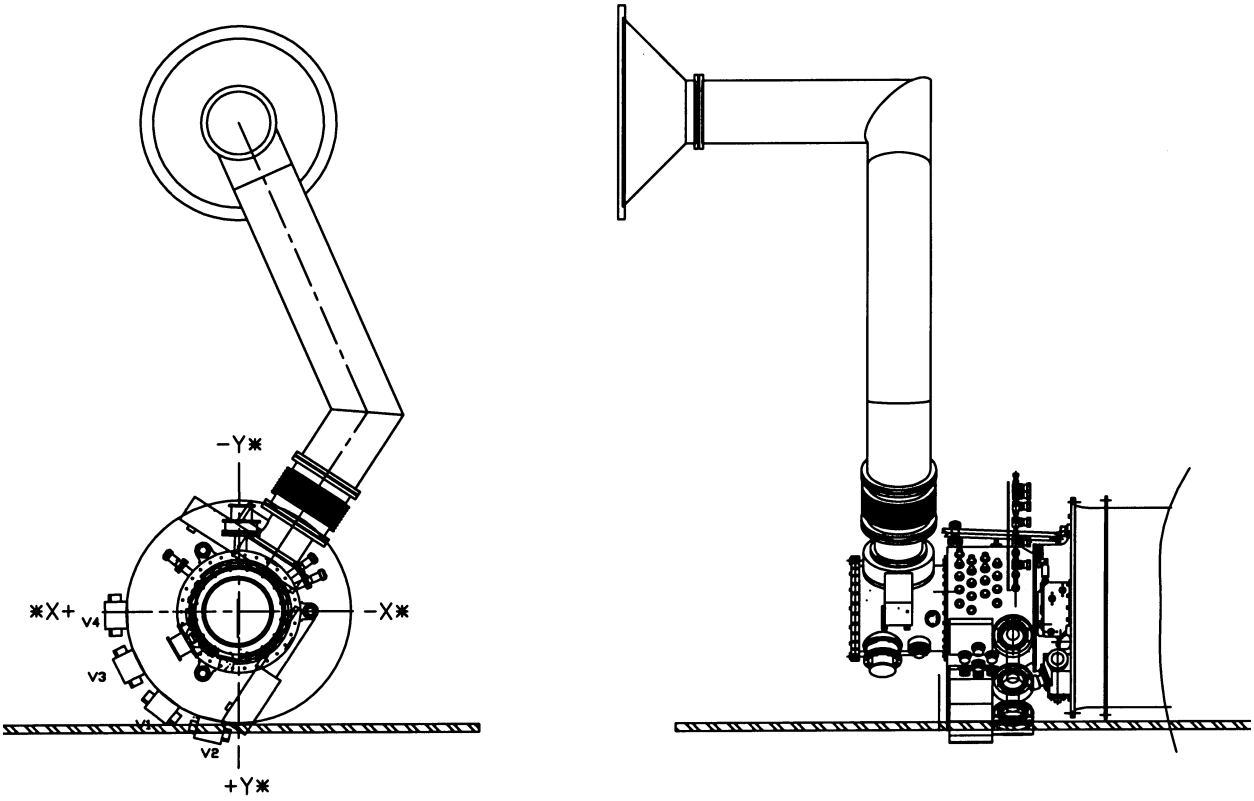

Figure 1

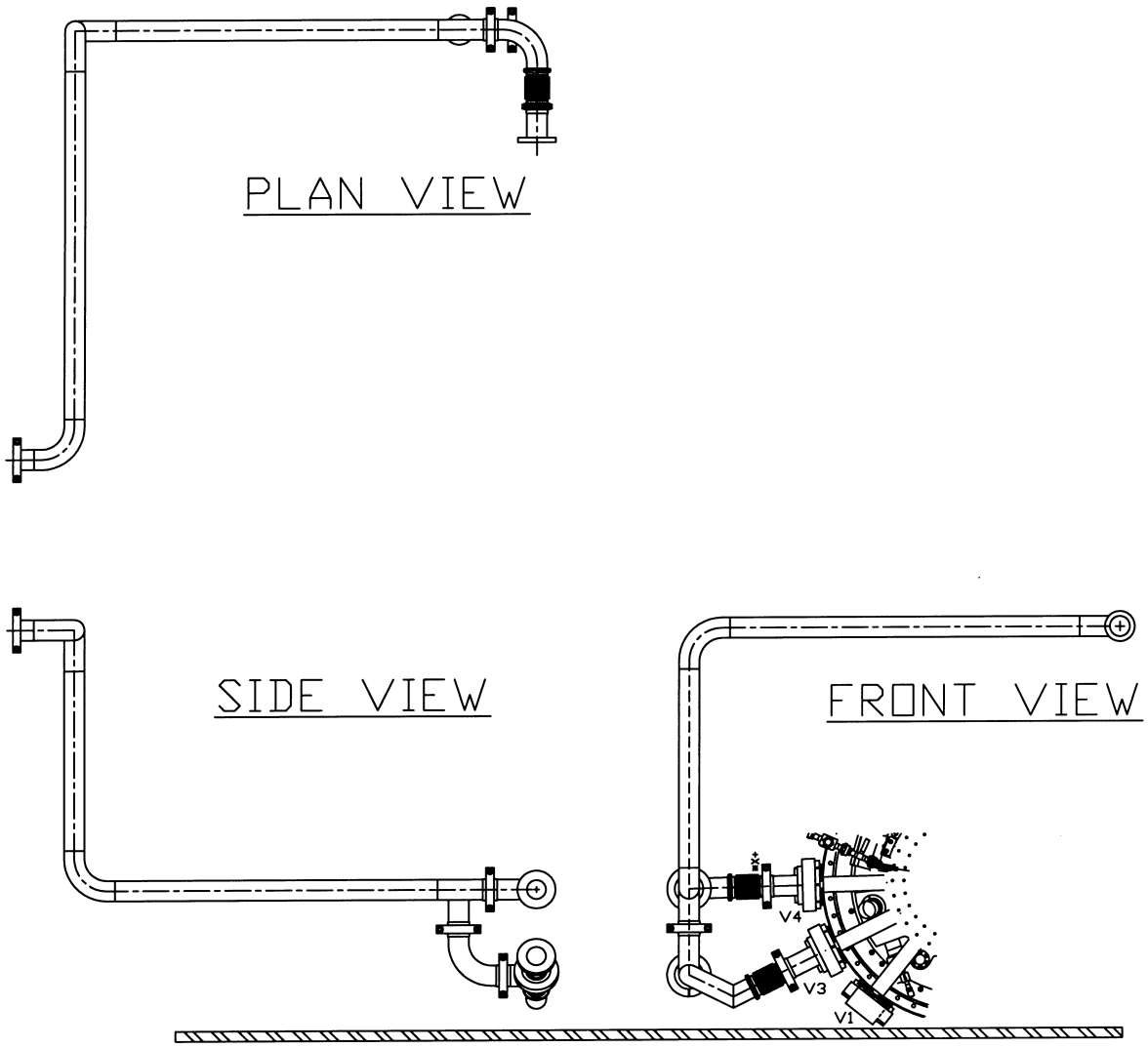

Figure 2

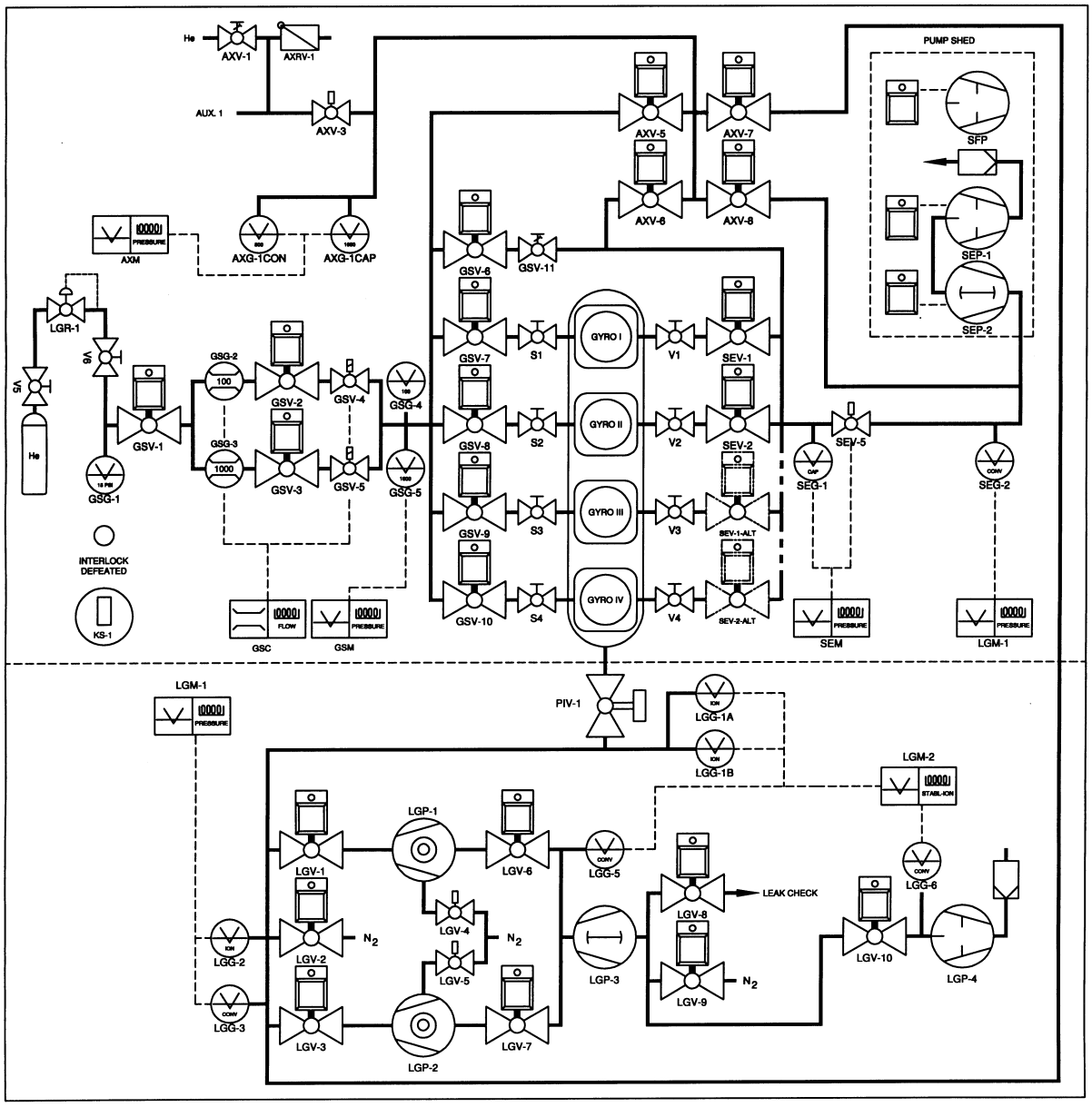
He
AXV-1
AXRV-1
AUX. 1
AXV-3
AXV-5
AXV-7
AXV-6
AXV-8
PUMP SHED
SFP
SEP-1
SEP-2
AXM
AXG-1CON
AXG-1CAP
GSV-6
GSV-11
LGR-1
V6
V5
He
GSG-2
100
GSV-2
GSV-4
GSG-4
GSV-1
GSG-3
1000
GSV-3
GSV-5
GSG-5
GSG-1
INTERLOCK DEFEATED
KS-1
GSV-7
GSV-8
GSV-9
GSV-10
S1
S2
S3
S4
GYRO I
GYRO II
GYRO III
GYRO IV
V1
V2
V3
V4
SEV-1
SEV-2
SEV-1-ALT
SEV-2-ALT
SEV-5
SEG-1
SEG-2
GSC
GSM
SEM
LGM-1
PIV-1
LGG-1A
LGG-1B
LGM-2
LGP-1
LGV-1
LGV-6
LGG-5
LGV-8
LEAK CHECK
LGG-6
LGV-4
LGV-2
LGG-2
LGV-5
LGP-3
LGV-10
LGP-4
LGV-9
LGG-3
LGV-3
LGV-7
LGP-2
N_2

Figure 3