GRAVITY PROBE B

PROCEDURE FOR

PAYLOAD VERIFICATION

(PTP) INSTALL GSE GAS/VAC. LINES (HORIZ.)

P0627 Rev. A
11/6/00
ECO 1224

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	11/6/00		1) Title changed: was: "…(-Y Axis Up)", is: "…(Horiz.)" 2) Content revised to allow for connection of leakage gas pumping line in both –X and –Y up configurations 3) Incorporated redlines from PL Test I 4) Added Figure 3. 5) Added QA, ONR notification 6) Added provision for supplying He gas to P1a

Acronyms and Abbreviations:

Acronym / Abbreviation	**Meaning**
GSE	Ground Support Equipment
LD	Leak Detector
LGS	Leakage Gas System
PPMS	Probe Pressure Measurement System
SGSS	Spinup Gas Supply System
SMD	Science Mission Dewar

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A Scope

This procedure effects the installation of gas/vacuum lines between the Probe and the Gyro Spinup Gas / Vac. GSE while the Payload is in thehorizontal orientation. These lines include the leakage gas pumping line, the spinup gas supply lines and the spinup gas exhaust lines (-Y axis up only). As an option, a provision is made for the installation of a gas supply line to P1a for the purposes of supplying exchange or damping gas. In this procedure it is assumed that the LGS pumping line is being connected to the 6" Vatterfly valve LV1 (located in the -X, -Y quadrant) when the Payload is in the –Y up orientation and to LV2 (located in the –X, +Y quadrant) when the Payload is in the –X up orientation. Since the two Vatterfly valves are clocked 90° apart, the same LGS pumping line can be used in both instances (see Fig. 1). The spinup supply lines, however, are different for each of the two horizontal orientations. It is assumed that spinup gas exhaust line installation occurs only when the Payload is in the –Y up orientation.

B Requirements Verification N/A

C Configuration Requirements

Probe-C is integrated into the SMD per drawing 65113-1C34292 and oriented with the -Y or –X axis vertical and the +Z axis facing the LGS. All six Vatterfly valves (LV1, LV2, V1-4) have protective GSE caps installed, and the spinup supply valves (S1-4) as well as P1a have GSE “connector savers” that adapt from the Gamah fittings on the Probe to VCR fittings with series isolation valves. The VCR fittings have protective caps installed. The LGS is shut down and vented to 1 atmosphere.

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:

Manufacturer	Model	Serial Number	Calibr. Exp. Date
Varian He Leak Detector	960	DRAD6002	N/A
Alternate leak detector: Varian He Leak Detector	636-60	W-161	N/A
Varian Calibrated He leak for LD	F3264302	LLF059	5/30/01
Calibrated He leak for alternate LD	F3264302		

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

D.4 GSE / hardware:

Description	No. Req'd
Spinup Gas/Vac. System	1
8" LGS mitered pumping line (for horizontal configuration) per Fig. 1	1
6" x 8" dia. bellows with K-style ISO 200 flanges	1
3/8-16 threaded rods for 6" bellows	4
3/8-16 spherical nuts and washers	32 nuts, 16 washers
6"-8" adapter with ion gauge ports (to adapt from 8" line to 6" Vatterfly valve)	1
Edwards steel double-claw clamps for K-style ISO 200 vacuum flanges	36 (12/seal)
Evac aluminum seals for ISO 200 vacuum flanges	3
ISO 160 centering ring with Viton o-ring (for adapter / 6" Vatterfly joint)	1
4' x 4' HEPA filter downflow unit with vinyl curtains mounted below gantry	1
-Y axis up only:2" exhaust gas pumping line assembly per Fig. 2 consisting of:	
2" exhaust gas pumping line	1
ISO-63/KF-50 adapter	2
V3 bellows assembly	1
V4 bellows assembly	1
2" elbow	1
ISO-63 centering ring with Viton o-ring	2
EVAC KF-50 aluminum gaskets	6
Edwards KF-50 clamps for metal seals	6
1/4" stainless steel spinup lines made of cleaned and capped tubing, with female VCR fittings on the ends, and configured to run from the gas supply outlets to the gyro inlet connections S1-S4 on the Probe	2
1/4" stainless steel line made of cleaned and capped tubing, with female VCR fittings on the ends, and configured to run from an unused gas supply outlet to the P1a port on the Probe	1
1/4" VCR gaskets	6

D.5 Tools

Description	No. Req'd
misc wrenches including 17 mm	A/R

D.6 Expendables

Description	Quantity
Ethanol	A/R

E **Software Required**: N/A

F **Procedures Required**: N/A

G **Equipment Pretest Requirements**:P0567A, Probe Gas/Vac GSE Certification

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, and Tom Welsh with Mike Taber being the leader.

I **Safety Requirements**

These operations are to be preformed 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 those which are on flight equipment and/or must be sealed with metal gaskets.

J **General Instructions**

J.1 QA Notification: ***The ONR representative and SU QA program office shall be notified 24 hours prior to the start of this procedure.*** Upon completion of this procedure, the QE Manager will certify 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.

J.2 Redlines can be initiated by Mike Taber and must be approved by QA.

J.3 Any nonconformance or test anomaly should be reported by a Discrepancy Report. Refer to the Quality Plan, P0108, for guidance. Do not alter or break test configuration if a test failure occurs; notify quality assurance.

J.4 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 Verify Appropriate QA Notification

- o Verify SU QA program office notified.

  Record: Individual notified _____,

  Date/time _____/_____.

- o Verify ONR representative notified.

  Record: Individual notified _____,

  Date/time _____/_____.

L.2 Record Op. No. and date of performance of P0567A, Probe Gas/Vac GSE Certification:_____.

L.3 Specifiy Payload orientation: ❑ -Y up ❑ -X up

L.4 Locate the 4' x 4' HEPA filter downflow unit with vinyl curtains mounted below gantry over the LGS adapter cone.

L.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.6 Verify that the pumping line components have been cleaned and bagged.

L.7 Installation of the 8" LGS pumping line:

NOTE:

While assembling a vacuum joint with an Evac aluminum seal, do not attempt to reclock the joint during assembly without completely loosening the clamp as this may damage the aluminum seal and cause a leak.

L.7.1 In a class 1000 environment, assemble the 6" long x 8" dia. bellows to the 6"-8" adapter using an Evac aluminum seal and 12 Edwards steel double-claw clamps Cover the open ends of the assembly with a double layer of aluminum foil.

L.7.2 Loosely install 4 threaded rods with spherical nuts and washers between the flanges on the ends of the bellows. Do not tighten.

L.7.3 Cover the open ends of the pumping line with aluminum foil.

L.7.4 Verify that two "Stabil-ion" ion gauges have been installed into the ion gauge ports on the adapter unit. Rebag the adapter assembly.

L.7.5 Remove the preassembled hardware to the FIST Lab.

L.7.6 In the following steps, the person working in the HEPA downflow unit should use appropriate clean room garb:

L.7.6.1 Record the pressure on the protective cover on the Vatterfly valve LV1(-Y up case) or LV2 (-X up case): _____ psig. Remove the protective cap from LV1 (LV2) and store in a clean bag.

L.7.6.2 Install the adapter and bellows assembly on LV1 (LV2) with a ISO 160 centering ring (Viton seal). Orient the adapter such that the ion gauge tee is located on the +Z side. Keep a protective cover over the bellows until ready to connect the pumping line.

L.7.6.3 Arrange a support for the pumping line such that the height of the horizontal portion of the line aligns with the cone of the LGS.

L.7.6.4 Using two persons to support the pumping line, remove protective covering material and mate the long end of the pumping line with an Evac aluminum gasket onto the LGS cone while holding the lower end slightly away from the bellows.

L.7.6.5 Adjust the LGS platform position as necessary to allow the pumping line to mate with the adapter and bellows. Record the vertical motion: _____inches up / down, and horizontal motion: _____inches north / south

L.7.6.6 Adjust the orientation of the pumping line as necessary to mate the lower end with the bellows using another aluminum gasket. Clamp together both joints using 12 clamps on each.

L.7.6.7 Adjust and tighten the threaded rod support struts on the bellows using the spherical nuts and washers.

L.7.6.8 Connect the ion gauge cables from LGM-2 to the ion gauge tubes, being sure to have the IG-1 and IG-2 identifications consistent with that used in calibration.

L.7.7 Installation of the pumping line complete.

QA witness: _____

Date / time: _____

L.8 Install the spinup exhaust line (-Y up orientation only):

L.8.1 In a class 1000 environment, assemble the ISO-63/KF-50 adapters to the V3 and V4 bellows assemblies using Evac KF-50 aluminum gaskets and clamps. As an option, the 2" elbow may also be loosely connected to the V3 bellows assembly using an Evac KF-50 gasket and clamp with the orientation as shown in Fig. 2. Loosely intall threaded rods with spherical nuts and washers between

the flanges at the ends of the bellows.

L.8.2 Record the pressure on the protective cover on the Vatterfly valve V4: _____ psig. Remove the protective cover from V4 and store in a clean bag.

L.8.3 Install the V4 bellows/adapter assembly on V4 using an ISO-63 centering ring (Viton o-ring).

L.8.4 Remove the cap from SEV-2 and install the exhaust line loosely to SEV-2 on the LGS using an Evac KF-50 aluminum gasket and clamp.

L.8.5 Mate the exhaust line to V4 using another Evac KF-50 aluminum gasket and clamp.

L.8.6 Record the pressure on the protective cap on the Vatterfly valve V3: _____ psig. Remove the protective cover from V3 and store in a clean bag.

L.8.7 If not already installed, install the 2" elbow between the exhaust gas line and the V3 bellows assembly using 2 Evac gaskets and clamps as shown in Fig. 2. Otherwise, loosen the joint between the 2" elbow and the V3 bellows assembly and rotate as necessary to mate the elbow with the exhaust gas line.

L.8.8 Adjust and tighten the threaded rod support struts on both bellows using the spherical nuts and washers.

L.8.9 Installation of the pumping line complete.

QA witness: _____

Date / time: _____

L.9 Install the gas supply lines

L.9.1 Verify that the HEPA downflow unit is located over the top of the GSE spinup gas supply connection fittings and has been running in that location for ~1 hour.

L.9.2 Remove the caps from the spinup GSE supply fittings for gyros 3 and 4 for -Y axis up (gyros 1 and 2 for -X axis up), and connect the spinup supply lines.

L.9.3 Option: Remove a cap from an unused spinup GSE supply fitting, and connect the P1a gas supply line. Record which gas supply outlet is being used:_____.

L.9.4 Remove the VCR caps from the the connector savers at S3, S4 (S1, S2) and connect the lines. Verify that the correct line assignments have been made.

L.9.5 (Option) If the P1a line is being installed, remove the VCR cap from the connector saver at P1a and connect that line.

L.10 Move the HEPA downflow unit away from the dewar. If desired, remove from the gantry per engineering instruction, and stow the HEPA unit back on its mounting frame.

L.11 Leak check of the GSE lines.

L.11.1 Initial set up:

L.11.1.1 Ensure that the following conditions are true:

L.11.1.1.1 All circuit breakers (except Turbo 1 and Turbo 2) are on at the Power Distribution Box;

L.11.1.1.2 Turbo 1 and Turbo 2 circuit breakers are off;

L.11.1.1.3 Water chiller (located outside the east wall of the lab under the stairs) is on with ~ 50 psig pressure at the outlet;

L.11.1.1.4 Water inlet valves (green-handled Nupro valves behind flowmeter panel) for Turbo 1, Turbo 2 (LGP-1, -2) and dry pump (LGP-4) are open;

L.11.1.1.5 Water flow ~0.4 GPM for LGP-1, -2 and ~1 GPM for LGP-4 as indicated by the Kobold flow meters;

L.11.1.1.6 Compressed air pressure >100 psig as indicated by pressure gauge near flowmeters;

L.11.1.1.7 Compressed air supply valve is open;

L.11.1.1.8 All LGV's SEV's, GSV's, and AXV's are closed as indicated on control panel (see Figure 3);

L.11.1.1.9 All pressure and flow gauge controllers are on;

L.11.1.1.10 Regulator output valve (V6) at Spinup Gas He supply is closed with the supply valve (V5) open and the regulator set 5 - 10 psig.

L.11.1.1.11 Bag all newly made joints in the leakage and exhaust lines. (It is not necessary to bag the VCR joints of the spinup supply lines.) All the joints in the region of V3, V4 may be bagged together.

L.11.2 System pumpdown:

L.11.2.1 Place the valve control system in "Interlock Defeat" mode and verify that the yellow LED is blinking.

L.11.2.2 Open the following valves:

L.11.2.2.1 LGV-3, -1;

L.11.2.2.2 AXV-5, -7; (Note: AXV-8 will be opened later.)

L.11.2.2.3 SEV -2

L.11.2.2.4 GSV-7, -8, -9, -10, –11(a few turns);

L.11.2.2.5 GSV-5 by setting the controller mode switch to "auto" and adjusting the flow control set point to approximately one-half turn.

L.11.2.2.6 GSV-1, -3

L.11.2.3 Close / verify closed vent valves LGV-2, -8, -9, and LGV-4, -5.

L.11.2.4 Turn on SEP-1, -2 to evacuate the Spinup Exhaust System.

L.11.2.5 Open AXV-8 to evacuate the LGS and SGSS.

L.11.2.6 After GSG-4 bottoms out, close AXV-8.

L.11.2.7 When SEG-1 reads less than 0.050 torr, (closing SEV-5) turn off SEP-1, -2. (Note: With these pumps off, SEV-5 will not reopen.)

L.11.2.8 Start pumping with the LGS:

L.11.2.8.1 Turn the TCS 120 Pumping Unit Control master switch on, press the "Pumping Unit" button and confirm illumination of the annunciator.

L.11.2.8.2 Turn on LGP-4 by activating the circuit breaker F3 on the TCS 120.

L.11.2.8.3 Open LGV-10.

L.11.2.8.4 Turn on LGP-3 by activating the circuit breaker F15 on the TCS 120.

L.11.2.8.5 When LGG-5 reads less than 100 millitorr, open LGV-6, -7.

L.11.2.8.6 Turn on LGP-1, & -2 by activating the Turbo 1 and Turbo 2 circuit breakers on the Power Distribution Box.

L.11.2.9 Verify pumpdown:

L.11.2.9.1 Monitor pressures at LGG-3, -5, -6 to verify that pressures are decreasing.

L.11.2.9.2 Monitor turbo speed on both TCP-5000 controllers (for LGP-1, & -2) and verify that turbo speeds are increasing. As long as turbo speeds are <80% of operating speed, the LGP-1, & -2 LED indicator lights will blink. When the LGP-1, & -2 LED indicator lights stay on continuously (indicating >80% full speed), continue with the following.

L.11.2.10 Open AXV-6 to allow the exhaust manifold to be pumped by the LGS.

L.11.2.11 When LGG-3 reads <10 mtorr, turn on the LGG-1A ion gauge (IG-1 on LGM-2)

L.11.2.12 When LGG-6 reads <20 mtorr, LGG-5 reads <5 mtorr, and LGG-1A reads $<10^{-6}$ torr, proceed with the next section.

QA witness:_____

L.11.3 Close GSV-1, and GSV-3.

L.11.4 Perform system leak check:

L.11.4.1 Start up leak detector:

L.11.4.1.1 Install / verify installed blankoff plug on the LD test port.

L.11.4.1.2 Start up LD per manufacturer's instructions.

L.11.4.1.3 Perform LD autocal (if appropriate).

L.11.4.1.4 Turn on LD calibrated leak and record:
_____sccs He
Calibrated leak value: _____sccs

He

QA witness:_____

L.11.4.1.5 Turn off the calibrated leak and vent LD.

L.11.4.1.6 Connect LD to LGV-8 (leak check access port) with 1" flexible pumping line.

L.11.4.1.7 Start LD and spray leak check up to LGV-8; increase above background should be $<10^{-7}$ sccs He. Record results:

Background leak rate:_____sccs

Leak rate during test: _____sccs

QA witness: _____

L.11.4.1.8 Make the LD the backing pump for the system: (Note: the following steps are necessary because the base pressure of the dry pump, LGP-4, is too high for the LD to cross directly over to fine leak check mode.)

L.11.4.1.8.1 Set the transfer pressure of the LD to "hold".

L.11.4.1.8.2 Place the LD test switch on "start" and rough pump to ≤10 millitorr.

L.11.4.1.8.3 Open LGV-8 and close LGV-10.

L.11.4.1.8.4 Wait until the test port pressure drops to ≤10 millitorr.

L.11.4.1.8.5 Slowly adjust the transfer pressure upwards until the LD goes into test mode.

L.11.4.1.8.6 If the LD does not successfully transfer into test mode, close LGV-8, open LGV-10, put LD Test Switch to its center position (to reset) and return to L.10.4.1.8.1 above.

L.11.4.1.8.7 Disable the LD vent.

L.11.4.2 Apply He to the bag enclosing the 8" seal at the LGS cone for a period of three minutes; increase above background should be $<10^{-7}$ sccs He. Record results:

Background leak rate:_____sccs

Leak rate during test: _____sccs

QA witness: _____

L.11.4.3 Apply He to the bag enclosing the 8" bellows and adapter assembly at the Vatterfly valve for a period of three minutes; increase above background should be $<10^{-7}$ sccs He. Record results:

Background leak rate:_____sccs

Leak rate during test: _____sccs

QA witness: _____

L.11.4.4 Apply He to the leak check hole in each spinup supply line VCR nut (including the P1a line, if installed) for a period of one minute for each gland; increase above background should be $<10^{-7}$ sccs He. Record results:

Background leak rate:_____sccs

Leak rate during test: _____sccs

QA witness: _____

L.11.4.5 Apply He to the bag enclosing the 2" KF joint at SEV-2 for a period of three minutes; increase above background should be $<10^{-7}$ sccs He. Record results:

Background leak rate:_____sccs

Leak rate during test: _____sccs

QA witness: _____

L.11.4.6 Apply He to the bag enclosing the V3, V4 joints for a period of three minutes; increase above background should be $<10^{-7}$ sccs He. Record results:

Background leak rate:_____sccs

Leak rate during test: _____sccs

QA witness: _____

L.11.5 Shut down leak check:

L.11.5.1 Open foreline valve LGV-10 and close LGV-8.

L.11.5.2 Enable the LD vent.

L.11.5.3 While monitoring LGG-6, vent the LD.

L.11.5.4 Disconnect the pumping line from LGV-8 and cap.

L.11.5.5 Shut down LD per manufacturer's instructions.

L.11.6 Close / verify closed the following valves:

L.11.6.1 GSV-1, -2, -3, -6, -7, -8, -9, -10.

L.11.6.2 GSV-4, -5 by setting set point controls to zero and switching mode switches to "off".

L.11.6.3 SEV-1, -2

L.11.6.4 AXV-5, -6, -7

L.11.7 Turn off Interlock Defeat (KS-1).

L.12 [Optional] System shut down:

L.12.1 Close / verify closed all GSV, SEV, AXV valves.

L.12.2 Turn off SEP-1, -2.

L.12.3 Close valves LGV-1, -3, -6, -7.

L.12.4 Close valve LGV-10.

L.12.5 Flip off breakers Turbo 1 and Turbo 2 (on the Power Distribution Box).

L.12.6 Turn off LGP-3 at circuit breaker F15 on the TCS 120.

L.12.7 Turn off LGP-4 at circuit breaker F3 on the TCS 120.

L.12.8 Turn the TCS 120 Pumping Unit Control master switch off.

L.12.9 Wait 30 minutes and slowly open LGV-4, -5 to vent the turbopumps.

L.12.10 Open vent valve LGV-9.

L.12.11 If desired, vent the LGS chamber by slowly opening LGV-2.

Operation completed.

Completed by: _____

QA witness: _____

Date: _____

Time: _____

Figure 1

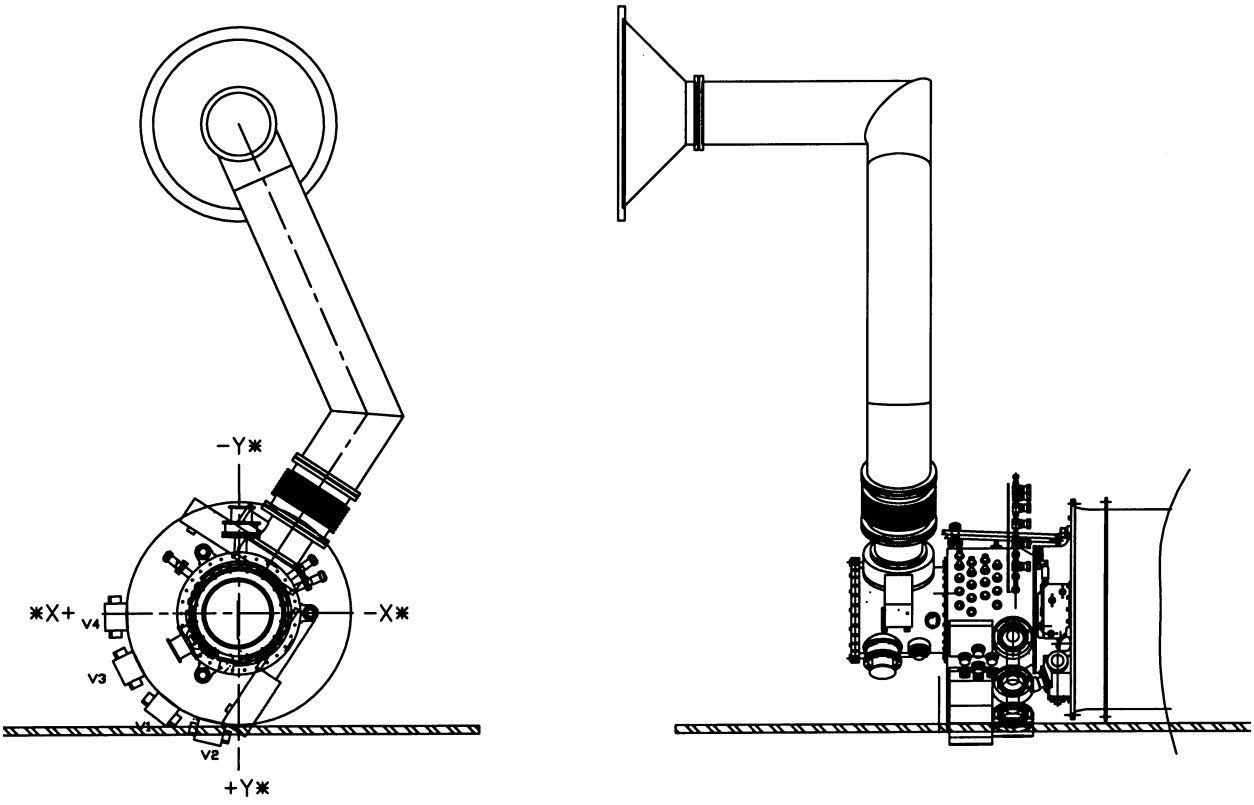


Figure 2.

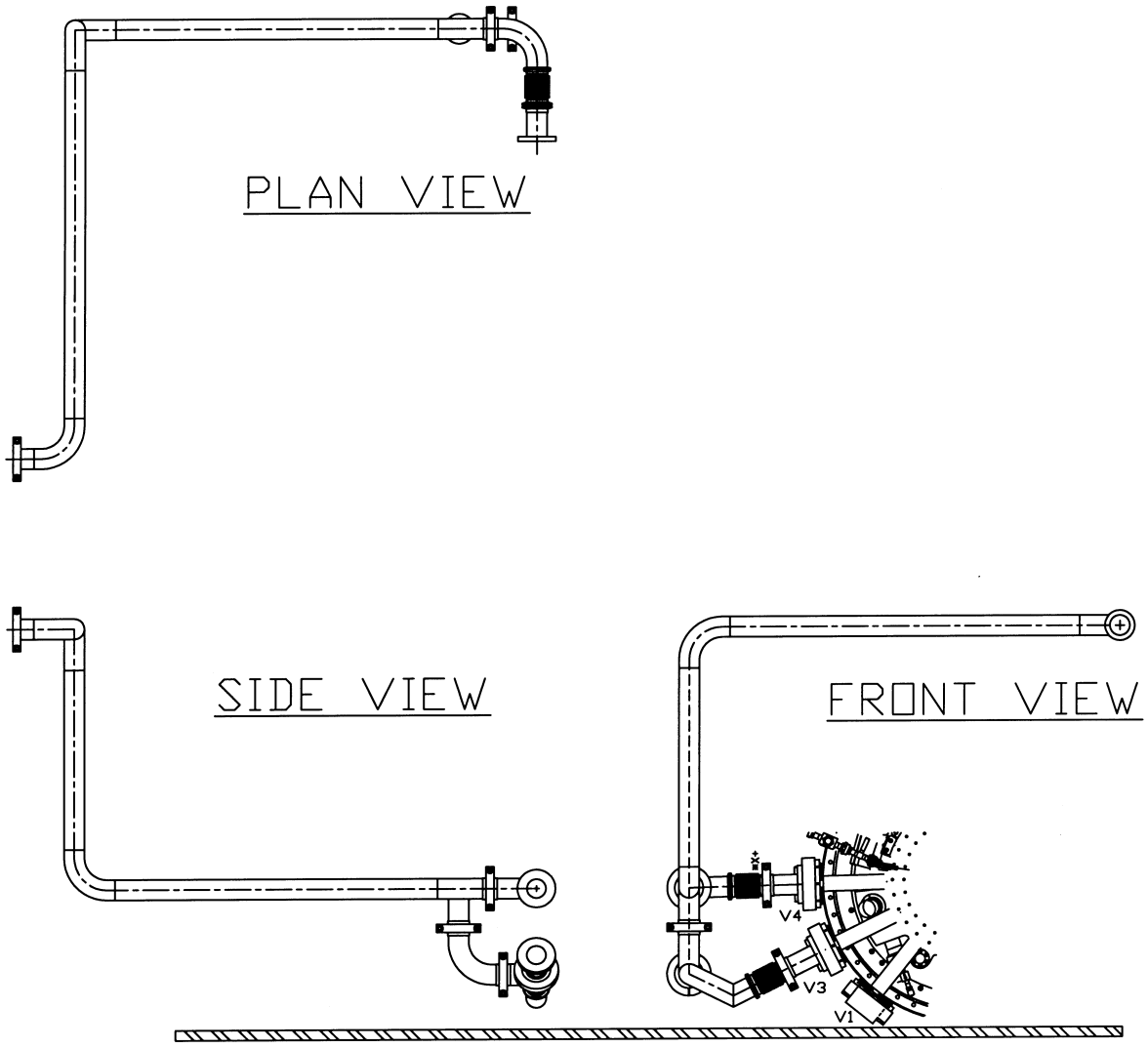
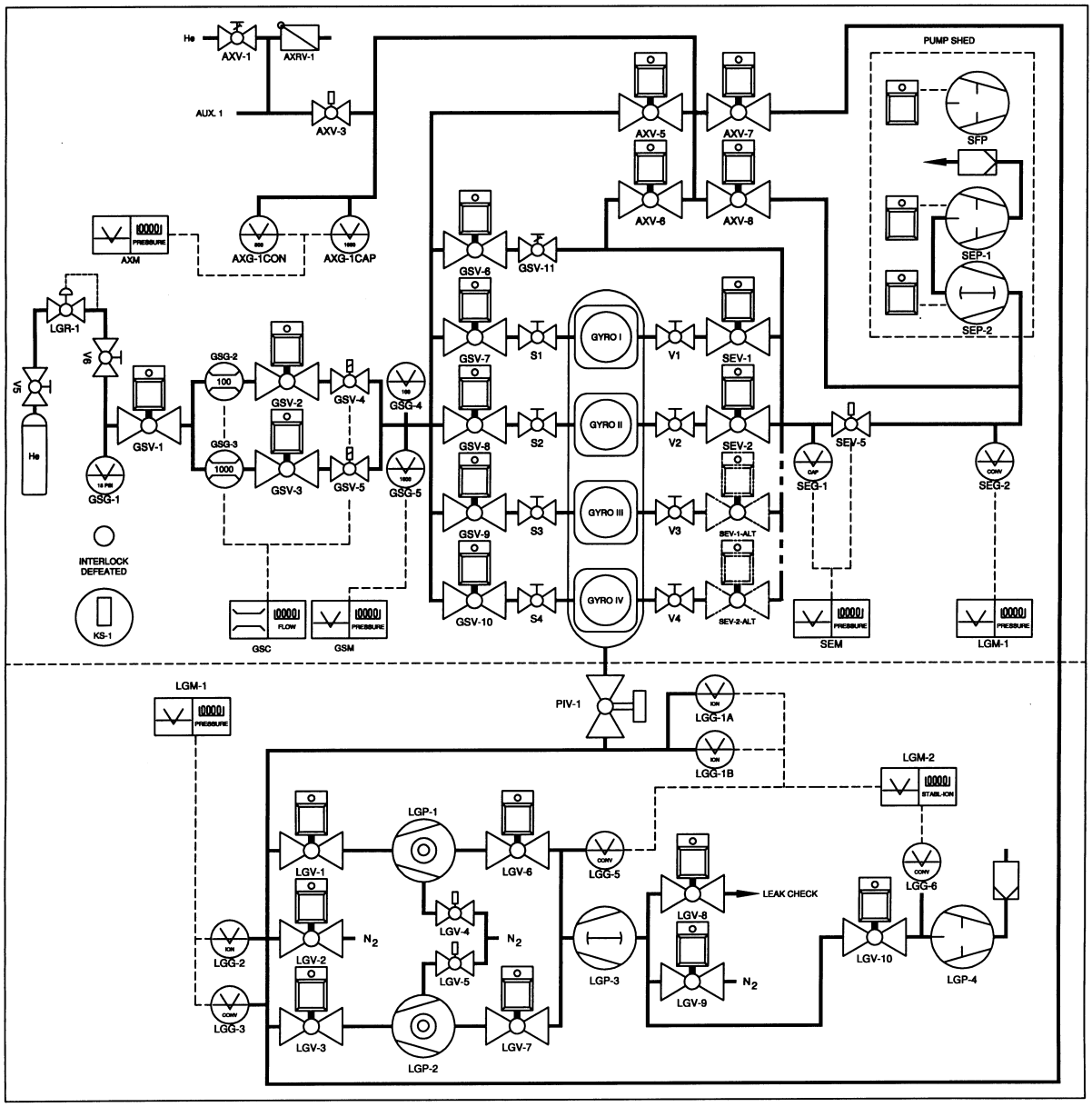


Figure 3.


He
AXV-1
AXRV-1
AUX. 1
AXV-3
PUMP SHED
SFP
SEP-1
SEP-2
AXV-5
AXV-7
AXV-6
AXV-8
AXM
AXG-1CON
AXG-1CAP
GSV-6
GSV-11
LGR-1
V6
V5
GSG-2
GSG-3
GSV-1
GSV-2
GSV-3
GSV-4
GSV-5
GSG-4
GSG-5
GSG-1
He
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
SEM
LGM-1
INTERLOCK DEFEATED
KS-1
GSC
GSM
LGM-1
PIV-1
LGG-1A
LGG-1B
LGM-2
LGP-1
LGV-1
LGV-6
LGG-5
LGV-2
LGV-4
LGV-5
LGV-3
LGV-7
LGP-2
LGP-3
LGG-2
LGG-3
N_2
LEAK CHECK
LGV-8
LGV-9
LGV-10
LGG-6
LGP-4