GRAVITY PROBE B

PROCEDURE FOR

PAYLOAD VERIFICATION

(PTP) PROBE GAS/VAC GSE CERTIFICATION

P0567 Rev. A
5/8/00

ECO 1132

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		
B. Muhlfelder Payload Technical 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	5/8/00	1132	1) Incorporated redlines from last performance of procedure; 2) added QA notification requirement; 3) added Table 1 to simplify recordation of leak check results; 4) specified conditions under which various tests need to be performed for recertification.

Acronyms and Abbreviations:

Acronym / Abbreviation	**Meaning**
AXV-#	Auxiliary Valve #
GSE	Ground Support Equipment
GSG-#	Gas Supply Gauge #
GSV-#	Gas Supply Valve #
LD	Leak Detector
LGG-#	Leakage Gas Gauge #
LGP-#	Leakage Gas Pump #
LGS	Leakage Gas System
LGV-#	Leakage Gas Valve #
PLC	Programmable Logic Controller
PPMS	Probe Pressure Measurement System
RGA	Residual Gas Analyzer
SES	Spinup Exhaust System
SEG-#	Spinup Exhaust Gauge #
SEP-#	Spinup Exhaust Pump #
SGSS	Spinup Gas Supply System

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A Scope

This procedure verifies proper operation of the gas and vacuum GSEused with Probe-C in payload verification. This GSE consists of the following subsystems: the Leakage Gas System (LGS), the Spinup Exhaust System (SES), the Spinup Gas Supply System (SGSS), and the Programmable Logic Controller (PLC), which controls the other three subsystems. Verification consists of a) pumping down the entire system, b) leak checking all subsystems, c) verifying valve sequencing used during spinup operations, d) power interruption tests, and e) pump failure tests. (The last three tests verify proper PLC operation.) Verification of spinup gas purity is not included in this suite of tests. **No flight equipment is involved in this procedure.**

B Requirements Verification

B.1 Requirements Cross Reference: N/A

B.2 Expected Data for verification per requirement: N/A

C Configuration Requirements

The Spinup Gas Supply, Leakage Gas System and Spinup Exhaust GSE are configured as indicated schematically in Fig. 1 with the following exceptions:

C.1 Ion gauge LGG-2 does not exist. LGM-1 is used for readout of the PPMS ion gauges, PPG-1, -2.

C.2 Valve PIV-1 does not exist except in the form of 6" Vatterfly valve(s) on Probe-C. The inlet to the LGS is connected to the Probe at the closed 6" Vatterfly valve (located in the-X-Y quadrant) per P0557A.

C.3 Valves GSV,-7, -8, -9, -10 are connected to closed valves S-1, -2, -3, -4, respectively, on the Probe per P0557A.

C.4 Valves SEV-1, -2 are blanked off and not connected to the probe.

D D Hardware Required

D.1 Flight hardware required: N/A

D.2 Commercial test equipment / instrumentation:

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	LLC9030	
Calibrated He leak for alternate LD	F3264302	EBAL5056	
MKS Flow Meter Readout / Controller (GSG-2, -3)	260MF-1 (with plug-in modules)	65769-11	
MKS mass flow meter (GSG-2, 100 sccm He)	179A12CR3BM-S	000471909	4/11/01
MKS mass flow meter (GSG-3, 1000 sccm He)	179A13CR3BM-S	000471910	4/11/01
MKS power supply / capacitance manometer readout (SEG-1)	PDR-C-2C	65769-13A	

Manufacturer	Model	Serial Number	Calibr. Exp. Date
Varian capacitance manometer (SEG-1, 0-1 torr)	VCMH01TBA	LID90866	
MKS power supply / capacitance manometer readout (GSG-4, -5)	PDR-C-2C	66724-2	
MKS capacitance manometer (GSG-4)	122AA-00100BB	65769-7	
MKS capacitance manometer (GSG-5)	122AA-01000BB	66724-1	
Granville-Phillips ion gauge readout for "Stable-ion" ion gauges (LGG-1A, -1B) designated as LGM-2	360101	94100501	
Granville-Phillips "Stable-ion" ion gauge (IG-1 = LGG-1A)	360120	94063001	
Granville-Phillips "Stable-ion" ion gauge (IG-2 = LGG-1B)	360120	94082405	
Granville-Phillips ion gauge readout for "Stable-ion" ion gauges (PMG-1A, -1B) designated as LGM-1	360101	97071702	
Granville-Phillips "Stable-ion" ion gauge (IG-1 = PMG-1A)	360120	99012705	
Granville-Phillips "Stable-ion" ion gauge (IG-2 = PMG-1B)	360120	97071808	

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

D.4 Tools: N/A

D.5 Expendables

Description	Quantity
Certified grade 6.0 He gas in K or T bottle or equivalent	1 bottle

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 qualified personnel. Chuck Warren and Mike Taber are qualified to perform this procedure. The QA representative shall be either Russ Leese or Dorrene Ross.

I **Safety Requirements**

This procedure does not involve any significant hazardous operations or safety issues. General emergency instructions can be found in "FIST Emergency Procedures", P0141.

J **General Instructions**

J.1 QA Notification: ***The 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 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.

J.4 Only the following persons have the authority to exit/terminate this test or perform a retest: Mike Taber

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

Op. Order No._____
Date Initiated_____
Time Initiated_____

L Operations

L.1 Enter the calibration due dates for the equipment listed in section D.2 and verify that calibrations are current.

L.2 Verify Appropriate QA Notification

- Verify SU QA program office notified.

  Record: Individual notified _____,

  Date/time _____/_____.

L.3 Initial set up:

L.3.1 Ensure that the following conditions are true:

L.3.1.1 All circuit breakers (except Turbo 1 and Turbo 2) are on at the Power Distribution Box;

L.3.1.2 Turbo 1 and Turbo 2 circuit breakers are off;

L.3.1.3 Water chiller (located outside the east wall of the lab under the stairs) is on with ~ 50 psig pressure at the outlet;

L.3.1.4 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.3.1.5 Water flow ~0.4 GPM for LGP-1, -2 and ~1 GPM for LGP-4 as indicated by the Kobold flow meters;

L.3.1.6 Compressed air pressure >100 psig as indicated by pressure gauge near flowmeters;

L.3.1.7 Compressed air supply valve is open;

L.3.1.8 All LGV's SEV's, GSV's, and AXV's are closed as indicated on control panel;

L.3.1.9 All pressure and flow gauge controllers are on;

L.3.1.10 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.3.2 Bag any remade or reworked joints per the regions in Table 1 for leak checking. (VCR joints need not be bagged.) Also bag any joints which are suspect or have a history of leaking. Indicate in the designated column of Table 1 whether each region is to be spray or bag leak checked. (Note: See section L.5 to determine whether a leak check is required or not.)

L.4 System pumpdown:

L.4.1 Place the valve control system in "Interlock Defeat" mode and verify that the yellow LED is blinking.

L.4.2 Open the following v alves:

L.4.2.1 LGV-6, -7;

L.4.2.2 LGV-3, -1;

L.4.2.3 AXV-5, -7; (Note: AXV-8 will be opened later.)

L.4.2.4 SEV-1, -2

L.4.2.5 GSV-7, -8, -9, -10;

L.4.2.6 GSV-3;

L.4.2.7 GSV-1;

L.4.2.8 GSV-5 by setting the controller mode switch to "auto" and adjusting the flow control set point to approximately one-half turn.

L.4.3 Turn on SEP-1, -2 to evacuate the Spinup Exhaust System up to SEV-1, -2.

L.4.4 Open AXV-8.

L.4.5 Open GSV-6.

L.4.6 After GSG-4 bottoms out, close AXV-8.

L.4.7 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.4.8 Start pumping with the LGS:

L.4.8.1 Turn the TCS 120 Pumping Unit Control master switch on, press the "Pumping Unit" button and confirm illumination of the annunciator.

L.4.8.2 Turn on LGP-4 by activating the circuit breaker F3 on the TCS 120.

L.4.8.3 Open LGV-10.

L.4.8.4 Turn on LGP-3 by activating the circuit breaker F15 on the TCS 120.

L.4.8.5 When LGG-5 is <1 torr, turn on LGP-1, & -2 by activating the Turbo 1 and Turbo 2 circuit breakers on the Power Distribution Box.

L.4.9 Verify pumpdown:

L.4.9.1 Monitor pressures at LGG-3, -5, -6 to verify that pressures are decreasing.

L.4.9.2 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.

QA witness:_____

L.4.9.3 Open AXV-7 and AXV-6 to allow the exhaust and supply manifolds to be pumped by the LGS.

L.4.9.4 When LGG-3 reads <10 mtorr, turn on the LGG-1A ion gauge (IG-1on LGM-2)

L.4.9.5 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.4.10 Zero the readouts of the following gauges:

L.4.10.1 GSG-4, -5.

L.4.10.2 SEG-1.

L.5 System leak check: Perform this section if any changes have occurred which could affect the vacuum integrity of any of the subsystems or if more than a year has elapsed since the system was last leak checked. If no leak check is required, record the Op. Order number of the previous leak check:_____.

L.5.1 Start up leak detector:

L.5.1.1 Install / verify installed blankoff plug on the LD test port.

L.5.1.2 Start up LD per manufacturer's instructions.

L.5.1.3 Perform LD autocal (if appropriate).

L.5.1.4 Turn on LD calibrated leak and record: _____sccs He

Calibrated leak value: _____sccs He

QA witness:_____

L.5.1.5 Turn off the calibrated leak and vent LD.

L.5.1.6 Connect LD to LGV-8 (leak check access port) with 1" flexible pumping line.

L.5.1.7 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.5.1.8 Make the LD the backing pump for the system: (Note: the following steps are necessary because the backing pressure of the dry pump, LGP-4, may be too high for the LD to cross directly over to fine leak check mode.)

L.5.1.8.1 Set the transfer pressure of the LD to "hold".

L.5.1.8.2 Place the LD test switch on "start" and rough pump to ≤10 millitorr.

L.5.1.8.3 Open LGV-8 and close LGV-10.

L.5.1.8.4 Wait until the test port pressure drops to ≤10 millitorr.

L.5.1.8.5 Slowly adjust the transfer pressure upwards until the LD goes into test mode.

L.5.1.8.6 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.5.1.8.1 above.

L.5.2 Perform leak check of all the regions listed in Table 1. (Note: The leak checks may be performed in any convenient order. It is advantageous to leave to the last the leak checking of any bagged rubber o-rings such as gatevalve bonnet seals in order to avoid excessive background.) Enter the results in Table 1. Any increase above background should be $<10^{-7}$ sccs He for all leak checks.

L.5.3 All leak checks passed:

QA witness: _____

Date / time: _____

L.5.4 Shut down leak check:

L.5.4.1 Open foreline valve LGV-10 and close LGV-8.

L.5.4.2 While monitoring LGG-6, vent the LD.

L.5.4.3 Disconnect the pumping line from LGV-8 and cap.

L.5.4.4 Shut down LD per manufacturer's instructions.

L.5.5 Close / verify closed the following valves:

L.5.5.1 GSV-1, -2, -3, -6, -7, -8, -9, -10.

L.5.5.2 Close GSV-4, -5 by setting set point controls to zero and switching mode switches to "off".

L.5.5.3 SEV-1, -2

L.6 Verification of the Gas Supply System and valve sequencing: Perform this section if the PLC program has been altered. If no alteration has occurred since the last certification, record the Op. Order number of that certification procedure: _____.

L.6.1 Turn on SEP-1, -2.

L.6.2 Turn off "Interlock Defeat" and verify that the yellow LED stops blinking.

L.6.3 Open shutoff valve at the SGS GHe supply bottle (V5) and set pressure to 2-5 psig.

L.6.4 Open the regulator output valve (V6).

L.6.5 Open GSV-1, -2.

L.6.6 Set the GSV-4 mode switch at GSC to "auto".

L.6.7 Open the front panel on LGM-2 and verify that set point 1 is set to "SP" and that the set point 1 indicator light is on (indicating that the pressure is below 2×10^{-5} torr).

L.6.8 Press SEV-1; the indicator light will blink slowly to indicate that the valve is armed but not open.

L.6.9 Open GSV-6.

L.6.10 Set GSV-4 to 10 sccm and verify flow by observing a pressure increase at GSG-4.

L.6.11 Verify GSV-7 operation:

L.6.11.1 Press the GSV-7 switch and verify that GSV-7 opens and GSV-6 closes.

L.6.11.2 Immediately open the front panel to LGM-2 and and switch "SP-1" to "off". (This simulates the condition of the pressure at LGG-1 exceeding 2×10^{-5} torr as it would during a high speed spinup of a gyro.)

L.6.11.3 Verify that SEV-1 opens as indicated by the sound of the valve operating and the indicator light turning on continuously.

L.6.11.4 Open GSV-6 and close SEV-1. Verify that GSV-7 has closed as a result of opening GSV-6.

L.6.11.5 Set switch SP-1 of LGM-2 to "SP".

L.6.12 Verify GSV-8 operation:

L.6.12.1 Press SEV-2; the indicator light will blink slowly to indicate that the valve is armed but not open.

L.6.12.2 Press the GSV-8 switch and verify that GSV-8 opens and GSV-6 closes.

L.6.12.3 Immediately open the front panel to LGM-2 and and switch "SP-1" to "off". (This simulates the condition of the pressure at LGG-1 exceeding 2×10^{-5} torr as it would during a high speed spinup of a gyro.)

L.6.12.4 Verify that SEV-2 opens as indicated by the sound of the valve operating and the indicator light turning on continuously.

L.6.12.5 Open GSV-6 and close SEV-2. Verify that GSV-8 has closed as a result of opening GSV-6.

L.6.12.6 Set switch SP-1 of LGM-2 to "SP".

L.6.13 Verify GSV-9 operation:

L.6.13.1 Press SEV-1; the indicator light will blink slowly to indicate that the

valve is armed but not open.

L.6.13.2 Press the GSV-9 switch and verify that GSV-9 opens and GSV-6 closes.

L.6.13.3 Immediately open the front panel to LGM-2 and and switch "SP-1" to "off". (This simulates the condition of the pressure at LGG-1 exceeding 2 x 10^{-5} torr as it would during a high speed spinup of a gyro.)

L.6.13.4 Verify that SEV-1 opens as indicated by the sound of the valve operating and the indicator light turning on continuously.

L.6.13.5 Open GSV-6 and close SEV-1. Verify that GSV-9 has closed as a result of opening GSV-6.

L.6.13.6 Set switch SP-1 of LGM-2 to "SP".

L.6.14 Verify GSV-10 operation:

L.6.14.1 Press SEV-2; the indicator light will blink slowly to indicate that the valve is armed but not open.

L.6.14.2 Press the GSV-10 switch and verify that GSV-10 opens and GSV-6 closes.

L.6.14.3 Immediately open the front panel to LGM-2 and and switch "SP-1" to "off". (This simulates the condition of the pressure at LGG-1 exceeding 2 x 10^{-5} torr as it would during a high speed spinup of a gyro.)

L.6.14.4 Verify that SEV-2 opens as indicated by the sound of the valve operating and the indicator light turning on continuously.

L.6.14.5 Open GSV-6 and close SEV-2. Verify that GSV-10 has closed as a result of opening GSV-6.

L.6.14.6 Set switch SP-1 of LGM-2 to "SP".

L.6.15 Close GSV-2, -6.

L.6.16 Verification of the Gas Supply System and valve sequencing complete.

QA witness: _____

Date / time: _____

L.7 Short-duration power interruption test: Perform this section if the PLC program has been altered. If no alteration has occurred since the last certification, record the Op. Order number of that certification procedure: _____. (Note: This test is intended to simulate the conditions that would occur when the Probe is being pumped on by the LGS and there are no spinup activities. Under these conditions, standby power would restore power to the facility after a delay of ~5 sec.)

L.7.1 Verify that the LGS is operating under normal conditions: pumps LGP-1, -2, -3, -

4 are running and valves LGV-1, -3, -6, -7, -10 are open.

L.7.2 Verify that all GSV, AXV, and SEV valves are closed.

L.7.3 Verify that individuals responsible for all other activities in the facility have been notified of the power interruption and have had the opportunity to make satisfactory preparations. (Any critical computers should be on UPS.)

L.7.4 Station one person at electrical panel CR-2 outside the FIST Lab next to the east door and another person at the spinup system control panel. When ready, shut off facility power by switching the "Service Disconnect" to off for 5-10 seconds and then turn back on.

L.7.5 Record the valves that reopen:_____

L.7.6 Record the pumps that restart:_____

L.7.7 If the LGS has not returned to its original state, perform the following:

L.7.7.1 Verify that pumps LGP-3, -4 are on and valve LGV-10 is open

L.7.7.2 Open, verify open valves LGV-6, -7.

L.7.7.3 If both turbopumps do not automatically restart, push the reset button on the appropriate TCP 5000, and verify that it restarts. (LGP-1 is the most likely to need resetting.)

L.7.7.4 Verify that LGV-1, -3 reopen if their respective turbopumps are at >80% speed as indicated by a steady LED on the control panel.

L.7.7.5 Turn on IG-2 at LGM-2.

L.7.8 System satisfied success criteria for short-duration power failure test: Valve LGV-6 (LGV-7) does not reopen after power restoration unless LGP-1 (LGP-2) restarts, and valve LGV-1 (LGV-3) does not reopen unless LGP-1 (LGP-2) is at >80% full speed.

QA witness: _____

Date / time: _____

L.8 Momentary power interruption test: Perform this section if the PLC program has been altered. If no alteration has occurred since the last certification, record the Op. Order number of that certification procedure: _____. (Note: This test is intended to simulate the conditions that would occur when a spinup with a high flow is underway. Under these conditions, standby power would restore power to the facility after a delay of a fraction of a second – the time needed for the transfer switch to activate.)

L.8.1 Verify that the LGS is operating under normal conditions: pumps LGP-1, -2, -3, -4 are running and valves LGV-1, -3, -6, -7, -10 are open.

L.8.2 Verify that all GSV, AXV, and SEV valves are closed.

L.8.3 Turn on / verify on SEP-1, -2.

L.8.4 Open GSV-1, -2.

L.8.5 Set the GSV-4 mode switch at GSC to "auto".

L.8.6 Open the front panel on LGM-2 and verify that set point 1 is set to "SP" and that the set point 1 indicator light is on (indicating that the pressure is below 2×10^{-5} torr).

L.8.7 Press SEV-1; the indicator light will blink slowly to indicate that the valve is armed but not open.

L.8.8 Open GSV-6.

L.8.9 Set GSV-4 to 1 sccm and verify flow by observing a pressure increase at GSG-4.

L.8.10 Press the GSV-7 switch and open the front panel to LGM-2 and switch "SP-1" to "off" to open SEV-1.

L.8.11 Verify that individuals responsible for all other activities in the facility have been notified of the power interruption and have had the opportunity to make satisfactory preparations. (Any critical computers should be on UPS.)

L.8.12 Turn the standby generator keyswitch (inside the east door) to “on”, and verify that the red indicator light comes on indicating that the generator is running.

L.8.13 Station one person at transfer switch outside the FIST Lab next to the east door and another person at the spinup system control panel. When ready, open the door to the transfer switch and flip the “Test Transfer Switch” toggle switch to “Test”. This will cause the load to be transferred to the standby generator.

L.8.14 Record any changes in valve states:_____

L.8.15 Record any changes in pump operation:_____

L.8.16 Return the load to utility power by flipping the “Test Transfer Switch” toggle switch to “Retransfer”.

L.8.17 Record any changes in valve states:_____

L.8.18 Record any changes in pump operation:_____

L.8.19 Close / verify closed GSV-1, -2, -7

L.8.20 Verify that pumps LGP-3, -4 are on and valve LGV-10 is open

L.8.21 Open, verify open valves LGV-6, -7.

L.8.22 If both turbopumps are not running, push the reset button on the appropriate TCP 5000, and verify that it restarts. (LGP-1 is the most likely to need resetting.)

L.8.23 Verify that LGV-1, -3 reopen when their respective turbopumps are at >80% speed as indicated by a steady LED on the control panel.

L.8.24 System satisfied success criteria for momentary power failure test: During the load switching process: 1) Valve GSV-7 closes unless all other valves and pumps are unchanged; 2) valve LGV-6 (LGV-7) does not stay open after power restoration unless LGP-1 (LGP-2) remains running; 3) valve LGV-1 (LGV-3) does not stay open unless LGP-1 (LGP-2) is >80% full speed.

QA witness: _____

Date / time: _____

L.8.25 Turn the standby generator keyswitch (inside the east door) to “off”. (Note: Generator shuts off only after a delay for cooldown.)

L.8.26 Pumping out supply and exhaust lines:

L.8.26.1 Set the keyswitch to "Interlock Defeat"

L.8.26.2 Close GSV-1, -2, -6.

L.8.26.3 Open GSV-7, -8, -9, -10.

L.8.26.4 Verify SEP-1, -2 are on.

L.8.26.5 Open AXV-8, -5 to pump out the gas supply manifold.

L.8.26.6 When the pressure at GSG-4 reads <0.3 torr, close / verify closed:

L.8.26.6.1 GSV-4 by setting set point controls to zero and switching mode switches to "off".

L.8.26.6.2 All remaining GSV's

L.8.26.7 Close AXV-5 and open AXV-6.

L.8.26.8 Open SEV-1 and SEV-2 until SEG-1 reads <0.1 torr and then reclose both valves.

L.8.26.9 Close AXV-6, -8, and GSV-6, -7, -8, -9, -10.

L.8.27 Set Interlock Defeat switch to off.

L.9 Pump failure tests: Perform this section if the PLC program has been altered. If no alteration has occurred since the last certification, record the Op. Order number of that certification procedure: _____.

L.9.1 Verify that the LGS is operating under normal conditions: pumps LGP-1, -2, -3, -4 are running and valves LGV-1, -3, -6, -7, -10 are open.

L.9.2 Verify that all GSV, AXV, and SEV valves are closed.

L.9.3 Verify response to LGP-4 (forepump) failure:

L.9.3.1 Switch off the breaker to LGP-4 (F3 on the TCS 120).

L.9.3.2 Verify that all LG valves close and LG pumps shut down.

L.9.3.3 Restore power to LGP-4; LGV-10 should reopen after a short delay and LGP-3 should restart.

L.9.3.4 Reopen LGV-6, -7; LGP-1, -2 should restart and LGV-1, -3 should reopen.

L.9.4 Verify response to LGP-3 (blower) failure:

L.9.4.1 Switch off the breaker to LGP-3 (F15 on the TCS 120).

L.9.4.2 Verify that all LG valves except LGV-10 close and LG pumps except LGP-4 shut down.

L.9.4.3 Restore power to LGP-3.

L.9.4.4 Reopen LGV-6, -7; LGP-1, -2 should restart and LGV-1, -3 should reopen.

L.9.5 Verify response to LGP-2 (turbopump 2) failure:

L.9.5.1 Switch off the breaker to LGP-2 (on power distribution box).

L.9.5.2 Verify that LGV-7, -3 close.

L.9.5.3 Restore power to LGP-2.

L.9.5.4 Reopen LGV-7; LGP-2 should restart and LGV-3 should reopen.

L.9.6 Verify response to LGP-1 (turbopump 1) failure:

L.9.6.1 Switch off the breaker to LGP-1 (on power distribution box).

L.9.6.2 Verify that LGV-6, -1 close.

L.9.6.3 Restore power to LGP-1.

L.9.6.4 Reopen LGV-6; LGP-1 should restart and LGV-1 should reopen.

L.9.7 System passed pump failure tests

QA witness: _____

Date / time: _____

L.10 System shut down:

L.10.1 Close / verify closed all GSV, SEV, AXV valves.

L.10.2 Turn off SEP-1, -2.

L.10.3 Close valves LGV-1, -3, -6, -7.

L.10.4 Close valve LGV-10.

L.10.5 Flip off breakers Turbo 1 and Turbo 2 (on the Power Distribution Box).

L.10.6 Turn off LGP-3 at circuit breaker F15 on the TCS 120.

L.10.7 Turn off LGP-4 at circuit breaker F3 on the TCS 120.

L.10.8 Turn the TCS 120 Pumping Unit Control master switch off.

L.10.9 Open vent valves LGV-2, -9. (LGP-1, -2 stay evacuated unless manually vented.)

Test completed. Completed by: _____

QA Witness: _____

Date/time: _____

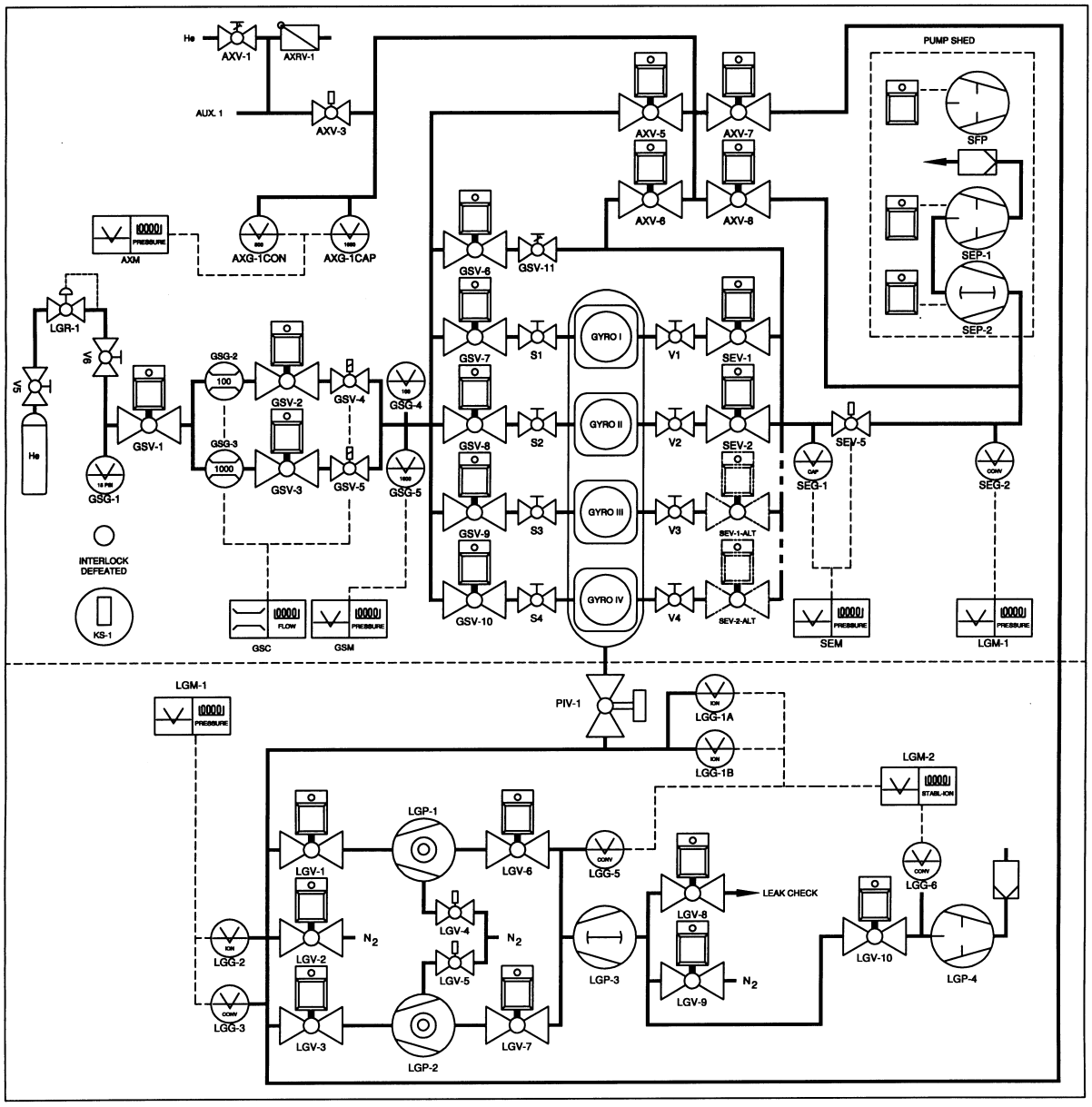
He
AXV-1
AXRV-1
AUX. 1
AXV-3
PUMP SHED
SFP
SEP-1
SEP-2
AXV-5
AXV-7
AXV-6
AXV-8
AXM
AXG-1CON
AXG-1CAP
GSV-6
GSV-11
LGR-1
V6
V5
He
GSG-2
100
GSV-2
GSV-4
GSG-4
GSV-1
GSG-3
1000
GSV-3
GSV-5
GSG-5
GSG-1
INTERLOCK DEFEATED
KS-1
GSV-7
S1
GYRO I
V1
SEV-1
GSV-8
S2
GYRO II
V2
SEV-2
SEV-5
SEG-1
SEG-2
GSV-9
S3
GYRO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

Figure 1.

Table 1 Leak Check Results (Sec. L.5)

Location	Bag/spray	Background	Leak rate	Time	Date	QA witness
LGS foreline up to LGP-6, -7						
LGP-1 foreline joints including LGP-6						
LGP-2 foreline joints including LGP-7						
LGP-1 inlet joints including pump side ofLGV-1						
LGP-2 inlet joints including pump side ofLGV-2						
Joint on chamber side of LGV-1						
Joint on chamber side of LGV-2						
Rear LGS chamber joints						
24” dia. LGS chamber seal						
LGS viewport						
8” dia. Pumping line joints on elbow nearest chamber						
6” long bellows on 8” dia pumping line						
3” long bellows on 8” dia pumping line						
8” dia. elbow and adapter ass’y at the Vatterfly valve						
SGSS plumbing from GSV-6 thru GSV-10 to V6						
Spinup connections at the Probe incl. connector savers						
Exhaust system from caps on SEV-1, -2 to SEV-5, SEV-5, GSV-11, and AXV-6						

Location	Bag/spray	Background	Leak rate	Time	Date	QA witness
Auxiliary System including both sides of AXV-5, -6, -7 and the manifold to AXV-3 (checking AXV-3 for through leaks						