GRAVITY PROBE B

PROCEDURE FOR

GSE CERTIFICATION

GSE SPINUP GAS CERTIFICATION

P0764 Rev. -
10/2/00

Prepared by: M. Taber

Approvals:

Program Responsibility	Signature	Date
C. Warren Gas/Vac. Engineer		
M. Taber Cryogenic 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
			.

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 #
LV#	6” Vatterfly Leakage Valve on the Probe
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 purges the Spinup Gas Supply System (SGSS) and collects a sample of He gas at an output of the SGSS at approximately 100 psig for analysis and verification of gas purity. **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 either a) connected to the Probe at a closed 6" Vatterfly valve (LV1 or LV2) per P0557B, or b) blanked off.

C.3 Valves GSV,-7, -8, -9, -10 are blanked off.

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

C.5 Baratron capacitance gauges GSG-4, -5 each have isolation valves.

C.6 The SGSS manifold has been pumped out and leak checked per P0567B. It may still be evacuated or it may be backfilled with He gas from the spinup gas cylinder.

D D Hardware Required

D.1 Commercial test equipment / instrumentation:

Manufacturer	Model	Serial Number	Calibr. Exp. Date
MKS Flow Meter Readout / Controller (GSG-2, -3)	260MF-1 (with plug-in modules)	65769-11	N/A
MKS mass flow meter (GSG-2, 100 sccm He)	179A12CR3BM-S	000471909	N/A
MKS mass flow meter (GSG-3, 1000 sccm He)	179A13CR3BM-S	000471910	N/A
MKS power supply / capacitance manometer readout (SEG-1)	PDR-C-2C	65769-13A	N/A
Varian capacitance manometer (SEG-1, 0-1 torr)	VCMH01TBA	LID90866	N/A
MKS power supply / capacitance manometer readout (GSG-4, -5)	PDR-C-2C	66724-2	N/A
MKS capacitance manometer (GSG-4)	122AA-00100BB	65769-7	N/A
MKS capacitance manometer (GSG-5)	122AA-01000BB	66724-1	N/A

D.2 Mechanical/Electrical Special test equipment:

D.2.1 1 liter stainless sample vessel type DOT-3A1800, (Swagelok 304L-HDF4-1000) with Swagelok SS-4H-TH3 valve and a 1/4" male VCR fitting on both ends or similar vessel provided by analytical vendor. This vessel is cleaned and evacuated per engineering direction.

D.2.2 Stainless plumbing and adapters to allow connection of one end of the sample vessel to GSV-7 and the other end to SEV-1. Flex line should not be used on the GSV side.

D.3 Tools: N/A

D.4 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:** Leak check of SGSS per P0567B, Probe Gas/vac GSE Certification

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 Record the op. order number for the performance of the SGSS leak check (P0567B, Probe Gas/vac GSE Certification): _____, and record date performed: _____.

L.2 Install the sample vessel between GSV-7 and SEV-1 per engineering direction. Do not open any valves. Nomenclature note: The valve on the GSV side of the sample vessel will be referred to as "S1" and the valve on the SEV side will be referred to as "V1" in a manner consistent with Fig. 1.

L.3 Verify that all other ports on the SGSS (at GSV-8, 9, 10) and the port at SEV-2 are capped.

L.4 Verify Appropriate QA Notification

- Verify SU QA program office notified.

  Record: Individual notified _____,

  Date/time _____/_____.

L.5 Initial set up:

L.5.1 Ensure that the following conditions are true:

L.5.1.1 All circuit breakers (except Turbo 1 and Turbo 2) are on at the Power Distribution Box;

L.5.1.2 Turbo 1 and Turbo 2 circuit breakers are off;

L.5.1.3 Compressed air pressure >100 psig as indicated by pressure gauge near flowmeters;

L.5.1.4 Compressed air supply valve is open;

L.5.1.5 All LGV's SEV's, GSV's, and AXV's are closed as indicated on control panel;

L.5.1.6 All pressure and flow gauge controllers are on;

L.5.1.7 Regulator output valve (V6) at Spinup Gas He supply is closed with the supply valve (V5) open and the regulator set 2 - 5 psig.

L.6 System pumpdown:

L.6.1 Place the valve control system in "Interlock Defeat" mode and verify that the yellow LED is blinking.

L.6.2 Open the following valves:

L.6.2.1 LGV-6, -7;

L.6.2.2 LGV-3, -1;

L.6.2.3 AXV-5, -7; (Note: AXV-8 will be opened later.)

L.6.2.4 SEV-1

L.6.2.5 GSV-7;

L.6.2.6 GSV-2, -3;

L.6.2.7 GSV-1;

L.6.2.8 GSV-4, -5 by setting the controller mode switch to "auto" and adjusting the flow control set point to approximately one-half turn on each controller.

L.6.3 Turn on SEP-1, -2 to evacuate the Spinup Exhaust System up to V-1.

L.6.4 Open AXV-8.

L.6.5 Open GSV-6.

L.6.6 After GSG-4 bottoms out, close AXV-8.

L.6.7 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.6.8 Start pumping with the LGS:

L.6.8.1 Turn the TCS 120 Pumping Unit Control master switch on, press the "Pumping Unit" button and confirm illumination of the annunciator.

L.6.8.2 Turn on LGP-4 by activating the circuit breaker F3 on the TCS 120.

L.6.8.3 Open LGV-10.

L.6.8.4 Turn on LGP-3 by activating the circuit breaker F15 on the TCS 120.

L.6.8.5 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.6.9 Verify pumpdown:

L.6.9.1 Monitor pressures at LGG-3, -5, -6 to verify that pressures are decreasing.

L.6.9.2 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.6.9.3 Open AXV-6 to allow the exhaust and supply manifolds to be pumped by the LGS. (AXV-5, -7 should already be open.)

L.6.9.4 When LGG-3 reads <10 mtorr, turn on the LGG-1A ion gauge (IG-1 on LGM-2)

L.6.9.5 When LGG-6 reads <20 mtorr, LGG-5 reads <5 mtorr, and LGG-1A reads $<10^{-6}$ torr, proceed with the next step.

QA witness:_____

L.6.10 Zero the readouts of the following gauges:

L.6.10.1 GSG-4, -5.

L.6.10.2 SEG-1.

L.7 SGSS pre-purge:

L.7.1 Close the following valves:

L.7.1.1 AXV-5, -6, -7;

L.7.1.2 GSV-4,-5 by adjusting the flow control set point to zero and setting the controller mode switch to "off" on each controller;

L.7.1.3 GSV-2;

L.7.1.4 GSV-7;

L.7.1.5 SEV-1.

L.7.2 Slowly open the following valves:

L.7.2.1 V6 (at the gas supply cylinder);

L.7.2.2 GSV-11 to about half turn.

L.7.3 Verify that the shutoff valve at the SGS GHe supply bottle (V5) is open.

L.7.4 Verify that GSV-1, -3, -6 are open.

L.7.5 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.7.6 Turn on SEP-1, -2 and verify operation.

L.7.7 Turn off "Interlock Defeat".

L.7.8 On the controler for GSV-5, set the mode switch to "auto" and adjust the flow control set point to 500 sccm.

L.7.9 Adjust GSV-11 to obtain ~6 torr at GSG-4. This will ensure viscous conditions throughout the SGSS. If 6 torr is not obtainable with GSV-11 fully open, record the minimum pressure obtainable:_____,

L.7.10 Slowly close V6 while monitoring the flow rate at GSG-3. (This will require two people.) Continue closing until the flowrate starts to drop and then reopen sufficiently to obtain 500 sccm. This will establish V6 as the primary throttling point with a high gas velocity downstream of that point.

L.7.11 Record Date / time:_____.

L.7.12 After 30 minutes have elapsed, continue with the following.

L.8 Sample vessel purge:

L.8.1 Record Date / time:_____.

L.8.2 Press SEV-1 switch; the indicator light will blink slowly to indicate that the valve is armed but not open.

L.8.3 Open both S1 and V1 on the sample vessel.

L.8.4 Press the GSV-7 switch; GSV-7 will open and GSV-6 will close.

L.8.5 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.8.6 Verify that SEV-1 opens as indicated by the sound of the valve operating and the indicator light turning on continuously. Gas is now flowing through the sample vessel.

L.8.7 Open V6 fully and verify that the flow rate is still 500 sccm.

L.8.8 Adjust valve V1 on the sample vessel to obtain approx. 5-10 torr at GSG-4.

L.8.9 Record Date / time:_____.

L.8.10 Temporarily close sample vessel valve V-1 and then reopen when the pressure at GSG-5 reaches ~ 1 atm. Repeat this a total of ten times before proceding to collect the gas sample.

L.8.11 After two hours have elapsed, continue with the following.

L.9 Collect gas sample:

L.9.1 Record Date / time:_____.

L.9.2 **Close the isolation valves for GSG-4, -5. Failure to close these valves will result in damage to these gauges during the following steps.**

L.9.3 Close sample vessel valve V1.

L.9.4 Close SEV-1.

L.9.5 Set switch SP-1 of LGM-2 to “SP”.

L.9.6 When the flow rate drops below 500 sccm, increase the regulator output pressure by 10 psi. Repeat this process every time the flowrate diminishes until the regulator setpoint is 100 psig.

L.9.7 Close sample vessel valve S1.

L.10 Bleed down the SGSS and restore to normal conditions.

L.10.1 Close GSV-11.

L.10.2 Open GSV-6.

L.10.3 Open GSV-11 until 500 sccm is reached.

L.10.4 Back down the pressure regulator slowly until the output pressure reaches 2-5 psig.

L.10.5 Reduce the flow rate set point on GSV-5 to zero and set the mode switch to “off”.

L.10.6 Close GSV-6, -3, -1,.

L.10.7 **Reopen the isolation valves to GSG-4, -5.**

L.11 Remove sample vessel:

L.11.1 Disconnect the sample vessel from the ports at GSV-7 and SEV-1.

L.11.2 Recap the ports at GSV-7 and SEV-1.

L.11.3 Remove the connecting plumbing from the sample vessel and install caps on the sample vessel.

L.11.4 Tag the sample vessel with the date and contents.

L.12 Helium gas sample preparation complete:

QA witness: _____

Date / time: _____

L.13 System shut down:

L.13.1 Close / verify closed all GSV, SEV, AXV valves.

L.13.2 Turn off SEP-1, -2.

L.13.3 Close valves LGV-1, -3, -6, -7.

L.13.4 Close valve LGV-10.

L.13.5 Flip off breakers Turbo 1 and Turbo 2 (on the Power Distribution Box).

L.13.6 Turn off LGP-3 at circuit breaker F15 on the TCS 120.

L.13.7 Turn off LGP-4 at circuit breaker F3 on the TCS 120.

L.13.8 Turn the TCS 120 Pumping Unit Control master switch off.

L.13.9 Open vent valves LGV-2, -9. (LGP-1, -2 stay evacuated unless manually vented.)

L.14 Sample analysis:

L.14.1 Package and ship the sample vessel to the analysis vendor per DOT regulations and vendor requirements as soon as possible after collecting the sample. Request analysis for N_2, O_2, Ar, CO_2, H_2, water vapor, and total hydrocarbon content.

L.14.2 Total impurity level should be $\leq 1.2 \times 10^{-5}$ per memo by G. M. Keiser and R. Brumley titled "Allowable leak rates and condensed air in the spin-up inlet lines", revised March 1, 2000.

L.14.3 Attach a copy of the analysis results to this completed procedure.

Test completed.

Completed by: _____

QA Witness: _____

Date/time: _____

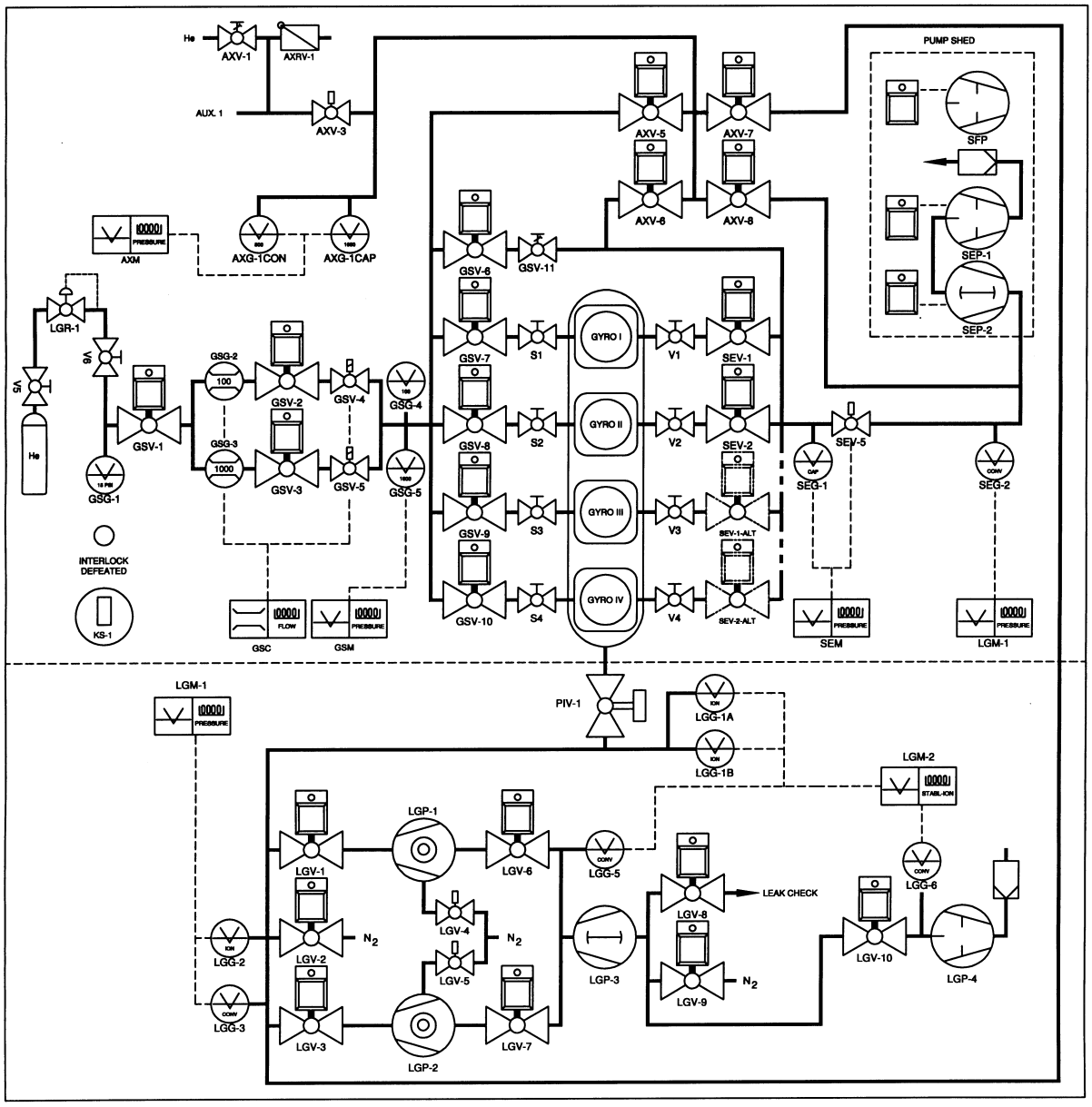
He
AXV-1
AXRV-1
AUX. 1
AXV-3
PUMP SHED
SFP
SEP-1
SEP-2
AXV-5
AXV-7
AXV-6
AXV-8
AXM
AXG-1CON
AXG-1CAP
GSV-6
GSV-11
LGR-1
V6
V5
He
GSG-2
100
GSV-2
GSV-4
GSG-4
GSV-1
GSG-3
1000
GSV-3
GSV-5
GSG-5
GSG-1
INTERLOCK DEFEATED
KS-1
GSV-7
S1
GYRO I
V1
SEV-1
GSV-8
S2
GYRO II
V2
SEV-2
SEV-5
SEG-1
SEG-2
GSV-9
S3
GYRO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