GRAVITY PROBE B
PROCEDURE FOR
PAYLOAD VERIFICATION

(PTP) PROBE PRESSURE MEASUREMENT SYSTEM REMOVAL
P0649 REV. -
12/8/99

Prepared by: M. Taber

Approvals:

<table>
<thead>
<tr>
<th>Program Responsibility</th>
<th>Signature</th>
<th>Date</th>
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</thead>
</table>
| 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:

<table>
<thead>
<tr>
<th>Rev</th>
<th>Rev Date</th>
<th>ECO #</th>
<th>Summary Description</th>
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### Acronyms and Abbreviations:

<table>
<thead>
<tr>
<th>Acronym / Abbreviation</th>
<th>Meaning</th>
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</thead>
<tbody>
<tr>
<td>GSE</td>
<td>Ground Support Equipment</td>
</tr>
<tr>
<td>LD</td>
<td>Leak Detector</td>
</tr>
<tr>
<td>LGS</td>
<td>Leakage Gas System</td>
</tr>
<tr>
<td>PPMS</td>
<td>Probe Pressure Measurement System</td>
</tr>
<tr>
<td>RGA</td>
<td>Residual Gas Analyzer</td>
</tr>
<tr>
<td>SMD</td>
<td>Science Mission Dewar</td>
</tr>
<tr>
<td>UTS</td>
<td>Utility Turbopump System</td>
</tr>
</tbody>
</table>
# Table of Contents

A Scope .......................................................................................................................... 4  
B Requirements Verification ............................................................................................. 4  
C Configuration Requirements .......................................................................................... 4  
D Hardware Required ...................................................................................................... 4  
E Software Required ....................................................................................................... 5  
F Procedures Required ..................................................................................................... 5  
G Equipment Pretest Requirements .................................................................................. 5  
H Personnel Requirements ............................................................................................... 5  
I Safety Requirements ....................................................................................................... 5  
J General Instructions ....................................................................................................... 5  
K References and Applicable Documents ........................................................................... 6  
L Operations ........................................................................................................................ 7
A  Scope
This procedure effects the removal of the Probe Pressure Measurement System. It is mounted onto the upper cylinder portion of the SMD and is connected to the interior of the Probe-C via pressure sense port P1 (See Figs. 1, 2a). A Convectron pressure gauge (GSE version of P9) will then be attached to the P1 pressure sense port. This gauge is mounted on a small manifold with a Nupro shutoff valve teed into it (see Fig. 2b).

B  Requirements Verification
B.1 Requirements Cross Reference: N/A
B.2 Expected Data for verification per requirement: N/A

C  Configuration Requirements
Probe-C is integrated into the SMD per drawing 65113-1C34292 and oriented with the +Z axis vertical. The exchange gas has been pumped out of the Probe and the pressure is less than 10^{-4} torr. The PPMS is installed and connected to pressure sense port P1 per P0558, Probe Pressure Measurement System Installation and Leak Check Procedure.

D  Hardware Required
D.1 Flight hardware required

<table>
<thead>
<tr>
<th>Description</th>
<th>No. Req’d</th>
</tr>
</thead>
<tbody>
<tr>
<td>65113-1C34292 Probe-C / Science Mission Dewar Assembly</td>
<td>1</td>
</tr>
</tbody>
</table>

D.2 Commercial test equipment

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Model</th>
<th>Serial Number</th>
<th>Calibr. Exp. Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varian He Leak Detector</td>
<td>960</td>
<td>DRAD6002</td>
<td>N/A</td>
</tr>
<tr>
<td>Alternate leak detector: Varian He Leak Detector</td>
<td>636-60</td>
<td>W-161</td>
<td>N/A</td>
</tr>
<tr>
<td>Varian Calibrated He leak for LD</td>
<td>F3264302</td>
<td>LLC9030</td>
<td>3/10/00</td>
</tr>
<tr>
<td>Calibrated He leak for alternate LD</td>
<td>F3264302</td>
<td>EBAL5056</td>
<td>3/18/00</td>
</tr>
</tbody>
</table>

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

D.4 GSE / hardware:

<table>
<thead>
<tr>
<th>Description</th>
<th>No. Req’d</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convectron gauge assembly (Fig. 2b)</td>
<td>1</td>
</tr>
<tr>
<td>4’ x 4’ HEPA filter downflow unit with vinyl curtains mounted below gantry</td>
<td>1</td>
</tr>
<tr>
<td>1/2” aluminum Gamah gasket</td>
<td>1</td>
</tr>
<tr>
<td>1” or 1.5” stainless flexible pumping line (length A/R)</td>
<td>1</td>
</tr>
<tr>
<td>KF-VCR adapter (to connect between pumping line and 1/4” male VCR)</td>
<td></td>
</tr>
<tr>
<td>Utility Turbopump System (Fig. 3)</td>
<td>1</td>
</tr>
</tbody>
</table>
D.5 Tools

<table>
<thead>
<tr>
<th>Description</th>
<th>No. Req’d</th>
</tr>
</thead>
<tbody>
<tr>
<td>wrenches</td>
<td>A/R</td>
</tr>
<tr>
<td>75 ft-lb. torque wrench</td>
<td>1</td>
</tr>
</tbody>
</table>

D.6 Expendables

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2” aluminum Gamah gasket</td>
<td>1</td>
</tr>
<tr>
<td>1/4” VCR gaskets</td>
<td>A/R</td>
</tr>
<tr>
<td>Aluminum foil</td>
<td>A/R</td>
</tr>
<tr>
<td>Felpro C5-A anti-seize compound (or equivalent)</td>
<td>A/R</td>
</tr>
<tr>
<td>He gas</td>
<td>A/R</td>
</tr>
</tbody>
</table>

E Software Required

E.1 Flight Software: N/A
E.2 CSTOL Scripts: N/A
E.3 SPC Scripts: N/A
E.4 Test Support Software

Test Software Name

<table>
<thead>
<tr>
<th>Test Software Name</th>
<th>Version No.</th>
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<tbody>
<tr>
<td>Inficon TranspectorWare (for RGA)</td>
<td>3</td>
</tr>
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</table>

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, Dave Murray, Tom Welsh, and Mike Taber are qualified to perform this procedure with either Mike Taber or Dave Murray being operations leader. The QA representative shall be either Russ Leese or Dorrene Ross.

I Safety Requirements
Movement of the gantry used to support the HEPA downflow booth 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. General emergency instructions can be found in "FIST Emergency Procedures", P0141.

J General Instructions
J.1 Redlines can be initiated by Mike Taber or Dave Murray and must be approved by QA.
J.2 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.3 Only the following persons have the authority to exit/terminate this operation or approve D-Log dispositions: Mike Taber, Dave Murray.

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: P0558, Probe Pressure Measurement System Installation and Leak Check Procedure
L. Operations

L.1 Removing the PPMS:
   L.1.1 Turn off / verify off both ion gauges and the RGA on the PPMS.
   L.1.2 Close the probe P1 isolation valve.
   L.1.3 Install / verify installed the HEPA downflow unit over the top of the SMD / probe; at least one hour of operation in this location should elapse before proceeding. Observe General Instruction J.4 in the following steps.
   L.1.4 Remove the KF-40 cap at the guard valve on the PPMS and connect a flexible pumping line to the UTS (Fig. 3).
   L.1.5 Connect a purged source of He gas to the let-up port at TV-5.
   L.1.6 Start up the UTS:
      L.1.6.1 Place the Interlock switch in the “override” position.
      L.1.6.2 Push the red “reset” button to reset the interlock circuit.
      L.1.6.3 Turn on the Vane Pump and Converter.
      L.1.6.4 Verify that the foreline valve switch (red illuminated switch on the front panel) is on.
      L.1.6.5 Push the Sensor button on the vacuum gauge display so that the “Pir” annunciator shows.
      L.1.6.6 Slowly open TV-4.
      L.1.6.7 When the vacuum gauge reads < 1 torr, open the guard valve on the PPMS.
      L.1.6.8 Push the Start button on the Turbo Controller.
      L.1.6.9 When the “Normalbetrieb” light comes on, open the gatevalve, TV-1, and close TV-4.
      L.1.6.10 Switch the valve interlock switch to the “protected” position.
      L.1.6.11 Push the sensor button on the Vacuum Gauge readout so that the “Hi-Vac” annunciator shows, and push the Emis button to turn on the cold
cathode gauge (TG-1).

L.1.7 When TG-1 reads less than $10^{-4}$ torr, open the PPMS pumpout valve.

L.1.8 Turn off TG-1 and close TV-1.

L.1.9 Slowly open TV-5 and admit He gas until TG-3 reads ~9 torr.

L.1.10 Record the pressure at TG-3 for 30 minutes and verify that the pressure does not drop by more than 0.2 torr during the last 20 minutes.

<table>
<thead>
<tr>
<th>Time:</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Pressure:</td>
<td></td>
<td>-------</td>
</tr>
</tbody>
</table>

L.1.11 Slowly open TV-5 and admit He gas until TG-3 reads one atmosphere.

L.1.12 Verify that probe temperatures have not changed as a consequence of venting the PPMS.

L.1.13 Close the PPMS guard valve.

L.1.14 Disconnect the flexible pumping line and cap off the PPMS access port.

L.1.15 Disconnect the PPMS from the P1 sense line at the 1/2” Gamah fitting and cover the glands with aluminum foil.

L.1.16 Remove the PPMS from its mounting bracket and stow.

L.1.17 Remove the PPMS mounting bracket from the dewar and stow with its mounting hardware.

L.2 Installing the Convectron gauge assembly to P1:

L.2.1 Locate the P1 Convectron assembly and verify that the Gamah nut has a small amount of anti-seize compound on the interface between the nut and the gland.

L.2.2 Using a fresh aluminum Gamah gasket, install the Convectron gauge assembly on the P1 port. Care should be taken to minimize the rotation between the two Gamah glands.

L.3 Leak checking the Convectron gauge assembly:

L.3.1 Verify leak detector operation:

L.3.1.1 Install a blankoff plug on the LD test port.

L.3.1.2 Perform LD autocal (model 960) or manually check LD tuning.

L.3.1.3 Turn on LD calibrated leak and record: ________________ sccs He

Calibrated leak value: ________________ sccs

QA witness:_________
L.3.1.4 Turn off the calibrated leak and vent LD.

L.3.2 Connect the pumping line to the LD and connect the other end to the Convectron assembly access valve using a KF-VCR adapter.

L.3.3 Install a plastic bag around the Convectron assembly including the Gamah joint to P1 isolation valve.

L.3.4 Open the Convectron assembly access valve.

L.3.5 Start LD and apply He to the bag for 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.4 Verify Convectron operation:

L.4.1 Connect Convectron gauge cable.

L.4.2 Turn on Convectron and verify proper operation. Record pressure: mtorr.

L.4.3 When the pressure in the Convectron assembly is $<1$ mtorr, close the Convectron assembly access valve.

L.4.4 Vent the leak detector and verify that the Convectron gauge reading does not change.

L.4.5 Open the probe P1 isolation valve. Record pressure: __________ mtorr.

L.5 Finalize configuration:

L.5.1 Disconnect the pumping line from the Convectron assembly access valve.

L.5.2 [Optional] Shut down the LD per manufacturer’s instructions.

L.5.3 [Optional] Turn off and remove the HEPA downflow unit per engineering instructions.

Operation completed. Completed by: ____________________

QA witness: ____________________

Date: ____________________

Time: ____________________
Figure 2a  Initial configuration with PPMS installed

Figure 2b  Configuration with Convectron assembly installed
Figure 3 Utility Turbopump System configuration and nomenclature