GRAVITY PROBE-B
PAYLOAD TESTING
PROCEDURE

CERTIFY UTS AFTER TRANSPORT

P0787a

ECO 1298

August 10, 2001

Originator
J. Maddocks

Approvals:

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_____ Date _____

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GP-B Quality Engineer

REVISION RECORD

REVISION	ECO	PAGES	DATE
A	1298	Added minor redlines Changed expected values of pressure in Section G.1.11 Changed numbering format and updated Sections A through F.	8/10/01

Table of Contents

List of Abbreviations and Acronyms

AG-x	Gauge x of Gas Module auxiliary section	MT	Main Tank
AMI	American Magnetics Inc.	MTVC	Main Tank Vent Cap
ATC	Advanced Technology Center	MTVC-G	Main Tank Vent Cap pressure gauge
APR-x	Pressure regulator x of Gas Module	MTVC-RV	Main Tank Vent Cap relief valve
AV-x	Valve x of Gas Module auxiliary section	MTVC-V	Main Tank Vent Cap valve
CG-x	Gauge x of portable helium pressurization source	NBP	Normal boiling point
CPR-x	Pressure regulator x of portable helium pressurization source	ONR	Office of Naval Research
CV-x	Valve x of portable helium pressurization source	PFCG	Fill Cap assembly pressure Gauge
CN [xx]	Data acquisition channel number	PFM	Pump equipment Flow Meter
DAS	Data Acquisition System	PG-x	Gauge x of Pump equipment
EFM	Exhaust gas Flow Meter	PM	Pump Module
EG-x	Gauge x of Gas Module exhaust section	psi	pounds per square inch
EH-x	Vent line heat exchanger in Gas Module	psig	pounds per square inch gauge
EM	Electrical Module	PTD	Payload Test Director
ERV-x	Relief valve of Gas Module exhaust section	PV-x	Valve x of the Pump equipment
EV-x	Valve number x of Gas Module exhaust section	QA	Quality Assurance
FCV	Fill Cap Valve	RAV-x	Remote Actuated Valve-x
FIST	Full Integrated System Test	RGA	Residual Gas Analyzer
GHe	Gaseous Helium	SMD	Science Mission Dewar
GM	Gas Module	STV	SMD Thruster vent Valve
GP-B	Gravity Probe-B	SU	Stanford University
GSE	Ground Support Equipment	SV-x	SMD Valve number x
GT	Guard Tank	TG-x	Gauge x of Utility Turbo System
GTVC	Guard Tank Vent Cap	TV-x	Valve x of Utility Turbo System
GTVC-G	Guard Tank Vent Cap pressure gauge	UTS	Utility Turbo System
GTVC-RV	Guard Tank Vent Cap relief valve	Vac	Vacuum
GTVC-V	Guard Tank Vent Cap valve	VCP-x	Vent cap pressure gauge
GTV-G	Guard Tank vent pressure gauge	VCRV-x	Vent cap relief valve
GTV-RV	Guard Tank vent relief valve	VCV-x	Vent cap valve
GTV-V	Guard Tank vent valve	VDC	Volts Direct Current
KFxx	Quick connect o-ring vacuum flange (xx mm diameter)	VF-x	Liquid helium Fill line valve
LHe	Liquid Helium	VG-x	Gauge x of Vacuum Module
LHSD	Liquid Helium Supply Dewar	VM	Vacuum Module
LHV-x	Liquid Helium Supply Dewar valves	VV-x	Valve x of Vacuum Module
LLS	Liquid level sensor	VW-x	Valve x of Dewar Adapter
LM	Lockheed Martin Co.		

A. SCOPE

This procedure describes the steps necessary start up the UTS after transportation, and check all gauges, pneumatic valves, and pumps for proper operation.

B. SAFETY

B.1. Potential Hazards

Personal injury and hardware damage can result during normal positioning, assembly and disassembly of hardware. Examples include: positioning Dewar in tilt stand; integrating probe with airlock; positioning airlock on Dewar; removing airlock from Dewar; removing probe from Dewar; and positioning support equipment such as pressurized gas cylinders and supply dewars.

A number of undesired events may be associated with these operations. For example, personnel or equipment can be struck when hardware is being moved (e.g. by forklift or crane load). Personnel are subject to entrapment while positioning hardware, such as hands or feet caught between objects as hardware is moved into place. Suspended hardware may be dropped. Personnel can be caught between objects such as forklifts and walls or loads and building support columns.

In addition, liquid helium used in the SMD represents a hazardous material for the personnel involved in the operations. Cryogenic burns can be caused by contact with the cold liquid or gas, high pressures can result if boiling liquid or cold gas is confined without a vent path, and asphyxiation can result if the vent gas is allowed to accumulate.

The SMD Safety Compliance Assessment, document GPB-100153C discusses the safety design, operating requirements and the hazard analysis of the SMD.

B.2. Mitigation of Hazards

B.2.1. Lifting hazards

There are no lifting operations in this procedure

B.2.2. Cryogenic Hazards

There are no cryogenic operations in this procedure.

B.2.3. Injuries

In case of any injury obtain medical treatment as follows
LMMS **Call 117;** Stanford University **Call 9-911**

C. QUALITY ASSURANCE

C.1. QA Notification

The ONR representative and SU QA shall be notified 24 hours prior to the start of this procedure. Upon completion of this procedure, the QE Manager will certify his/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.

C.2. Red-line Authority

Authority to red-line (make minor changes during execution) this procedure is given solely to the PTD or his designate and shall be approved by the QA Representative. Additionally, approval by the Payload Technical Manager shall be required, if in the judgement of the PTD or QA Representative, experiment functionality may be affected.

C.3. Discrepancies

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.

Any time a procedure calls for verification of a specific configuration and that configuration is not the current configuration, it represents a discrepancy to be dealt with in one of three ways.

1. If the discrepancy has minimal effect on procedure functionality (such as the state of a valve that is irrelevant to performance of the procedure) it shall be documented in the procedure, together with the resolution. Red-lines to procedures are included in this category.
2. If the discrepancy is minor, but affects procedure functionality, it shall be recorded in the D-log. Resolution shall be in consultation with the PTD and QA representative.
3. All critical and major discrepancies shall be documented in Discrepancy Reports.

D. TEST PERSONNEL

D.1. Personnel Responsibilities

The performance of this procedure requires a minimum complement of personnel as determined by the Test Director. The Test Director is the designated signer for the “witnessed by” sign-off located at the end of each procedure. The person in charge of the operation (Test Director or Test Engineer) is to sign the “completed by” sign-off.

D.2. Personnel Qualifications

The Test Director must have a detailed understanding of all procedures and facility operations and experience in all of the SMD operations. Test Engineers must have SMD Cryogenic operations experience and an understanding of the operations and procedures used for the cryogenic servicing/maintenance of the Dewar.

D.3. Qualified Personnel

Test Director	***Test Engineer***
Mike Taber	Tom Welsh
Dave Murray	Chris Gray
Jim Maddocks	Bruce Clarke
Dave Frank	Ned Calder

E. REQUIREMENTS

E.1. Electrostatic Discharge Requirements

This procedure does not include any equipment sensitive to electrostatic discharge.

E.2. Lifting Operation Requirements

There are no lifting operations in this procedure

E.3. Hardware/Software Requirements

E.3.1. Commercial Test Equipment

No commercial test equipment is required for this operation.

E.3.2. Ground Support Equipment

None required

E.3.3. Additional Test Equipment

Item	Description	Manufacturer
1	Helium leak detector	Varian

E.3.4. Additional Hardware

None required

E.3.5. Tools

None required

E.3.6. Expendables

Description	Quantity	Mfr./Part No.
Liquid nitrogen	AR	N/A
99.99% pure helium gas	AR	N/A

E.4. Instrument Pretest Requirements

N/A

E.5. Configuration Requirements

N/A

E.6. Optional Non-flight Configurations

N/A

E.7. Verification/Success Criteria

N/A

E.8. Payload Constraints and Restrictions

N/A

E.9. Configuration Requirements

N/A

F. REFERENCE DOCUMENTS

F.1. Drawings

Drawing No.	*Title*
LMMS-5833394	*Instrumentation Installation*

F.2. Supporting documentation

Document No.	*Title*
SU/GP-B P0108	*Quality Plan*

F.3. Additional Procedures

Document No.	*Title*
SU/GP-B P0792	*Prepare Payload GSE for Transport*

Operation Number:_____

Date Initiated:_____

Time Initiated:_____

G. OPERATIONS

G.1. Establish Initial Condition of UTS

G.1.1. Visually inspect UTS. Record damage: _____

_____

G.1.2. Verify all access ports are capped.

1. Primary pump-out port (at TV-1)
2. Leak Detector port (TV-3)

G.1.3. Ensure over-ride switch in protect position.

G.1.4. Ensure valves TV-3, TV-4, TV-5, TV-6 and RGA-V are closed.

G.1.5. Start compressor to pressurize air for pneumatic valve operation.

G.1.6. Turn on converter (Note: converter switch provides power to turbopump controller and pirani and cold-cathode vacuum-gauge display.)

G.1.7. Record status of pneumatic valves per lighted switches.

Valve	*Switch Light on (Open)*	*Switch Light off (Closed)*	*Expected Status*
TV-1 (Gate Valve)			Closed
TV-2 (Foreline Valve)			Closed

G.1.8. Turn on/verify on pressure gauges TG-2, and TG-3.

G.1.9. Push the “Sensor” button on the vacuum gauge display to read the foreline pressure (TG-4). (This is the pirani gauge. The “Pir” annunciator will appear in upper left corner of the display.)

G.1.10. Verify UTS shut down according to procedure P0792, *Prepare Payload GSE for Transport*.

Record Operation Number _____ and date _____.

Note: if UTS not shut down according to P0792 the expected values in the following step may not be obtained.

G.1.11. Record pressures and compare to expected values. If pressures are significantly higher than expected, a leak may be indicated. In any case, continue with the remainder of the procedure.

Actual Reading	*Expected Reading (approximate)*
TG-2 _____ torr	< 10 torr
TG-3 _____ torr	< 10 torr
TG-4 _____ torr	< 10 torr

G.1.12. Verify normal operation of TV-2 and rotary vane pump (Fore pump) as follows:

1. Place valve interlock switch in “over-ride” position.
2. Record pressures
    a. TG-3 _____ torr.
    b. TG-4 _____ torr.
3. Turn on vane pump.
4. Push the red “reset” button to activate the interlock over-ride circuit. (the yellow-orange indicator light will come on).
5. Turn “foreline” switch on, to open TV-2. Verify that the switch illuminates.
6. When pressure at TG-4 < 25 mtorr, record pressures
    a. TG-3 _____ torr.
    b. TG-4 _____ torr.
7. Verify decrease in pressure TG-4 to verify pump operating and TV-2 opened.
8. Verify pressure at TG-3 unchanged to verify TV-1 is closed.
9. When satisfied vane pump is operating normally, TV-2 opened, and TV-1 is closed (TG-4 < 25 mtorr), proceed to next step.

G.1.13. Verify normal operation of TV-1.

1. Record pressures
    a. TG-3 _____ torr.
    b. TG-4 _____ torr.
2. Close TV-2.
3. Open TV-1 (Verify that switch illuminates).
4. When pressures TG-3 and TG-4 stabilize, record
    a. TG-3 _____ torr.

b. TG-4 _____ torr.

5. Verify increase in pressure TG-4 and decrease in pressure TG-3 to verify VV-1 opened).
6. Wait 1 minute then record pressures:
   a. TG-3 _____ torr.
   b. TG-4 _____ torr.
7. Verify pressures TG-3 and TG-4 remain unchanged (or increase slightly) to verify TV-2 closed.
8. When satisfied TV-1 opened normally and TV-2 closed normally, close TV-1.
9. Open TV-2.
10. Wait 1 minute and record pressures:
    a. TG-3 _____ torr.
    b. TG-4 _____ torr.
11. Verify that TV-4 decreased and TV-3 remained unchanged (or increased slightly) to verify TV-1 closed.
12. When satisfied TV-1 and TV-2 operate normally proceed to next step.

G.1.14. Verify normal operation of turbo pump.

1. Record date/time: _____/_____
2. Verify closed/close TV-1.
3. Verify open/open TV-2.
4. Slowly open TV-4.
5. When foreline pressure (TG-4) < 1 torr, push “Start” button on turbo controller.
6. When the ”Normalbetrieb” light illuminates on turbo controller, indicating turbopump is up to speed, open gate valve TV-1 and close TV-4.
7. Switch the valve interlock switch to the “protected” position.
8. 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).
9. Record the ”Hi-Vac” pressure (TG-1) _____ torr.
10. Continue evacuation up to capped-off pump-out port until the pressure at TG-1 is < 1.0×10^{-6} torr then record:
    a. Time of day:_____
    b. TG-1 pressure:_____ torr.

11. When satisfied that turbo is operating normally, the procedure to certify operation of the UTS is complete.

G.2. **Leak Test UTS**

G.2.1. Turn on and verify calibration of leak detector. Record

1. Calibrated leak value _____ sccs; cal exp. Date:_____
2. Measured leak value _____ sccs

G.2.2. Connect leak detector to the UTS at access port (LD).

G.2.3. Leak test the system up to closed valve TV-3

G.2.4. Turn the leak detector's vent disable switch to the disabled position.

G.2.5. Slowly open leak detector access valve TV-3. Monitor the system pressure, as read on gauge TG-1, as this valve is opened to ensure it does not rise above 1 x 10-5 torr.

G.2.6. Close valve TV-2.

G.2.7. Leak test all pumping lines and connections.

G.2.8. Record Leak detector readings:

1. Initial background:_____sccs He
2. Final reading:_____sccs He

G.2.9. Verify no leaks > 1.0×10^{-7} sccs are present.

G.2.10. Open valve TV-2.

G.2.11. Close valve TV-3.

G.2.12. Turn the leak detector's vent disable switch to the off position.

G.2.13. Vent the leak detector to air.

G.2.14. Disconnect the leak detector from the leak check access port.

H. **PROCEDURE COMPLETION**

Completed by:_____

Witnessed by:_____

Date: _____

Time:_____

Quality Manager_____ **Date**_____

Payload Test Director_____ **Date**_____

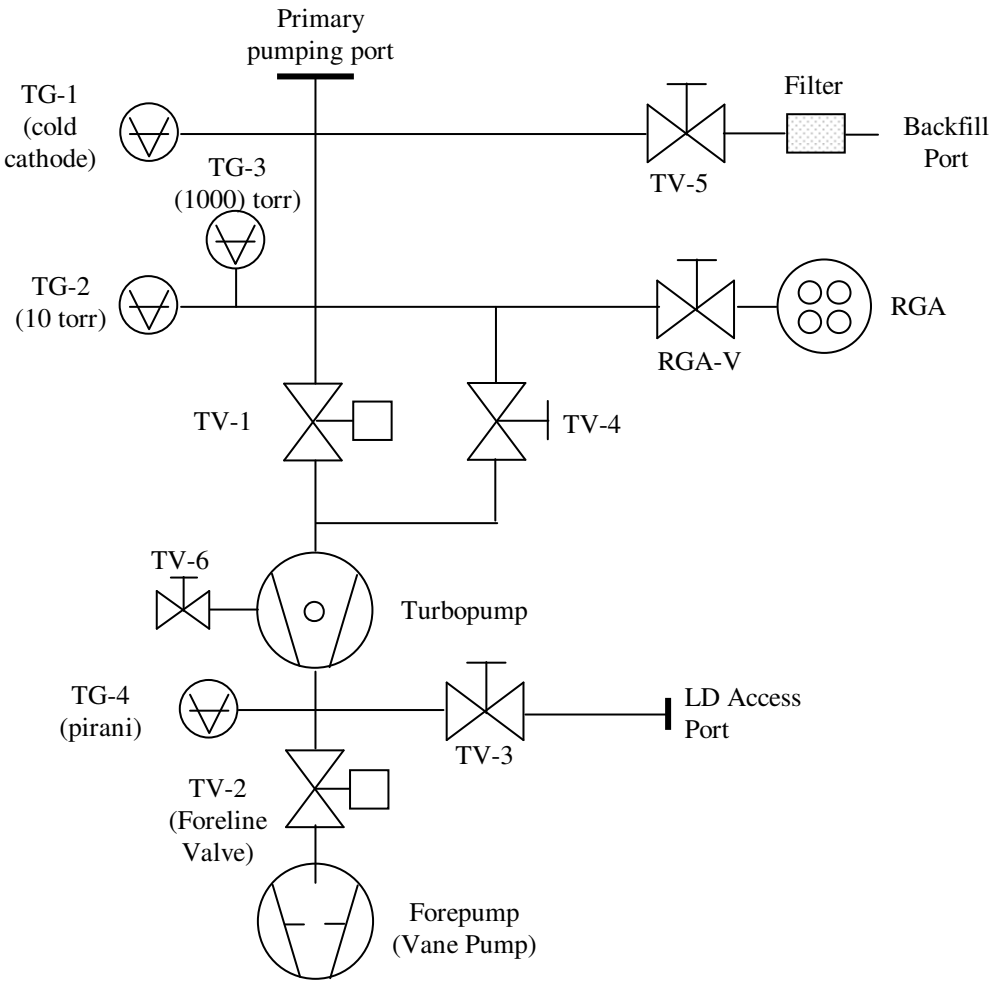

Figure 1. Schematic diagram of Utility Pumping System (UTS)