

**GRAVITY PROBE B
PROCEDURE FOR
PAYLOAD OPERATIONS**

**CONFIGURE PAYLOAD FOR
TRANSPORT TO LOCKHEED**

P0873 Rev. -
8/14/01

Prepared by: M. Taber

Approvals:

Program Responsibility	Signature	Date
D. Murray Cryo. Test Director		
M. Taber Payload Test Director		
D. Ross GP-B Quality Assurance		
R. Brumley Payload Technical Manager		

NOTES:

Level of QA required during performance of this procedure:

- 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
DAS	SMD Data Acquisition System
FDAS	Facility Data Acquisition System (used to monitor the Probe)
GSE	Ground Support Equipment
GT	Guard Tank
LGS	Leakage Gas System
MT	Main Tank
MTVP	Mock Thruster Vent Pallet
NBP	Normal boiling point
PPMS	Probe Pressure Measurement System
RGA	Residual Gas Analyzer
SMD	Science Mission Dewar

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Gravity Probe B

8/14/01

Configure Payload for Transport to Lockheed

Procedure No. P0873 Rev. -

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A Scope

This procedure effects the preparation of the Payload (Probe-C integrated with the SMD) for shipment Stanford University to Lockheed Martin.

B Requirements Verification:

N/A

C Configuration Requirements

Probe-C is integrated into the SMD per drawing 65113-1C34292 and oriented with the +Z axis vertical in the Assembly and Test Stand. No electronic boxes are mounted on the Payload. The Main Tank is at NBP and venting through the Gas Module valves EV-9 and ERV-1. The thuster vent has the Mock Thruster Vent Pallet (MTVP) installed per P0834. The Guard Tank is either empty of liquid and being maintained at a pressure slightly above atmospheric by an external source of helium gas, or is at least 15% full of liquid helium. The Well and Probe are both evacuated, and the Probe Pressure Measurement System (PPMS) is installed and functional. The Probe He partial pressure as measured by the RGA at the PPMS should be $<5 \times 10^{-6}$ torr. The fill line burst disk port has special double relief valve and pressure transducer GSE installed. The Fill Bayonet (B3) has a standard GSE Fill Cap Assembly installed.

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
Varian Calibrated He leak for LD	K3264302	LLC9030	1/25/02

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

D.4 GSE / hardware:

Note: Items in parentheses are for reference, their use being described in a called procedure.

Description	No. Req'd
4' x 4' HEPA filter downflow unit	1
Main Tank vent cap GSE (bayonet cap with Circle Seal 532B-4MP- 1 and 532B-4M-.5 relief valves in series; see Fig. 2)	1
(Utility Turbopump System, UTS)	1
Dewar Protective Cover, 06887-8A02673GSE-101	1

D.5 Tools

Description	No. Req'd

Description	No. Req'd

D.6 Expendables

Description	Quantity
Ethanol or isopropanol	A/R
Lint-free wipes	A/R

E **Software Required:**

N/A

F **Procedures Required**

(Note: All the following should be available; however, depending on circumstances, not all will be needed.):

- P0213, *SMD Connection of High Vacuum Module*
- P0214, *Stop Pumping SMD Vacuum Shell / Disconnect Vacuum Module*
- P0442, *Main Tank Fill with Guard Tank Precool – Main Tank at NBP*
- P0564, *Pump Out Probe-C with UTS*
- P0566, *Discontinue Pump-Out of Probe C with UTS*
- P0595, *Reduce Level in MT (Liquid at NBP)*
- P0613, *Repump Well with Probe Installed*
- P0645, *Fwd. Rev. C SRE and ECU Engineering Unit Removal*
- P0648, *Main Tank Fill After Uprighting – Guard Tank Initially Empty*
- P0649, *Probe Pressure Measurement System Removal*
- P0675, *Disconnect MT Vent Line from Gas Module – MT at NBP*
- P0677, *Disconnect GT Vent Line from GM*
- P0788, *Disconnect Electrical GSE from SMD*
- P0789, *Connect TM&A to SMD*
- P0794, *Drain GT into MT*
- P0795, *Install Fill Line Burst Disk on SMD*
- P0797, *Pressurize the Guard Tank*
- P0799A, *Prepare and Verify Probe Configuration for Shipment*

G **Equipment Pretest Requirements:**

N/A

H **Personnel Requirements**

This procedure is to be conducted only by certified personnel. Persons certified to perform this procedure are Mike Taber, Dave Murray, Jim Maddocks, Tom Welsh, and Ned Calder. Persons authorized to be Test Director for this procedure are Mike Taber, Dave Murray or Jim Maddocks.

I **Safety Requirements**

These operations are to be performed in the vicinity of and on flight equipment. All heavy tools or other objects that could drop onto flight equipment and cause damage shall be tethered. Safety requirements in procedures called by this procedure shall be observed.

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 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 Workers inside the HEPA filter downflow unit should use 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 NASA representative notified.
Record: Individual notified _____,
Date/time _____ / _____.
L.2 Install the scaffold and scaffold platform if not already installed.
 - L.3 Remove / verify removed any test forward electronics still mounted on the SMD.
Record Op(s). No(s).as needed:_____.
 - L.4 Remove, verify removed, non-flight forward electronics brackets Oper
engineering instruction.
 - L.5 Perform Procedure P0799A, *Prepare and Verify Probe Configuration for
Shipment*. Record Op. No.:_____. Note: Do not disconnect the FDAS
instrumentation cables from the Probe at this time. This will be done at the
same time the SMD instrumentation cables are disconnected (L.23).
 - L.6 Verify that the He partial pressure as measured by the RGA on the PPMS is $<5 \times 10^{-6}$ torr and record: _____torr If the He partial pressure does
not meet this requirement, Perform P0564, *Pump Out Probe-C with UTS*.
Record Op. No.:_____
 - L.7 Check pressure in the SMD vacuum jacket:
 - L.7.1 Turn on the Ion Pump and record time /
date:_____
 - L.7.2 Initiate [Monitor Data] on the DAS using channel no. 99.
 - L.7.3 Wait until the pressure stabilizes and record vacuum jacket pressure
(IP):_____torr.
 - L.7.4 Exit [Monitor Data] and collect data with [Set Data Interval] (use existing
data interval).
 - L.7.5 After the data cycle is complete, turn off the Ion Pump.

- L.8 If the pressure measured by the Ion Pump is $>8 \times 10^{-6}$ torr, or it has been over a month since the SMD vacuum shell has been pumped on, or the Test Director determines that it is necessary, pump on the on SMD vacuum jacket using P0213, *Connect Vacuum Module / Pump on SMD Vacuum Shell*. Record the Op No.:_____.
- L.9 Record the liquid levels in the Main Tank and Guard Tank:
Main Tank:_____ %
Guard Tank:_____ %
- L.10 If the Main Tank is $<40\%$ full, fill Main Tank to 48 – 50 %:
o Guard Tank empty: Perform P0648, *Main Tank Fill After Uprighting – Guard Tank Initially Empty*. Record Op. No.:_____.
- o Guard Tank $>15\%$ full: Perform P0442, *Main Tank Fill with Guard Tank Precool – Main Tank at NBP*. Record Op. No.:_____
- Note:** Guard Tank should not be filled more than necessary.
- L.11 Prepare the Guard Tank for transport:
o Guard Tank not more than 15% full: Perform P0797, *Pressurize Guard Tank*. Record Op. No.:_____
- o Guard Tank $>15\%$ full: Perform P0794, *Drain Guard Tank into Main Tank*, leaving Guard Tank in a regged-up condition. Record Op. No.:_____. Note: The pressurization line used to reg up the Guard Tank should be long and flexible enough to allow the Payload to be lifted and translated to the Tilt Dolly when it is stationed on the west side of the FIST Lab.
- L.12 If Main Tank is $>50\%$ full, perform P0595, *Reduce Level in MT (Liquid at NBP)* to achieve 48 – 50 %. Record Op. No.:_____.
- L.13 If the Probe is being pumped by the UTS, wait until the He partial pressure indicated by the RGA on the PPMS meets the requirement specified in L.6, and then perform P0566, *Discontinue Pump-Out of Probe C with UTS*. Record Op. No.:_____.
- L.14 If the Well has not been pumped on since the last MT/GT transfer or since any other operation known to introduce He gas into the Well (such as caging Gyro 2), perform P0613, *Repump the Well with the Probe Installed*, through section G.4 (Pump on Well). Record Op. No.:_____.
- L.15 If the Well does not need to be pumped but the Well Vent Manifold is still installed, perform P0613, skipping sections G.4 and G.6, to remove the Well

Vent Manifold.
Record Op. No.:_____.

- L.16 Verify that the Well Relief Valve (RV2, 5833420-101) is capped per 5833500.
- L.17 Verify that the Well Orbit Vent (pyrovalve) Assembly (PV3, 5833903-101, Rev. A) is mounted on the SMD per 5833500, Rev. C with all openings covered with plastic caps. (Note: The bracket depicted in these drawings is obsolete flight hardware which will be replaced before flight.) Tape the caps securely in place.
- L.18 Prepare Guard Tank vent line for transport:
 - L.18.1 If the Guard Tank vent line is connected to the Gas Module, perform P0677, *Disconnect Guard Tank Vent Line from Gas Module*. This will leave the short GT vent line installed along with GTV-V and the Guard Tank Vent Cap Assemblies. Record Op. No. of the last performance of P0677 (or of this performance if it is needed):_____.
- L.19 Prepare Main Tank Vent (B1):
 - L.19.1 Perform P0675, *Disconnect Main Tank Vent Line From Gas Module – Main Tank at NBP*, with the following exceptions and options:
 - L.19.1.1 Record P0675 Op. No.:_____;
 - L.19.1.2 At G.6.2 of the procedure, select the option of disconnecting at the bayonet B1 (at SV-9);
 - L.19.1.3 Install the Main Tank vent cap specified in D.4 (Fig. 2) at SV-9 instead of the MTVC specified in P0675;
 - L.19.1.4 Skip the GT/MT manifold option at G.6.8.
 - L.19.1.5 Record the initial MT pressure as by the Thruster Vent Endeveco (CN 49):_____ torr. Date/time:_____
 - L.19.2 Observe the SMD temperatures (particularly at STA 200 and at the top of the lead bag) and pressures (particularly the GT pressure) until the MT is venting through the MT vent cap relief valves at ~1.5 psid. Record the venting MT pressure as measured by the Thruster Vent Endeveco (CN 49):_____ torr. Date/time:_____
- L.20 If the Well is being pumped on and at least 24 hrs. have elapsed since actual pumping was initiated (or since the last event which introduced helium into the Well, whichever was later), complete P0613 (initiated at L.14), *Repump the Well with the Probe Installed*, starting at section G.5 and selecting option G.7, which provides for the removal of the Well Vent Manifold.

- L.21 Perform P0649, *Remove the PPMS*. Record Op. No.:_____.
- L.22 Perform P0788, *Disconnect Electrical GSE from SMD*. Record Op. No.:_____.
- L.23 If the FDAS is connected to the Probe, make a comment in the FDAS that the FDAS is being shut down in preparation for shipment, and disconnect the cables from the FDAS to the Probe instrumentation connectors per P0799A, *Prepare and Verify Probe Configuration for Shipment*. (See step L.5, above)
- L.24 Perform P0789, *Connect TM&A to SMD*. Record Op. No.:_____.
- L.25 Visually inspect the Probe Cross Flange and Top Hat regions as well as the SMD Top Plate region to ensure that no transport preparation issues involving the forward part of the Payload were overlooked.
- L.26 Using ethanol or isopropanol and lint-free wipes, wipe down all accessible surfaces of the SMD (down to the top of the scaffold platform) and Probe.
- L.27 Install the forward portions of the Payload Protective Cover (parts 8A02673GSE-106, -105, -104) and external bagging that require access to the forward part of the Payload per drawing 8A02673GSE, Rev A and engineering instruction.
- L.28 Remove the scaffold platform and the remaining portions of the scaffold per engineering instruction.
- L.29 Provide temporary support for the GTV-V assembly sufficient for shipment.
- L.30 Remove the flooring and stanchions around the SMD.
- L.31 Install / verify installed 90-deg. elbows with plastic dust covers on burst disks BD5A&B and BD7A&B. The elbows should be pointed in the aft direction while the SMD is still mounted in the Assembly and Test Stand.
- L.32 Inspect the vacuum jacket pyrovalve (PV1) to verify that all openings are covered with dust caps. Tape the dust caps securely in place.
- L.33 If the Vacuum Module pumping line is connected to the SMD vacuum shell pumpout port (PO), perform P0214, *Stop Pumping SMD Vacuum Shell / Disconnect Vacuum Module*. Record Op. No.:_____.
- L.34 Inspect the Ion Pump (IP) to verify that the high voltage cable has been removed and that the shield and magnet are securely installed.
- L.35 Inspect the SMD fill bayonet (B3) to verify that the standard fill cap assembly (ref., e.g., Figure 3 of P0442) is installed. Disconnect the pumping line, if connected, and install a KF cap where the pumping line connects.

- L.36 After Lockheed Martin procedure installing the payload into the Tilt Dolly, use ethanol or isopropanol and lint-free wipes, wipe down all accessible surfaces of the SMD down to the aft dome.

- L.37 Install the remaining panels of the Payload Protective Cover (part 8A02673GSE-102, -103) and external bagging per drawing 8A02673GSE, Rev A and engineering instruction.

Operation completed.

Completed by: _____

QA witness: _____

Date: _____

Time: _____

QA Program Engineer _____ **Date** _____

Payload Test Director _____ **Date** _____

Figure 1 (Note: SMD valve references in the text have an "S" prefix.)

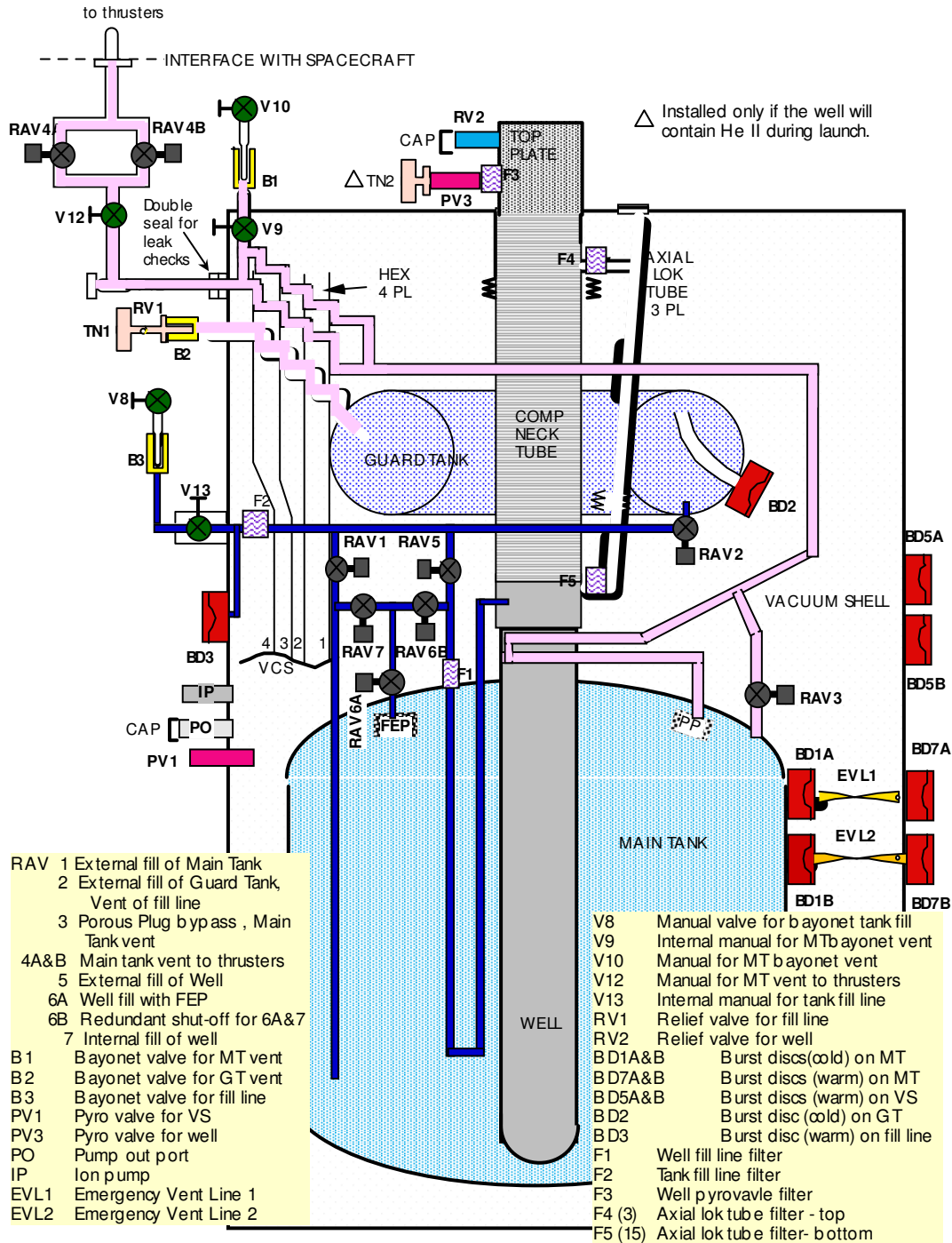


Figure 2. Cap assembly for Main Tank Vent Bayonet, B1.

