



**W. W. Hansen Experimental Physics Laboratory
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Gravity Probe B Relativity Mission

Proton Monitor Thermal – Vacuum Test Procedure

GP-B P0635

19 November, 1999

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STI

Approved by: Awele Ndili **Date**
Proton Monitor Product Team Leader

Approved by: S. Buchman **Date**
Hardware Manager

Approved by: Dorrene Ross **Date**
Quality Assurance

Notes:

1. This procedure was originally written by STI as document No.: GPB-GI-210.
- 2: All redlines must be approved by QA
Level of QA required during performance of this procedure:
 Stanford QA Representative
 Government QA Representative

1 Scope

This Document provides important information and specification of the thermal-vacuum testing (including thermal cycling) to be performed on the Proton Detectors (FM and FS) in addition to contract PR 9071.

2 Personnel Requirements

This test to be conducted only by certified personnel: Peter Rusznyak and Awele Ndili. Notify ONR 24 hours prior to beginning testing.

Person Contacted: _____ Date and Time: _____

Notify QA 24 hours prior to beginning testing.

Person Contacted: _____ Date and Time: _____

3 Quality Assurance

Operations shall be conducted on a formal basis to approved and released procedures. The QA program office shall be notified of the start of this procedure. A Quality Assurance Representative, designated by D. Ross shall be present during the procedure and shall review any discrepancies noted and approve their disposition. Upon completion of this procedure, the QA Program Engineer, D. Ross or her designate, nominally R. Leese, 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. Discrepancies will be recorded in a D-log or as a DR per Quality Plan P0108.

4 Safety Requirements

- 4.1 Electrical mating and demating of flight hardware connectors
 - 4.1.1 Place cable connector A only into socket A, etc.
 - 4.1.2 Strain relieve all cables
 - 4.1.3 Connection and disconnection shall be performed only when the equipment involved is in a powered-down state.
 - 4.1.4 Connectors shall be inspected for contamination and for bent, damaged, or recessed pins prior to mating.
 - 4.1.5 Connector savers are to be used on the Proton Monitor connectors.

Note: The mating and demating of all flight connectors must be recorded in a log. This procedure does not require removal or replacement of connector savers onto the flight connectors--they should already be in place.

4.2 Electro Static Discharge (ESD)

4.2.1 No special precautions for ESD are required for this device.

4.3 Environmental Precautions

4.3.1 The vacuum during the testing shall always be better than 10^{-6} atm (approx. 5×10^{-4} torr) inside the TV chamber. Once pumping the pressure down has started, under no circumstances can the device be switched on while the vacuum in the chamber is less than 10^{-6} atm. Also, the operator must allow at least one hour outgassing time for the PD after reaching this safe pressure. Furthermore, the PD must not be switched on for at least one hour after the pressure inside the chamber has reached normal atmospheric pressure. Failure to observe these rules will result in a catastrophic failure of the device under test.

4.3.2 To prevent condensation when the testing is finished, it is mandatory to ensure that the PD has been kept in vacuum at +30 °C temperature for at least 1 hour before the pressure inside the chamber can be increased to normal atmospheric pressure. This rule also applies to any other termination of the testing than nominal (which is shown in Figure 1.).

5 General Instructions

This section should include general instructions that apply throughout the procedure and are not covered elsewhere.

5.1 Red-line Authority

5.1.1 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 Hardware Manager shall be required, if in the judgement of the PTD or QA Representative, experiment functionality may be affected.

5.1.2 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.

5.1.3 Only the following persons have the authority to exit/terminate this test or perform a retest: Peter Rusznyak and Awele Ndili

6 Cleanliness requirements

The Proton Detector FM and FS should always be kept in a Class 100,000 or better environment. The units must be handled using gloves. Cleaning of the units is possible using ethanol only. Special precaution has to be made to avoid ethanol getting under the titanium shields.

The TV testing shall be done using witness plates inside the TV chamber to capture any potential contamination (outgassing, etc.) generated by either the PDs or by the chamber itself.

7 Hardware Required:

Flight Proton Monitor, PN _____

Ground Support Equipment: _____

<u>Metric Torque Wrench</u>	<u>Range</u>	<u>Serial ID</u>	<u>Cal Due Date</u>
GPB-GI-215	STIL	Thermal Vacuum Test Cabling	

8 Applicable Documents

PR 9071	Stanford	contract to design, fabricate and deliver the High Energy Proton Monitor
GPB-HW-052	STIL	Mechanical Interface Control Drawing (envelope dimensions)
GPB-GI-401	STIL	Functional Testing Specification / Procedures

9 Installing the Proton Detector

RECORD TEST LOCATION:

The PD shall be mounted into the Thermal Vacuum chamber using a suitable mechanical interface structure. The PD has to be mounted to the interface structure using 4 pieces of M5 stainless steel screws, including washers. No spacers or brackets should be used. The torque used on the M5 screws shall be 6 Nm.

Confirm torque setting: Test Operator Initial: _____, Date: _____, Time: _____

QA Witness: _____ Date: _____

The PD has to be installed in the TV chamber with the connector savers on. Suitable cables have to be used to allow the PD operate inside the chamber. Refer to STIL document GPB-GI-215 for the description of the cables. Ideally the two PDs (FM and FS) can be installed in the TV chamber in parallel, with two identical sets of cables to allow consecutive testing at a given temperature.

At least one – calibrated - temperature sensor has to be mounted on each side of the PDs before the thermal vacuum testing begins, as well as one sensor on the interface structure.

Set Up Compete: Test Operator Initial: _____, Date: _____, Time: _____

QA Witness: _____ Date: _____

10 Test Procedure

Test Entry: Test Operator Initial: _____, Date: _____, Time: _____

Description:

CPT (Comprehensive Performance Test) shall be performed on the PD after installation in the TV chamber, LPT (Limited Performance Test) at -40 °C and at +50 °C, LPT at +25 °C during thermal cycling and CPT at +30 °C at the end of the testing (refer to STIL document ref. no. GPB-GI-400). Figure 1 shows the test flow, which is based on approx. 10 °C/hour temperature gradient.

The LPT at operational temperature limits must be performed 1 hour after the temperature sensors mounted on the side walls of the unit have reached the specified temperature (rate of change is <1 °C/15 minutes). This delay is required to ensure that the temperature inside the Proton Detector will have stabilized.

Procedure:

<u>Step</u>	<u>Action</u>	√ complete
1	With unit in Thermal – Vacuum Chamber, perform CPT (Comprehensive Performance Test, GPB-GI-401) at ambient temperature and pressure <= 10 ⁻⁶ atm. Record Temperature: _____ Record Pressure: _____	
2	Begin thermal cycling per Figure 1 and requirements stated in Section 11.	
3	Perform LPT (Limited Performance Test, GPB-GI-401) 4 times during thermal-vacuum cycling. LPT 1 temperature: _____ LPT 2 temperature: _____ LPT 3 temperature: _____ LPT 4 temperature: _____	_____ _____ _____ _____
4	With unit in Thermal – Vacuum Chamber, perform CPT (Comprehensive Performance Test, GPB-GI-401) at ambient temperature (as shown in Figure 1).	
5	Remove power from the PD	

6	Bring the Thermal-Vacuum chamber to ambient pressure.	
7	Remove PD from thermal – vacuum chamber	

Test Complete with acceptable results.	
Performed by: _____	Date: _____
QA Witness: _____	Date: _____

11 Thermal Vacuum test specification

The Proton Detector shall be capable of nominal performance after exposure to the TV environment as specified in Table 1.

Temperature	operational	non-operational
negative	-40 °C	-50 °C
positive	+50 °C	+100 °C

Table 1. Thermal Vacuum Test limits

In addition, the PD shall remain fully functional after three cycles to the non-operational temperature limits (device not powered).

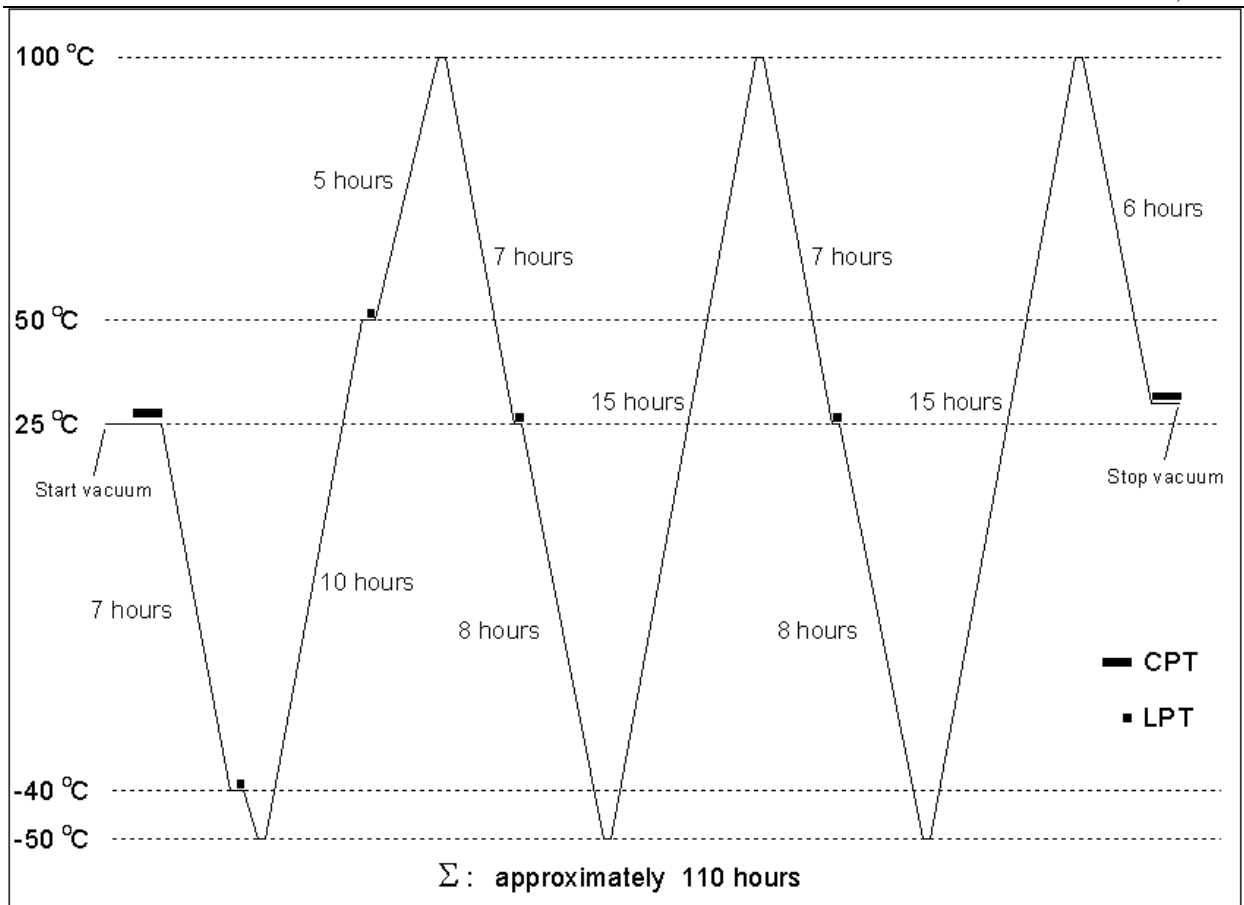


Figure 1. Test flow of the Thermal Vacuum testing

12 Procedure Completed

Test Complete with acceptable results.

Performed by: _____ Date: _____

QA Witness: _____ Date: _____

Discrepancies if any:

Approval. The information obtained under this assembly and test procedure is as represented and the documentation is complete and correct:

Test Director/ PTD: _____ Date: _____

QA Manager: _____ Date: _____