STANFORD UNIVERSITY
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GRAVITY PROBE B, RELATIVITY GYROSCOPE EXPERIMENT
STANFORD, CALIFORNIA 94305-4085

P0508 Rev -
STAKING OF FIBER-OPTIC CABLE CONNECTORS IN PROBE C

GP-B SCIENCE MISSION PROCEDURE

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PREPARED	B. Clarke, RE Charge Control	Date
APPROVED	P. Bayer, Gyro Integration Engineer	Date
APPROVED	R. Brumley, Gyro Manager	Date
APPROVED	D. Bardas, Integration Manager	Date
APPROVED	D. Ross, QA & Safety	Date
APPROVED	S. Buchman, Hardware Manager	Date

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1 SCOPE

This document provides the procedure staking the fiber optic cabling at the gyro connection. It assumes that Probe-C is mounted on the Precision Manipulator per P0205(SM) in the HEPL Class 10 Cleanroom, and the Probe Vacuum Shell has been removed per P0376(SM).

1.1 Acronyms

The following acronyms are used in this document

PM	Precision Manipulator
T-_Q	SIA Temperature Sensor
T-_P	Probe Temperature Sensor
H-_P	Probe Heater
H-_Q	Probe Heater
GRT	Germanium Resistance Thermometer
SD	Silicon Diode
TB_	Terminal Block X
DMM	Digital Multimeter
BPS_	Belleville Preload System
SIA	Science Instrument Assembly
HEPL	Hansen Experimental Physics Lab
GPB	Gravity Probe B
QA	Quality Assurance
ITD	Integration and Test Director
NA or N/A	Not Applicable
SM	Science Mission
Mohm or M?	Meg Ohm
V	Volt
I	Current
I-_	Top Hat Connector
HEX_	Heat Exchanger
UV	ultra violet

2 APPLICABLE DOCUMENTS

2.1 Plans and Procedures

P0059	GPB Contamination Control Plan
P0057	Stanford Magnetic Control Plan
P0205(SM)	Mounting Probe on Precision Manipulator
P0376(SM)	Removing the Probe Vacuum Shell
P0431AB	Hook-Up and Check-out of all Gyro Cables with Probe connectors

3 GENERAL REQUIREMENTS

3.1 Environmental Requirements

3.1.1 This procedure will be conducted in the Stanford Class 10 Cleanroom in the HEPL facility with the probe in the horizontal position. The height of the probe should be such that the engineers can work comfortably on it, typically 3 to 4 feet off the floor.

3.1.2 Cleanliness

The Class 10 clean room where this integration takes place shall be maintained at the cleanliness levels per GPB Contamination Control Plan P0059. Certified Class 10 cloth garments shall be worn in the Class 10 clean room.

Personnel should always work downstream of the probe relative to the HEPA wall, and avoid putting any part of their body between the HEPA wall and the probe. **Ion sprayers must be in place upstream of the probe**.

3.1.3 Particulate Contamination

All parts and tools shall be cleaned using methods consistent with achieving Mil Spec 1246B Level 100 cleanliness. In addition, all parts shall be maintained at level 100 cleanliness per Procedure P0059. A portable particle counter shall monitor downstream of the local work area, to ensure that particulate counts are consistent with GP-B Contamination Control Plan P0059.

3.1.4 Magnetic Contamination

Parts to be staked are in Zone 1. Take all necessary precautions to keep tooling and handling free of magnetic contamination. Tools that come in contact with these components must be of Beryllium Copper, Phosphor Bronze, ceramic, copper, brass, titanium, mating GP-B flight connectors, as well as appropriate plastics.

3.2 Integration Personnel

3.2.1 Integration and Test Director

The Integration and Test Director (ITD) shall be Bruce Clarke. He has overall responsibility for the implementation of this procedure and shall sign off the completed procedure. The Gyroscope Manager, Robert Brumley, shall also sign off this procedure.

3.2.2 Other Personnel

All personnel participating in this procedure shall work under the direction of the ITD who shall determine whether the person is qualified. Paul Bayer shall perform the staking (application of epoxy). Assisting integration engineers are expected to be (at various times) Chris Gray, Bruce Clarke and Robert Brumley. Section 6 will show all appropriate signatures.

3.3 Safety

3.3.1 General

Personnel working in the Class 10 Cleanroom must be cognizant of the base of the Precision Manipulator, and take special care to avoid tripping or bumping into it.

3.3.2 Hardware Safety

Extreme care must be taken to avoid accidentally bumping the Probe or damaging the connectors. Connector savers or equivalent adapters shall be used to protect the connector pins from damage during the measurements. A properly grounded ESD wrist strap must be worn while mating to or de-mating from Probe connectors.

3.3.3 Maximum Number of People in Cleanroom

Under normal operating conditions, there shall be no more than 5 people in the Class 10 Cleanroom. This is to avoid violating legal make up air requirements, and to provide an efficient workspace. Exceptions for short periods only must be approved by Doron Bardas, Integration Manager.

3.4 Quality Assurance

Integration 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 review any discrepancy noted during this procedure, and approve its disposition. Upon completion of this procedure, the QA Program Engineer, D. Ross, will certify 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

3.5 Red-line Authority

Authority to red-line this procedure is given solely to the ITD and QA representative. Approval by the Hardware Manager shall be required if experiment functionality may be affected. QA Program Engineering concurrence is required before final review/buyoff (on last page) of the completion of the activity described in this procedure.

3.6 Procedure Computerization Special Requirements

Because of cleanliness requirements in the Class 10 room, and to conveniently record data directly into the procedure thus generating the "as-built" document, the procedure will be handled in a paperless fashion until completed. The ITD or QA Representative will operate a Laptop computer containing an electronic version of this procedure and data shall be recorded by typing directly into the electronic file.

Following completion of the procedure, a hard copy of the "as-built" procedure shall be printed ***and signed off by all the designated parties***. It shall then be filed including an electronic copy into the database.

The electronic editing of this document shall be as follows:

- Data will be inserted into the document using normal font, i.e. non-bold, non-italic
- BLACK CAPITAL BOLD LETTERS shall designate "Signatures".
- "Redlines" shall be in ***RED BOLD ITALICS*** to make them distinguishable both on the Laptop screen and on the hard copy printout.
- Digital pictures shall be inserted into the document where appropriate.

4 REQUIRED EQUIPMENT

4.1 Flight Hardware

P/N 1C34115-102 Probe-C Assembly, w/o sunshade

4.2 Commercial Test Equipment

Description	Model	Serial Number	Calibration Expiration Date
Fluke Multimeter			

4.3 Mechanical/Electrical Special Test Equipment

Description	Part No.	Rev. No.	Serial No.	Certification Date
None needed.				

4.4 Tools

Description	Number required
Unplugging probe tool	1

Beryllium-copper 6” probe	1
Ceramic tweezers	1
Visor and loop	1
Vacuum oven designated for use in outgassing epoxy	1

4.5 Expendables

Description	Quantity
TRA-BOND EPOXY BA-2115	1 packet
Small plastic container w/secondary container	1 set

Note: No computer software is needed to perform this procedure.

5 FIBER OPTIC CABLE STAKING

5.1 Initial Preparations

Started _____ at _____ Signed: _____
date time ITD or QA Representative

5.1.1 The wire end of the unplugging probe tool must be “looped” or “hooked” in order to hold the correct amount of epoxy. Paul Bayer will determine if the tool is acceptable as is and make any changes required to bring it to his satisfaction.

5.1.2 Mix the TRA-BOND BA-2115 epoxy and dispense into the smallest of the two plastic containers. Record the batch number and expiration date below. QA is to confirm this batch has not yet expired.

TRA-BOND BA-2115 batch # _____

Expiration date _____

5.1.3 Place the container with epoxy in an acceptable vacuum oven and evacuate the chamber in order to outgas the epoxy. Let the epoxy outgas for 3 – 5 minutes.

5.1.4 Valve off the pump and vent the oven with nitrogen. Remove the small container of epoxy and place it in the larger container (secondary container).

Completed _____ at _____ Signed: _____
date time ITD or QA Representative

5.2 Inspection and Staking of Fiber Optic Cables

Started _____ at _____ Signed: _____
date time ITD or QA Representative

5.2.1 Rotate the probe such that - 45-degrees is straight up (this is the 45-degree line between SIA –Y and +X per drawing # 23171 Rev A). This should place the readout side of gyros 3 & 4 on the 45-degree line from vertical up, facing away from the HEPA filters.

5.2.2 Begin with Gyro #4, Fiber A (10:00).

5.2.3 Using the ceramic tweezers or the beryllium-copper probe, check to see if the UV fastener (P/N 23225-101) is loose. If it is loose, tighten it as best you can with the ceramic tweezers or the beryllium-copper probe. Make a note in Table I below that this part was tightened.

5.2.4 If the UV fastener was found to be loose and tightened in step 5.2.3, measure the fixture to top hat resistance for the bias connection to this fixture per P0431 and record this value in Table I. Refer to P0431AB for the top hat pin assignments.

5.2.5 Submerge the wire end of the unplugging tool into the epoxy and draw it out slowly as to hold only the smallest amount possible on the tip (loop). The amount of epoxy needed is to be determined by Paul Bayer.

5.2.6 Under the discretion of Paul Bayer, step 5.2.3 may be repeated as many times as necessary to get the correct amount of epoxy on the loop.

5.2.7 Dispense this small bead of epoxy onto the thread of the UV Fastener (P/N 23225-101) so that it flows down onto the thread of the mating part, UV Holder (P/N 23218-101).

5.2.8 Records “YES” in the column marked “STAKED?” and enter any remarks in the “REMARKS” column in Table I.

5.2.9 Repeat 5.2.3 to 5.2.8 for Gyro #4, Fiber B and for Gyro #3, Fibers A and B.

5.2.10 Rotate the probe through the smallest possible angle such that that - 135-degrees is straight up (this is the 45-degree line between SIA –Y and -X per drawing # 23171 Rev A). This should place the readout side of gyros 1 & 2 on the 45-degree line from vertical up, facing away from the HEPA filters and the readout side of gyros 3 & 4 on the 45-degree line from the vertical facing towards the HEPA filters.

5.2.11 Perform 5.2.3 through 5.2.8 for Gyro #2, Fibers A and B and then for Gyro #1, Fibers A and B.

TABLE I – FIBER OPTIC CONNECTIONS – GYRO END

Fiber optic positions (10:00 and 2:00) are as viewed from the outside of the gyro with the scribe line oriented along the 12:00/6:00 line and the open fiber optic bore at 6:00.

PROBE "UP" ORIENTATION	GYRO	FIBER	STAKED	LOOSE? (YES/NO)	R (Ohms)	REMARKS
-45 degrees	4	A (10:00)				
		B (2:00)				
	3	A (10:00)				
		B (2:00)				
-135 degrees	2	A (10:00)				
		B (2:00)				
	1	A (10:00)				
		B (2:00)				

Completed _____ at _____ Signed: _____
date time ITD or QA Representative

NOTE THAT THE PROBE IS NOT TO BE ROTATED FROM THE –135-degree UP ORIENTATION FOR AT LEAST 12 HOURS AFTER THE LAST UV CONNECTOR IS STAKED.

6 PROCEDURE COMPLETION

The results obtained in the performance of this procedure are acceptable:

Integration Engineer(s)

_____ Date _____

_____ Date _____

_____ Date _____

Discrepancies if any:

ITD _____ Date _____

Gyro Manager _____ Date _____

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

Integration Manager _____ Date _____

QA Representative _____ Date _____

QA Program Engineer_____ Date _____

7 DATA BASE ENTRY

The following data shall be entered into the GP-B database:

a) Name, number and revision of this procedure
b) An electronic copy of this document
c) A copy of the "as-built" procedure with data and pictures, when completed