STANFORD UNIVERSITY
W.W. HANSEN EXPERIMENTAL PHYSICS LABORATORY
GRAVITY PROBE B, RELATIVITY GYROSCOPE EXPERIMENT
STANFORD, CALIFORNIA 94305-4085

# BONDING THE TELESCOPE TO THE QUARTZ BLOCK

## GP-B SCIENCE MISSION PROCEDURE

**12 February, 1999**

PREPARED _____ _____
A. Nakashima Date

APPROVED _____ _____
K. Bower, Telescope Integration Date

APPROVED _____ _____
J. Gwo, Test Director Date

APPROVED _____ _____
D. Bardas, Integration Manager Date

APPROVED _____ _____
J. Janicki, Safety Engineering Date

APPROVED _____ _____
B. Taller, Quality Assurance Date

| | | |
|---|---|---|
| APPROVED | _____ | _____ |
| | S. Buchman, Hardware Manager | Date |

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# 1 SCOPE

This document provides procedures for bonding the Science Mission Telescope (Telescope #3) to the Science Mission Quartz Block (QB#3). This procedure assumes that (1) precision cleaning of the Quartz Block and Telescope have been completed, (2) the QB is in the X-Y cart in the Class 10 Cleanroom, (3) the Telescope is in the Class 10 Cleanroom, and (4) the bonding material has been prepared separately. The following procedures are included in this document.

- Initial Preparations
- Positioning Telescope and Quartz Block
- Cleaning the interface surfaces
- Bonding Telescope #3 (P/N 25091-201) to Quartz Block #3 (P/N 22770-101)
- Curing the Bond

## 1.1 Rehearsal

There shall be a rehearsal of the essential elements of this procedure using the Lexan models of the QB and the Telescope prior to beginning the work.

Completed: _____ Concurrence: _____
ITD QA or QA Representative

## 1.2 Acronyms

The following acronyms are used in this document

| | |
|---|---|
| QB | Quartz Block |
| QB/PM | Quartz Block on its vertical Precision Manipulator |
| QB/T | QB and Telescope Unit, bonded together |
| PM | Precision Manipulator |
| ITD | Integration Test Director |
| GSE | Ground Support Equipment |

# 2 REFERENCES

## 2.1 Plans and Procedures

- SU/P0218 Bonding Procedure for Fused Quartz Components
- P0057 GP-B Magnetic Control Plan, Science Mission
- P0059 GP-B Contamination Control Plan
- P0270 Transfer QB from RM to QB/PM cart

## 2.2 Drawings

- Telescope Kit (Dwg #25091-201 Rev B)
- Block, Quartz, SM (Dwg # 22770-101 Rev B)
- QB/Telescope Assembly (Dwg # 23521-101 Rev A)

# 3 GENERAL REQUIREMENTS

## 3.1 Environmental Requirements

*This procedure will be conducted in the Stanford Class 10 Cleanroom in the HEPL facility.*

3.1.1. 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.

3.1.2 Particulate Contamination

All parts and tools shall be cleaned at least to the cleanliness levels of the rooms where they are used for assembly or testing. In addition, all flight parts shall be maintained at level 100 cleanliness per GP-B Contamination Control Plan (P0059). Take all necessary precautions to keep tools and handling equipment free of particulate contamination.

To the maximum extent possible, personnel shall keep parts of their bodies downstream of the QB and Telescope, relative to the HEPA wall.

3.1.3. Magnetic Contamination

All parts and tools shall be screened per Procedure P0057.

3.1.4. Electrostatic Discharge Control

The particle ionizer should always be upstream of the QB/T relative to the fan wall, to prevent electrostatic charge buildup on the QB/T.

3.1.5 PM and the QB/PM shall be grounded

## 3.2 Integration and Test Personnel

3.2.1 Integration and Test Director (ITD)

The Integration and Test Director (ITD) shall be Dr. Jason Gwo. The ITD has overall responsibility for the implementation of this procedure and shall sign off the completed procedure.

3.2.2 Integration Engineer

The Integration Engineer shall be Ken Bower

3.2.3 Integration Manager

The Integration and Test Director (ITD) shall be Dr. Doron Bardas who shall be present to transfer the QB into the QB/PM, to set up the QB under the telescope, and to verify alignment of the Telescope to the Quartz Block, and to sign off relevant sections.

## 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.

**Safety Engineering to be notified prior to any major movement of the Quartz Block or Telescope. (i.e., any movement other than rotations or minor adjustments)**

### 3.3.2 Hardware Safety

Extreme care must be taken to avoid accidentally bumping or scratching the QB or Telescope.

Extreme care must be taken to avoid touching the bonding surfaces and the polished surfaces of the telescope and QB.

### 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 must be for short periods only, and be approved by the 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, nominally A. Nakashima, designated by B. Taller 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, B. Taller or P. Unterreiner, will certify his 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.

**The ONR representative shall be notified prior to beginning this procedure.**

## 3.5 Red-line Authority

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

## 3.6 Procedure Computerization Special Requirements

3.6.1 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. A Laptop computer containing an electronic version of this procedure will be operated by the ITD or QA Representative and data shall be recorded by typing directly into the electronic file.

3.6.2 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 data base.

3.6.3 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
- "Signatures" shall be designated by **BLACK CAPITAL BOLD LETTERS**.
- "Redlines" shall be in ***RED BOLD ITALICS*** to make them distinguishable both on the Laptop screen and on the hard copy printout.
- If available, digital pictures shall be inserted into the document where appropriate.

## 4 REQUIRED EQUIPMENT

The following equipment shall be in the Class 10 cleanroom.

Flight Hardware

- Quartz Block #3 (Dwg #22770-101 Rev B)
- QB/Telescope Assembly (Dwg #23521-101 Rev A)

Ground Support Equipment

- Precision Manipulator
- Precision Manipulator Support Plate (rectangular with cutoff corners)
- Extension Cables, threaded (3)
- QB/PM Translation Cart
  Note: X-Y-Z-Θ stages on QB/PM do not need calibration since they are used for visual adjustments only.
- Telescope Support Plate (circular)
- Delrin Fingers for Telescope Support Plate (3)
- A3200 Fiberlite 150 W fiber optics light source
- Methanol $CH_3OH$ (1 ppm residue after evaporation - low acetone grade)
- Technicloth low particulate polyester, i.e., VWR TWTX604 or -609)
- Polyester "Small Alpha" swabs (woven polyester tip; i.e., VWR TWTX742B)
- Polyethylene Shim Stack, 1 mil minimum
- SPI Protracto Level, Cal Date _____
- Lead Block (≈ 4" by 6")
- Telescope Be Cu Wrap-around Clip
- Pressure cans of filtered (0.2 micron) Freon TF liquid
- Pressure cans of filtered (0.2 micron) compressed air
- Plastic sheeting and tape as needed to protect the QB from drips

# 5 INITIAL PREPARATIONS

Record Start Date and Time: _____

**The DPAs are ESD sensitive. Do not touch them or the connectors on their cables**

## 5.1 Install Precision Manipulator Support Plate and Cables

5.1.1 Install the PM Support Plate onto the PM, by screwing in the bolts on the Plate extension into the corresponding bolt pattern on the PM mounting plate.
The plate in final configuration is shown in Figure 1.

5.1.2 Install the 3 telescope support plate extension cables on the PM Plate, by inserting a threaded end of the cable into the bolt holes on the PM plate, approximately 120 degrees apart. Secure with washers and nuts on top side of PM plate.
Cable clocking is arbitrary.

## 5.2 Install Telescope Support Plate and Fingers

5.2.1 Install the 3 Delrin Fingers onto the Circular Telescope Support Plate, approximately 120 degrees apart. The fingers have threaded holes into which screws are inserted through the plate. The fingers are held loosely so that they can rotate 180 degrees.

5.2.2 Install the Telescope Support Plate with fingers onto the bottom end of the extension cables, by inserting the lower threaded end of the extension cables through the bolt holes on the plate, and securing with washers and nuts. One person supports the Plate, while a second person hand tightens the washer and nuts. Secure and visually level the Support Plate on all 3 cables. The Support plate in final configuration is shown in Figure 1.

5.2.3 Place the SPI Protracto Level on the top surface of the Telescope Support Plate. With two people manipulating the cable nuts, level the support plate in two horizontal orthogonal directions. Accept when level is $\leq \pm 0.1°$

**Section 5 completed:**

Completed: _____ date: _____
Integration Engineer

Approved: _____ date: _____
J. Gwo, ITD

Discrepancies if any:

Disposition and signoff: _____ Date: _____
Integration Manager

Approved: _____ Date: _____
QA Representative

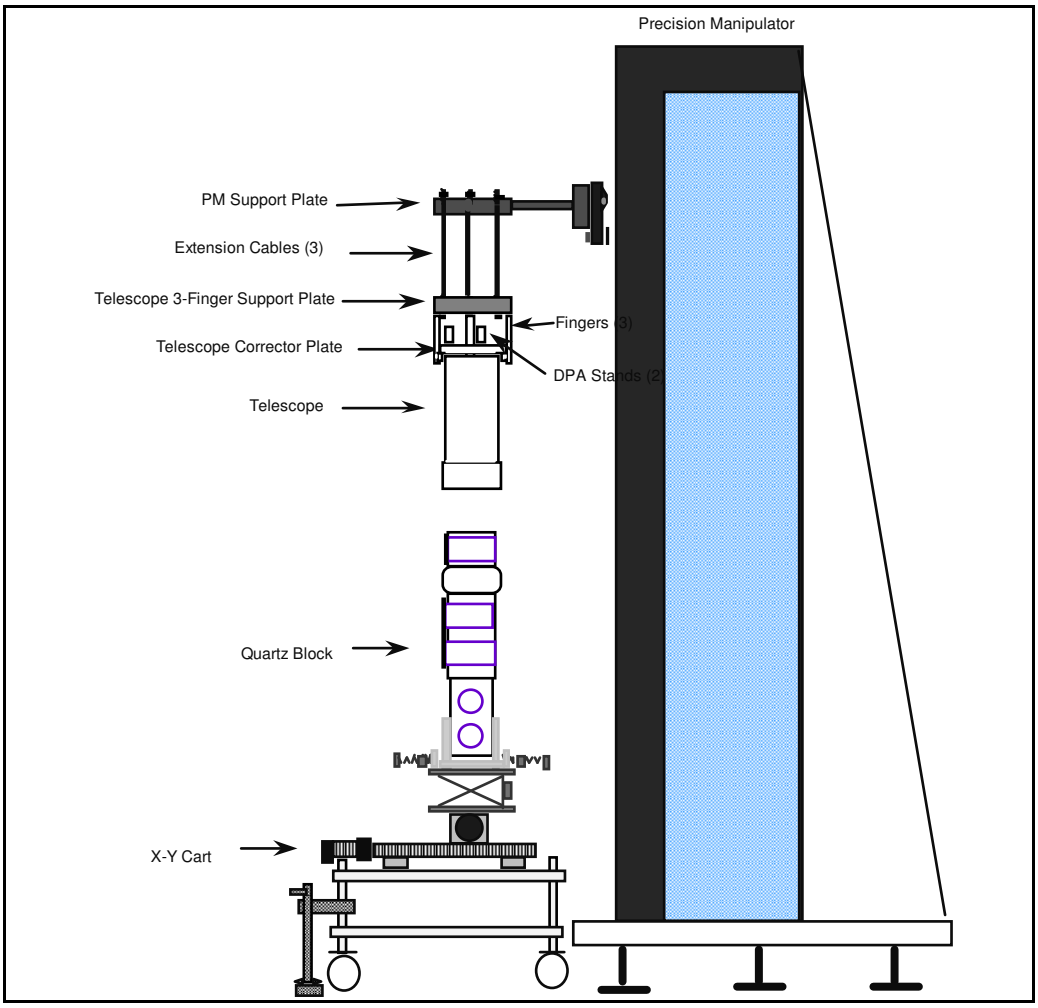


**Figure 1. Schematic of Bonding Configuration (not to scale)**

# 6 ALIGN TELESCOPE AND QUARTZ BLOCK AND BOND

Record Start Date and Time: _____

## 6.1 Install Telescope On 3-Finger Support

6.1.1 Place the Telescope on a cleanroom table on the floor directly under the Telescope Support Plate. Clock the Telescope so that the X and Y axes markers on the Telescope's bottom flange, are located approximately at the intended clocking of the QB in the X-Y cart to be moved underneath. There is a 5 mil scribe mark on the +X axis on the circumference of the QB outer flange. See Figure 2 below for orientation.

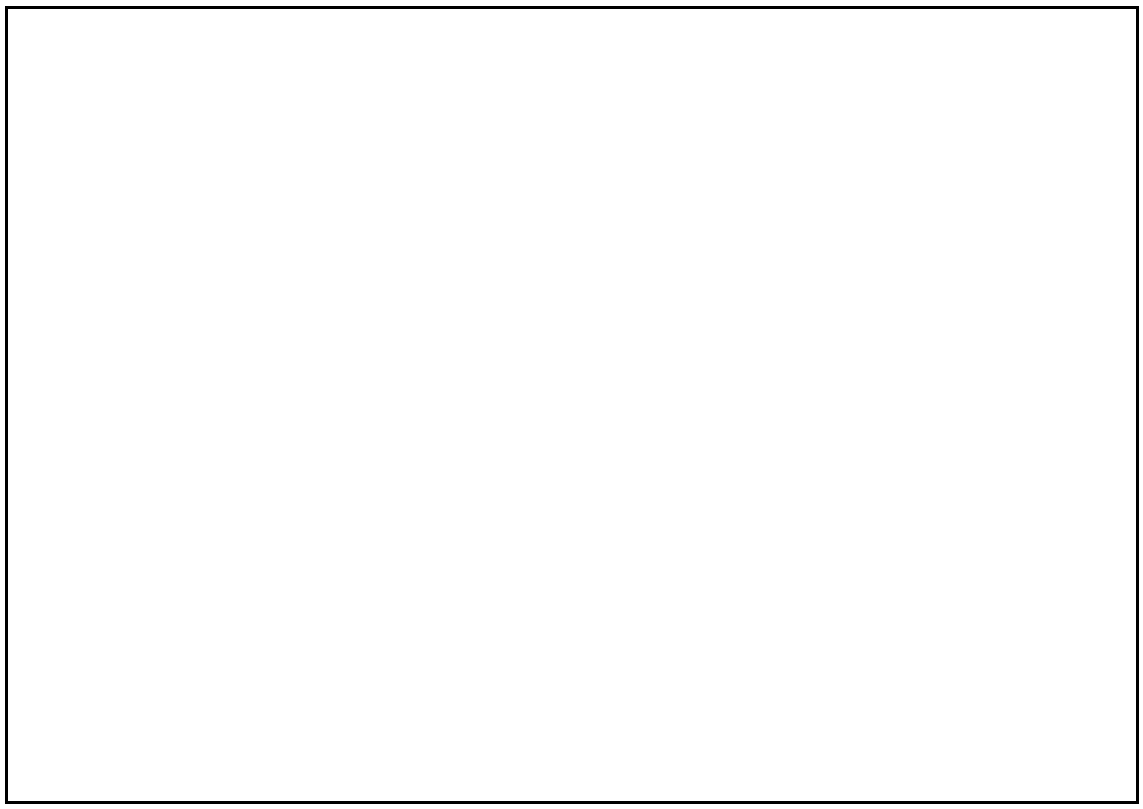

**Figure 2. Quartz Block/Telescope Assembly**
***Note that during bonding +Z points vertically upwards and the clips are not present. These latter items are installed after the bond has cured significantly.***

**CAUTION: Extreme care must be taken to avoid touching the bonding and polished surfaces of the Telescope and QB.**

6.1.2 With the 3 finger hooks turned radially outward, carefully lower the Support Plate using the PM motor until the hooks pass under the bottom rim of the Telescope Corrector Plate. Do this process slowly, with one person watching that the fingers do not bump the telescope, while another operates the PM motor. Adjust the location of the Telescope, as required, so that the fingers clear the outer flange of the Telescope.

**CAUTION: Extreme care must be taken not to allow the Finger Hooks to touch the Telescope while being lowered.**

6.1.3 With the top of the 3 finger hooks clearly below the bottom rim of the corrector plate, rotate the hooks 180 degrees so that they fit under the corrector plate rim. Tighten the screws securely.

6.1.4 With all 3 finger hooks under the corrector plate rim, raise the fingers slightly until the hooks are secure under the rim.

6.1.5 Wrap Kapton tape around the outer perimeter of the 3 fingers to secure the Telescope on the Finger Support.

6.1.6 After ensuring that the Telescope is securely supported by the 3 finger hooks, raise the Telescope off the table, using the PM motor. Raise to a height about 2 feet greater than that of the Quartz Block in QB/PM Cart, so that the latter can be placed underneath with adequate clearance to the telescope with no danger of contamination.

**Section 6.1 completed:**

Completed: _____ date: _____
Integration Engineer

Approved: _____ date: _____
J. Gwo, ITD

Discrepancies if any:

Disposition and signoff: _____ Date: _____
Integration Manager

Approved: _____ Date: _____
QA Representative

## 6.2 Position Quartz Block in QB/PM Cart

*This part of the procedure assumes the Quartz Block has been transferred from the Roller Mechanism and Cart to the Quartz Block Precision X-Y Manipulator Cart (abbreviated to X-Y Cart) as described in P0270.*

6.2.1 With one person positioning the QB in the X-Y cart, and holding it secure, a second person turns the clamps until the Quartz Block is secured in the cart.

6.2.2 Move the Cart under the Telescope Support Plate so that the QB is directly under Telescope and is visually concentric; approximately align the +X and +Y scribe marks on the QB outer flange with those of the telescope.

6.2.3 Secure the QB/PM by lowering its jacks and weigh down its corners with the lead at least 2 blocks at each corner. Use as many blocks as practical.

6.2.4 Place the SPI Protracto Level on a clean wipe on the top surface of the QB (the bonding surface). Adjust the jacks of the QB/PM until the top surface is level. Accept when level is within approximately 0.1° of horizontal.

**Section 6.2 completed:**

Completed: _____ date: _____
Integration Engineer

Approved: _____ date: _____
J. Gwo, ITD

Discrepancies if any:

Disposition and signoff: _____ Date: _____
Integration Manager

Approved: _____ Date: _____
QA Representative

## 6.3 Initial Cleaning (Special New Procedure by J. Gwo)

Record Start Date and Time: _____

6.3.1 Required Equipment:

A3200 Fiberlite fiber optics light source (150 W, with infrared-removing filter installed)
Anhydrous methanol (< 1 ppm residue after evaporation, ~1 liter)
Anhydrous ethanol (~1 liter)
De-ionized Water (18 MΩ-cm, ~4 liters)
Polyester "Small Alpha" swabs
Polyester cleanroom wipes
Regular disposable 10 milli-liter pipette
Micro cleaning solution (10% of original concentration)
Lucite plates (20 cm X 20 cm X ~3 mm, two)
Kapton tape
Saran wrap

6.3.2 Required Condition: The two bonding surfaces of the telescope and Quartz Block should be about ~40 cm apart.

6.3.3 Inspection of each of the two bonding surfaces:

6.3.3.1 Inspect and try to remove suspected particulate(s) on the surface. Follow Section 5.2 of Bonding Procedure for Fused Quartz Components (SU/GP-B P0218) but with 5.2 (d) modified and conducted as follows.

6.3.4 Clean the bonding surface

6.3.4.1 Completely cover the bonding surface with a stack of ten layers of polyester cleanroom wipe.

6.3.4.2 Saturate the stack with Micro cleaning solution.

6.3.4.3 Cover the stack with Lucite plate, and fix the plate with Kapton tape onto the quartz system.

6.3.4.4 Cover and wrap the plate with Saran wrap
(Make sure no contact between Saran wrap and wet wipe.)

6.3.4.5 Wait approximately one hour.

6.3.4.6 Unwrap, re-expose, and clean the bonding surface by gently wiping off residual Micro solution with cleanroom wipe impregnated with de-ionized water, at least three times each with a new piece of wipe.

6.3.4.7 Before going to Step 6.3.5, inspect per section 6.3.3. If the criteria in that section are not met, repeat steps three times 6.3.4.1 through 6.3.4.6, otherwise, repeat steps 6.3.4.1 through 6.3.4.6 only once.

6.3.5 Rinse the surface thoroughly with de-ionized water, then with methanol, and dry the surface with de-ionized air before methanol evaporates.

6.3.6 Re-inspection

6.3.6.1 If no particulate can be identified, then get ready for bonding.

6.3.6.2 If particulates are observed, try to remove them by following Section 5.2 of *Bonding Procedure for Fused Quartz Components* (SU/GP-B P0218) through 5.2(c), and then go repeat steps 6.3.4.1 through 6.3.4.6 to attempt removal of the particle(s).

6.3.6.3 If the suspected particulate(s) cannot be removed after conducting steps 6.3.4.1 through 6.3.4.6 B six times (including the three previous times in 6.3.4), then management should make an immediate decision as to whether to proceed with possible compromise of bonding strength, or abort.

6.3.7 Final Cleaning of the Bonding Surfaces (at discretion of the ITD)

6.3.7.1 Use a polyester swab, dipped in Methanol, to clean all bonding surfaces of the Telescope and Quartz Block. Inspect and clean under A3200 Fiberlite. Carefully inspect for particles, and clean off with swab.

6.3.7.2 Perform water drop test on bonding surfaces. Accept if water drop spreads.

**Section 6.3 completed:**

Completed: _____ date: _____
Integration Engineer

Approved: _____ date: _____
J. Gwo, ITD

Discrepancies if any:

Disposition and signoff: _____ Date: _____
Integration Manager

Approved: _____ Date: _____
QA Representative

## 6.4 Alignment check of Quartz Block and Telescope

6.4.1 Lower the Telescope so that its bonding surface is approximately 2 inches above that of the QB.

6.4.2 Use the X-Y, and rotations mechanisms of the QB/PM to center the QB under the Telescope visually.

6.4.3 Use the electronic controls on the Precision Manipulator, to carefully lower the Telescope over the QB until they are almost touching ( within 1/2").

**CAUTION: Do not allow the bonding surfaces to touch**

6.4.4 Refine the alignment of the QB under the Telescope using the X-Y, and rotations mechanisms of the QB/PM. One person should be directing the centering while the other adjusts the QB/PM. Check that the +X and +Y scribe marks of the QB outer flange is aligned with the +X and +Y marks on the Telescope flange.

*Note: The rotational displacement allocation requirement to the QB/T interface is 0.2˚, or .013 inch along the circumference. The accuracy requirement for measuring clocking is 2 arc-min, or .002 inch along the circumference. The centering requirement is .010 inch radius, measured to an accuracy of .001 inch in both X and Y directions. The rotation alignment is based on matching the .005 scribe marks on the QB outer flange with the .006 wires on the outer-flange of the telescope base. These requirements can be found in the GP-B drawing (Dwg #23521-101 Rev A), QB/Telescope Assembly including the detailed notes and dimensional requirements therein.*

- Actual alignment estimate: Rotation ≤ + or - _____ are-min for the Telescope relative to QB
- Actual displacement estimate: $X_T$ vs. $X_{QB}$ ≅ _____ mils; $Y_T$ vs. $Y_{QB}$ ≅ _____ mils

**Section 6.4 completed:**

Completed: _____ date: _____
Integration Engineer

Approved: _____ date: _____
J. Gwo, ITD

Discrepancies if any:

Disposition and signoff: _____ Date: _____
Integration Manager

Approved: _____ Date: _____
QA Representative

## 6.5 Bond the Telescope to the Quartz Block

6.5.1 Raise the Telescope on its 3 finger hooks approximately 6" off the QB, using the PM controls. Allow enough clearance for the bond applicator.

6.5.2 Apply bond material on the QB, in accordance with Procedure P0218.

6.5.3 Lower the Telescope onto the QB almost to contact, using the PM controls.

6.5.4 Do the final contact by raising the QB using its support jack. Check that the axes marks of the QB and Telescope are aligned. Record displacement below.

**CAUTION: The first few minutes after contact are critical for de-bonding. De-bonding after this period will put the hardware at risk.**

Rotational Displacement of alignment marks: _____ arc-min

Estimated displacement of telescope and QB flanges: _____ mils

6.5.5 Cut the Kapton Tape wrapped around the 3 Finger Support, so that the Telescope can be moved around slightly to spread the adhesive, in accordance with Procedure P0218. Align and secure the bond, in accordance with Procedure P0218.

6.5.6 Check for any internal reflection or partially attenuated internal reflection (sign of defective bonding) from the interface at approximately one foot away and at ~45˚ relative to the normal of the interface. If the defective area is over 20% of the originally intended bonding area, debonding should be considered.

6.5.7 Finally, verify that the bonding coverage is over 80%, otherwise de-bonding should be considered. *Note that prior results obtained using Procedure P0218 have shown that if bonding coverage is over 80%, the wedge angle meets the ≤ 1 arc-sec requirement.*

Estimated Bond Area _____ %

**Section 6.5 completed:**

Completed: _____ date: _____
Integration Engineer

Approved: _____ date: _____
J. Gwo, ITD

Discrepancies if any:

Disposition and signoff: _____ Date: _____

Integration Manager

Approved: _____ Date: _____
QA Representative

## 6.6 Secure for Curing

6.6.1 Install the Be-Cu wrap-around clip around the circumference of the bonded flanges.

6.6.2 Lower the 3 Finger Support so that the hooks are slightly above the midway height of the Telescope, being careful that there is ample clearance between the support plate and telescope detector stands on the corrector plate.

6.6.3 Wrap cleanroom tape around the circumference of the fingers to secure the Telescope in place.

6.6.4 Let stand in place for curing. Do not move the QB/T Unit position for at least 3 days. Monitor the bond cure and estimated alignment

**Section 6.6 completed:**

Completed: _____ date: _____
Integration Engineer

Approved: _____ date: _____
J. Gwo, ITD

Discrepancies if any:

Disposition and signoff: _____ Date: _____
Integration Manager

Approved: _____ Date: _____
QA Representative

# 7 MONITORING OF BOND CURE AND ALIGNMENT

Record Start Date and time: _____

## 7.1 Alignment Check after Curing in Position for 3 Days

7.1.1 After 3 days of curing (with the 3 finger support in place), remove the telescope wrap-around clip.

7.1.3 On at least a daily basis for the next 10 days, check the bond interface around the circumference in using procedure P0218. Record the estimated percent bond area.

7.1.2 On at least a daily basis for the next 10 days, check the radial displacement of the Telescope and QB flanges. Using a set of polyethylene shims measure to an accuracy of ± 0.0005 inch. Record the estimated bond area and the radial displacement in the +X, -X, +Y and –Y directions below in Table 1.

7.1.4 On at least a daily basis for the next 10 days, record the rotational alignment of the marks on the +X and +Y axes in Table 1. Measure to an accuracy of 2 arc-min rotation (.002 inch circumference).

7.1.5 After recording the measurements re-install the wrap-around clip. Leave the 3-finger support in place.

7.1.6 Leave the QB/T in the X-Y Cart under the Precision Manipulator. *This is the safest configuration in case of any movement due to earthquake or the like.*

7.1.7 Let stand in this location for another 10 days (13 days total).

7.1.8 The ITD shall examine the results of Table 1 and document his conclusions below. He shall make a recommendation to the Integration Manager and the Hardware Manager as to the quality of the bond and alignments. It shall then be determined whether to continue with the curing process or whether to move on to Section 7.2.

7.1.9 Conclusions and Recommendations of the ITD

**Table 1. Measurements from 1st through 13th day**

| Days after Bond | Date | Bond Area (%) | Displacement of Telescope Flange relative to QB flange (mils) | | | | Rotation of QB wrt Telescope (arc-min) | Comments |
|---|---|---|---|---|---|---|---|---|
| | | | +X | -X | +Y | -Y | | |
| 3 | | | | | | | | |
| 4 | | | | | | | | |
| 5 | | | | | | | | |
| 6 | | | | | | | | |
| 7 | | | | | | | | |
| 8 | | | | | | | | |
| 9 | | | | | | | | |
| 10 | | | | | | | | |
| 11 | | | | | | | | |
| 12 | | | | | | | | |
| 13 | | | | | | | | |

**Section 7.1 completed:**

Completed: _____ date: _____
Integration Engineer

Approved: _____ date: _____
J. Gwo, ITD

Discrepancies if any:

Disposition and signoff: _____ Date: _____
Integration Manager

Approved: _____ Date: _____
QA Representative

## 7.2 Installation of Clips *plus* Forming/Stowage of DPA Cables

**The DPAs are ESD sensitive. Do not touch them or the connectors on their cables**

7.2.1 The Integration Manager, in conjunction with the Telescope Engineer and the ITD shall install the 16 long clips approximately equally spaced around the circumference of the QB and the Telescope. Special tooling provided by the vendor shall be used to stretch the clips and care will be taken to avoid damaging the quartz surfaces.

7.2.2 The Integration Manager, in conjunction with the Telescope Engineer and the ITD shall install the short clips at all the pre-designated locations on the telescope top flange. Special tooling provided by the vendor shall be used to stretch the clips and care will be taken to avoid damaging the quartz surfaces.

7.2.3 The Integration Manager, in conjunction with the Telescope Engineer and the ITD shall form the DPA cables in, and secure them to the telescope, in preparation for QBA integration later SIA to Probe Integration. Where appropriate, the DPA cables will be formed to shape. All cables will be tied down securely including those that are folded over the top of the telescope and secured to the beam splitter box. To protect this latter unit, a Delrin cover shall be provided by the Telescope Group.

**Section 7.2 completed:**

Completed: _____ date: _____
Integration Engineer

Approved: _____ date: _____
J. Gwo, ITD

Discrepancies if any:

Disposition and signoff: _____ Date: _____
Integration Manager

Approved: _____ Date: _____
QA Representative

## 7.3 Continued monitoring of the bond area and alignment

7.3.1 The ITD and/or the Telescope Engineer shall continue to monitor the same parameters as in Table 1 as long as the observations can be made, i.e. until the installation of the SIA into the probe. Results shall be documented in Table 2. on a bi-daily basis.

**Table 2. Measurements from 14th day onwards**

| Days after Bond | Date | Bond Area (%) | Displacement of Telescope Flange relative to QB flange (mils) | | | | Rotation of QB wrt Telescope (± arc-min) | Comments |
|---|---|---|---|---|---|---|---|---|
| | | | +X | -X | +Y | -Y | | |
| 14 | | | | | | | | |
| 16 | | | | | | | | |
| 18 | | | | | | | | |
| 20 | | | | | | | | |
| 22 | | | | | | | | |
| 24 | | | | | | | | |
| 26 | | | | | | | | |
| 28 | | | | | | | | |
| 30 | | | | | | | | |

7.3.2 The ITD shall examine the results of Table 1. and document his conclusions below. He shall make a recommendation to the Integration Manager and the Hardware Manager as to the quality of the bond and alignments. It shall then be determined whether to continue with the curing process or whether to move on to Section 8.

**Section 7.3 completed:**

Completed: _____ date: _____
Integration Engineer

Approved: _____ date: _____
J. Gwo, ITD

Discrepancies if any:

Disposition and signoff: _____ Date: _____
Integration Manager

Approved: _____ Date: _____
QA Representative

## 8 PROCEDURE COMPLETION

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

Integration Engineer _____ Date _____

ITD _____ Date _____

Discrepancies if any:

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 _____

Quality Assurance _____ Date _____

## 9 DATA BASE ENTRY

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

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