



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

**CLEANING THE  
QUARTZ BLOCK**

***REPEAT OF CLEANING DUE TO CRACKS AND REWORK***

**GP-B SCIENCE MISSION PROCEDURE**

**22 February, 1999**

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Date

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## 1 SCOPE

This document provides the procedure for cleaning Quartz Block #3 (P/N 22770-101) prior to bonding of the quartz block with the telescope. This procedure begins in the FIST OPS inspection area, and then proceeds to the 132 cleanroom, and terminates in the Class 10 Cleanroom in the HEPL Building. It assumes that the Crest, Alcohol Rinse, and Quadrex Cleaning Tanks have been setup, and are ready for use. The following procedures are included in this document.

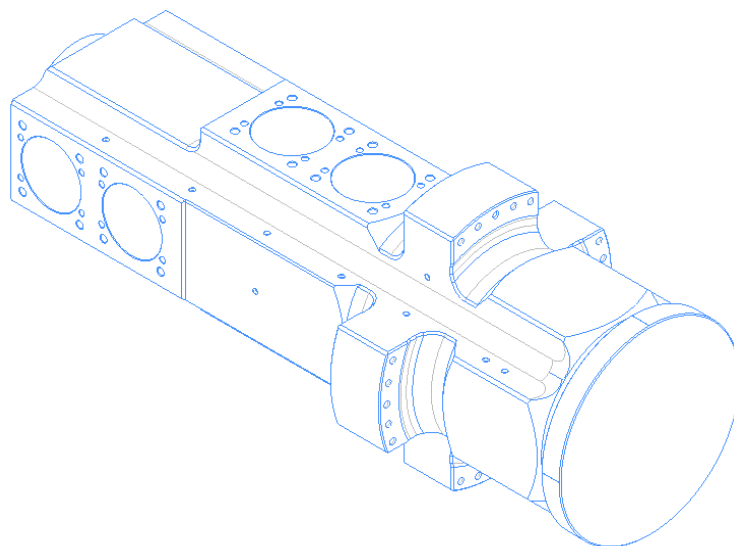
### Special Notes

- Due to the fact that this is the second cleaning, all times will be cut in half. Special attention must be taken to the areas where tape marks the new fiducials for rotation alignment.
- If, in the judgement of the ITD, 'first time' cleaning is appropriate, double the times shown for each soaking operation. Refer to revision B of this procedure as desired.
- Initial External Cleaning of the Quartz Block
- Aqueous Cleaning of the Quartz Block
- Alcohol Rinse of the Quartz Block
- Freon Cleaning of the Quartz Block in the Shearstress cleaner (QUADREX)

### 1.1 Acronyms

The following acronyms are used in this document

|            |                                   |
|------------|-----------------------------------|
| QB         | Quartz Block                      |
| RM         | Quartz Block Roller Mechanism     |
| QB/RM      | Quartz Block in Roller Mechanism  |
| QB/RM/Cart | QB in RM in Roller Mechanism Cart |
| ITD        | Integration and Test Director     |



**Figure 1. Quartz Block**

## **2 APPLICABLE DOCUMENTS**

### **2.1 Procedures**

P0059 GPB Contamination Control Plan

## **3 GENERAL REQUIREMENTS**

### **3.1 Environmental Requirements**

The first procedure is done in the inspection area adjacent to the FIST OPS lab. The Crest cleaning and Alcohol Rinse procedures are conducted in the Class 10000 Cleanroom 132 and the Quadrex cleaning is done in the Class 1000 Cleanroom. Finally, the procedure terminates with the QB delivered to the Class 10 Cleanroom.

#### **3.1.1. Cleanliness**

The Class 1000 clean rooms where this cleaning takes place shall be maintained at the cleanliness levels per GPB Contamination Control Plan P0059. Minimum protective garments for personnel working in the clean rooms shall be the standard Tyvek clean room apparel for room classes from 10,000 to 100 and certified Class 10 cloth garments for wear during operations in the class 10 clean room.

#### **3.1.2. Particulate Contamination**

All parts and tools shall be cleaned using methods consistent with achieving and maintaining level 100 cleanliness per GPB Contamination Control Plan P0059. Take all necessary precautions to keep tools and handling equipment free of particulate contamination. Tools to be sprayed with Freon from Pressure can (filtered to < 0.2 micron) prior to use, or when contaminated.

### **3.2 Integration and Test Personnel**

#### **3.2.1 Integration and Test Director**

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

#### **3.2.2 Integration Engineers**

The engineers performing this operation shall be J. Stamets and C. Gray, G. Asher, and others that the ITD shall determine are appropriate. All engineers and technicians participating in this procedure shall work under the direction of the ITD who shall determine whether the person is qualified to participate in this procedure.

### 3.3 Safety

#### 3.3.1. General

The responsible engineer shall ensure that all personnel are aware of the specific personnel and hardware safety concerns indicated in the safety requirements, cautions and warnings in the procedure. **WARNING:** Because of the possible fire hazard, when performing the Isopropyl alcohol dip bath the precautions outlined in 7.1 must be followed stringently.

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

#### 3.3.2. 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 approved by the ITD.

### 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 J. Stamets, 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.

### 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

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.

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.

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

### Flight Hardware

Quartz Block #3 (P/N 22770-101), Serial Number

### Ground Support Equipment (GSE)

Deionized Water 18 MΩ-cm Source and Dispenser  
Polyester "Small Alpha" swabs  
Microclean Detergent (≈ 100 ml)  
Z Foam Pads  
Methanol CH<sub>3</sub>OH  
Isopropanol (≈ 5 gallons)  
Crest Ultrasonic Cleaning tank  
Alcohol Rinse Tank with Manual Siphon-actuated pumps  
Class 10 Mobile Tent  
Quadrex High Pressure Cleaning Chamber with Freon Spray  
Quartz Block Roller Mechanism and Cart  
Quartz Block Box Container  
Filtered N<sub>2</sub> gas, and appropriate gas guns  
Pressure cans of filtered (0.2 micron) Freon TF liquid  
Pressure cans of filtered (0.2 micron) compressed air



## 5 INITIAL EXTERNAL CLEANING OF THE QUARTZ BLOCK

This procedure assumes the QB is in its shipping container in the inspection area.

Record Start Date:/Time: \_\_\_\_\_

***Notify Safety prior to starting Section 5. DONE 2/10/99, BY DB***

### 5.1 Transfer the QB to the 132 Cleanroom

- 5.1.1 Retrieve the QB in its blue shipping container inside the inspection area and sign off paper work. Also get any copies of documentation available from inspection.
- 5.1.2 Remove the top half of the shipping container inside the inspection area, and carry the bottom half with the block in it to the ante-room outside the inspection room. Place the container on the white table in this room.
- 5.1.3 Lay down two layers of Z-foam pads on top of a sturdy clean room cart. Using gloves, with one person at each end of the QB, lift the QB onto the cleanroom cart so that it rests with the two arms of the QB flange and the QB flange aft end, on the Z-foam pads.
- 5.1.3 Clean the bagging with alcohol as best as possible.
- 5.1.4 Secure the QB by taping it to the cart. ***Ensure that it is stable and cannot move.***
- 5.1.5 Slowly roll the cart to the cleanroom changing room. Wipe down the cart and wheels.
- 5.1.6 Remove the bench from the middle of the changing room and roll the cart into the changing room, ensuring that the wheels roll over the sticky mats several times.
- 5.1.7 Thoroughly wipe down the outside of all surfaces of the cart and the QB plastic wrapping.
- 5.1.8 Remove the wrapping and bag for weighing. Carefully wipe down all surfaces of the QB and spray with Freon to clean as best as possible.
- 5.1.9 Roll the cart through the two sets of doors into Room 132 and place near the roller mechanism cart for next stage of transfer

### 5.2 Transfer QB to the Roller Mechanism in Rm. 132

- 5.2.1 Ensure that the two top semi-circular brackets from the RM have been removed by unscrewing the silver plated socket head cap screw bolts.
- 5.2.2 Orient the QB so that it is parallel to the RM. Bring the RM to same elevation as clean room cart and locate in line about six feet away.
- 5.2.3 Disconnect the retaining cable on the roller mechanism and make sure the hinges are locked. **DO THE NEXT STEP AFTER THE QB IS TRANSFERRED TO THE RM. (5.2.4 – 5.2.7)** Also, install the four extender handles into the four block of the RM.

Remove the Delrin pads from the bottom of the RM, if possible, so that they do not fall off.

- 5.2.4 With one person aft of the QB and one forward, lift the QB and place it in the RM. The aft end of the QB installs into the smaller semi-circular bracket of the RM while the precision cylindrical surface (adjacent to the forward side of the QB flange) installs into the larger semi-circular bracket of the RM. Do this very carefully; ***Do not touch polished surfaces.***
- 5.2.5 Install the aft half of the roller mechanism, ensuring that it allows free rotation of the block.
- 5.2.6 Install the front half of the roller mechanism, ensuring that it allows free rotation of the block. Be very careful not to touch the QB with the metal as it is installed.
- 5.2.7 Tighten all the screws holding the front and aft halves securely. **REMOVE THE TRANSPORT CART AWAY FROM THE AREA.**
- 5.2.8 With four people holding the handles securely, and one stabilizing the cart, rotate the RM 180° and hold securely. Open the hinges so that the RM can be removed from the cart.
- 5.2.9 With four people holding the handles securely, and one stabilizing the cart, lift the QB/RM off the cart as high as possible to clear the tanks.

**Completion of section 5.**

**Date and time:**

Discrepancies if any:

**NONE**

Disposition and signoff: \_\_\_\_\_ Date: \_\_\_\_\_  
ITD

Concurrence: \_\_\_\_\_ Date: \_\_\_\_\_  
QA Representative

## 6 AQUEOUS CLEANING (CREST) AND ALCOHOL DIP

*Notify Safety prior to starting Section 6.*

### 6.1 Tank Preparations

- 6.1.1 Connect the Crest cleaning tank to the DI water supply and drain.
- 6.1.2 Rinse and fill the non-ultrasonic tank with DI water/Microdetergent and activate its heaters until the water reaches approximately 100 °F. Concentration of the solution should be 0.5 ounces /10 gallons of DI water.
- 6.1.3 Fill the ultrasonic tank with DI water/Microdetergent. Set the ultrasonic level to 7.

### 6.2 Micro-detergent Cleaning

- 6.2.1 With four people, lift the QB in RM off the cart and lower it into the warm DI water/Micro-detergent rinse tank, being careful not to allow the QB to contact metal.
- 6.2.2 With the QB/RM submerged in the warm DI water, thoroughly scrub all QB surfaces and bores with foam pads **FOR 10 MINUTES**. Use the swabs to reach hard to clean spaces such as within the 0.25 inch holes and QB flange holes. Rotate the QB as necessary.
- 6.2.3 Drain the warm DI water from the tank while rinsing the QB with DI sprayers.

### 6.3 Ultrasonic Cleaning

- 6.3.1 With four people, transfer the QB/RM into the DI ultrasonic tank, being careful not to allow the QB to contact metal.
- 6.3.2 Let stand submerged for **20** minutes, while rotating the QB by 90 degrees in **5** minute intervals. Stop the Ultrasonic every **5** minutes and rub the surfaces as in 6.2.2
- 6.3.3 Drain the warm DI water from the Ultrasonic tank while rinsing the QB with DI sprayers.

### 6.4 Rinse

- 6.4.1. Refill the rinse tank with DI water (no Microdetergent)
- 6.4.2 With four people, transfer the QB/RM into the first tank, for rinsing, being careful not to allow the QB to contact metal.
- 6.4.3 Thoroughly spray surfaces with DI water, with the QB partially submerged in the rinse while rotating the QB in the RM to expose all areas to the rinse water. **RINSE FOR APPROXIMATELY 10 MINUTES. DRAIN AND SPRAY CLEAN WHILE DRAINING.**
- 6.4.4 Rinse IN ULTRASONIC TANK
- 6.4.5. Refill the ULTRASONIC tank with DI water (no Microdetergent)

- 6.4.6 With four people, transfer the QB/RM into the ULTRASONIC tank, for rinsing, being careful not to allow the QB to contact metal.
- 6.4.7 Thoroughly spray surfaces with DI water, with the QB partially submerged in the rinse while rotating the QB in the RM to expose all areas to the rinse water. RINSE FOR APPROXIMATELY 10 MINUTES TOTAL.

## 6.5 Alcohol dip

This avoids water spots from forming.

*Note: This a potentially hazardous situation. The tank must be grounded at all times.*

**CAUTION: Whenever using the alcohol rinse tank with alcohol exposed to air, always use the grounded safety straps and ensure fire extinguishers are at hand.**

- 6.5.1 Pre-fill the alcohol rinse tank with approximately 20 gallons of pure Isopropanol.
- 6.5.2 While the QB/RM is still wet with DI water, with two people, transfer the QB in RM to the alcohol rinse tank.
- 6.5.3 Fill the tank with up to 5 gallons total of Isopropanol in order to submerge the QB in alcohol as soon as possible.
- 6.5.4 Leave submerged for 10 minutes.

## 6.6 Transfer QB/RM back to Roller Mechanism Cart

- 6.6.1 With four people, transfer the QB/RM from the alcohol rinse tank to the Roller Mechanism cart, carefully reversing the procedures of 5.2.8 and 5.2.9
- 6.6.2 SPRAY DRY WITH ULTRAJET SPRAY, INCLUDE ALL CAVITIES.
- 6.6.3 Roll the cart into the Class 100 room in front of the Quadrex.

## 6.7 Clean Up Alcohol

- 6.7.1 Pump the used alcohol in the rinse tank back into the bottles, label the containers as “used Isopropanol” and restore them to the flammables cabinet.

**Completion of section 6. \_\_\_\_\_**

Discrepancies if any:

Disposition and signoff: \_\_\_\_\_ Date: \_\_\_\_\_  
ITD

Concurrence: \_\_\_\_\_ Date: \_\_\_\_\_  
QA Representative

**7 QB FREON CLEANING (QUADREX)**

*Notify Safety prior to starting Section 8.*

**7.1 Transfer QB into Quadrex**

7.1.1 Raise the height of the cart rails to match that of the rails inside the Quadrex. Roll the QB/RM into the Quadrex and close the hatch.

**7.2 Quadrex Cleaning**

7.2.2 Thoroughly clean the QB in the Quadrex at 500 psi with the medium fan spray for at least ten minutes. Pay special attention to the polished surfaces. Roll the QB/RM as necessary to facilitate spraying all areas and crevices.

7.2.3 Allow the Quadrex to go through its drying cycle.

**7.3 Transfer QB/RM into Cart**

7.3.1 Transfer the QB/RM back on to the QB/RM cart.

7.3.2 Roll the QB/RM cart into the Class 10 clean room and leave the QB/RM/cart downstream of the ion bar array for later mating of the telescope.

**Completion of section 7.**

Discrepancies if any:

Disposition and signoff: \_\_\_\_\_ Date: \_\_\_\_\_  
ITD

Concurrence: \_\_\_\_\_ Date: \_\_\_\_\_

## QA Representative

## 8 PROCEDURE COMPLETION

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

Test 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:

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