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

TRANSFER THE QB/T FROM THE OPTICAL TABLE TO VERTICAL MANIPULATOR

GPB SCIENCE MISSION PROCEDURE

14 April, 1999

PREPARED _____ _____
D. Bardas, Integration Manager Date

APPROVED _____ _____
D. Bardas, Integration Manager Date

APPROVED _____ _____
B. Taller, Quality Assurance Date

APPROVED _____ _____
S. Buchman, Hardware Manager Date

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1 SCOPE

This document provides the procedure for transferring the Science Mission Quartz Block/Telescope Assembly (QBA), Part Number 23171-101, from the Roller Mechanism (RM) on the Optical Table to the RM Cart and subsequently to the QB/T Vertical Manipulator Cart (VM). This procedure assumes that the QB/T has been integrated according to procedure P0175(SM), and is in the Roller Mechanism on the Optical Table in the Class 10 Cleanroom. It also assumes that the VM is in the Class 10 Cleanroom.

1.1 Acronyms

The following acronyms are used in this document

- SIA Science Instrument Assembly
- RM Roller Mechanism
- QB/T Quartz Block/Telescope
- QB/T/RM QB/T on Roller Mechanism
- ITD Integration and Test Director
- Pr-C Probe C, the Science Mission flight probe
- QBS Quartz Block Support (aluminum support on probe)
- QA Quality Assurance
- TB Terminal Block

2 REFERENCES

P0059	GPB Contamination Control Plan
P0057	Stanford Magnetic Control Plan
P0175 (SM)	Integration of Gyro Assemblies into the Quartz Block

3 GENERAL REQUIREMENTS

ONR representative, QA and Safety to be notified prior to beginning this procedure

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 their bodies and garments downstream of the SIA, relative to the HEPA wall.

3.1.3. Magnetic Contamination

All parts and tools shall be screened per Procedure P0057. All parts and tools shall be cleaned using methods consistent with achieving Mil Spec Level 100 cleanliness. In addition, all parts shall be maintained at level 100 cleanliness per GP-B Magnetic Control Plan, P0057. Take all necessary precautions to keep tools and handling equipment free of particulate contamination. Tools to be cleaned with Ethyl Alcohol prior to use, or when contaminated.

3.1.4. Electrostatic Discharge Control

To prevent electrostatic charge buildup on the QB/T the particle ionizer shall always be upstream of the QB/T relative to the fan wall and the PM and the QB/PM shall be grounded.

3.2 Integration and Test Personnel

3.2.1 Integration and Test Director

The Integration and Test Director (ITD) shall be Dr. Doron Bardas or an alternate that he shall designate. The ITD has overall responsibility for the implementation of this procedure and shall sign off the completed procedure and relevant sections within it.

3.2.2 Integration Engineers and other personnel

All engineers and technicians participating in this procedure shall work under the direction of the ITD who shall determine personnel that are qualified to participate in this procedure. Participants in this procedure are expected to be D. Bardas, G. Asher, C. Gray, K. Bower. with assistance from LMMS at certain times.

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 or scratching the QB/Telescope.

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 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, 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 his designate, nominally R. Leese, 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

3.5.1 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 Hardware Manager shall be required, if in the judgment of the ITD or QA Representative, experiment functionality may be affected.

3.5.2 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.

3.5.3 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

Hardware	Part Number
Quartz Block Assembly	23171-101

Ground Support Equipment

- QB Roller Mechanism
- Roller Mechanism Cart
- VM
- Silver Plated Bolts for clamping halves of Roller Mechanism
- Oriel Optical Table

Tools and Miscellaneous

- Allen wrenches, various

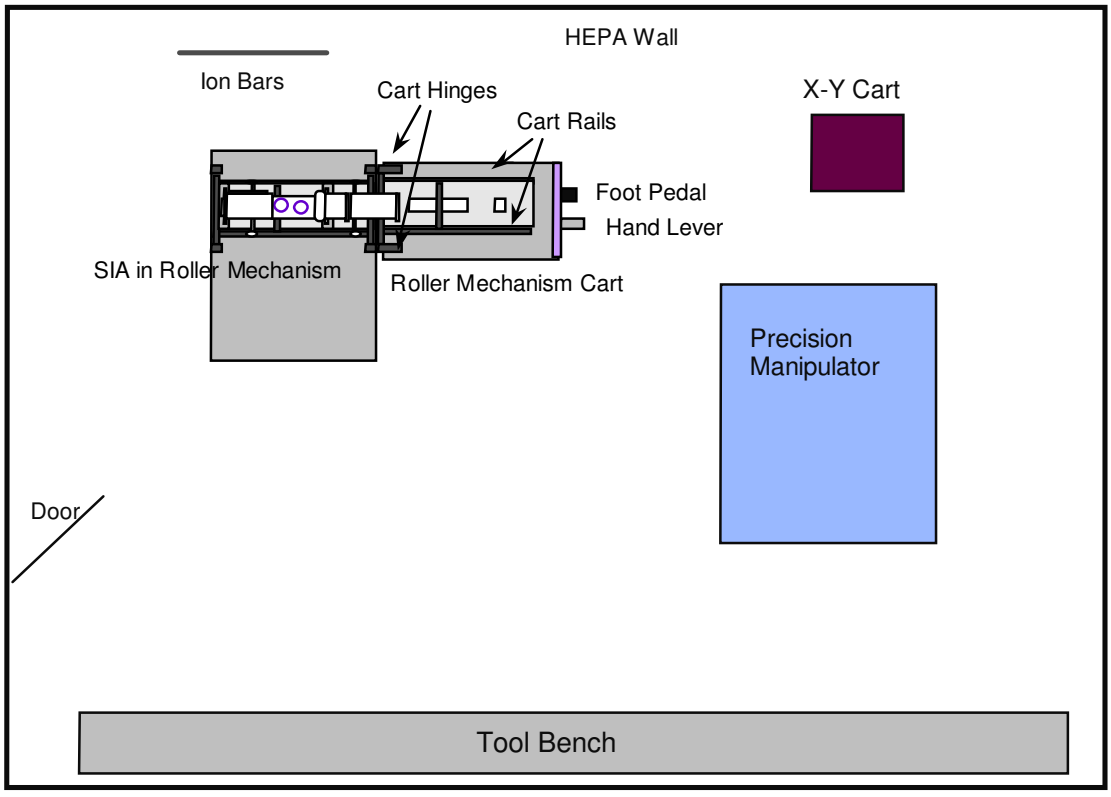
5 TRANSFER QBA/RM FROM OPTICAL TABLE TO RM CART

Record Start Date and Time _____

5.1 Initial Layout and Setup

5.1.1 The QBA should be in the Roller Mechanism on the Optical Table with the Telescope facing the Observation Window.

5.1.2 With the height of the Cart table slightly below the height of the Optical Table, position the Roller Mechanism Cart perpendicular to the long dimension of the Optical Table, with the rails on the cart aligned with the Roller Mechanism wheels as shown in Figure 1. Roll the Cart as close as possible to the Optical Table.



Top View of Class 10 Cleanroom - not to scale

Figure 1. Class 10 Room Layout at Start of Procedure

5.1.3 Check the following on the RM cart:

- Hinges on front of RM cart are locked
- Restraining cable end is firmly attached to cart
- Adjustment lever is attached to cart

5.1.4 Ensure that the QB is secure in the RM, by checking that the upper semicircular halves of the two rollers are securely bolted together

5.1.5 Manipulate the height of the cart with the foot pedal (to raise cart) and hand lever (to lower cart) so that the cart hinge and rails are just above the top of the optical table.

5.1.6 When the cart is properly aligned, lock the RM Cart.

5.2 Transfer QB/T onto RM Cart

5.2.1 Unclamp the C-clamps which secure the RM to the Optical Table.

5.2.2 Lift the square support block on the RM over the front hinges on the RM cart, and place the RM wheels onto the cart rails.

CAUTION: To the maximum extent possible, personnel should continue to keep their body parts downstream of the QBA, relative to the HEPA wall.

5.2.3 Continue sliding the QB/T/RM onto the RM Cart by rolling the wheels down the rail, until the dumbbell bar on the gyro side of the QB is on the front hinges of the cart.

CAUTION: Extreme care must be taken not to jar the QB/T

5.2.4 Wrap the two hooks near the hinge around the front dumbbell bar so that it is securely latched.

5.2.5 Connect the loose end of the cart's restraining cable onto the slot of the crossbar of the RM on the telescope side.

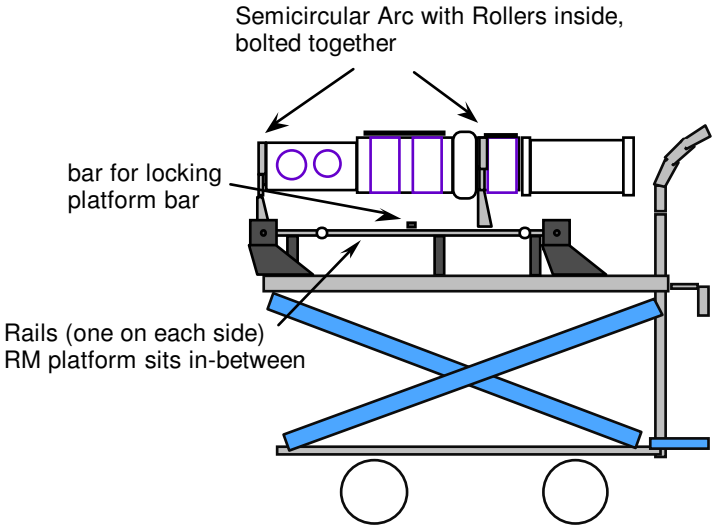
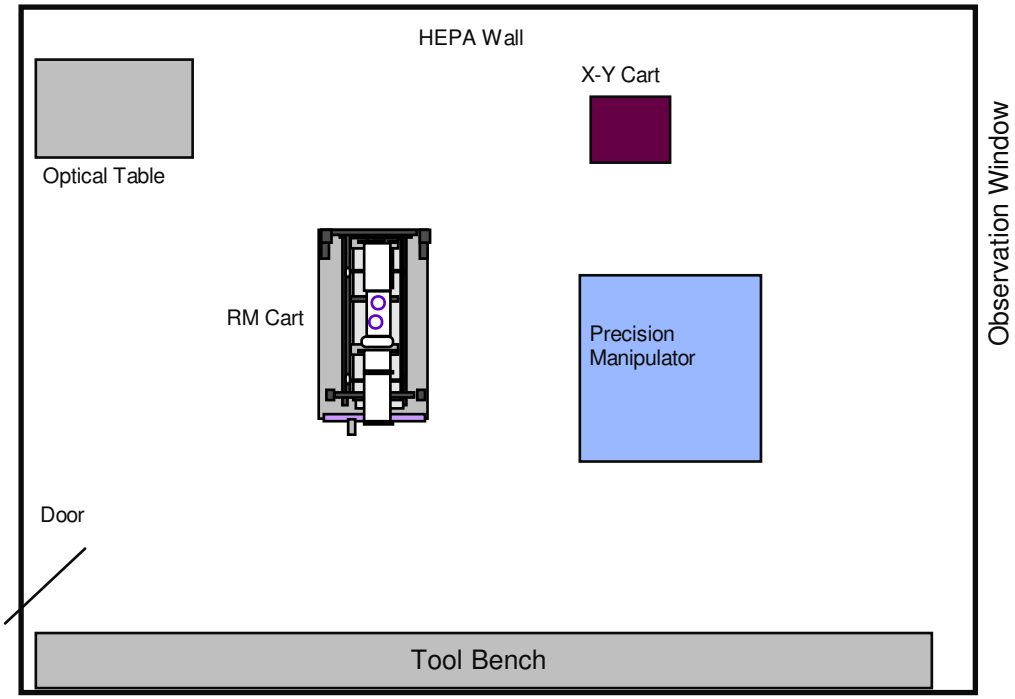


Figure 2. Side View of QB/T/RM in RM Cart (not to scale)

6 TRANSFER QBA FROM RM CART TO VM CART

6.1 Initial Preparations

6.1.1 Move the Optical Table to the corner of the room and position the RM Cart as in Figure 3 below. There should be sufficient room to allow a person to be on each side, in front, or in back of the Roller Mechanism Cart.



Top View of Class 10 Cleanroom - not to scale

Figure 3. Room Setup for Start of Transferring QBA to RM Cart

6.1.2 Check the following on the RM and RM cart:

- Hinges on front of RM are locked
- Restraining cable ends are firmly attached to RM and cart
- Adjustment lever is attached to cart

6.1.3 Rotate the QB/T in the RM so that the flat sides adjacent to Gyros 3 & 4 are vertical.

6.2 Rotate QB/T to Vertical

6.2.1 Manipulate the height of the cart with the foot pedal (to raise cart) and hand lever (to lower cart) so that the cart platform is at a height of approximately 2 ft. (One should be able to comfortably reach both ends of the RM when it is raised vertically)

CAUTION: Ensure that the QBA is secure in the RM, by checking that the upper semicircular halves of the two rollers are securely bolted together.

6.2.3 With one person on each side of the cart to ensure against tipping of the cart, each holding a square support block on the bar near the telescope interface, rotate the RM about its hinge 90 degrees to vertical. A third person raises the platform bar lever and positions it in its locking slot on the RM. Once the bar is locked in place, the others may let go of the QB/RM. See Figure 4 below.

CAUTION: Avoid touching the bonding or polished surfaces of the QBA

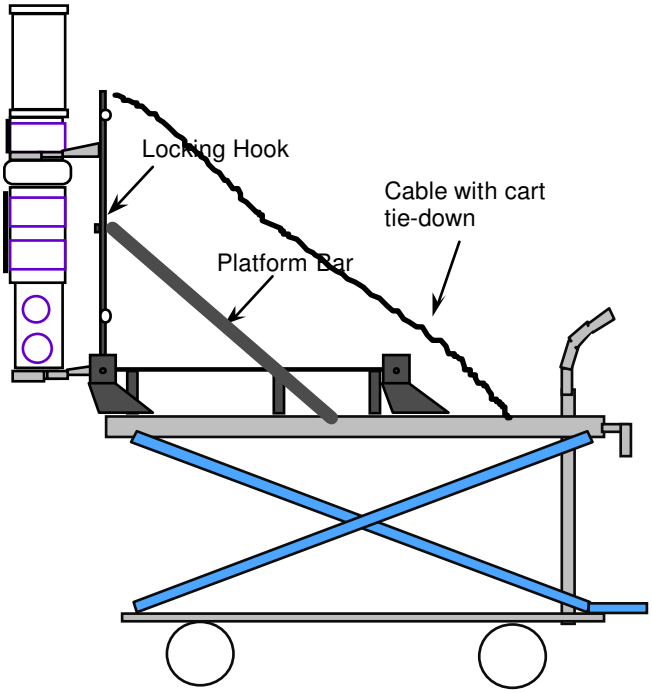


Figure 4. Side View of RM Cart with QB/T/RM Vertical (not to scale)

6.3 Install QB/T into VM Cart

6.3.1 Position the RM Cart under the QBA such that the slide supports (clamps) on the RM Cart mechanism are orthogonal to the RM Cart (i.e., the clamps mate with the clamping surfaces on the X and -X sides of the QB).

6.3.2 Remove the two side plates on the RM cart by loosening the Hex bolts which hold each one to a clamp. Carefully slide the plates out.

6.3.3 Slowly lower the RM Cart with the hand lever until the bottom of the QB is approximately 1 in. above the center spacer of the RM cart. One person guides the other on the controls to avoid abrupt contact with clamps.

6.3.4 Adjust the clamps around the QB. The bottom of the QB should be centered on the center spacer and the clamp knobs on the QB sides.

6.3.5 Use the VM cart vertical control to make final contact with the bottom of the QB.

6.3.6 Install the two side plates on the RM cart by sliding them carefully between the QB and the clamps, then inserting and tightening the hex bolts.

6.3.7 Remove the upper arc of the smaller roller by using an Allen wrench to remove the silver plated bolts which hold the arcs together. Slide the arc out taking care not to touch the QB. Lay the arc on the cart.

6.3.8 Loosely tighten the clamps around the QB such that the QB remains held in place but can still be shifted within the clamps.

6.4 Remove the RM from QB

6.4.1 Remove the upper arc of the larger roller by using an Allen wrench to remove the silver plated bolts which hold the arcs together. Slide out the arc taking care not to touch the QB. Lay the arc on the cart.

CAUTION: The QB/T should be held in place at all times during this operation.

6.4.2 Tighten the clamp on the QB until the vise is securely holding the QB. See Figure 5 for final configuration

6.4.3 Adjust the RM cart height slightly until the RM cart can be backed up without contacting the QB.

6.4.4 Slowly back up the RM Cart away from the QB/T, being careful not to bump the QB against the RM lower arcs.

6.4.5 Lower the RM in the RM Cart to horizontal by unlocking the platform bar and guiding the RM back to horizontal. Release the hand lever.

6.4.6 Move the QB/T in the RM Cart in front of the ion bars near the HEPA wall to the observation window side of the room..

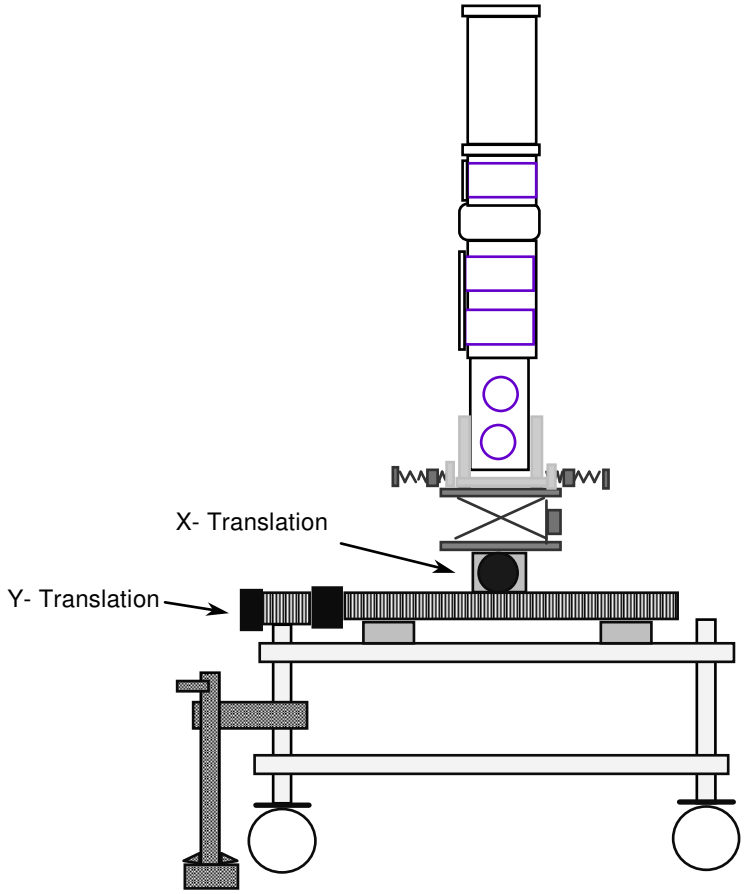


Figure 5. Quartz Block Assembly in RM Cart (not to scale)

7 PROCEDURE COMPLETION

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

Integration Engineer(s)_____ Date _____

_____ Date _____

_____ Date _____

ITD _____ Date _____

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

QA Representative _____ Date _____

QA Program Engineer_____ Date _____

Copy discrepancies to D-Log and open Discrepancy Reports when required.

8 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.