



W. W. Hansen Experimental Physics Laboratory  
STANFORD UNIVERSITY  
STANFORD, CALIFORNIA 94305 - 4085

Gravity Probe B Relativity Mission

## QUARTZ HOUSING COATING PROCEDURE

**GP-B P0044 Rev-**

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Prepared by: P. Zhou  
Gyroscope Coating Manager

Date

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Approved by: S. Buchman  
Manager, Gyro Development

Date

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Approved by: B. Taller  
Quality Assurance

Date

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Approved by: J. Turneure  
Hardware Manager

Date

## QUARTZ HOUSING COATING PROCEDURE

### A. General

1. Housings are inspected, cleaned, and vacuum baked before installation in coating fixtures. Support lands are coated first, followed by Talyron measurement of the lands and recleaning prior to coating of the electrodes and spin-up land.

2. Approved personnel: Ping Zhou  
Chris Gray  
Jim Perales

3. Use factory calibrated equipment

### B. Installation

#### 1. Vacuum Bake

All housings, immediately prior to assembly/installation should be cleaned in accordance with procedure P0001 Rev. A (dated 4/90). Following cleaning, the housing (s) should be baked at 60° Celsius for a minimum of one hour. Housings may then be removed for installation.

#### 2. Housing/Fixture Assembly

##### a) Fixture Preparation

Fixture base plates are different for readout and spin-up halves respectively. Use of the appropriate plate for the particular housing type is imperative. Use fixture 412850-S Spin-Up Half and 412850-R for Readout Half.

Fixtures should not be used if overcoated to the extent that loose or peeling surface material is observed.

##### b) Housing Installation

Each housing should be gently placed onto the fixture plate. Holddown studs are then dropped into the appropriate jig holes. If rotational adjustment is required, the housing should be lifted slightly before turning, to avoid scratching the parting plane. The studs are then screwed into the base plate, and lightly tightened with a screwdriver. Washers are then placed over the studs, and the nuts are tightened to contact only.

If the features to be coated are electrodes, the electrode pin bores should be blocked with foil from the back side to prevent deposition through the bore. Use a round piece of aluminum foil approximately 1/2" in diameter. Press the center of the foil circle firmly into the pin clearance bore from the outside of the housing using the Delrin rod tool. The housing cover cap is then fastened in place. The fixture assembly is then turned over carefully to allow mask installation.

c) **Mask Inspection**

Coating mask should undergo a post-fabrication microscopic inspection to prevent machining flash or burrs from damaging the housing when used.

The masks should also be inspected following chemical stripping operations.

d) **Mask Installation**

Use electrode mask Drawing No. 412847-D Rotor Support Land Mask, Drawing No. 512449-A, and Spin-up Land Mask Drawing No. 412852-E.

The Delrin sleeve is placed in the recess of the mounting plate. The mask is then held with the fingertips inside the mask cavity, and lowered gently into position through the sleeve. The sleeve is then removed. The mask should be checked to insure that it is completely seated in the mounting plate. The screws are then inserted and lightly tightened. The entire fixture is then gently turned over again, and the cover cap removed. Loosen the nuts holding the housing to the plate, then retighten slightly by hand. Replace the cover and fasten its screws. The housing assembly should then be tilted to 41° relative to the base plate and locked in place with the index screw and bracket. The assembly cover is then placed over the fixture and fastened with three screws and the location tabs. The fixture is now ready for installation in the sputtering system.

For electrode depositions, the addition of the insert ring and holddown hardware is required. The insert ring is placed in the mask opening, where it should fit loosely in place. The holddown spring assembly is then fastened to the mask using the two mask screws and two additional #2 screws and washers. The spring fingers should rest loosely upon the top rim of the insert ring. For spin-up land deposition, the spin-up inserts gently placed in the spin-up channel using tweezers, with the cylindrical portion of the insert loosely engaging the spin-up gas exhaust port. A three (3) inch length of 0.020" diameter Cu wire with a 1/16" long 90° bend in one end is

then fed through the hole in the end of the insert and further through the center hold in the housing, until the "hook" at the end of the wire rests against the insert, pointing toward the exhaust port. The wire is then held firmly to retain the insert while turning the fixture/housing over. The Delrin insert is then threaded over the loose end of the wire and should fit into place in the housing center hole. The wire is then pulled taut and bent 90° in the direction of one of the housing holddown studs where it exits the housing/insert. The holddown stud nut is then loosened, and the wire wrapped 180° around the stud, directly against the top surface of the washer. The nut is then lightly retightened, holding the wire in place.

### 3. Fixture Installation (in KJL system)

The system must be vented and the chamber cover raised using the hoist. The housing/fixture assemblies are then set in place in the numbered platen recesses in numerical order. The housing/mask cavity should be open towards one's right while facing the platen position, then the fixture is rotated clockwise until position to begin the deposition process. See Talyron Data for housing location in chamber respective to housing feature coated.

### C. Target Replacement

Targets: Copper  
OFHC  
Titanium 99.99% pure

Targets should be routinely checked for wear and replaced whenever there is insufficient material to allow for the next coating, including a ~10% safety margin.

Rotate the chamber top plate back out of the way to allow access to the chamber interior. Remove the deposition confinement cans by grasping the outside and pulling straight up. Disconnect the gas introduction lines from each sputter gun by hooking the elbow bend in the line with one finger and gently pulling away from the gun, then rotate the tubing so that the open end points away from the gun. Loosen three shield holddown screws at the base of the gun shields. This allows removal of the shields by gently rocking the shield while pulling straight up. The gun shutters should be opened before removing the shields, however, and this is done with the respective "open" buttons on the front panel of the Sycon deposition monitors in the center instrument console. With the gun shields removed, the target holddown rings are now accessible. Each ring is retained by four bolts which require only slight loosening before the ring can be rotated and removed. The targets can then be removed and replaced. The disassembly process is then reversed to complete the installation.

### D. Crystal Sensor Replacement

The crystal monitor sensors available remaining life is observable by pressing the "life" key on the Sycon deposition monitor. When replacement is required, the sensor shutters should be

manually lowered on their hinges allowing the removal of the sensor case by pulling straight down on the edges of the case while holding the sensor head steady. The Inficon crystal removal tool is then used to remove the insert from the back of the case, which allows the removal and replacement of the crystal sensor. After replacing the crystal sensor and insert, the case should be gently rocked back into place in the sensor head to avoid deforming the spring finger contacts. The shutter is then rotated back into place, and the "life" value rechecked to insure that the new crystal is functioning properly. (Should read 90% +).

#### **E. System Pumpdown**

After the housing/fixture installation, the chamber top plate is lowered into position using the hoist. Using the computer terminal keyboard, the "main pumping" menu is selected. By selecting "auto chamber pumpdown" the chamber pumpdown process is initiated. This process includes a chamber pressure check before opening the gate valve. Should the pressure remain higher than the preset crossover pressure, the pumpdown will abort, putting the system in safe state. The pumpdown process can then be restarted if the chamber pressure was only slightly too high for crossover. Otherwise the system should be examined for leaks or other problems.

## F. Process Preparation

### 1. System Parameters

The user programmed process parameters are accessible from the main menu by selecting the "process utility menu." Each of the sub-menus then listed contain a list of programmable values. The standard values for these parameters are as follows :

#### a) Thickness Utility Menu

Edit Density Factor 1	08.93
Edit Density Factor 2	04.50
Edit Density Factor 3	08.93
Edit Density Factor 4	08.93
Edit Z factor 1	.44
Edit Z Factor 2	0.63
Edit Z Factor 3	0.44
Edit Z Factor 4	0.44
Edit Tooling Factor 1	046
Edit Tooling Factor 2	102
Edit Tooling Factor 3	031
Edit Tooling Factor 4	019

#### b) Process Parameter Menu

##### (1) Land Deposition Parameters

Edit Substrate Temp	020 C
Edit Temp	+00
Edit Temp	100
Edit Deposition Rate 1	0015 A/Sec
Edit Deposition Rate 2A	005 A/Sec
Edit Deposition Rate 2B	005 A/Sec
Edit Deposition Rate 3	0015 A/Sec
Edit Deposition Rate 4	0015 A/Sec
Edit Running Time 1	19413 Sec
Edit Running Time 2A	00508 Sec
Edit Running Time 2B	01016 Sec
Edit Running Time 3	19413 Sec
Edit Running Time 4	19413 Sec
Edit No. of Cycles	001
Edit No. of Substrates	X
Xtal/Log Sample Time	180 Sec

**c) Gas and Bias Parameter Menu**

Edit Gas Flow 1	040 scc/m
Edit Gas Flow 2	000 scc/m
Edit Gas Calibration 1	1.44
Edit Calibration 2	1.44

**c) Gas and Bias Parameter Menu (Continued)**

Edit Pressure Setpoint	007 mT
Edit Bias Power	000 W
Edit Bias Time	000 Sec
Edit Bias Pressure	000 mT
Edit DC Bias Power	000 W

**G. Process Start**

Before starting the process, the following observations should be confirmed: The system pressure should be  $\leq 5.0E-7$ . The water supply for all instrumentation should be on. The sputtering power supplies should be in ready state. (Program mode). The MKS 147b should be in standby mode. The main on/off switch for the quartz lamps should be switched off unless auxiliary heating during the process is desired, in which case the Athena temperature controller should be programmed appropriately. (See Athena operation manual). The “shutter” indication should not be illuminated on any of the Sycon front panels. If an open shutter is observed, press the “close” key on the front panel to extinguish the indication. Check that no Sycon monitor is displaying a flashing “xtal fail” indication, and that the available remaining crystal sensor life is sufficient to complete the deposition cycle. Any failed or overused crystal sensor will require replacement before beginning the deposition process.

The process is initiated by selecting the “main process” menu, then “F10” (as directed by on-screen menu) for standard process run. The program will then prompt for a filename assignment for the datalog to be kept during the run. After entering the filename, press “enter” or “F7,” and the process will begin..

**H. Initial Process Checks**

Once the process has started, the following checks should be performed: As soon as the initial indexing of the platen is complete, the platen position #1 should be centered over gun #2. If this is not the case, the run should be aborted and the cause of the misalignment determined. the gas flow should remain relatively stable in maintaining the process pressure. Any large flow fluctuations other than those programmed to occur upon gun ignition should be investigated.

**I. System Vent**

The system should be vented following the completion of the deposition cycle program by using the “manual operation” menu. The ion gauge will automatically turn off upon manual menu selection. Once this menu is displayed, close the “hivac valve,” then open the “vent valve.” Observe the chamber pressure at the Convectron gauge. When the chamber is at atmospheric pressure, the “chamber atm” light will turn on, allowing operation of the chamber hoist.

**J. Fixture Removal**

The platen temperature indication should read less than 50° centigrade before opening the chamber. With the chamber vented, the hoist is used to lift the chamber top plate and platen. The fixtures can then be removed one at a time and carefully transported to the assembly bench.



### **K. Housing Removal**

The housings may be removed from the coating fixtures by reversing the installation procedure, with one important exception: The mask **must** be removed (using the Delrin sleeve again) **before** removing the cover cap or loosening the housing attachment stud nuts. **Do not** rock the mask out of its seat in the fixture plate, but gently pull straight up. This will prevent or minimize mask to housing contact. **Do not** make the mistake of attempting to remove the housing by pulling it up off of the attachment studs without removing the studs first. The housing will almost certainly bind on the studs, and removal may result in broken quartz!

### **L. Housing Storage**

After removing housings from their fixture assemblies, they should immediately be placed in an approved container, and stored safely at the back of the assembly bench. If no further coating or inspection is required, the housing in its container should be placed in the dry box next to the display area in Room 132.