W. W. Hansen Experimental Physics Laboratory

STANFORD UNIVERSITY

STANFORD, CALIFORNIA 94305 - 4085

Gravity Probe B Relativity Mission

PROCEDURE FOR SUPPLEMENTARY

CMM MEASUREMENTS FOR QUARTZ BLOCK #5

P0668

March 24, 2000

_____

1   Prepared by: John P. Turneaure, RE Date

_____

Approved by: Barry Muhlfelder   Date
2   Payload Technical Manager

_____

3   Approved by: Dorrene Ross Date

Quality Assurance

_____

Procedure for Supplementary CMM Measurements
for Quartz Block #5 — P0668

1 **INTRODUCTION**

3.1 Objective. The objective of this procedure is to make supplemental coordinate measuring machine (CMM) measurements of Quartz Block #5 to complete the set of measurements needed to verify the SIA to Probe C interface.

3.2 Flight Equipment Safety. The quartz block is a program critical item. Damage to Quartz Block #5 that renders it unacceptable for flight use may cause a substantial program delay and a large cost impact. Particular attention shall be given to preventing the quartz block from coming into contact with hard surfaces that could result in the quartz block being chipped.

3.3 Redlining of Procedure. This procedure shall only be redlined with concurrence of the QA representative.

4   CALIBRATION STATUS OF CMM

CMM Manufacturer, Model & Serial No.: _____

Accuracy: _____

Calibration Date: _____

CMM Operator   _____ Date _____

QA   _____ Date _____

5   MEASUREMENTS & RESULTS

5.1 Label CMM data as identified in this procedure and the attached Dwg #26227. Attach the CMM printout containing the recorded data to this procedure at the end of all measurements.

5.2 Establish Coordinate System

5.2.1 Use the 8 points in datum -C- given in Dwg #26227 (Sheet 2, Zone F6) to determine the direction of the +Z axis (outward normal of datum -C-) and the zero of the Z-axis.

5.2.2 Use datum -H- (Sheet 1, Zone E1) at the center of the 2.000 inch flange to establish its center in the X-Y plane (establishes zero positions of X- and Y-axes).

5.2.3 Use the outward normal of datum -D- (Sheet 1, Zone B6) to set the direction of the +X-axis.

5.3 Perform Measurements of Datum -G- and Report Results

5.3.1 Measure the 32 points labeled as G11 through G18, G21 through G28, G31 through G38, and G41 through G48 as described in Dwg #26227 (Sheet 2, Zone E2).

5.3.2 Record the 32 measurements in section 3.3.1 in Table 1.

Recorded: CMM Operator   _____ Date _____

                               QA   _____ Date _____

5.3.3   Calculate and record the average Z-position of the above 32 points on datum -G-.

Average Value (n.nnnn inch): _____

                               CMM Operator   _____ Date _____

                               QA   _____ Date _____

5.3.4   Calculate and record the flatness tolerance zone using the 32 points on datum -G-.

Flatness (n.nnnn inch) : _____

                               CMM Operator   _____ Date _____

                               QA   _____ Date _____

5.3.5   Calculate and record the parallelism of the 32 points on datum -G- with respect to datum -C-.

Parallelism (n.nnnn inch) : _____

                               CMM Operator   _____ Date _____

                               QA   _____ Date _____

5.3.6   Calculate and record the rotation angles about the X- and Y-axes of -G1n- with respect to datum -C- using G11 through G18.

PX to PZ: _____

PY to PZ: _____

                               CMM Operator   _____ Date _____

                               QA   _____ Date _____

5.3.7   Calculate and record the rotation angles about the X- and Y-axes of -G2n- with respect to datum -C- using G21 through G28.

PX to PZ: _____

PY to PZ: _____

                               CMM Operator   _____ Date _____

                               QA   _____ Date _____

5.3.8   Calculate and record the rotation angles about the X- and Y-axes of -G3n- with respect to datum -C- using G31 through G38.

PX to PZ **:**_____

PY to PZ: _____

CMM Operator _____ Date _____

QA _____ Date _____

5.3.9 Calculate and record the rotation angles about the X- and Y-axes of -G4n- with respect to datum -C- using G41 through G48.

PX to PZ **:**_____

PY to PZ: _____

CMM Operator _____ Date _____

QA _____ Date _____

Table 1

	Z Position (n.nnnnn inch)		**Z Position (n.nnnnn inch)**		**Z Position (n.nnnnn inch)**		**Z Position (n.nnnnn inch)**
G11		**G21**		**G31**		**G41**	
G12		**G22**		**G32**		**G42**	
G13		**G23**		**G33**		**G43**	
G14		**G24**		**G34**		**G44**	
G15		**G25**		**G35**		**G45**	
G16		**G26**		**G36**		**G46**	
G17		**G27**		**G37**		**G47**	
G18		**G28**		**G38**		**G48**	

5.4 Inspect 2.000 inch Dimension

5.4.1 Inspect 2.000 inch +0.020/-0.000 inch dimension in Dwg #26227 (Sheet 1, Zone B5) for each of the four flange ears associated with -G1-, -G2-, -G3- and -G4-. Record actual values for each ear in Table 2.

Passed: CMM Operator _____ Date _____

QA _____ Date _____

Table 2

Flange Ear	Thickness (n.nnn inch)
G1	
G2	
G3	
G4	

5.5 Inspect 10.22 inch Dimension

5.5.1   Inspect 10.22 inch +0.04/- 0.02 inch dimension in Dwg #26227 (Sheet 1, Zone B5) in two places. Record actual values in Table 3.

Passed: CMM Operator   _____ Date _____

                         QA   _____ Date _____

Table 3

Location	Length (n.nnn inch)
+X Side	
-X Side	

5.6 Inspect 16.850 Max inch Dimension

5.6.1   Inspect 16.850 inch maximum dimension in Dwg #26227 (Sheet 1, Zone D5). Record actual value.

Recorded value (n.nnn inch): _____

Passed: CMM Operator   _____ Date _____

                         QA   _____ Date _____

5.7 Inspect 9.3680 inch +/- 0.0005 inch Diameter

5.7.1   Perform diameter measurements on OD of flange (datum -H-) at four Z locations. With datum -G- at Z0, the four Z locations are Z1 = Z0 – 0.25 inch, Z2 = Z0 – 0.75 inch, Z3 = Z0 – 1.25 inch, and Z4 = Z0 – 1.75 inch. To establish the diameter at each Z location, make measurements at 20 angular locations; 5 equally spaced locations 9° 20 apart (centered on the flange holes) for each of the four flange sections.

5.7.2   Calculate average diameter and circularity for each Z location and record in Table 4 using the 20 measurements for each Z location.

Table 4

Z Location	Average Diameter (n.nnnn inch)	Circularity (n.nnnn inch)
Z1		
Z2		
Z3		
Z4		

5.7.3 Inspect 9.3680 inch +/- 0.0005 inch dimension in Dwg 26227 (Sheet 1, Zone F2) using the average diameter values in Table 4.

Passed: CMM Operator   _____ Date _____

                     QA   _____ Date _____

5.7.4 Calculate average diameter and cylindricity using all 80 measurements. Record actual values.

Average diameter (n.nnnn inch): _____

Cylindricity (n.nnnn inch): _____

                     CMM Operator   _____ Date _____

                     QA   _____ Date _____

5.8 Review Measurements for Completeness

5.8.1 Review measurement data for completeness and consistency, and verify that CMM data printout is attached.

Done: Test Director   _____ Date _____

                     QA   _____ Date _____