Procedure for Supplementary CMM Measurements for Quartz Block #3 — P0457

1 INTRODUCTION

1.1 Objective. The objective of this procedure is to make supplemental coordinate measuring machine (CMM) measurements of Quartz Block #3 to complete the set of measurements needed to verify the SIA to Probe C interface.

1.2 Personnel. The test director for this procedure is John Turneaure, responsible engineer for the Quartz Block (QB). The quality assurance (QA) and safety representative is Ben Taller. The CMM operator is Eric Lundahl of the Stanford Linear Accelerator Center (SLAC).

1.3 Flight Equipment Safety. The quartz block is a program critical item. Damage to Quartz Block #3 that renders it unacceptable for flight use will cause a substantial program delay and a large cost impact. Quartz Block #3 shall be handled and transported only in the manner given in this procedure. 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. New handling processes shall be practiced with one of the plastic quartz block models to verify the handling process.

1.4 Redlining of Procedure. This procedure shall be only redlined by the test director with concurrence by the QA representative.

2 TRANSPORT OF QUARTZ BLOCK TO SLAC

2.1 Packaging of Quartz Block. The quartz block shall be packed in its shipping container using the same materials used for shipping it from Speedring.

Packaging verified: Test Director _____ Date _____

QA _____ Date _____

2.2 Installation into Transport Vehicle. The shipping container with the quartz block in it shall be carried by two persons to the transport vehicle and strapped or tied into the floor of the transport vehicle so the shipping container does not slide or bounce during transport.

Installed as required: Test Director _____ Date _____

QA _____ Date _____

2.3 Transport. The test director shall drive the vehicle to SLAC taking precautions to avoid bumps and strong breaking during the trip. The QA representative shall accompany the test director on this trip.

No unusual events: Test Director _____ Date _____

QA _____ Date _____

2.4 Removal from Transport Vehicle. The shipping container shall be inspected to verify that it has remained strapped or tied in position. The shipping container shall then be unstrapped or untied from the floor of the transport vehicle. After inspecting the route over which the shipping container will be carried, it shall be carried by two persons to the location of the CMM.

Process completed: Test Director _____ Date _____

QA _____ Date _____

3 CALIBRATION STATUS OF CMM

CMM Manufacturer, Model & Serial No.: _____

Accuracy: _____

Calibration Date: _____

CMM Operator _____ Date _____

QA _____ Date _____

4 MOUNTING OF QB IN CMM

4.1 Verify Handling and Mounting of QB in CMM. Using a plastic model of the quartz block, verify the handling and mounting of the quartz block in the CMM using the precautions given in section 1.3.

Verified: Test Director _____ Date _____

QA _____ Date _____

4.2 Mount QB in CMM. Mount the quartz block in the CMM using the verified handling and mounting process established in section 3.1. Be sure to take the precautions given in section 1.3.

Safely Completed: CMM Operator _____ Date _____

QA _____ Date _____

5 MEASUREMENTS & RESULTS

5.1 Label CMM data as identified in this procedure and the attached Dwg #25768. Attach the CMM printout containing the recorded data to this procedure at the end of all measurements. If it is necessary to change the orientation of the quartz block for the various measurements, it shall be done according to section 4.

5.2 Establish Coordinate System

5.2.1 Use the 7 points in datum -C- given in Dwg #25768 (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 #25768 (Sheet 2, Zone E2).

5.3.2 Record the 32 measurements in section 5.3.1 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.

Rotation about X-axis: _____

Rotation about Y-axis: _____

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.

Rotation about X-axis: _____

Rotation about Y-axis: _____

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.

Rotation about X-axis: _____

Rotation about Y-axis: _____

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.

Rotation about X-axis: _____

Rotation about Y-axis: _____

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**		**G11**		**G21**	
G12		**G22**		**G12**		**G22**	
G13		**G23**		**G13**		**G23**	
G14		**G24**		**G14**		**G24**	
G15		**G25**		**G15**		**G25**	
G16		**G26**		**G16**		**G26**	
G17		**G27**		**G17**		**G27**	
G18		**G28**		**G18**		**G28**	

5.4 Inspect 2.000 inch Dimension

5.4.1 Inspect 2.000 inch +0.020/-0.000 inch dimension in Dwg #25768 (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 #25768 (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 #25768 (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 25768 (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 _____

6 TRANSPORT OF QUARTZ BLOCK TO HEPL

6.1 Packaging of Quartz Block. The quartz block shall be packed in its shipping container using the same materials used for shipping it from Speedring.

Packaging verified: Test Director _____ Date _____

QA _____ Date _____

6.2 Installation into Transport Vehicle. The shipping container with the quartz block in it shall be carried by two persons to the transport vehicle and strapped or tied into the floor of the transport vehicle so the shipping container does not slide or bounce during transport.

Installed as required: Test Director _____ Date _____

QA _____ Date _____

6.3 Transport. The test director shall drive the vehicle to the Hansen Experimental Physics Lab (HEPL) taking precautions to avoid bumps and strong breaking during the trip. The QA representative shall accompany the test director on this trip.

No unusual events: Test Director _____ Date _____

QA _____ Date _____

6.4 Removal from Transport Vehicle. The shipping container shall be inspected to verify that it has remained strapped or tied in position. The shipping container shall then be unstrapped or untied from the floor of the transport vehicle. The shipping container shall be returned to flight stores carried by two persons.

Process completed: Test Director _____ Date _____

QA _____ Date _____