LCLS Test Procedure LCLS Document # L143-00095	Undulator Support/Mover System	Revision 00

Test Procedure for LCLS Undulator Cam Actuator Assemblies

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Brief Summary: This document details the test procedure for LCLS Undulator Cam Actuator Assemblies.

Keywords: Undulator, test procedure, support/mover system, CAM movers

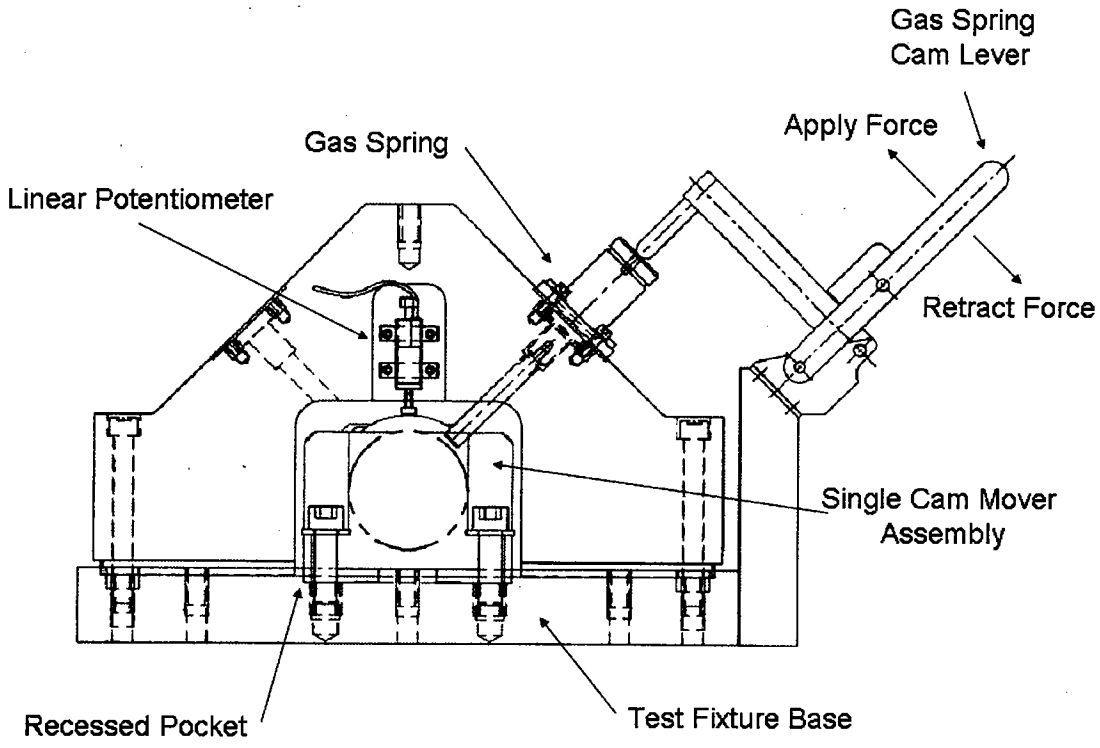
Key WBS#'s: 1.4.3.3.4.3

CHANGE HISTORY LOG

Rev Number	Revision Date	Sections Affected	Description of Change
000		All	Initial Version
001	6/19/07	All	Beta Version

Test Procedure for LCLS Undulator Cam Actuator Assemblies

1. Refer to the test fixture sketch below for clarification of assembly details as needed. Two test fixtures are provided, one for testing single cam actuator assemblies and another for testing double cam actuator assemblies. Both test fixtures interface with the provided universal data acquisition and control system. Each cam in the double cam actuator assemblies are tested separately and therefore the testing procedure is the same for all cam assemblies.



2. Locate the test fixture base on a table top and secure using the provided mounting holes.

3. The gas spring flange has eight bolts with four of them painted red. Use a 3/16" Allen wrench to partially unscrew the red-painted bolts approximately 5-mm. Pull back on the gas spring cam lever to retract the force from the end of the gas spring.

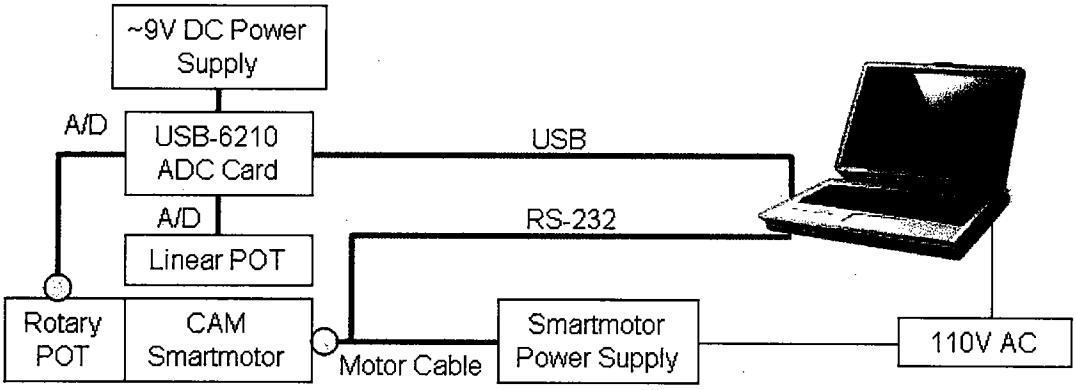
4. Manually retract the linear potentiometer plunger by placing a finger in the linear potentiometer recessed pocket and lift up on the plunger with a finger. Slide the retainer tab around the top of the plunger shaft to keep it retracted. Place the cam actuator into the pocket provided in the test fixture base. Secure the cam actuator assembly to the test fixture base using a 1/2" Allen wrench to tighten the bolts (four bolts for single cam actuator assemblies, six bolts for double cam actuator assemblies).

5. Release the linear potentiometer plunger by removing the retainer tab and it should contact the spherical ring of the cam actuator assembly.

6. Push forward on the gas spring cam lever to apply force to the back of the gas spring. Use a 3/16" Allen wrench to tighten the four red-painted bolts. The gas spring should now be applying approximately 650 pounds of force to the spherical ring of the cam actuator assembly.

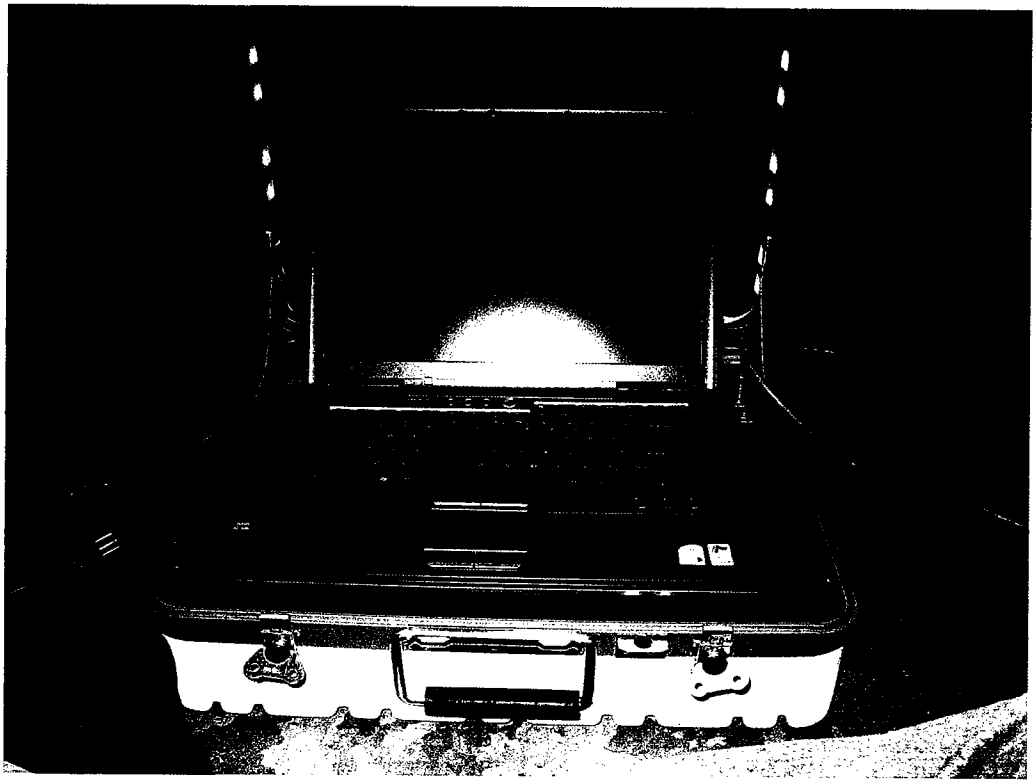
7. The universal data acquisition and control system layout is shown in the sketch below.

LCLS CAM ASSEMBLY QA CONTROL SYSTEM



USB-6210 ADC Card	: NI USB-6210 w/ 16 ADC (16-bit)
~9V DC Power Supply	: Agilent (HP) E3614A DC Power Supply
Laptop/Desktop	: Any PC w/ a USB port and a RS 232 serial port.
Ctl and DAQ Application SW	: In house development and test, 2 weeks effort.

All of the hardware shown in the previous sketch including the laptop computer is contained within an electronics suitcase. A picture of the electronics suitcase is shown below.



8. Open the electronics suitcase and install the power cable into the receptacle located on the rear left side of the suitcase. Plug the power cable in to a 120 VAC outlet.

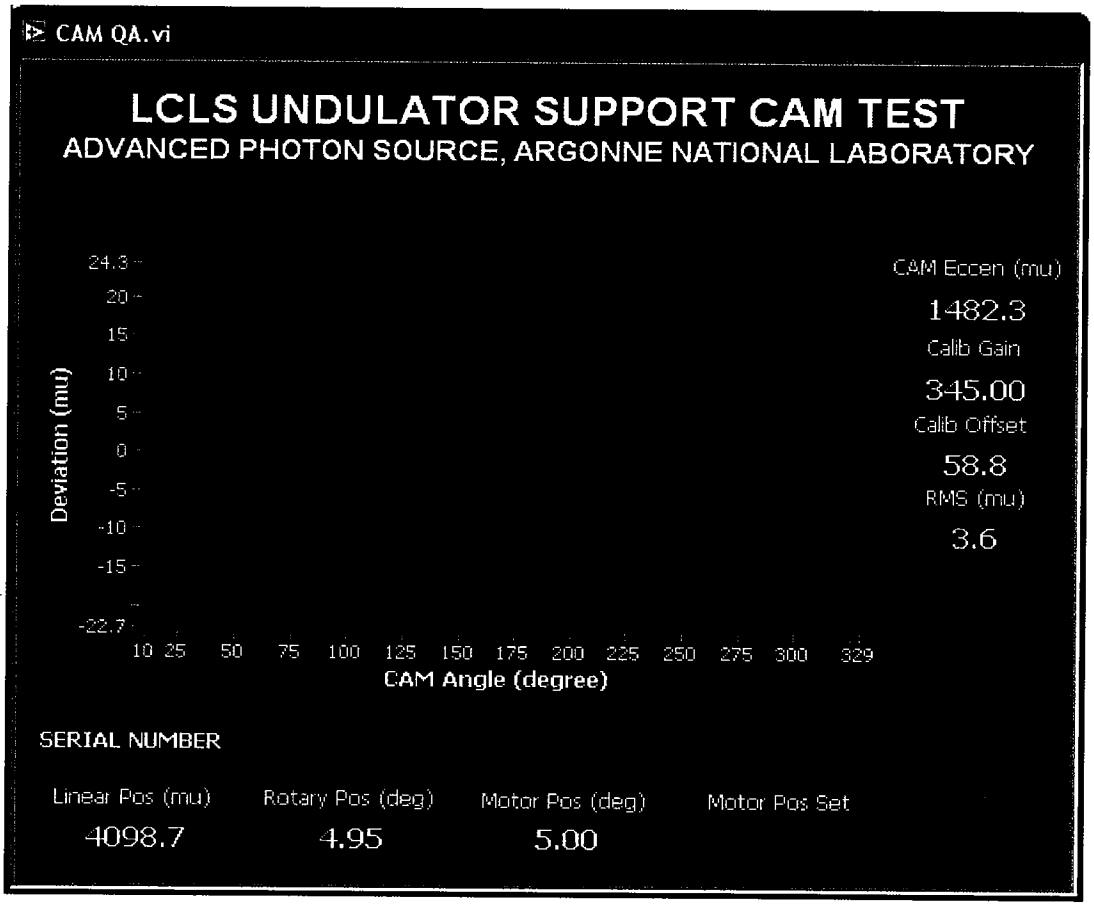
9. Locate the rotary potentiometer cable inside of the suitcase and connect one end into the receptacle located on the rear right side of the suitcase and connect the other end to the receptacle located on the aluminum end cap on the end of the cam actuator assembly.

10. Locate the SmartMotor™ cable inside of the suitcase and connect to the SmartMotor™ located on the other end of the cam actuator assembly.

11. Locate the linear potentiometer cable on the testing fixture and connect into the receptacle located on the rear right side of the suitcase.

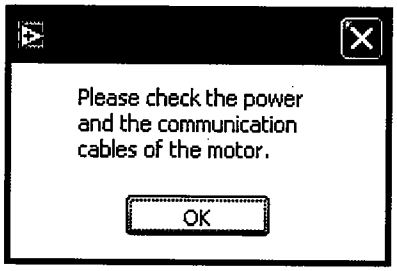
12. Make sure that all connections located on the rear of the laptop computer are secure. Open the laptop computer and turn the computer on. No password is required.

13. Find the icon located on the desktop named **CAM QA** and double click on the icon to open the data acquisition and control program. The **PRT SCN** button can be used at any time to print the current screen. The following screen will appear:



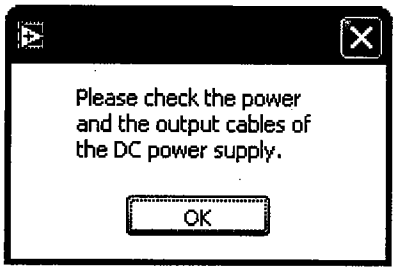
14. The program will automatically check to make sure that all of the cables are properly connected and will issue up to four prompts requesting corrective action if necessary.

    If the SmartMotor™ cable is not properly connected the following prompt will be displayed:



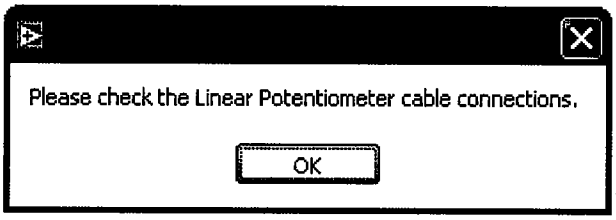
    Check to make sure that the SmartMotor ™ communication cables are properly secured and then click OK.

If the power and the output cables of the DC power supply are not properly connected the following prompt will be displayed:



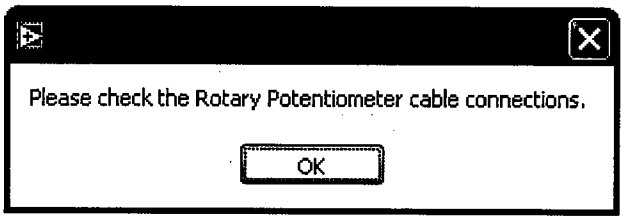
Check in the space behind and below the laptop computer to make sure that all of the power supply cables are properly connected and then click OK. Contact ANL personnel if the problem can not be corrected since this would indicate a problem with the DC power supply.

If the linear potentiometer cable is not properly connected the following prompt will be displayed:



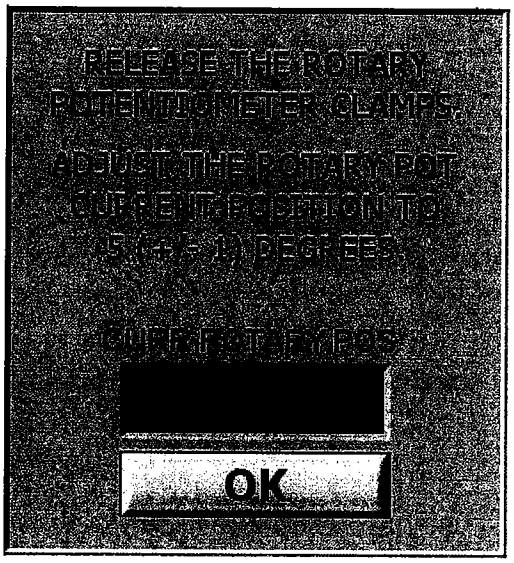
Check to make sure that the linear potentiometer cable on the test fixture is properly connected into the receptacle inside of the suitcase and then click OK.

If the rotary potentiometer cable is not properly connected the following prompt will be displayed:



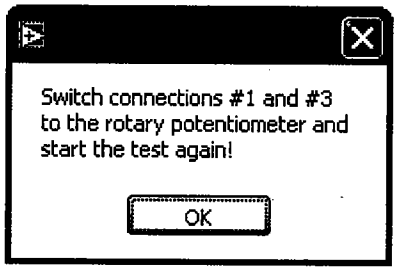
Check to make sure that the rotary potentiometer cable is properly connected to the receptacle inside of the suitcase and properly connected to the receptacle located on the aluminum end cap on the end of the cam actuator assembly. Click OK when the cable is secured.

15. If none of the above prompts appear then all of the cables are properly connected and the system is ready to begin testing. Click the Start button located on the lower right side of the program screen and an audible ring will be heard and the following prompt will appear:



16. The rotary potentiometer located on the end of the cam actuator assembly must be oriented in the proper position with the dead-band of the potentiometer outside of the testing range. Remove the aluminum end cap from the end of the cam actuator assembly to expose the rotary potentiometer. Use a small flat-blade screw driver to slightly loosen the 3 potentiometer clamps. Slowly rotate the potentiometer until the highest pitch audible ring is heard. The highest audible ring will correspond to the proper rotary potentiometer position of 5 degrees. The position will be displayed in the dialog box. Adjust the potentiometer to within +/- 1 degree of the 5 degree target position and tighten the three potentiometer clamp screws.

17. Reinstall the aluminum end cap onto the end of the cam actuator assembly and click the OK button in the dialog box. The program will automatically check to make sure that the switch connections on the rotary potentiometer are properly connected. If they are improperly connected the following dialog box will appear:



If this dialog box appears then the two leads, labeled #1 and #3, soldered to the rotary potentiometer must be unsoldered, reversed, and re-soldered. Remove the aluminum end cap from the cam actuator assembly, perform the soldering operation,

and reattach the aluminum end cap. Click the OK button and the program will return to step 15 of this procedure. Follow along from step 15 and repeat the rotary positioning procedure as before.

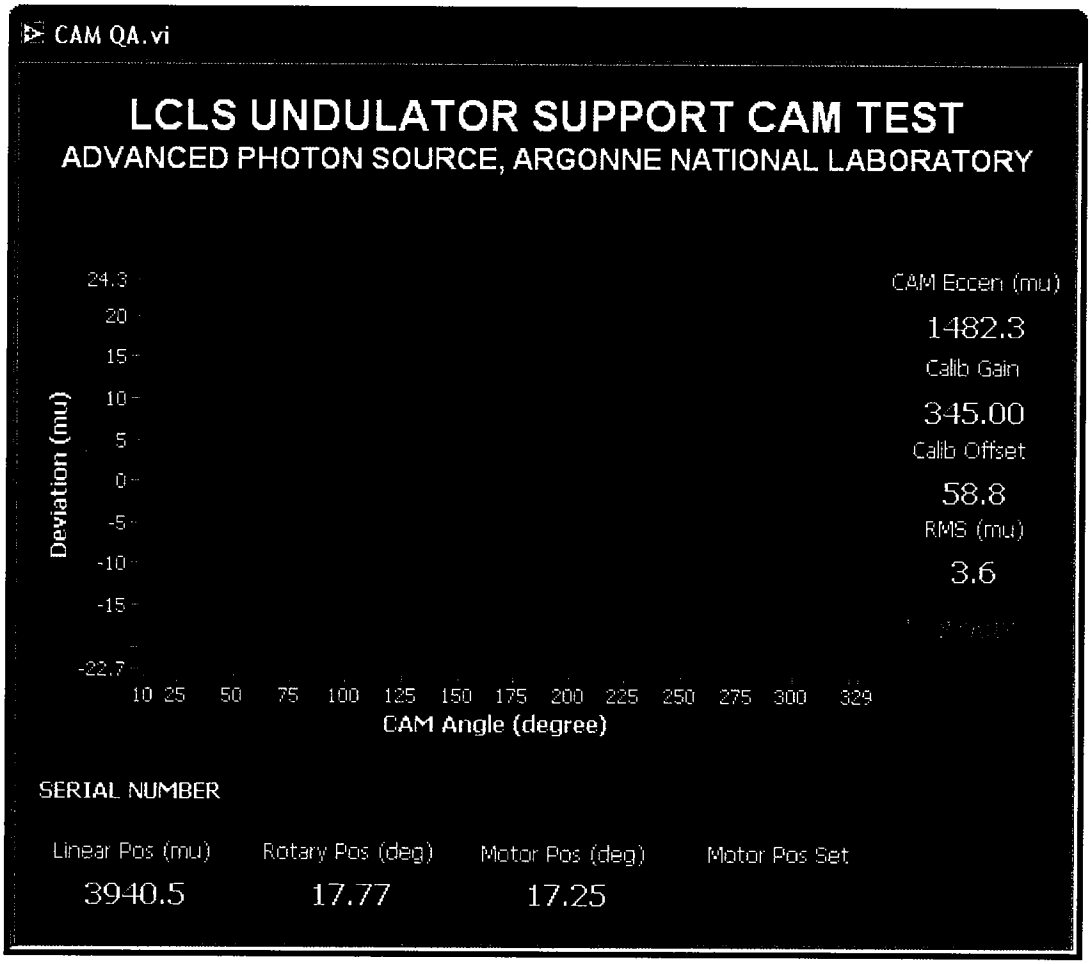
18. If the rotary potentiometer connections were properly installed to begin with the dialog box in step 17 will not appear but instead the following prompt will appear:

The serial number for each cam actuator assembly is stamped on the actuator housing and the following convention is used:

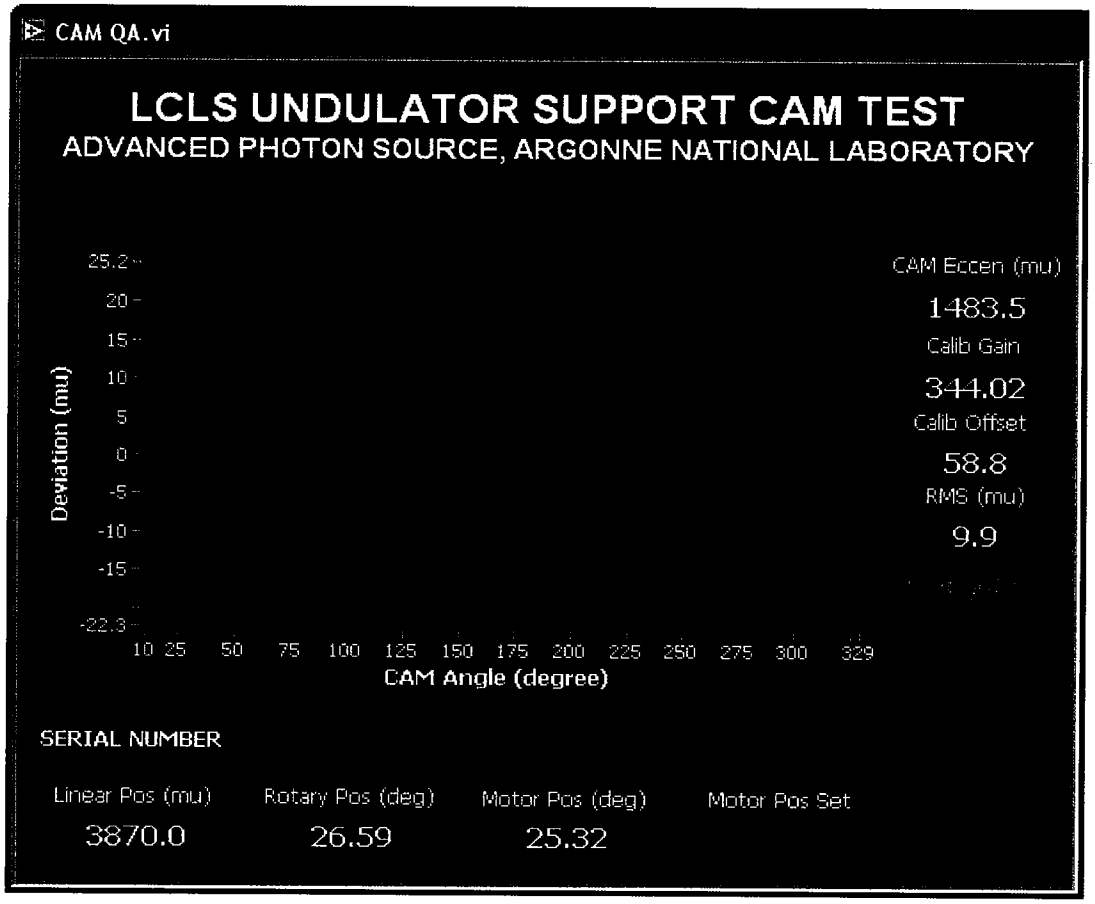
Single Cam Actuators with 1.50 mm. Eccentricity:	**SA-381-000-12-XX**
Single Cam Actuators with 2.12 mm. Eccentricity:	**SA-381-002-14-XX**
Double Cam Actuators, Side A:	**SA-381-000-22-XX-A**
Double Cam Actuators, Side B:	**SA-381-000-22-XX-B**

Enter the cam actuator serial number and click the OK button.

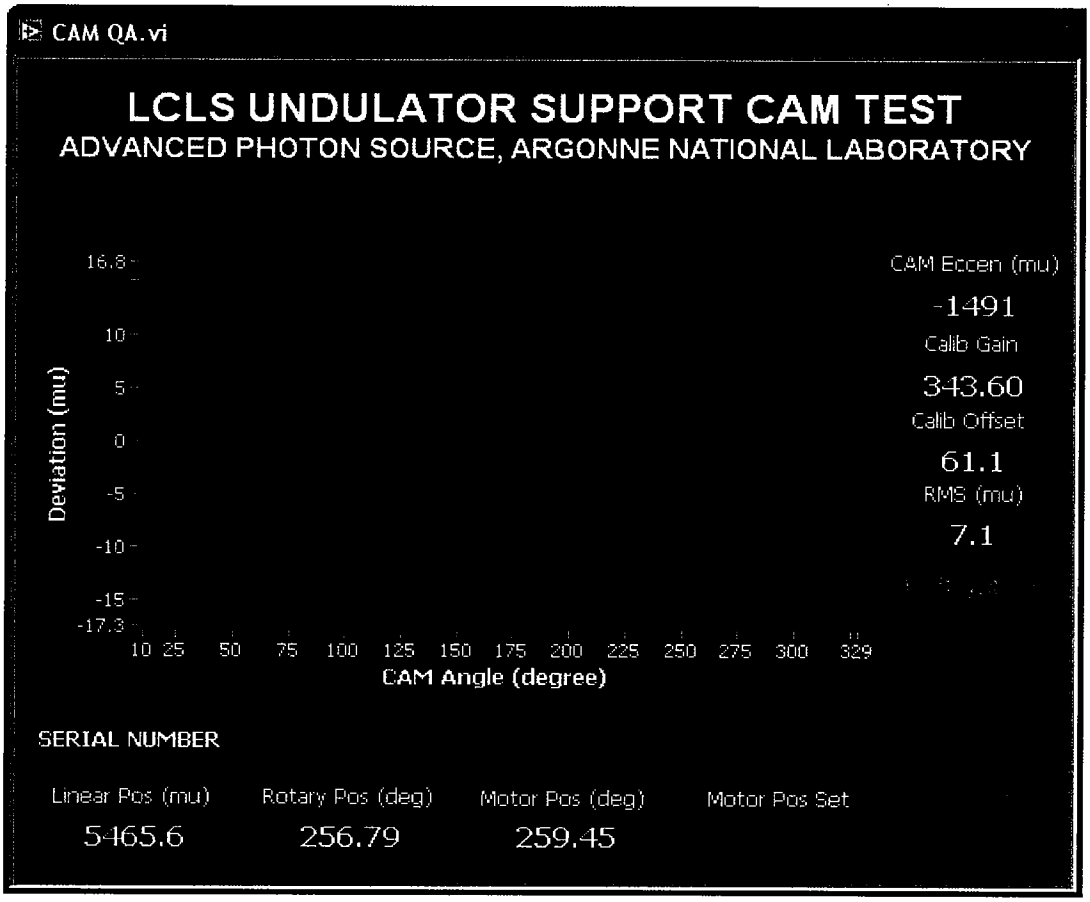
19. Next the program will automatically calibrate the rotary potentiometer gain by driving the cam through 90 degrees of motion, from 10 degrees to 100 degrees in 10 degree increments. The program will automatically collect nine data points, produce a linear fit to the data, and display the calibration gain in the program screen. First the program will check that the rotary pot connections are correct and then the following screen will appear:



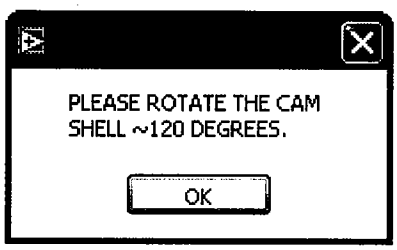
20. After the calibration process is complete the program will automatically begin the test sequence. The cam will be returned to the 10 degree position and then program will drive the motor and scan forward from 10 degrees to 330 degrees. The following screen will appear:



21. After scanning forward, the program will automatically scan backwards from 330 degrees to 10 degrees and the following screen will appear:



22. After the scanning is complete the following dialog box will appear:

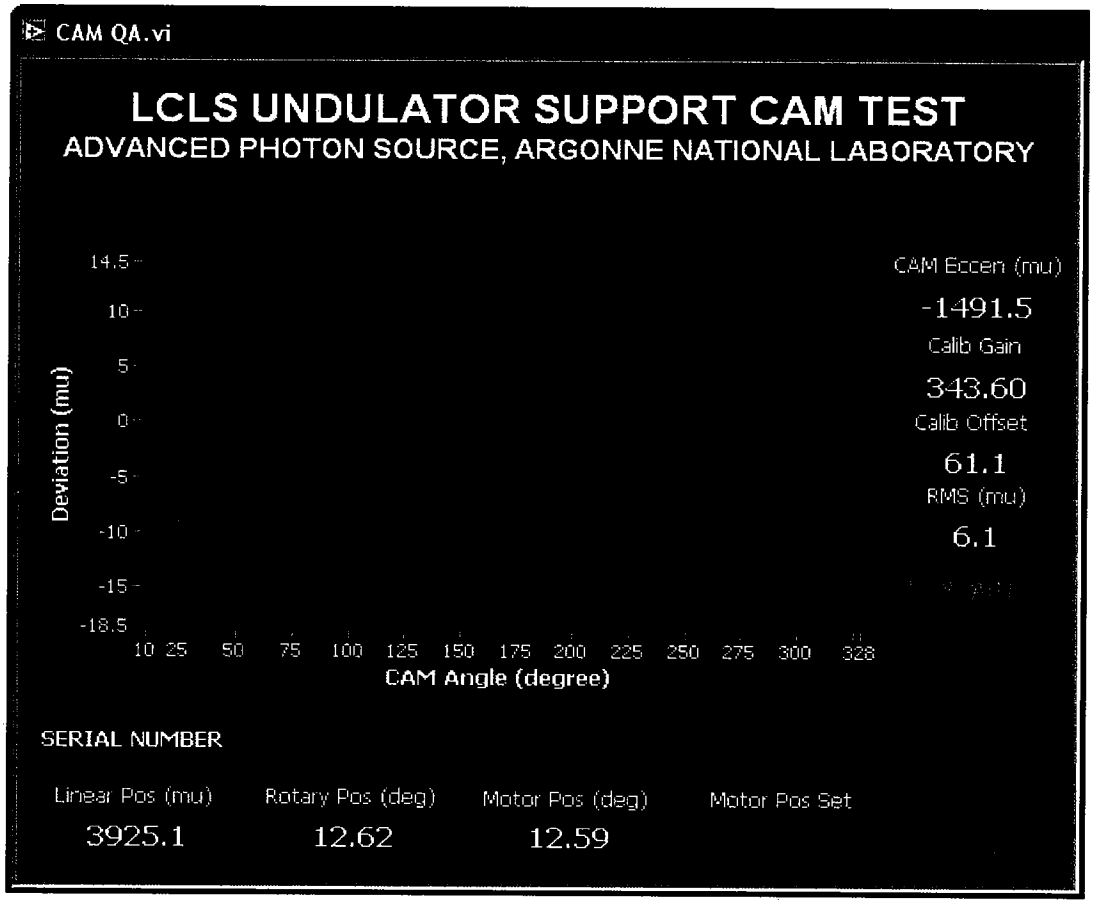


The spherical ring on the cam actuator assembly must be rotated approximately 120 degrees in order to perform another test with the internal bearings located in a different orientation.

Use a 3/16" Allen wrench to partially unscrew the red-painted bolts approximately 5-mm. Pull back on the gas spring cam lever to retract the force from the end of the gas spring. Rotate the spherical ring approximately 120 degrees by spinning it by hand.

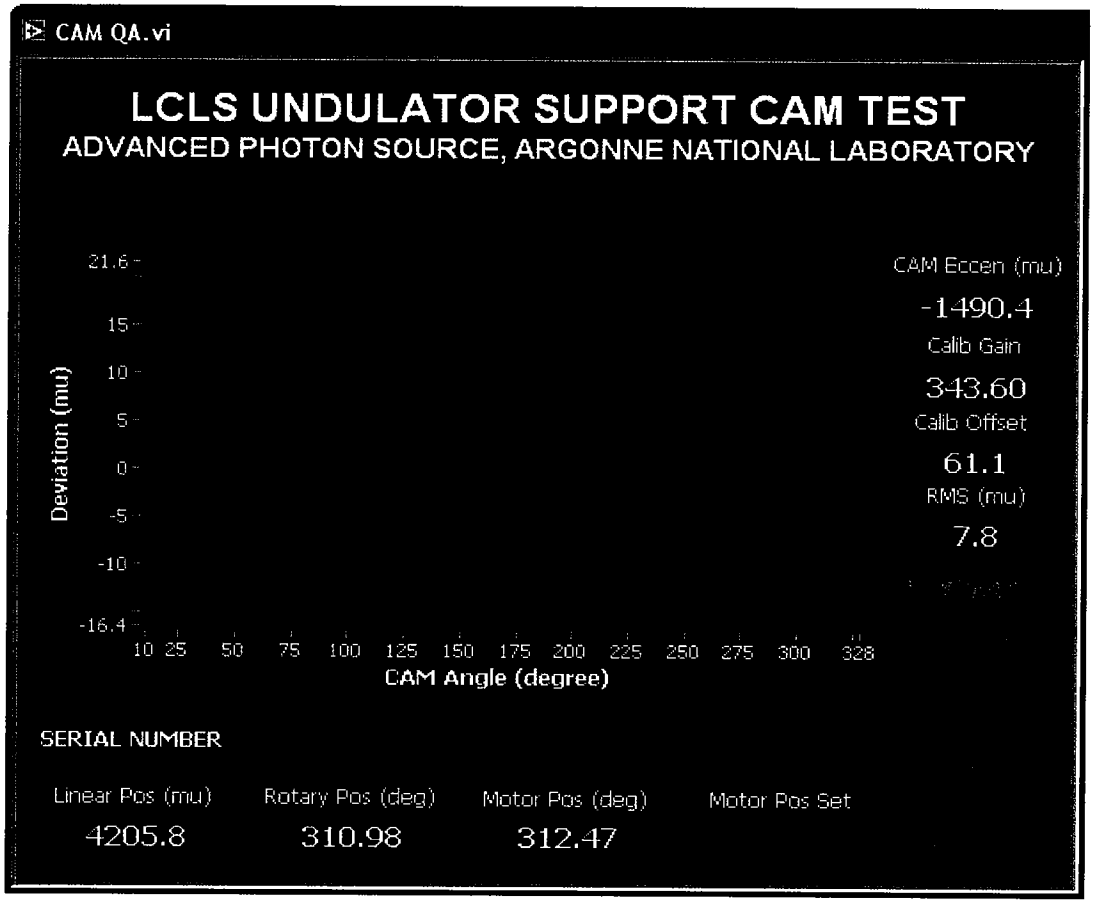
Push forward on the gas spring cam lever to apply force to the back of the gas spring. Use a 3/16" Allen wrench to tighten the four red-painted bolts. The gas spring should now be applying approximately 650 pounds of force to the spherical ring of the cam actuator assembly.

23. Once the spherical ring has been rotated approximately 120 degrees and the gas spring force has been reapplied, click the OK button in the dialog box to resume the test. The following screen will appear:

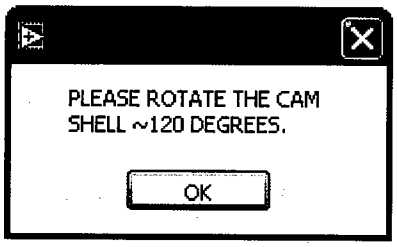


The program will once again perform the forward scanning process as before.

24. After scanning forward the program will automatically scan backward as before and the following screen will appear:



25. After the scanning is complete the following dialog box will appear:

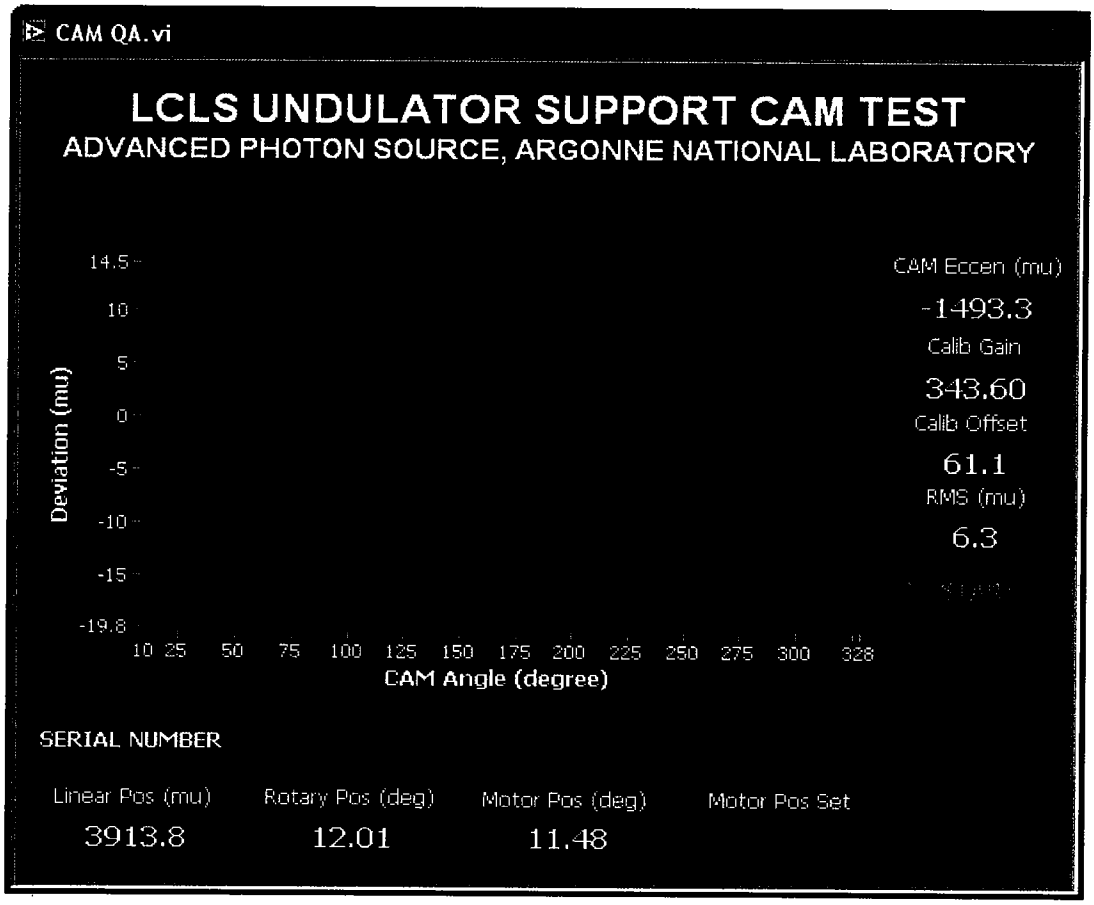


The spherical ring on the cam actuator assembly must again be rotated approximately 120 degrees in order to perform the last set of tests with the internal bearings located in a different orientation.

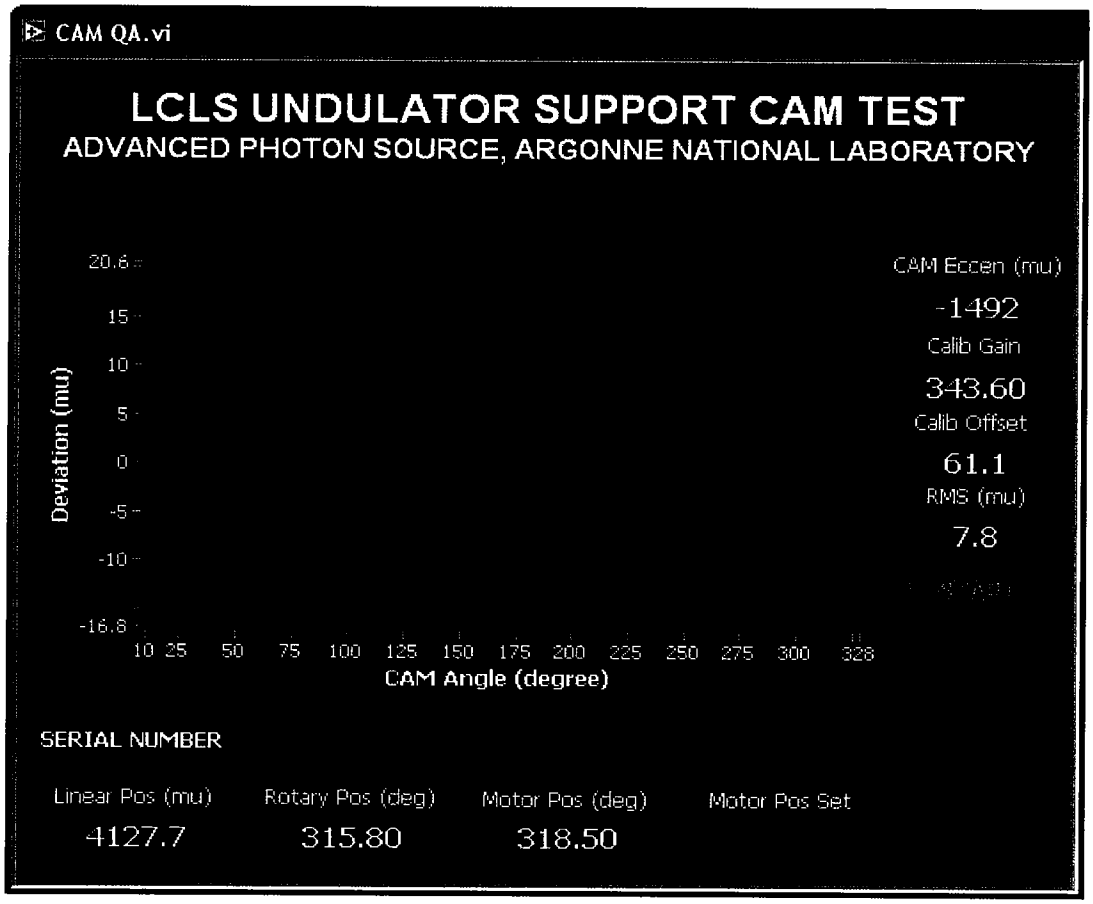
Use a 3/16" Allen wrench to partially unscrew the red-painted bolts approximately 4 mm. Pull back on the gas spring cam lever to retract the force from the end of the gas spring. Rotate the spherical ring approximately 120 degrees by spinning it by hand.

Push forward on the gas spring cam lever to apply force to the back of the gas spring. Use a 3/16" Allen wrench to tighten the four red-painted bolts. The gas spring should now be applying approximately 650 pounds of force to the spherical ring of the cam actuator assembly.

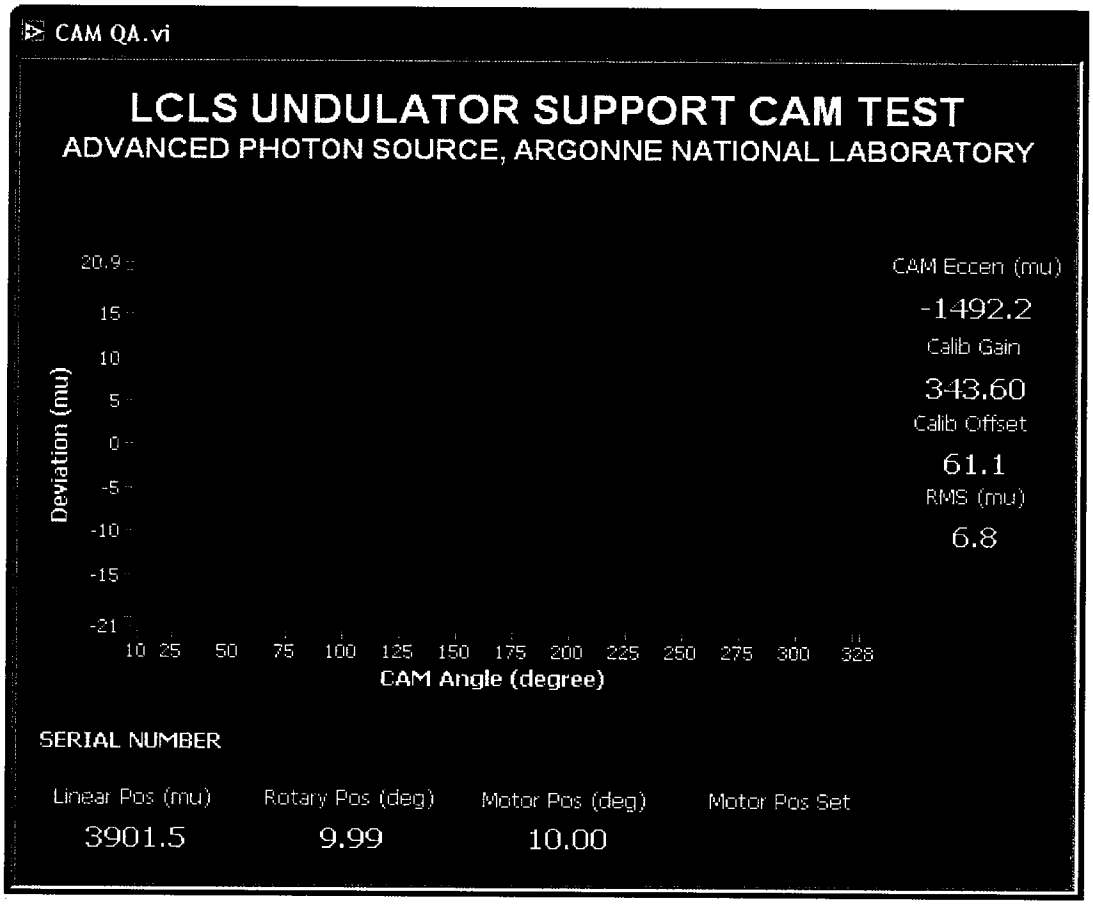
26. Once the spherical ring has been rotated approximately 120 degrees and the gas spring force has been reapplied, click the OK button in the dialog box to resume the test. The following screen will appear:



27. After scanning forward the program will automatically scan backward as before and the following screen will appear:



After the backward scan is complete the following screen shall appear:



28. The test is now complete. The calculated cam shaft eccentricity and RMS of the data will appear in the data boxes located on the right side of the program screen. If the test was successful the message "Test Pass!" will appear next to the serial number in the program screen and the box around it will be blue. If the test failed the message "Test Fail!" will appear next to the serial number in the program screen and the box around it will be red. The criteria for failure are if the RMS of the data is greater than 10 microns.

29. A test report is automatically generated and data from the test are automatically written to a data file that uses the cam actuator serial number as the file name. Data files are automatically saved to a test reports folder located on the hard drive named **CAM QA**. Clicking on the icon located on the desk top named **LCLS CAM Test Reports** automatically links to and opens the **CAM QA** test reports folder.

30. Use the button located on the lower right hand side of the screen labeled **PRT RPT** to print hard copies of the test report. Two copies will automatically be printed. Place one copy in with the traveler and place another copy in your company files.

31. Test failures are to be reported to the lab per section 4.12 of LCLS Statement of Work document #L143-00093.

32. Test reports are to be provided to the lab per section 5.2.3 of LCLS Statement of Work document #L143-00093.