XRD – PB Instructions

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These notes are meant to serve as an aid to assist users who have been trained and certified by MCC Staff. If ever you are unsure about the correct operation of the instrument or any of its components, please consult a MCC staff member before continuing. Never use equipment that you are not trained and approved to use.

Before using the MCC, please review the MCC User Handbook available through our website.

Contents

1. Package measurement flow

This manual describes how to set the measurement conditions and how to execute the Package measurement when the General (medium resolution PB) Package measurement is selected. Also, the conditions can be set and the measurement can be executed in the same way when one of the other General Package measurements is selected.

Figure 1.1 shows the procedural flow for a General (medium resolution PB) Package measurement.

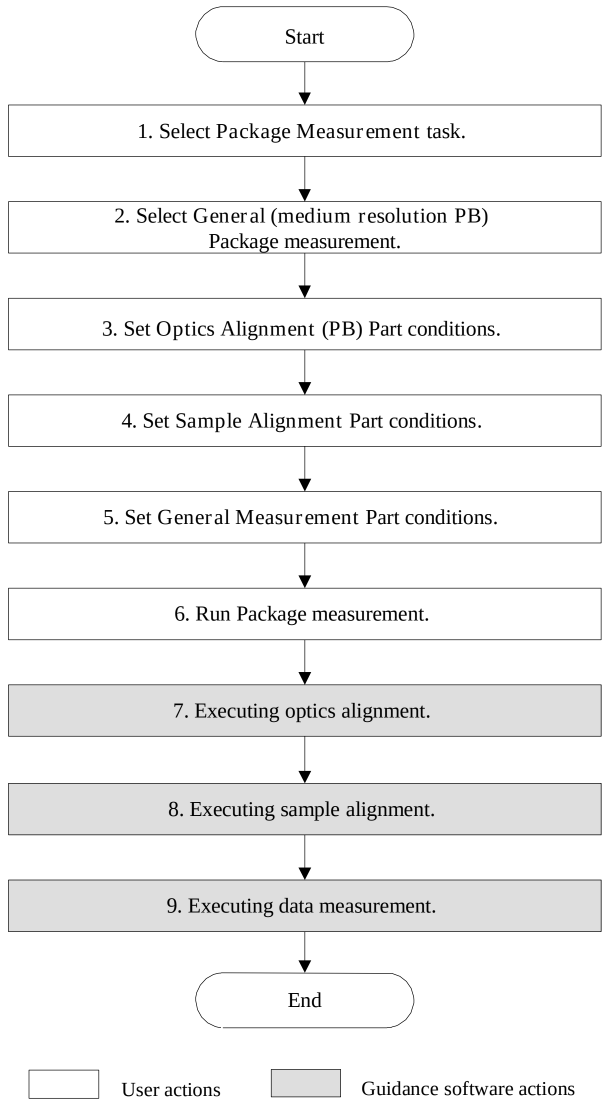
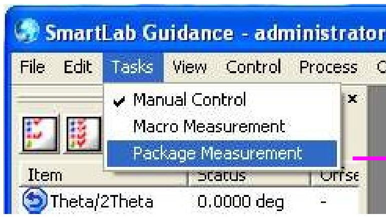
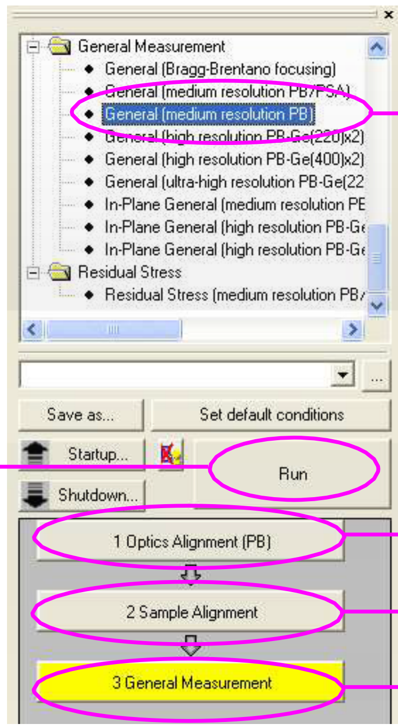


Fig. 1.1 General (medium resolution PB) Package measurement procedural flow

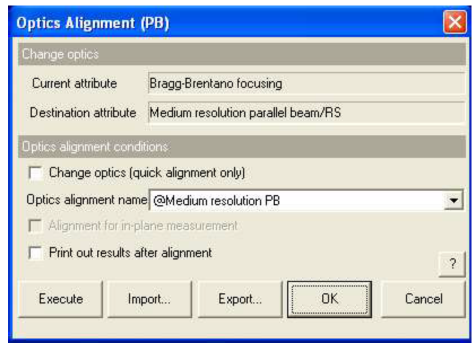


1. Click Package Measurement in the Tasks menu.

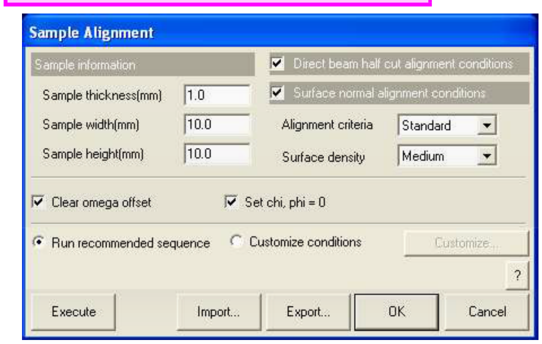
2. Click General (medium resolution PB).



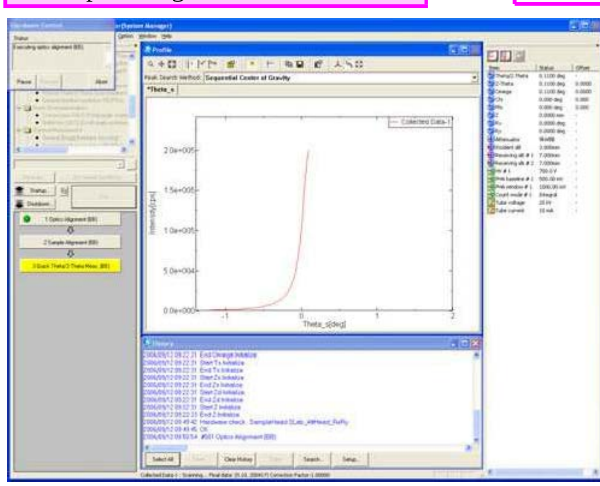
3. Set the Optics Alignment (PB) Part conditions.



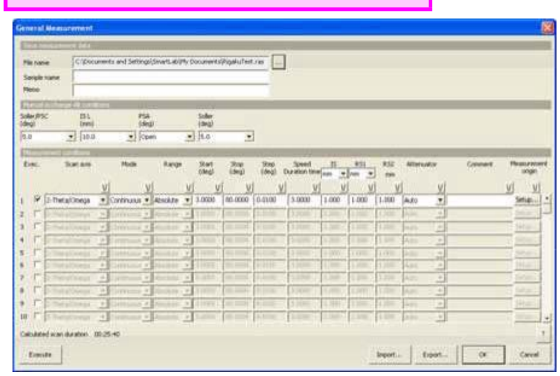
4. Set the Sample Alignment Part conditions.



6. When the Run button is clicked, the optics alignment is started.



5. Set the General Measurement Part conditions.



2. Measurement procedures

1. Startup

Before measurement, set the output of the x-ray generator (XG) as described below.

(1) Click the Startup button on the flow bar to open the Startup dialog box.

(2) Uncheck the Timer box.

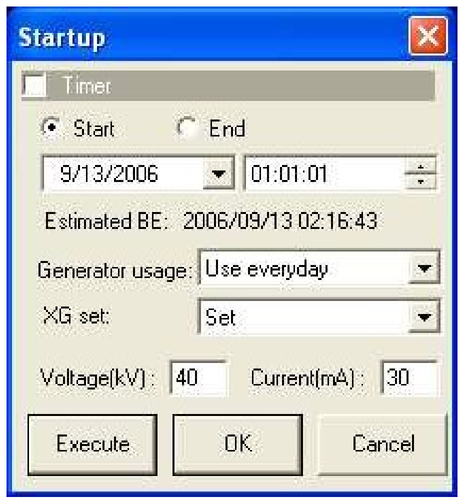


Fig. 2.1.1 Startup dialog box

(3) Select an appropriate setting in the Generator usage box, based on the frequency of XG usage.

(4) Select Set in the XG set box.

(5) Enter the following values in the Voltage (kV) and Current (mA) boxes.

When using 3-kW sealed tube	40 kV, 30 mA
When using 9-kW rotating anode	45 kV, 200 mA

(6) Click the Execute button.

(7) The aging operation begins. The XG output will be set to the values entered in step (5) within 30 to 60 minutes.

> CAUTION: If Not used for more than 3 weeks is selected in the Generator usage box, the aging operation will take approximately five hours.

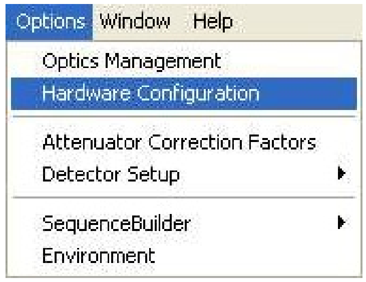
> Tip: For other functions available from the Startup dialog box, refer to Chapter 21 of the SmartLab Guidance Reference Manual (ME13365A).

2. Hardware setup

Before measurement, the equipment configuration must be set up for a General Package measurement.

The hardware setup method is described below.

(1) Select the Hardware Configuration command under the Options menu to open the Hardware Configuration dialog box.



(2) The Hardware Configuration dialog box shows the current hardware configuration.

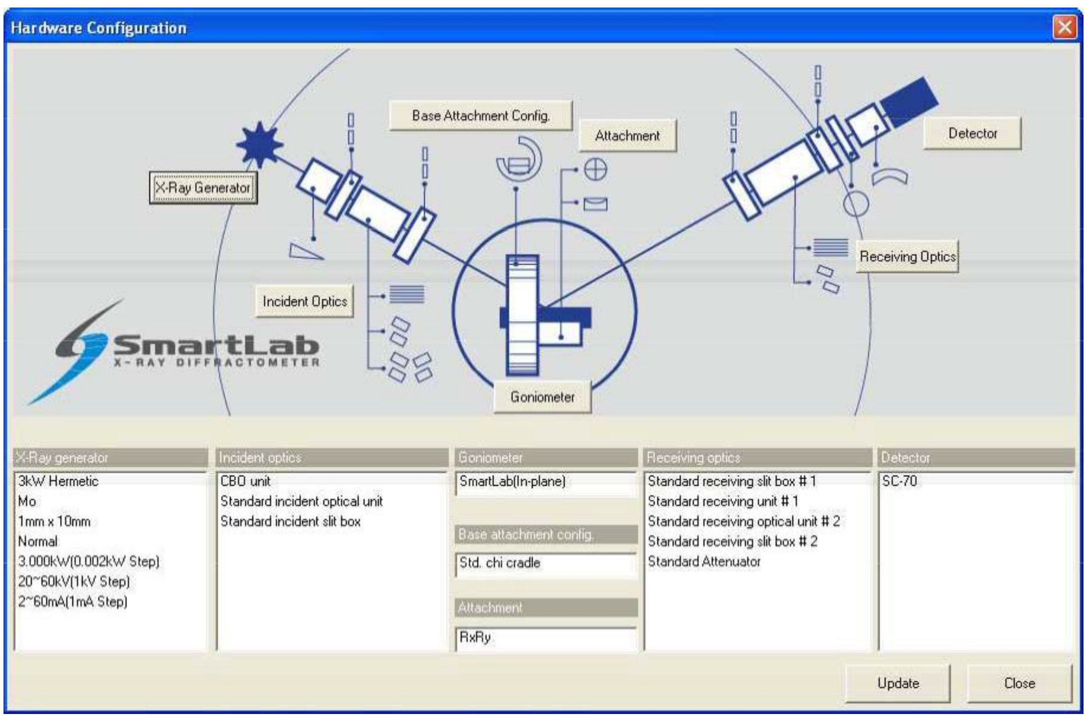


Fig. 2.2.1 Hardware Configuration dialog box

(3) Table 2.2.1 shows the hardware configuration that enables the General Package measurement. If the configuration units shown in the Hardware Configuration dialog box differ from those indicated in Table 2.2.1, install the units specified in Table 2.2.1 at the designated locations, referring to the Horizontal Sample Mount X-Ray Diffractometer for Thin Film Analysis Instruction Manual (ME11550A).

Table 2.2.1 Hardware configuration for the General Package measurement

Hardware configuration	Configuration units
X-ray generator	Cu target
Incident optics	CBO unit Standard incident optical unit Standard incident slit box
Goniometer	SmartLab or SmartLab(in-plane)
Base attachment configuration	Standard chi cradle
Attachment	Any
Receiving optics	Standard receiving slit box # 1 Standard receiving optical unit # 1 Standard receiving optical unit # 2 Standard receiving slit box # 2 Standard attenuator
Detector	Scintillation counter SC-70

For example, if the target is set to Mo in the X-Ray Generator dialog box, you must change the target setting to Cu, since the General Package measurement will not be made unless the Cu target is used. For sealed tubes, you must replace the Mo tube with the Cu tube.

(4) Click the X-Ray Generator button to open the X-Ray Generator dialog box.

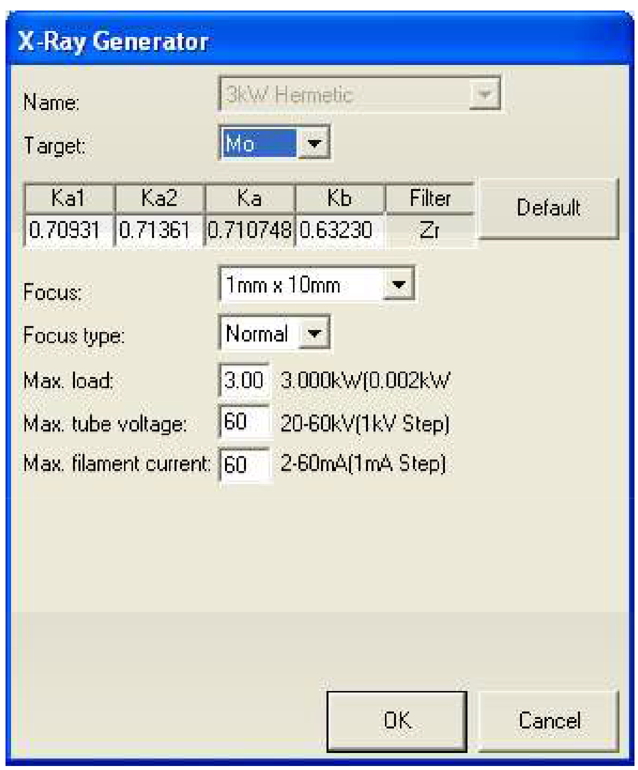


Fig. 2.2.2 X-Ray Generator dialog box

(5) Select Cu in the Target box. Change other applicable parameters, such as wavelength.

(6) Click the OK button to close the X-Ray Generator dialog box and register the changes made in the Hardware Configuration dialog box.

(7) If necessary, change configuration units using the Incident Optics, Receiving Optics, and Detector buttons. Modify the conditions in the Hardware Configuration dialog box in the same way.

(8) Click the Update button in the Hardware Configuration dialog box.

> Tip: Mounted configuration units are automatically detected for Base Attachment Configuration and Attachment.

(9) Confirm that each configuration unit displayed in the Hardware Configuration dialog box corresponds to the configuration unit indicated in Table 2.2.1, then click the Close button to close the dialog box.

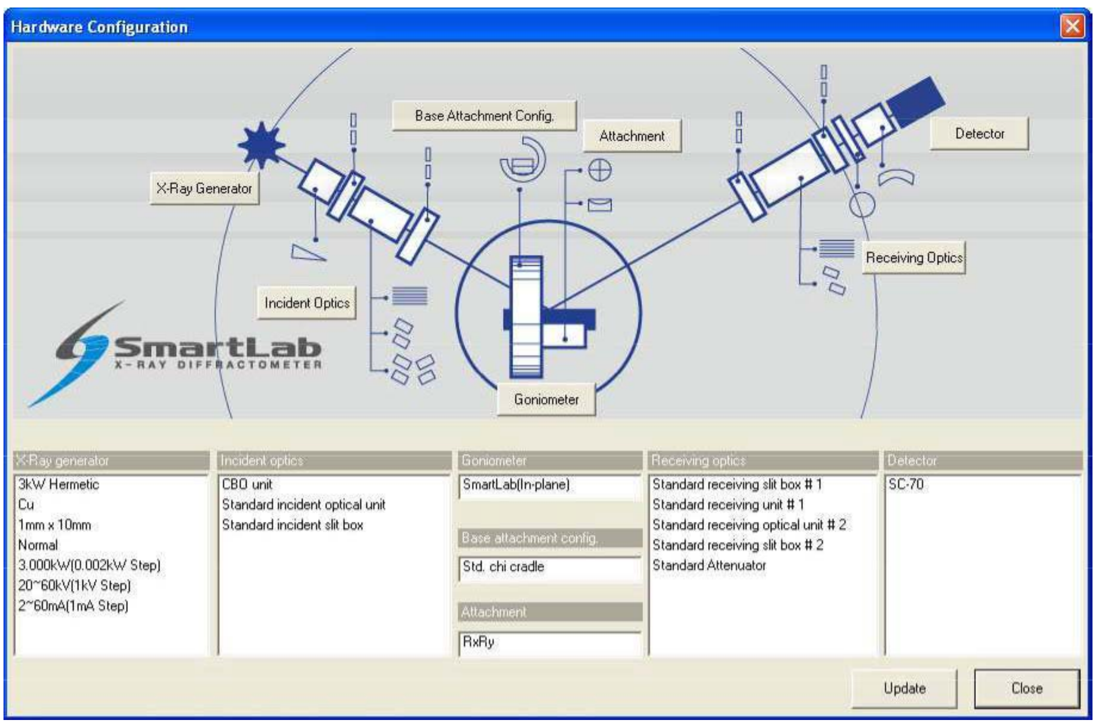


Fig. 2.2.3 Hardware Configuration dialog box

2.3 Setting Package measurement conditions

The Parts included in the General Package measurements are shown in the table below.

Package measurement	Configuration Parts
General (medium resolution PB)	• Optics Alignment (PB) • Sample Alignment • General Measurement
General (high resolution PB-Ge(220)x2)	• Optics Alignment (PB-Ge(220)x2) • Sample Alignment • General Measurement
General (high resolution PB-Ge(400)x2)	• Optics Alignment (PB-Ge(400)x2) • Sample Alignment • General Measurement
General (ultra-high resolution PB-(220)x4)	• Optics Alignment (PB-Ge(220)x4) • Sample Alignment • General Measurement
General (ultra-high resolution PB-(440)x4)	• Optics Alignment (PB-Ge(440)x4) • Sample Alignment • General Measurement

To perform the Package measurements, you must set the conditions of each of the three Parts individually. Described below is how to set the conditions of each Part.

CAUTION: If another Package measurement is selected or another task such as the Manual Control task is chosen, discard the set Part conditions. To save the set conditions to a file, click the Export button in each dialog box or save Package measurement conditions as described in the "Tip" section in Subsection 2.3.3 (6).

2.3.1 Setting Optics Alignment Part conditions

Described below is how to set the conditions of the Optics Alignment (PB) Part. Conditions can be set for the other Optics Alignment Parts in the same way.

(1) Click the Optics Alignment (PB) button on the flow bar to open the Optics Alignment (PB) dialog box.

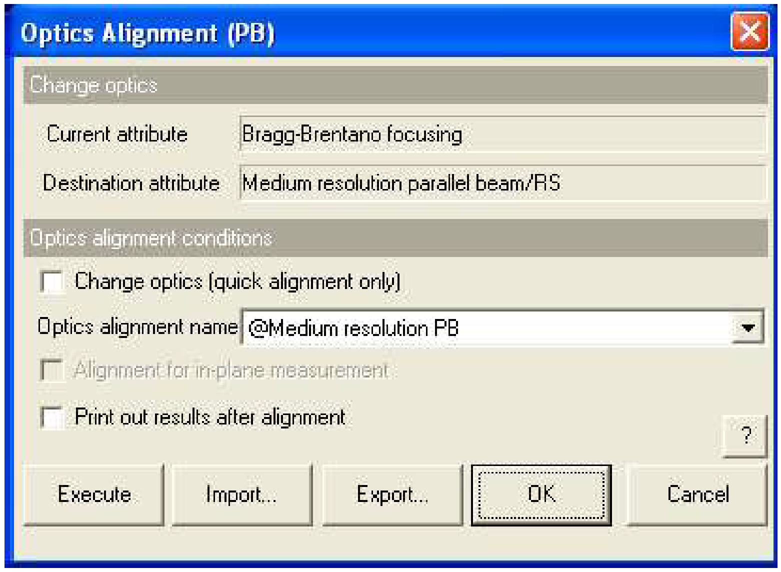


Fig. 2.3.1 Optics Alignment (PB) dialog box

(2) Uncheck the Change optics (quick alignment only) box.

> Tip: Check the Change optics (quick alignment only) box to switch optics for the data measurement using the alignment results stored under the selected optics alignment name by performing a quick alignment.

(3) In the Optics alignment name box, select a location for storing optics alignment results.

> Tip: To store optics alignment results under a new optics alignment name, click the OK or Cancel button to close the Optics Alignment (PB) dialog box. Then, select the Optics Management command from the Options menu to open the Optics Management dialog box and add a new optics alignment name. After adding a new optics alignment name, return to step (1) in this subsection. For more information on creating an optics alignment name, refer to Chapter 17 of the SmartLab Guidance Reference Manual (ME13365A).

(4) To print the optics alignment results, check the Print out results after alignment box.

> Tip: If both the Change optics (quick alignment only) and Print out results after alignment boxes are checked, the alignment results stored under the selected optics alignment name will be printed.

(5) Click the OK button to close the dialog box.

2.3.2 Setting Sample Alignment Part conditions

(1) Click the Sample Alignment button on the flow bar to open the Sample Alignment dialog box.

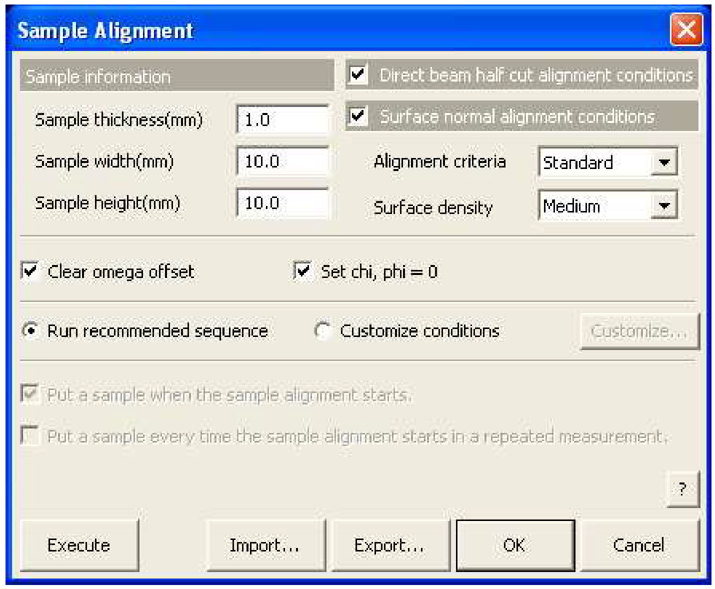
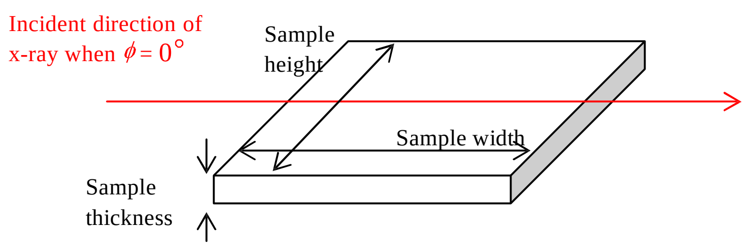


Fig. 2.3.2 Sample Alignment dialog box

(2) Enter the sample thickness, sample width and sample height in the Sample thickness (mm), Sample width (mm) and Sample height (mm) boxes.

Tip: The sample thickness, sample width and sample height refer to the dimensions (unit: mm) of the sample in the directions shown below.



(3) Check the Direct beam half cut alignment conditions box.

(4) If the incident x-ray angle to the sample surface has to be precisely determined to make a measurement such as a reflectivity measurement, check the Surface normal alignment conditions box.

(5) If the Surface normal alignment conditions box is checked, select Standard in the Alignment criteria box. And select the nominal density of the surface layer from Very low, Low, Medium, or High in the Surface density box.

Tip: For more information on the alignment criteria and the nominal density of the surface layer, refer to “Sample Alignment Part” Help Topic of the online help section of the SmartLab Guidance software.

(6) Check the Clear omega offset and Set chi, phi = 0 boxes.

> Tip: If the results of the previous sample alignment are kept, the next sample alignment uses this position as a reference and may not work correctly. In ordinary cases, check the Clear omega offset and Set chi, phi = 0 boxes.

(7) Select the Run recommended sequence radio button.

> Tip: To confirm or set the scan conditions, select the Customize conditions radio button, then click the Customize button.
>
> 2.4.1 Customizing Sample Alignment Part conditions

(8) Click the OK button to close the dialog box.

2.3.3 Setting General Measurement Part conditions

(1) Click the General Measurement button on the flow bar to open the General Measurement dialog box.

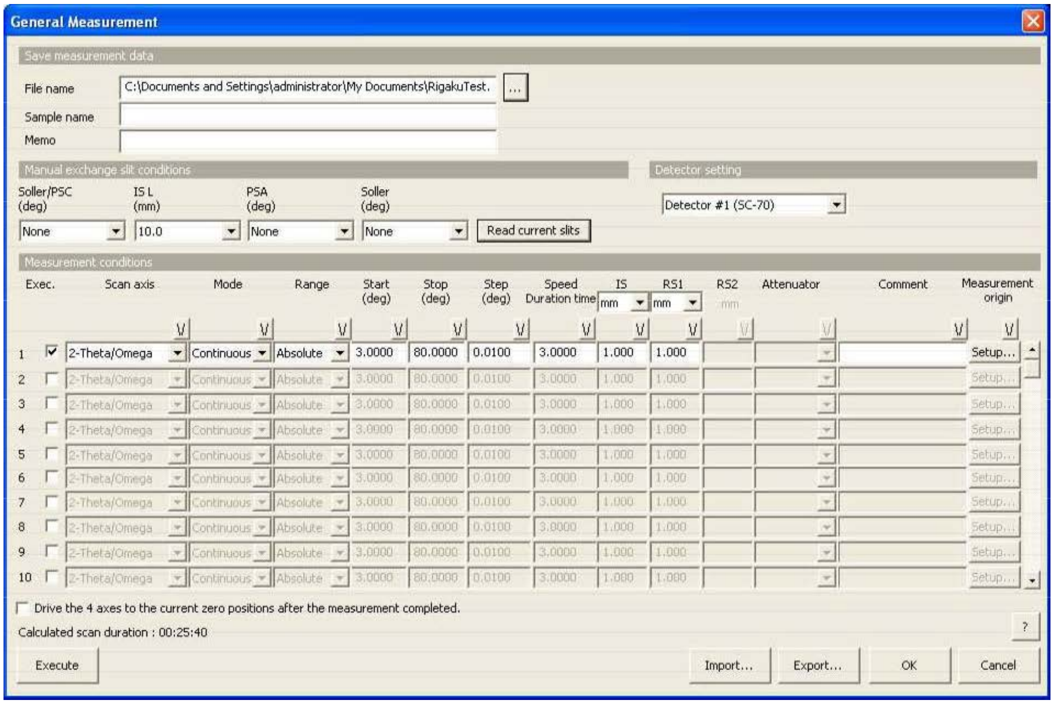


Fig. 2.3.3 General Measurement dialog box

(2) Set the folder to store the measurement data and the name of the measurement data file in the File name box in the Save measurement data section. After completing the data measurement, the measurement data will be saved with the specified file name.

1. Click the [...] button to open the Save As dialog box.

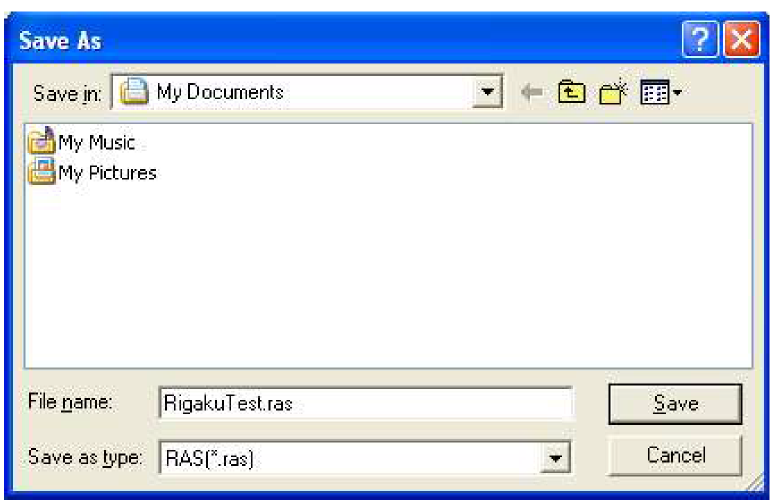


Fig. 2.3.4 Save As dialog box

2. Enter the settings in the Save in and File name boxes.

3. Click the Save button.

(3) Enter any required information in the Sample name and Memo boxes (optional).

> CAUTION: The information entered here will be saved to the file. Any number of characters may be entered, but only the first 30 characters of the sample name and the first 84 characters of the memo will appear on the printed measurement data.

(4) Set the manual exchange slit conditions.

(5) Select “SC-70” from Detector setting.

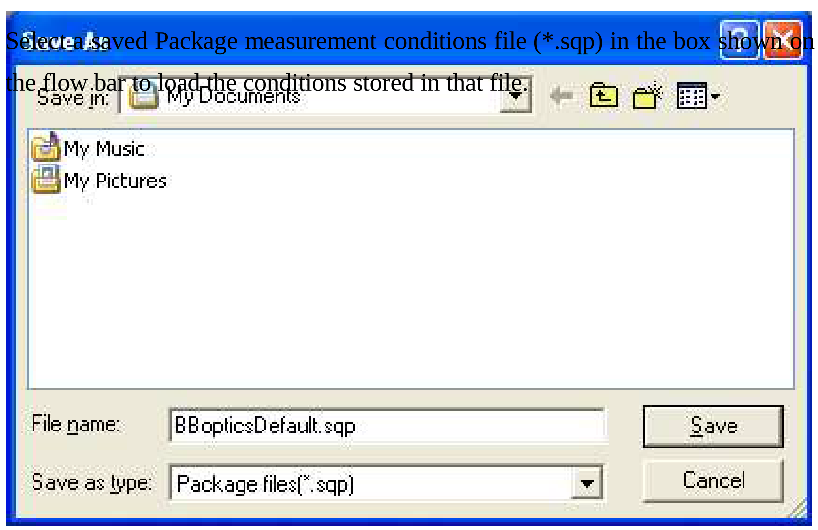
(6) Set the measurement conditions.

> Tip: To set the manual exchange slit conditions and measurement conditions, refer to “General Measurement Part” Help Topic of the online help section of the SmartLab Guidance software.

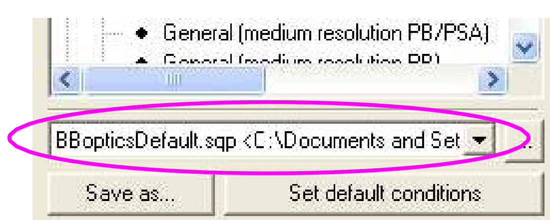
(7) If the four axes (2-theta, omega, chi, phi) are driven to the current zero positions after the data measurement, check the Drive the 4 axes to the current zero positions after the measurement completed box.

(8) Click the OK button to close the dialog box.

> Tip: To save all the Part conditions set in Subsections 2.3.1 through 2.3.3 to a single file, click the Save as button on the flow bar to open the Save As dialog box, then enter the settings in the Save in and File name boxes. Click the Save button.



Select a saved Package measurement conditions file (*.sqp) in the box shown on the flow bar to load the conditions stored in that file.



2.4 Customizing Part conditions

The user is free to set scan conditions and slit conditions of the Sample Alignment Part. Use the Customize dialog box to set scan conditions and slit conditions.

> Tip: To confirm the conditions set for Run recommended sequence, click the Set recommended values button in the Customize dialog box.

2.4.1 Customizing Sample Alignment Part conditions

(1) Select the Customize conditions radio button in the Sample Alignment dialog box.

(2) Click the Customize button to open the Customize dialog box.

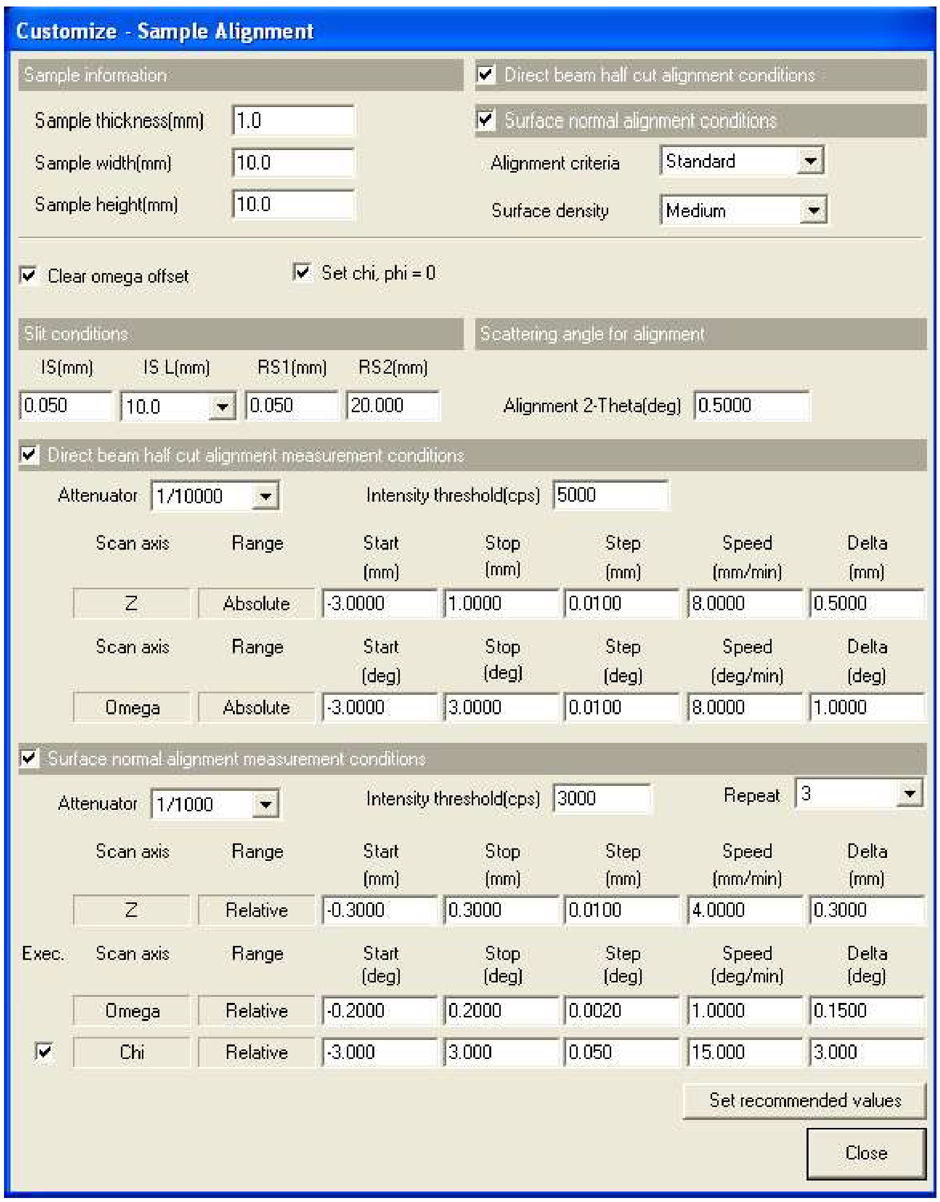


Fig. 2.4.1 Customize dialog box

The conditions set in the Sample Alignment dialog box are indicated in the Sample information, Direct beam half cut alignment conditions, Surface normal alignment conditions sections, and the Clear omega offset, Set chi, phi = 0 boxes.

(3) If necessary, set conditions in the Slit conditions, Scattering angle for alignment, Direct beam half cut alignment measurement conditions and Surface normal alignment measurement conditions sections.

> CAUTION: Clicking the Set recommended values button changes settings in the Slit conditions, Scattering angle for alignment, Direct beam half cut alignment measurement conditions and Surface normal alignment measurement conditions sections to the values recommended based on the settings specified in the Sample information and Surface normal alignment conditions sections. For more information, refer to "Sample Alignment Part" Help Topic of the online help section of the SmartLab Guidance software.

(4) After setting the conditions, click the Close button to close the Customize dialog box.

2.5 Executing a Package measurement

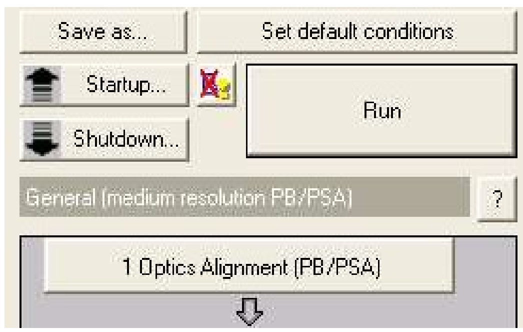
Described below is the procedure for executing the complete series of measurement operations from the optics alignment to the general measurement.

Tip: When executing optics alignment only, sample alignment only, or general measurement only, refer to 3. Executing a Part individually.

(1) Click the (Show confirmation messages) button to set it to (Don’t show confirmation messages).

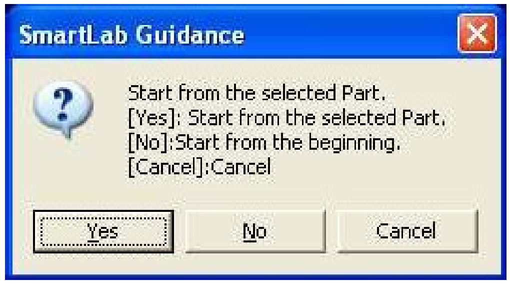
Tip: To confirm the optics alignment results or to show the message to verify that each Part has been completed, set it to (Show confirmation messages).

(2) Click the Run button on the flow bar.



Tip: After executing a Package measurement, the mark appears on a button on the flow bar. The mark indicates that the Part corresponding to the button is in progress.

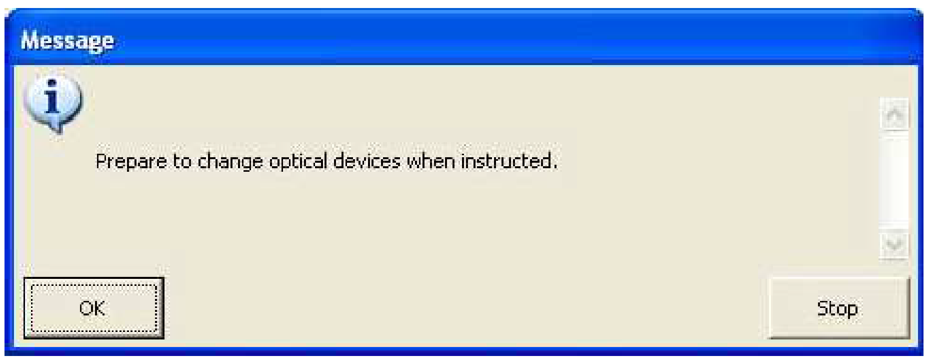
(3) If the following message appears, click the No button.



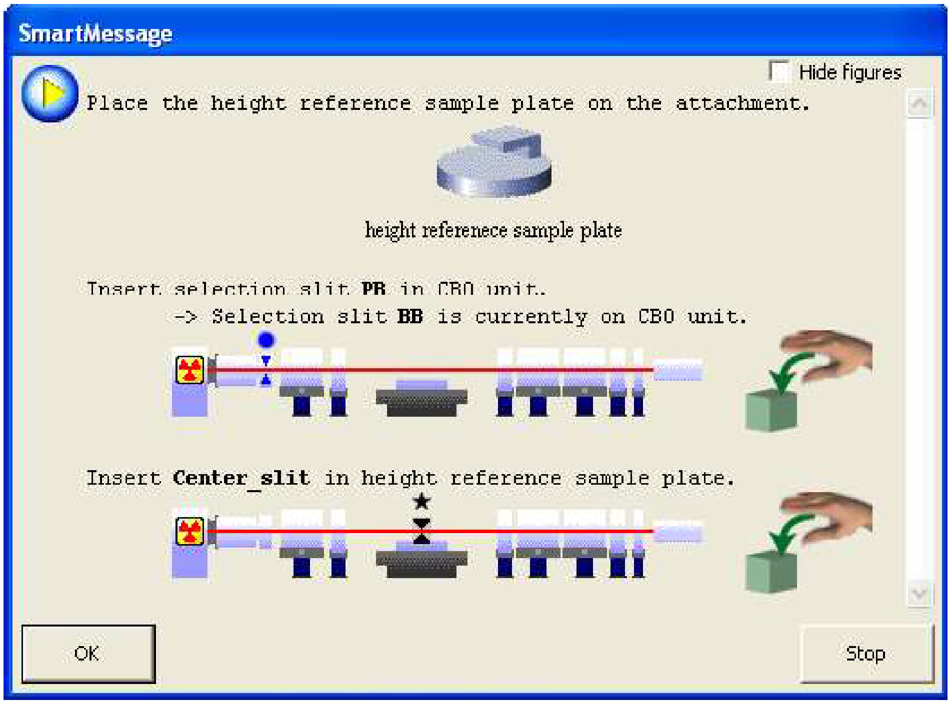
CAUTION: If the current hardware configuration setting is different from that for the operation of the General Package measurement, the measurement will be aborted and the Hardware Configuration dialog box will open. If this happens, replace the configuration units (e.g., the attachment) as prompted by the message in the dialog box.

2.6 Changing configuration units

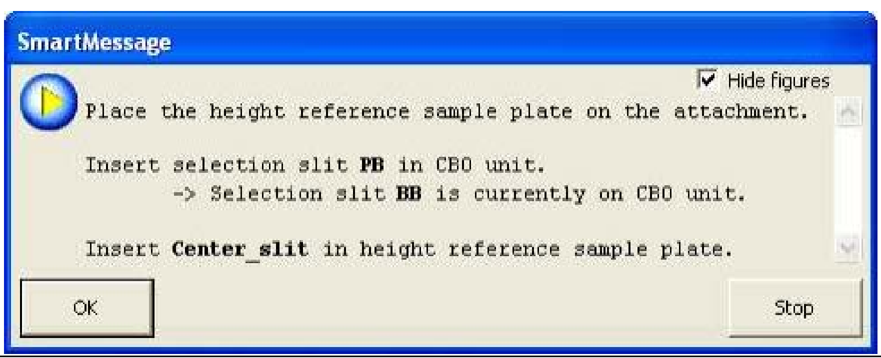
(4) A message will prompt you to replace optical devices in the middle of the measurement. Confirm the message and click the OK button.



(5) When the following message appears, place the height reference sample plate on the attachment and insert the center slit into the height reference sample plate. If another message appears at the same time prompting for replacement of the optical device(s) such as the selection slit, install the specified optical device(s) as indicated by the message.



Tip: When the Hide figures box is checked, only the message is displayed without figures.



(6) Click the OK button to execute optics alignment.
The optics alignment will be performed under the recommended conditions, and it will be completed in about 10 minutes.

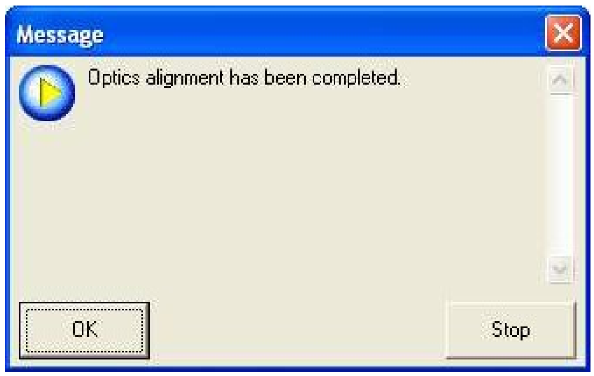
(7) The specific procedure in this step depends on the setting or on the flow bar. Follow the directions given below.

When (Don't show confirmation messages) is set:

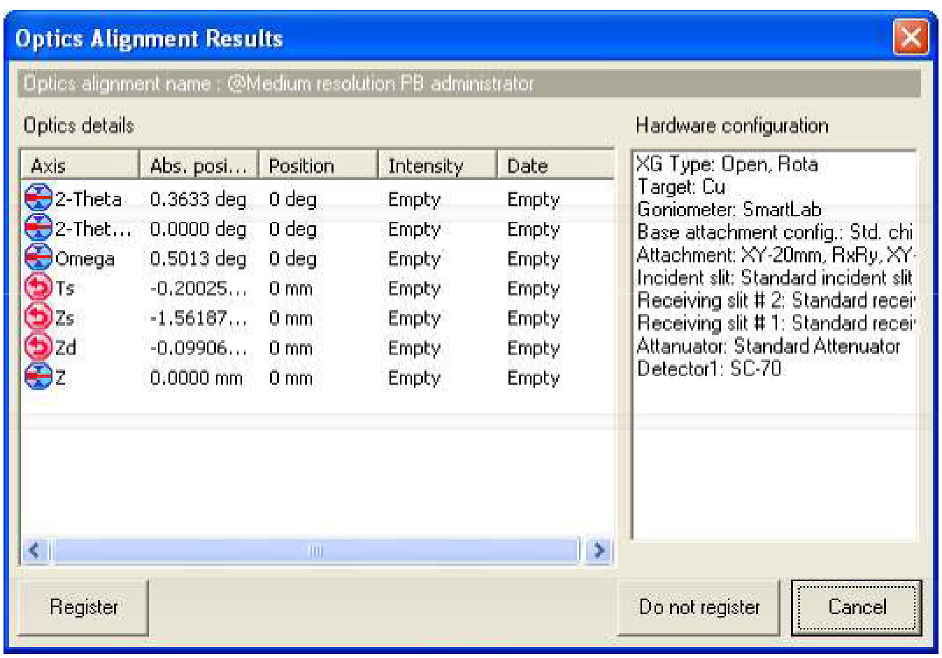
The optics alignment results will be registered in the optics management database.

When (Show confirmation messages) is set:

1. The following message will appear to verify the optics alignment has been completed. Click the OK button.

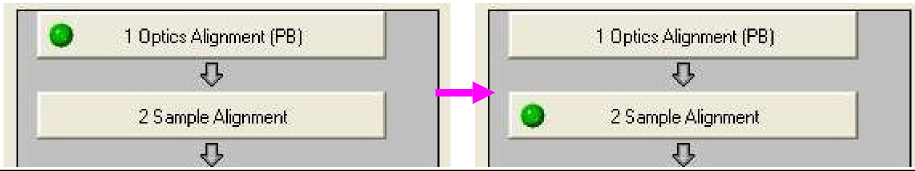


2. The Optics Alignment Results dialog box will appear. Confirm the results and click the Register button. The optics alignment results will be registered in the optics management database.

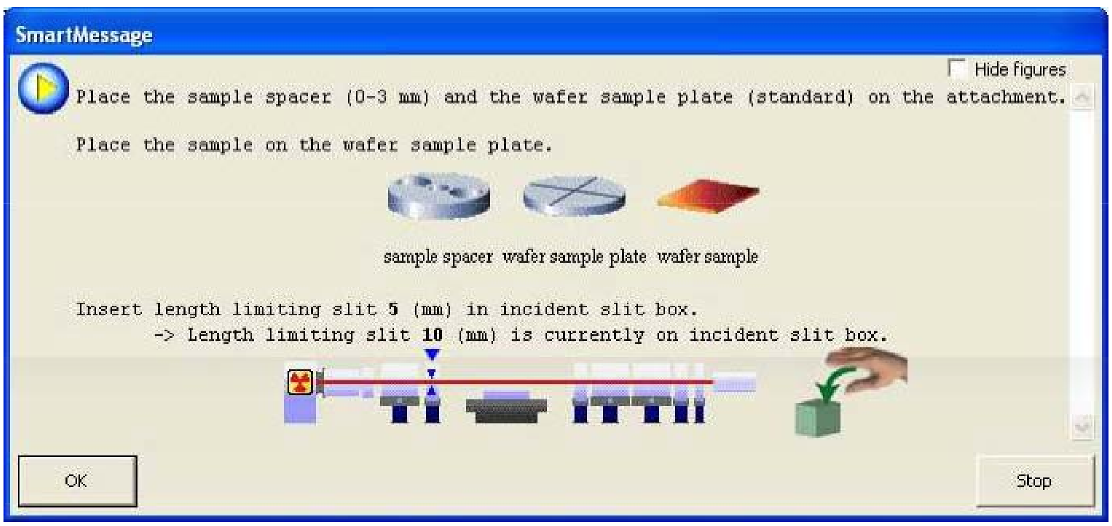


CAUTION: Clicking the Do not register button sets the zero offset value for each axis, but does not register the optics alignment results in the optics management database.

Tip: After completion of the optics alignment, the mark indicated on the Optics Alignment (PB) button on the flow bar moves to the Sample Alignment button.

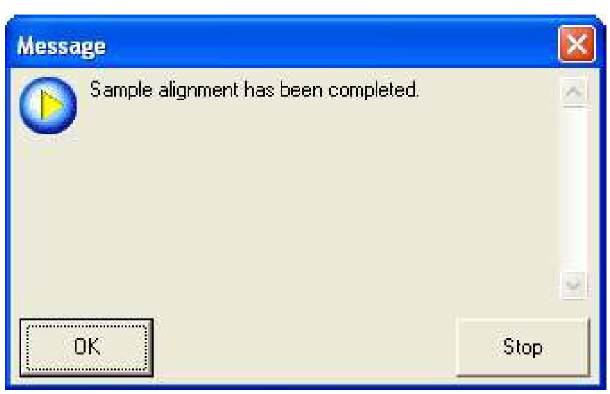


(8) The following message will appear. Based on this message, place the sample spacer on the attachment, place the wafer sample plate on the sample spacer, and place the sample on the wafer sample plate. If another message appears at the same time prompting for replacement of the manual exchange slit(s) such as the length limiting slit, install the specified manual exchange slit(s) as indicated by the message.



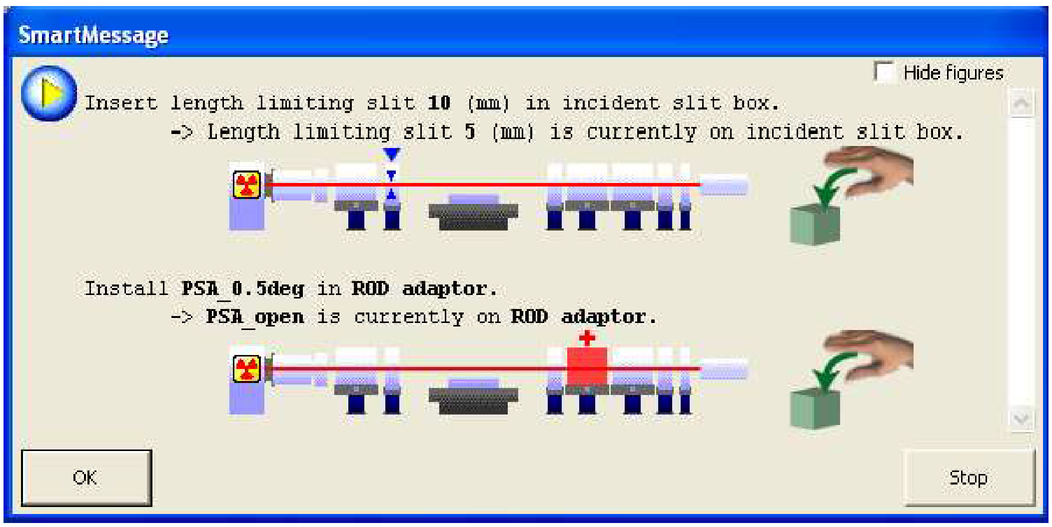
(9) Click the OK button to execute sample alignment.
Direct beam half cut alignment and surface normal alignment will be performed under the specified conditions. The sample alignment will be completed in about 10 minutes.

Only when (Show confirmation messages) is set on the flow bar, the message will appear to verify the sample alignment has been completed. Click the OK button.



Tip: After completion of the sample alignment, the mark indicated on the Sample Alignment button on the flow bar moves to the General Measurement button.

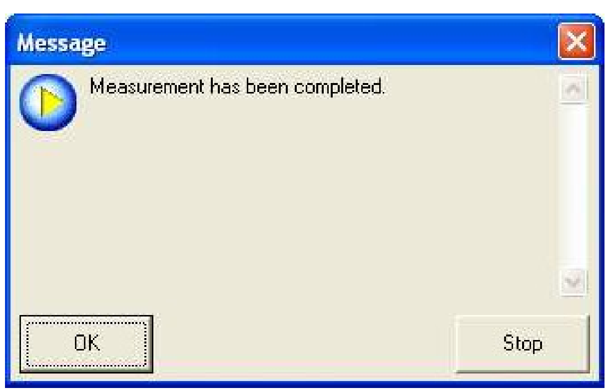
(10) If the manual exchange slit(s) differs from those specified in the General Measurement dialog box, a message will appear like below. If instructed by the message, install the specified manual exchange slit(s) as prompted.



(11) Click the OK button to execute a data measurement.
The data measurement will be made under the specified conditions.

(12) After completion of the measurement, the measurement data will be saved under the file name set in Subsection 2.3.3 (2).

Only when  (Show confirmation messages) is set on the flow bar, the message will appear to verify the data measurement has been completed. Click the OK button.



This is the end of the General Package measurement.

2.6 Changing configuration units

After a Package measurement (or Part) is executed, and the hardware configuration is not set for the Package measurement or the Part, the Hardware Configuration dialog box will open. A message appears below the dialog box prompting you to change the configuration units preventing the use of the Package measurement or the Part.

For example, if the target has been set to Mo in the X-Ray Generator dialog box, the displayed message will show “Target: Change Mo to Cu.”, since the target must be Cu for the General Package measurements.

> CAUTION: Execution of the Package measurement or Part aborts when the Hardware Configuration dialog box appears.

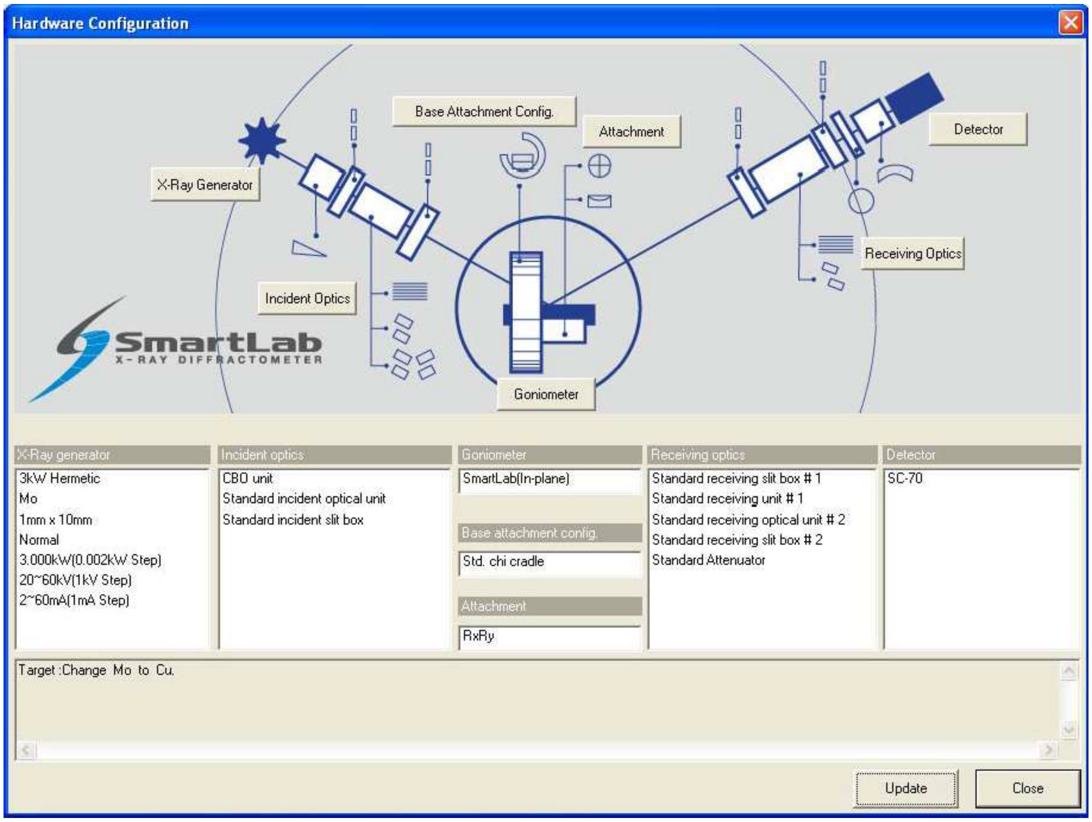


Fig. 2.6.1 Hardware Configuration dialog box

If the Hardware Configuration dialog box appears, replace the configuration units as prompted by the message in the dialog box and update the contents of the Hardware Configuration dialog box.

This procedure is described below.

(1) Change the target in the x-ray generator from Mo to Cu. For sealed tubes, replace the Mo tube with the Cu tube.

(2) Click the X-Ray Generator button to open the X-Ray Generator dialog box.

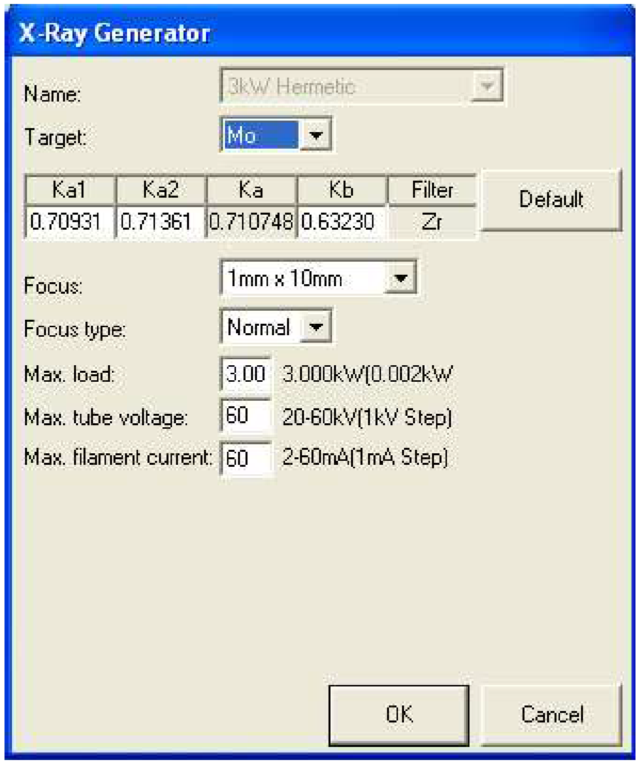


Fig. 2.6.2 X-Ray Generator dialog box

(3) Select Cu in the Target box. Change any other parameters as necessary.

(4) Click the OK button to close the dialog box.

(5) If necessary, make changes for Incident Optics, Receiving Optics, and Detector in the same way.

(6) Click the Update button in the Hardware Configuration dialog box.

(7) Confirm that the Hardware Configuration dialog box displays the message “Hardware check OK”, then click the Close button to close the dialog box.

CAUTION: To execute the measurement once again, click the Run button on the Package Measurement flow bar or the Execute button in the applicable Part dialog box.

7. Shutdown

After completion of all measurements, turn off the x-ray generator as described below.

(1) Click the Shutdown button on the flow bar to open the Shutdown dialog box.

(2) Uncheck the Execute box.

Fig. 2.7.1 Shutdown dialog box

(3) Select XG Off in the XG set box.

(4) Click the Execute button.

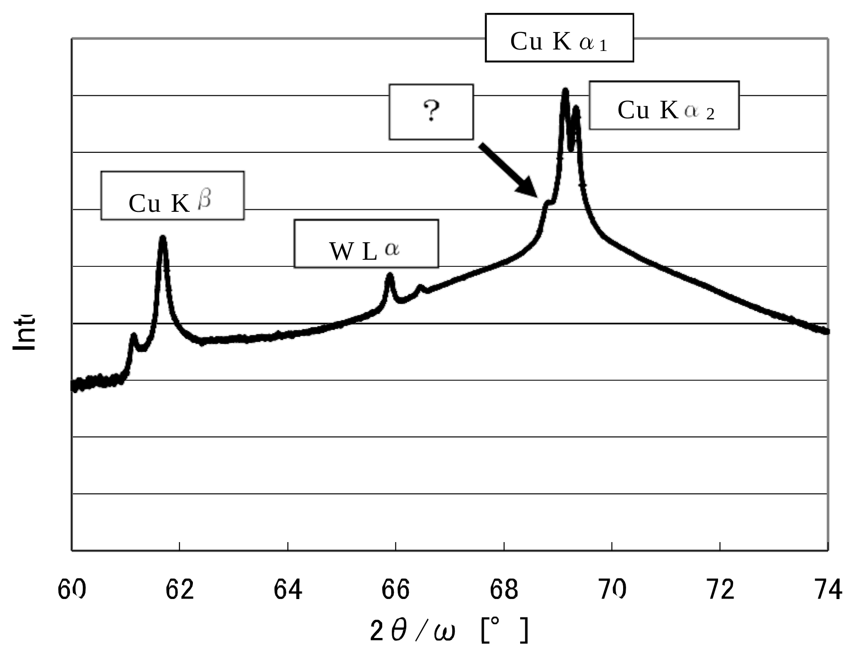
(5) The shutdown operation is executed. The x-ray generator will be turned off in about 10 minutes.

> Tip: For information on other functions available from the Shutdown dialog box, refer to Chapter 21 of the SmartLab Guidance Reference Manual (ME13365A).

Shoulder of Kα_1 radiation?

A 2-theta/omega scan of Si(004) collected with multilayer mirror and slit collimation optics is shown in the figure. A shoulder as indicated by the arrow in the figure can be observed on the lower side of the Cu Kα_1 diffraction peak when a single crystal that gives high diffraction intensity is used as the sample. The radiation whose wavelength corresponds to this shoulder is called a “K satellite” or a “nondiagram line.” The radiation is known to come from an electronic level created by a doubly ionized atom and has slightly higher energy than that of the ordinary Kα_1 created by a singly ionized atom. Since the excitation probability of this radiation is extremely low, the K satellite (nondiagram line) is observed only when the diffraction intensity of the Cu Kα radiation is high.

Reference: “X-Ray Spectroscopy: An Introduction (Springer Series in Optical Sciences)”, by B. K. Agarwal, Springer



3. Executing a Part individually

In this chapter, how to execute the following Parts individually is described.

Optics Alignment (PB) Part
Sample Alignment Part
General Measurement Part

1. Executing the Optics Alignment Part

Described below is how to execute the Optics Alignment (PB) Part. The other Optics Alignment Parts can be executed in the same way.

(1) Click the Optics Alignment (PB) button on the flow bar to open the Optics Alignment (PB) dialog box.

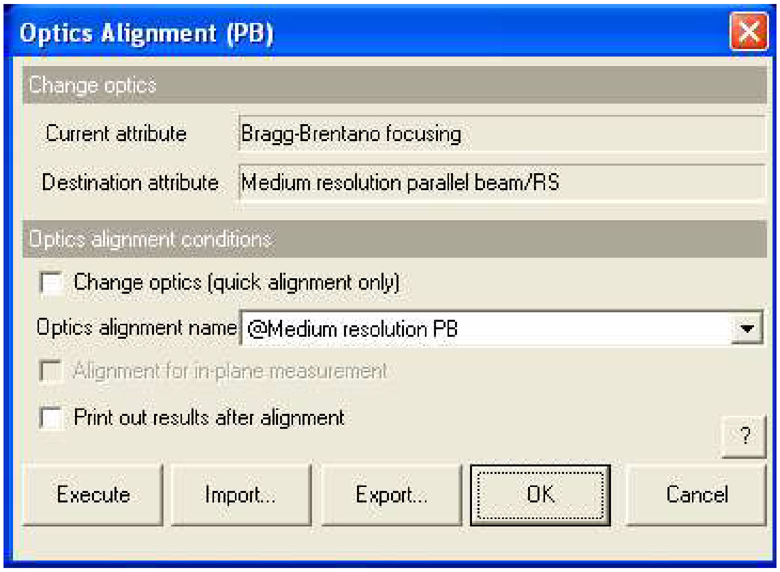


Fig. 3.1.1 Optics Alignment (PB) dialog box

(2) Uncheck the Change optics (quick alignment only) box.

Tip: Check the Change optics (quick alignment only) box to switch optics for the data measurement using the alignment results stored under the selected optics alignment name by performing a quick alignment.

(3) In the Optics alignment name box, select a location for storing optics alignment results.

Tip: To store optics alignment results under a new optics alignment name, click the OK or Cancel button to close the Optics Alignment (PB) dialog box. Then, select the Optics Management command from the Options menu to open the Optics Management dialog box and add a new optics alignment name. After adding a new optics alignment name, return to step (1) in this section. For more information on creating an optics alignment name, refer to Chapter 17 of the SmartLab Guidance Reference Manual (ME13365A).

(4) To print the optics alignment results, check the Print out results after alignment box.

> Tip: If both the Change optics (quick alignment only) and Print out results after alignment boxes are checked, the alignment results stored under the selected optics alignment name will be printed.

(5) Click the Execute button in the Optics Alignment (PB) dialog box.

(6) Optics alignment is executed followed by steps (5) through (7) in Section 2.5.

> CAUTION: If the current hardware configuration setting is different from that for the operation of the Optics Alignment (PB) Part, the optics alignment will be aborted and the Hardware Configuration dialog box will open. If this happens, replace the configuration units (e.g., the attachment) as prompted by the message in the dialog box.
>
> 2.6 Changing configuration units

2. Executing the Sample Alignment Part

(1) Click the Sample Alignment button on the flow bar to open the Sample Alignment dialog box.

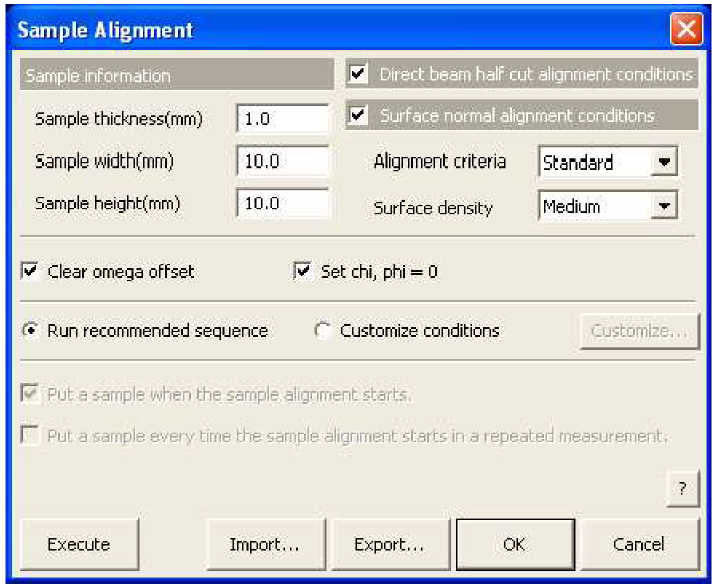
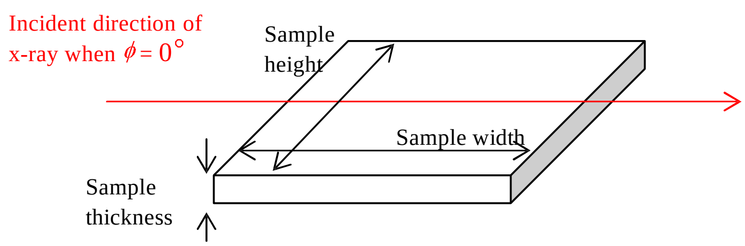


Fig. 3.2.1 Sample Alignment dialog box

(2) Enter the sample thickness, sample width and sample height in the Sample thickness (mm), Sample width (mm) and Sample height (mm) boxes.

> Tip: The sample thickness, sample width and sample height refer to the dimensions (unit: mm) of the sample in the directions shown below.
>
> 
>

(3) Check the Direct beam half cut alignment conditions box.

(4) If the incident x-ray angle to the sample surface has to be precisely determined to make a measurement such as a reflectivity measurement, check the Surface normal alignment conditions box.

(5) If the Surface normal alignment conditions box is checked, select Standard in the Alignment criteria box. And select the nominal density of the surface layer from Very low, Low, Medium, or High in the Surface density box.

> Tip: For more information on the alignment criteria and the nominal density of the surface layer, refer to “Sample Alignment Part” Help Topic of the online help section of the SmartLab Guidance software.

(6) Check the Clear omega offset and Set chi, phi = 0 boxes.

> Tip: If the results of the previous sample alignment are kept, the next sample alignment uses this position as a reference and may not work correctly. In ordinary cases, check the Clear omega offset and Set chi, phi = 0 boxes.

(7) Select the Run recommended sequence radio button.

> Tip: To confirm or set the scan conditions, select the Customize conditions radio button, then click the Customize button.
>
> 2.4.1 Customizing Sample Alignment Part conditions

(8) Click the Execute button in the Sample Alignment dialog box.

(9) Sample alignment is executed followed by steps (8) and (9) in Section 2.5.

> CAUTION: If the current hardware configuration setting is different from that for the operation of the Sample Alignment Part, the sample alignment will be aborted and the Hardware Configuration dialog box will open. If this happens, replace the configuration units (e.g., the attachment) as prompted by the message in the dialog box.
>
> 2.6 Changing configuration units

3. Executing the General Measurement Part

(1) Click the General Measurement button on the flow bar to open the General Measurement dialog box.

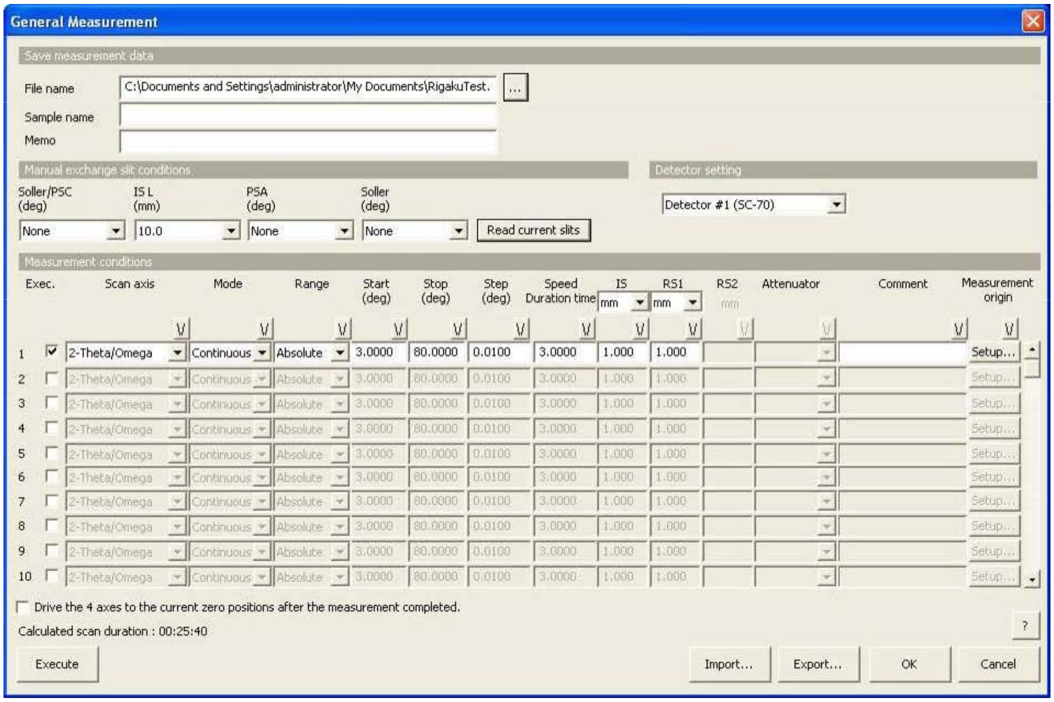


Fig. 3.3.1 General Measurement dialog box

(2) Set the folder to store the measurement data and the name of the measurement data file in the File name box in the Save measurement data section. After completing the data measurement, the measurement data will be saved with the specified file name.

1. Click the [...] button to open the Save As dialog box.

Fig. 3.3.2 Save As dialog box

2. Enter the settings in the Save in and File name boxes.

3. Click the Save button.

(3) Enter any required information in the Sample name and Memo boxes (optional).

> CAUTION: The information entered here will be saved to the file. Any number of characters may be entered, but only the first 30 characters of the sample name and the first 84 characters of the memo will appear on the printed measurement data.

(4) Set the manual exchange slit conditions.

(5) Confirm that the currently-installed detector is selected from Detector setting.

> CAUTION: If another detector is selected, optics alignment and sample alignment will be required using the selected detector before executing this Part.

(6) Set the measurement conditions.

> Tip: To set the manual exchange slit conditions or measurement conditions, refer to "General Measurement Part" Help Topic of the online help section of the SmartLab Guidance software.

(7) If the four axes (2-theta, omega, chi, phi) are driven to the current zero positions after the data measurement, check the Drive the 4 axes to the current zero positions after the measurement completed box.

(8) Click the Execute button in the General Measurement dialog box.

(9) Data measurement is executed followed by steps (10) through (12) in Section 2.5.

> CAUTION: If the current hardware configuration setting is different from that for the operation of the General Measurement Part, the data measurement will be aborted and the Hardware Configuration dialog box will open. If this happens, replace the configuration units (e.g., the attachment) as prompted by the message in the dialog box.
>
> 2.6 Changing configuration units

4. Troubleshooting

Problem	Response
Previously saved conditions cannot be imported through the Optics Alignment (PB) dialog box.	• Confirm that the user name displayed on the title bar of the main window is correct. • Add the name of the optics alignment again in the Optics Management dialog box.
Previously saved conditions cannot be imported through the Sample Alignment dialog box.	• Confirm that the user name displayed on the title bar of the main window is correct.
Previously saved conditions cannot be imported through the General Measurement dialog box.	• Confirm that the user name displayed on the title bar of the main window is correct.
Package measurement cannot be executed.	• Check to see if the XG output is as specified. • Check to see if the door of the radiation enclosure is closed.
Clicking the OK button in a message box will result in the same message box reappearing.	• Confirm that the specified slit and other devices are installed correctly. Also, make sure that the necessary devices have not been removed.
Sufficient intensity cannot be obtained for data measurement.	• Check to see if an absorber is inserted in the receiving slit box. • Confirm that the XG output has reached the specified levels. • Measure the Si wafer reference sample using the Run recommended sequence mode and check the intensity.