DEKTAK 150 SURFACE PROFILER

USER'S MANUAL

P/N 980-294 (Standard)

P/N 980-298 (Cleanroom)

Veeco

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Document Conventions

GENERAL CONVENTIONS

- Your system hardware operates with the the Dektak® 150 software and Wyko® Vision® software under Microsoft® Windows XP®. You can also run Wyko Vision independently of hardware under Microsoft Windows XP.

  The Dektak 150 and Wyko Vision software follows all Windows XP commands and conventions of use. If you need a refresher on how to work in the Windows XP environment, please refer to your Windows software guide.

- When the text indicates that you should enter a key combination (such as ALT-A), press and hold down the appropriate command key (in this case ALT) and then press the other indicated key.

- You can perform three basic actions with the buttons on your mouse: *clicking*, *double-clicking*, and *dragging*. To *click*, press and release the mouse button. To *double-click*, press and release the mouse button twice in rapid succession. To *drag*, press and hold down the mouse button while you move the mouse across your desktop.

- Menus are listings of commands or functions that are available to you at certain times. To open a menu, position the mouse pointer over a menu bar title and click on it with the mouse. A menu

will pop down from the menu bar. You can then select a command from the pop-down menu by clicking on it.

- Shortcut menus are available by clicking with the *right* mouse button on a plot (such as the 3D, Contour, or Profile plot). You can then select options from the shortcut menu that appears.
- In this manual, the commands you select from pop-down menus are displayed in the following format: **Hardware » Measurement Options**. The double arrow symbol (») indicates menu flow as it cascades down from the menu title.

TYPEFACE CONVENTIONS

This manual uses certain typeface conventions that provide visual cues to help you more easily locate and identify information.

boldface	Menu titles, commands, icons, and check box and button names are shown in **boldface** type.
italic type	*Italic type* indicates new terms, title and heading references, and shows emphasis.
`monospace type`	Code examples and commands that you must type in exactly as they appear are shown in `monospaced type`.
SMALL CAPITALS	Hardware placards and keyboard key labels are shown in SMALL CAPITALS (such as ESC, ENTER, ALT, etc.).
NOTE	NOTES contain information that can assist you in using the equipment. An example is shown in the margin.
CAUTION	Whenever you see a CAUTION, there is a possiblity that data will be lost, or there is some specific action you must perform for the system to work properly.
WARNING	Whenever you see a WARNING, there is the possibility of personal injury or equipment damage.

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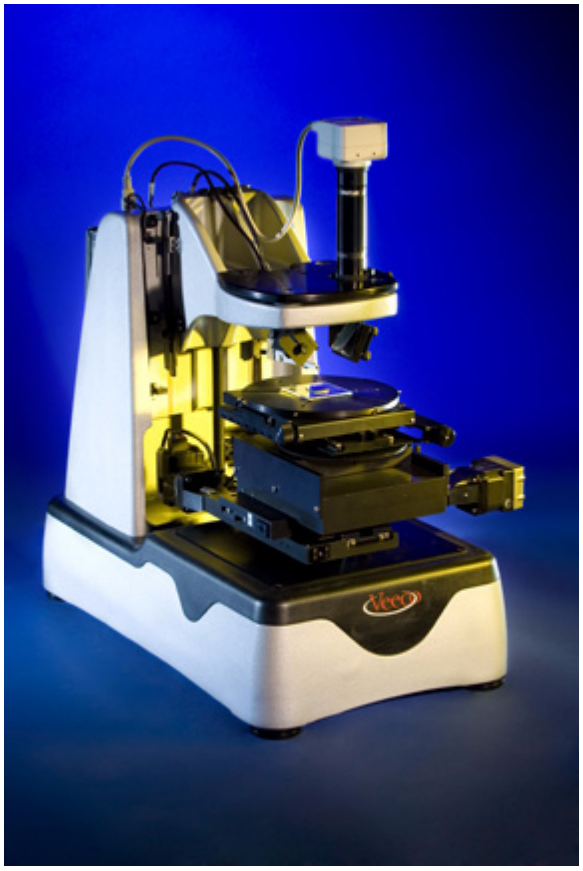
1

DEKTAK 150 SYSTEM OVERVIEW

The Dektak® 150 surface profiler is an advanced thin and thick film step height measurement tool capable of measuring steps below 100Å. It also measures samples up to six inches in dimension and up to four inches thick.

You can use the Dektak 150 to profile surface topography and waviness, as well as to measure surface roughness in the nanometer range. The system provides a step-height repeatability of 0.6 nm (6Å.)

Figure 1-1: The Dektak 150 Stylus Profiler



SYSTEM COMPONENTS

This section briefly describes the major components of the Dektak 150 system. For a complete listing of components and optional accessories, see Appendix B, Technical Specifications and Purchased Options.

System Configurations

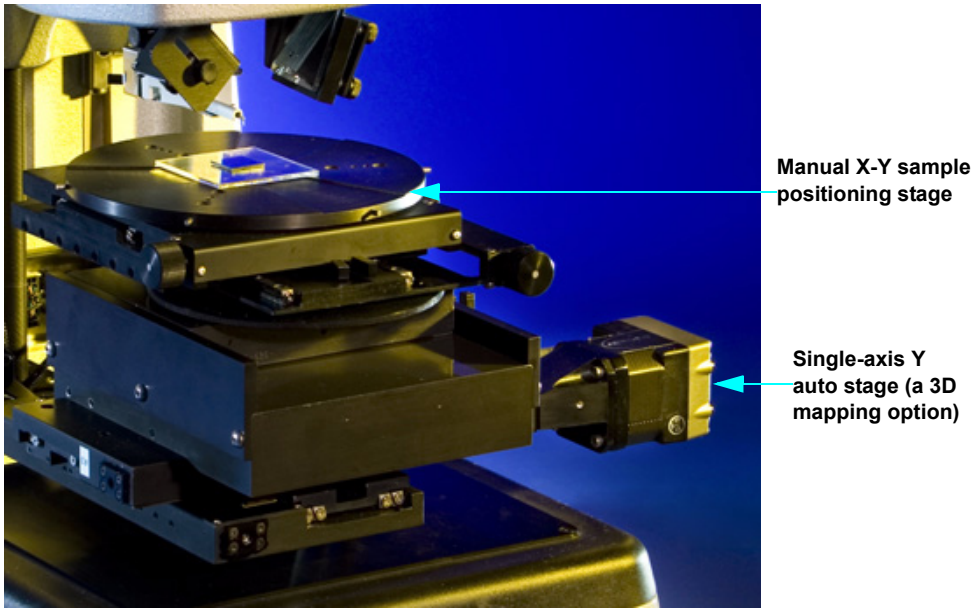
The Dektak 150 stylus profiler comes in the following three configurations:

- **The standard 2-D Dektak 150**, which uses a two-axis, manual sample-positioning stage with 4 x 4-inch X-Y translation, manual leveling and manual theta (see Figure 1-2).
- **The optional 3-D Mapping and Automation Packages**, which use either:
- A single-axis 4-inch Y auto stage that enables the mapping of 3D images in Wyko® Vision® (see Figure 1-2).
- A 6-inch X-Y auto stage that, in addition to 3D mapping, provides automation and programmability of up to 200 sites on samples of up to six inches in diameter.

All three configurations work with the hardware and software described in Appendix B, Technical Specifications and Purchased Options.

NOTE – Except where otherwise noted, the instructions in this manual apply to all three stage configurations.

Figure 1-2: Sample-Positioning Stage

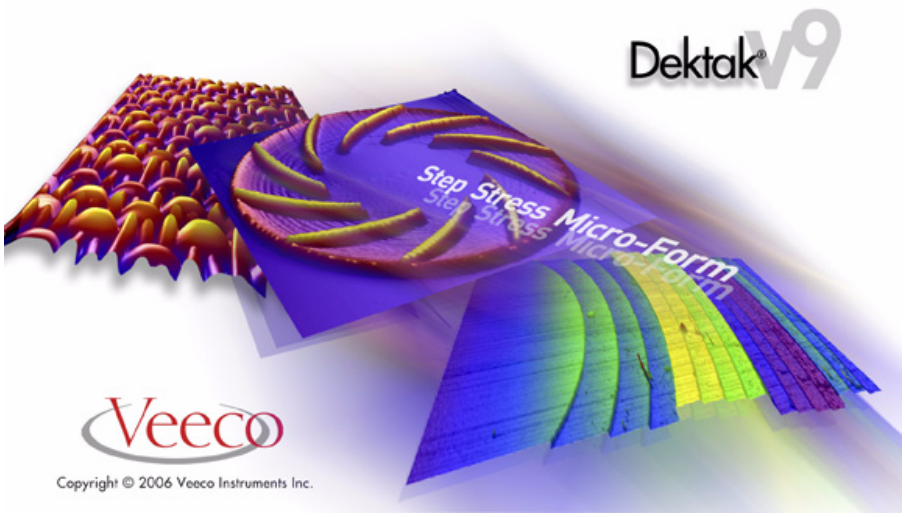


Computer and Software

The computer incorporates a Celeron® or Semprom™ 2.4 GHz or faster microprocessor (optional Pentium® 4 or Athlon™) with 1 GB of RAM and 40-GB internal drive. The computer includes a CD-R/RW drive. With the Pentium 4 or Athlon processor, it is also comes with a 1.4-MB, 3.5” high-density diskette drive. The computer console includes a keyboard and mouse.

The Microsoft® Windows® XP operating system provides a user-friendly interface. The pre-loaded Dektak 150 Version 9 software allows you to take single- or multiple-scan measurements, calculate analytical functions, and perform specialized operations, such as comparing analytical results from multiple scans. For more information, see Dektak 150 Software Functions on page 1-7.

Figure 1-3: The Dektak 150 Welcome Screen



Optional Video Monitor

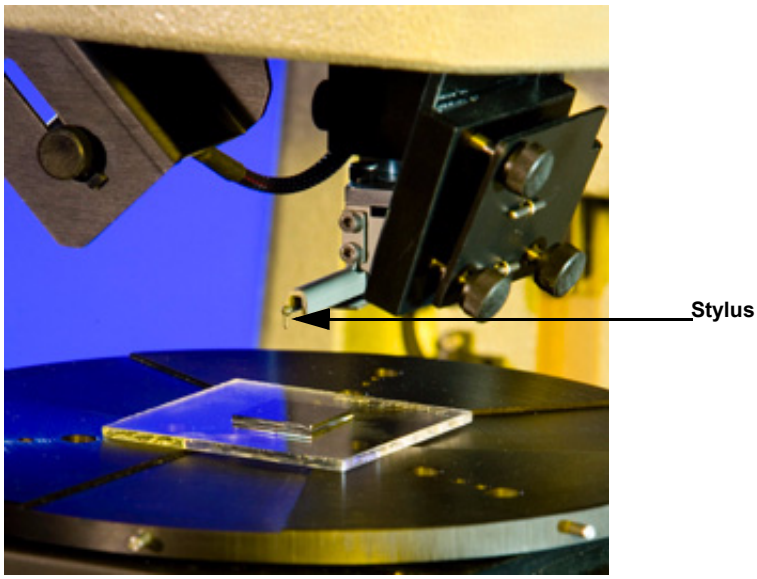
The optional Dektak 150 monitor provides a 17-inch, high-resolution, flat-panel color display. It shows programs and graphics in full color, along with a color video image of the sample surface from the USB camera in the optical assembly. The Dektak 150 software displays the substrate either alone or with superimposed graphics.

Stylus Surface Profiler

The Dektak 150 stylus surface profiler contains all of the the mechanical, electrical and optical components for sample placement, sample viewing, and scanning/measurement. Its cast aluminum frame and support elements provide good repeatability with a low-noise floor. As described in System Configurations on page 1-2, the profiler can be configured with one of two sample-automation stages.

A diamond-tipped L stylus permits accurate two-dimensional surface profiler measurements in a wide range of applications. In standard configuration, user-programmable stylus force from from 1 mg to 15 mg allows profiling on soft or hard surfaces. The *N*-Lite option enables stylus forces down to 0.03 mg.

Figure 1-4: Dektak 150 Stylus



Environmental Enclosure

The conductive acrylic environmental enclosure protects the sample and scan area from adverse outside influences such as noise, vibrations, dust and air currents.

USB Video Camera and Optical Assembly

The standard system is equipped with an optical assembly that includes a 640 x 480-pixel (1/3inch-format) USB video camera with fixed magnification. The field of view is 166X with the 17-inch video monitor.

The optional zoom optical assembly provides a manually adjusted 0.67-to-4.29 mm variable range. The field of view is 644X to 100X with the 17-inch video monitor.

With both optical assemblies, the intensity illumination adjusts to view samples with differing reflectivity. No special video card is required. However, USB camera drivers must be installed in order for the camera to operate properly.

Manual X-Y Stage

The standard stage (shown in Figure 1-2) accommodates samples up to four-inches thick, performs long scans of 55 millimeters, and provides ± 2-inch X-Y translation. In addition to 2”, 3”, 4”, 6”, 50 mm, 100 mm and 150 mm wafer alignment pins, the stage chuck provides three-point suspension for performing stress analysis.

Options and Accessories

A number of options and accessories are available for the Dektak 150, including:

- A 4-inch Y auto stage that enables 3D mapping (see Figure 1-2).
- A 6-inch X-Y auto stage that, in addition to 3D mapping, provides automation and programmability of over 200 sample sites.

- A broad line of calibration standards that calibrate the system for any application.
- A variety of styli for measuring fine surface features and softer samples.
- The *N*-Lite Low Force Package for using fine tips without damaging the surface.
- Extended vertical range for measuring large steps or curved surfaces.
- Scan-stitching software enables shape measurements on samples greater than 55 mm.
- Stress Measurement for calculating tensile or comprehensive stress on processed wafers.
- Wyko Vision analysis software (standard with the Y auto stage) that enables true 3D-mapping, bearing ratio, and over 200 additional analyses.
- Cantilever deflection for accurate force-over-time measurement.

For a full list of options and accessories, see Appendix B, Technical Specifications and Purchased Options.

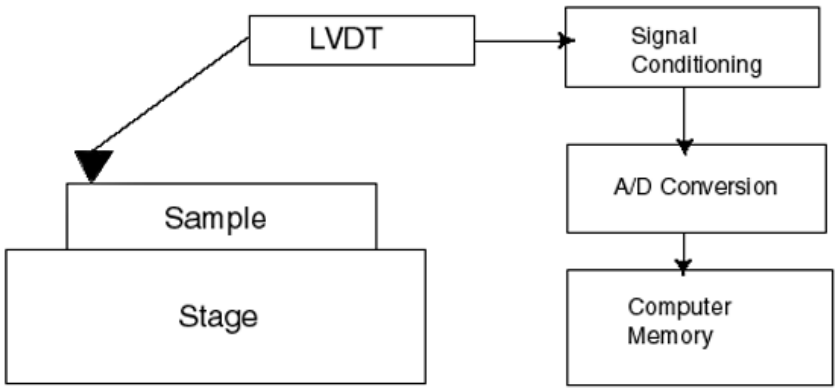
HOW THE SYSTEM WORKS

The Dektak 150 profiler takes measurements electromechanically by moving the sample beneath a diamond-tipped stylus. The high-precision stage moves a sample beneath the stylus according to a user-programmed scan length, speed and stylus force. The stylus is mechanically coupled to the core of an LVDT (Linear Variable Differential Transformer).

As the stage moves the sample, the stylus rides over the sample surface. Surface variations cause the stylus to be translated vertically. Electrical signals corresponding to stylus movement are produced as the core position of the LVDT changes. The LVDT scales an AC reference signal proportional to the position change, which in turn is conditioned and converted to a digital format through a high precision, integrating, analog-to-digital converter.

The digitized signals from performing a single scan are stored in computer memory for display, manipulation, measurement, and printing. The Dektak 150 stores programs that can easily be changed to suit both production and laboratory use.

Figure 1-5: Block Diagram of the Dektak 150 Architecture



Sample Positioning

The two-axis manual stage and the auto stages require different sample-positioning procedures.

Two-Axis Manual Stage

After loading the sample on the stage, you coarse-position the measurement site to the center of the crosshair using the quick-release clips. You then fine-position the scan site to the center of the crosshairs using the fine-positioning knobs.

X-Y Auto Stage and Single-Axis Y Auto Stage

After loading the sample on the stage, you position the sample under the stylus using the icons in the Stage Control Panel To fine-position the sample to the reticule, either enter relative moves in the Stage Control Panel, or left-click in the **Sample-Positioning** window. The stage follows the movement of the mouse.

A template in the shape or a wafer or disk appears in the Stage Control Panel. Point the mouse to the desired location on the template, double-click the location, and the stage automatically translates to that approximate position.

Scanning

When a scan routine begins, the stylus lowers, and the tip contacts the sample surface. As soon as the stylus makes contact with the surface, the tower (see Figure 2-1) slows and stops when the sensor is at the null position of the LVDT. This procedure guides the Tower Down process each time the stylus makes contact with surface.

> **NOTE –** If your system includes the N-Lite or 3-D Mapping option, or if the scan is set for Hill or Valley, the Tower Down process described above is somewhat different.

The stage moves the sample as the stylus rides over the surface features. The video monitor provides a view of both the physical scanning of the sample and the plotting of the data.

At the end of the scan, the stylus automatically retracts, the scan drive resets, and the system is immediately ready for the next scan. The surface features encountered by the stylus are represented as a two-dimensional profile that is plotted, scaled, and displayed on the monitor (see Data Plot Window on page 1-8).

> **NOTE –** When the optional Cantilever Deflection software is installed, the Dektak 150 profiler moves the stylus in a manner that produces highly accurate force-over-time measurements. The scan drive does not move.

Profile Manipulation and Measurement

An initial scan profile may require software leveling, zero referencing and software magnification to zoom in on an area of interest. Continuous measurement calculations are facilitated by movements of the reference (R) and measurement (M) cursors, which can be pre-set at desired bandwidths.

Measurement Output

The **Data Plot** window shows the live scan data, the user-set scan parameters, and the results of the calculations of any user-selected analytical functions, which provide detailed statistical information about the profile data. For more information, see Analytical Functions on page 1-7 and Data Plot Window on page 1-8.

DEKTAK 150 SOFTWARE FUNCTIONS

The Dektak 150 Version 9 software carries out all of the functions necessary to taking a single- or multiple-scan measurement and calculating analytical functions. In addition, it performs:

- **MicroForm™ adjustment**, which reveals difficult shapes and overcomes steep slopes, thus improving the accuracy of the slope calculation. The MicroForm algorithm adjusts the lateral plot to become a function of the vertical position of the stylus, thus compensating for the arcing motion of the stylus.
- **Step detection**, which automatically levels, detects and measures single or multiple steps in a single scan. It also provides an average of all the steps.

The following sections describe some of the major functions of the Dektak 150 software.

Automation Programs

Automation Program files can store a number of scan routines on the hard disk. Scan routines, along with their stage locations and analytical functions, are inserted into the automation program. Automation Programs are stored for various applications in Windows file format on the hard disk, giving the Dektak 150 virtually unlimited program storage capability.

The Automation Program Summary (APS) Report provides data in tabular form on the just-concluded or saved automation program. In addition to showing basic information such as the number of scan routines, this window displays the cursor locations and statistical information regarding each analytical function (see Analytical Functions on page 1-7).

Scan Routines

A Dektak 150 scan routine consists of up to sixteen individual scan parameters that you can select using the mouse. You can determine parameters such as scan length and speed, software leveling, and stylus force. A maximum of 10,000 scan routines can be entered into each automation program file.

Analytical Functions

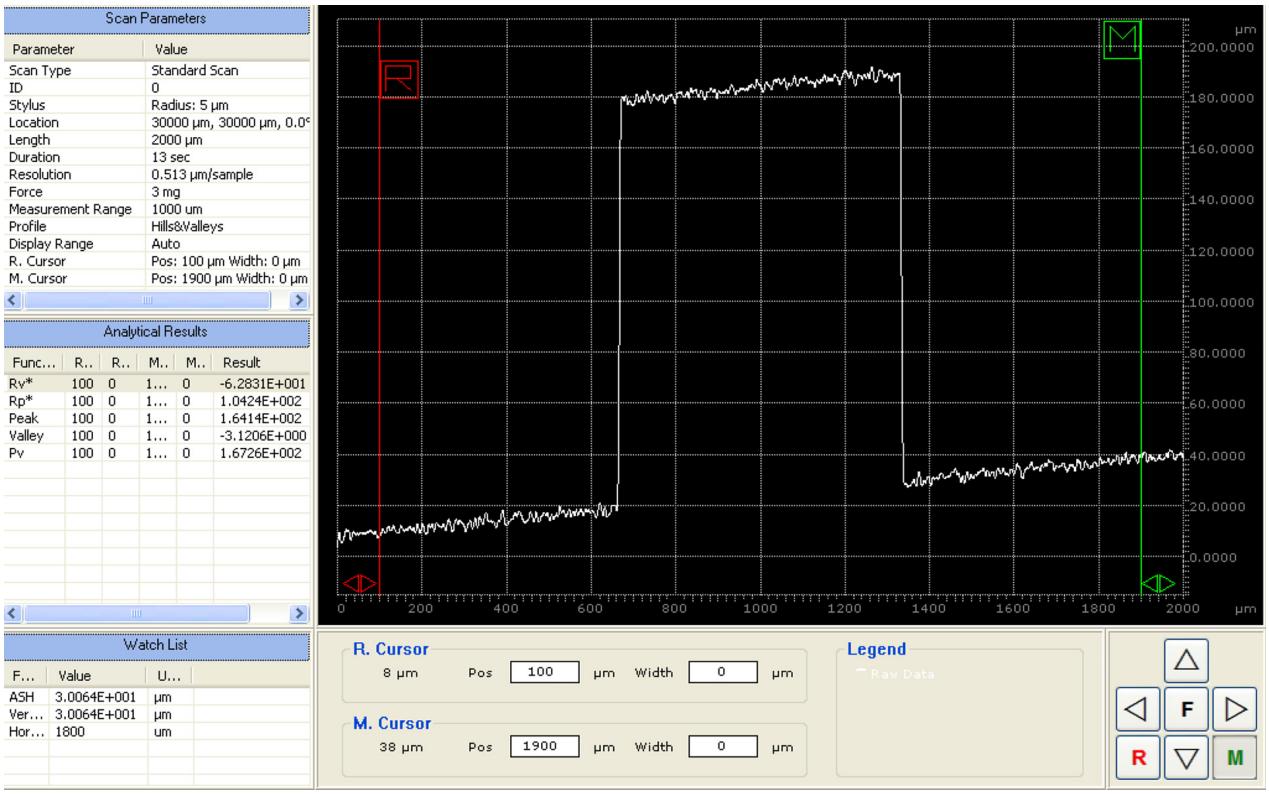
The Dektak 150 has a wide range of analytical functions available for analysis of roughness, waviness, step height, and geometrical measurements. You can log up to 30 analytical functions per scan to the APS.

Data Plot Window

The **Data Plot** window shows the scan data as well as various parameters from the scan routine, such as the stage X/Y and theta location, scan identification, scan length, scan speed, resolution, stylus force, measurement range and profile. Also shown are the vertical and horizontal distances between the cursor/trace intercepts, as well as the distances from the vertical and horizontal “zero” grid lines. If you want to change the units of measure before or after the scan, you can specify angstroms, um, or nm.

If you requested analytical functions, the results of those calculations also appear. Furthermore, the plotting screen includes a Watch List, which serves as a real-time monitor of ASH (delta average step height), horizontal distance and vertical distance.

Figure 1-6: Data Plot Window



DEKTAK 150 REFERENCE MATERIALS

The Dektak 150 reference materials include this manual in Adobe® Acrobat® Portable Document Format (PDF) and any software release notices relevant to the current version of the Dektak 150 application. These electronic files, which are both pre-installed and provided on a separate CD, provide a convenient way to quickly search for a particular subject, along with the capability to print specific sections of this manual.

In addition, the Dektak 150 application includes some context-sensitive help.

Context-Sensitive Help

When provided, context-sensitive Help offers pop-up assistance for specific fields and controls in a Dektak 150 dialog box.

To display the context-sensitive Help, click the question mark in the upper-right corner of a dialog box, and then click a particular field or control. Information about that item appears in a pop-up window.

Online Help

The online Help in the Dektak 150 application consists of this manual in PDF format. To access it, follow the instructions in the section below.

This Manual in PDF Format

To access the PDF file of this manual, do one of the following:

- On your Windows desktop, click the shortcut labled **Dektak 150 Manual**.
- Select **Start > All Programs > Veeco > Dektak 150 Manual.pdf**.
- Within the Dektak 150 application, click **Help** > **Contents** > **Dektak 150 Manual.pdf** or press the F1 key.

> **NOTE –** Due to Veeco copyright specifications, certain editing features for the PDF files have been disabled.

How to Use This Manual

After you have installed the Dektak 150 system according to the instructions in Chapter 2, proceed to Chapter 3 to gain familiarity with the basic features of the software interface and perform a step-by-step exercise that teaches you how to load, position, and unload a sample.

The Chapter 3 exercise is continued in Chapter 4, which teaches single-scan operation, and Chapter 5, which tells you how to take a multiple-scan measurement. After you have performed the complete set of exercises, you will have learned the basic skills required to program and run single and multiple scan routines.

Once you have mastered the basics, you can proceed to Chapter 6, which explains the many analytical functions that perform complex computations on the profile data. To learn how to customize your scan routines to fit your application, go to Chapter 7, which describes scan parameters, data parameters, and display parameters.

Chapter 8 provides a detailed description of every menu and toolbar in the Dektak 150 user interface, while Chapter 9 tells you how to calibrate and maintain your system.

The first two appendices contain facilities specifications, technical specifications, and a list of available purchased options. The appendices that follow them provide instructions for using specialized functions of the software.

Whether you actually perform the hands-on exercises or simply read them for information, this manual provides all the instructions that you need to effectively operate the Dektak 150 stylus surface profiler.

2

INSTALLING THE DEKTAK 150 SYSTEM

This chapter tells you how to install the Dektak 150 surface profiler and verify that the system is functioning correctly. If you encounter problems, call Dektak 150 Technical Support at 520-741-1044, extension 1220.

SAFETY PRECAUTIONS

Use Dektak 150 equipment only as specified in this manual and as specified in any documentation associated with its components. Any use of the equipment in an unspecified manner is strongly discouraged and may result in damage or injury as cautioned by signed warnings in this chapter and throughout the documentation.

Table 2-1: Safety Symbols Key

Symbol	Definition
	This symbol identifies conditions or practices that could result in damage to the equipment or other property, and in extreme cases, possible personal injury.
	Ce symbole indique des conditions d'emploi ou des actions pouvant endommager les équipements ou accessoires, et qui, dans les cas extrêmes, peuvent conduire à des dommages corporels.
	Dieses Symbol beschreibt Zustände oder Handlungen die das Gerät oder andere Gegenstände beschädigen können und in Extremfällen zu Verletzungen führen können.
	This symbol identifies conditions or practices that involve potential electric shock hazard.
	Ce symbole indique des conditions d'emploi ou des actions comportant un risque de choc électrique.
	Dieses Symbol beschreibt Zustaende oder Handlungen die einen elekrischen Schock verursachen koennen.

CAUTION: *Only* qualified personnel aware of the hazards involved may perform service and adjustments.

ATTENTION: Toute réparation ou étalonnage doit être effectué par des personnes qualifiées et conscientes des dangers potentiels.

VORSICHT: Service- und Einstellarbeiten sollten nur von qualifizierten Personen, die sich der auftretenden Gefahren bewußt sind, durchgeführt werden.

CAUTION: Follow company and government safety regulations. Keep unauthorized personnel out of the area when working on equipment.

ATTENTION: Il est impératif de suivre les prérogatives imposées tant au niveau gouvernemental qu'au niveau des entreprises. Les personnes non autorisées ne peuvent rester près du système lorsque celui-ci fonctionne.

VORSICHT: Befolgen Sie die gesetzlichen Sicherheitsbestimmungen Ihres Landes. Halten Sie nicht authorisierte Personen während des Betriebs fern vom Gerät.

CAUTION: Voltages supplied to and within certain areas of the system are potentially dangerous and can cause injury to personnel. Power-down everything and unplug from sources of power before doing ANY electrical servicing. (Veeco personnel *only*.)

ATTENTION: Les tensions utilisées dans le système sont potentiellement dangereuses et peuvent blesser les utilisateurs. Avant toute intervention électrique, ne pas oublier de débrancher le système. (Réservé au personnel de Veeco Instruments, Inc. seulement.)

VORSICHT: Die elektrischen Spannungen, die dem System zugeführt werden, sowie Spannungen im System selbst sind potentiell gefährlich und können zu Verletzungen von Personen führen. Bevor elektrische Servicearbeiten irgendwelcher Art durchgeführt werden ist das System auszuschalten und vom Netz zu trennen. (Veeco Personal.)

PROFILER COMPONENTS

Figure 2-1 shows the main components of the front of the Dektak 150 surface profiler. Figure 2-2 shows the main components of the back. Refer to these figures as you install the system.

Figure 2-1: Major Components of the Dektak 150 Surface Profiler

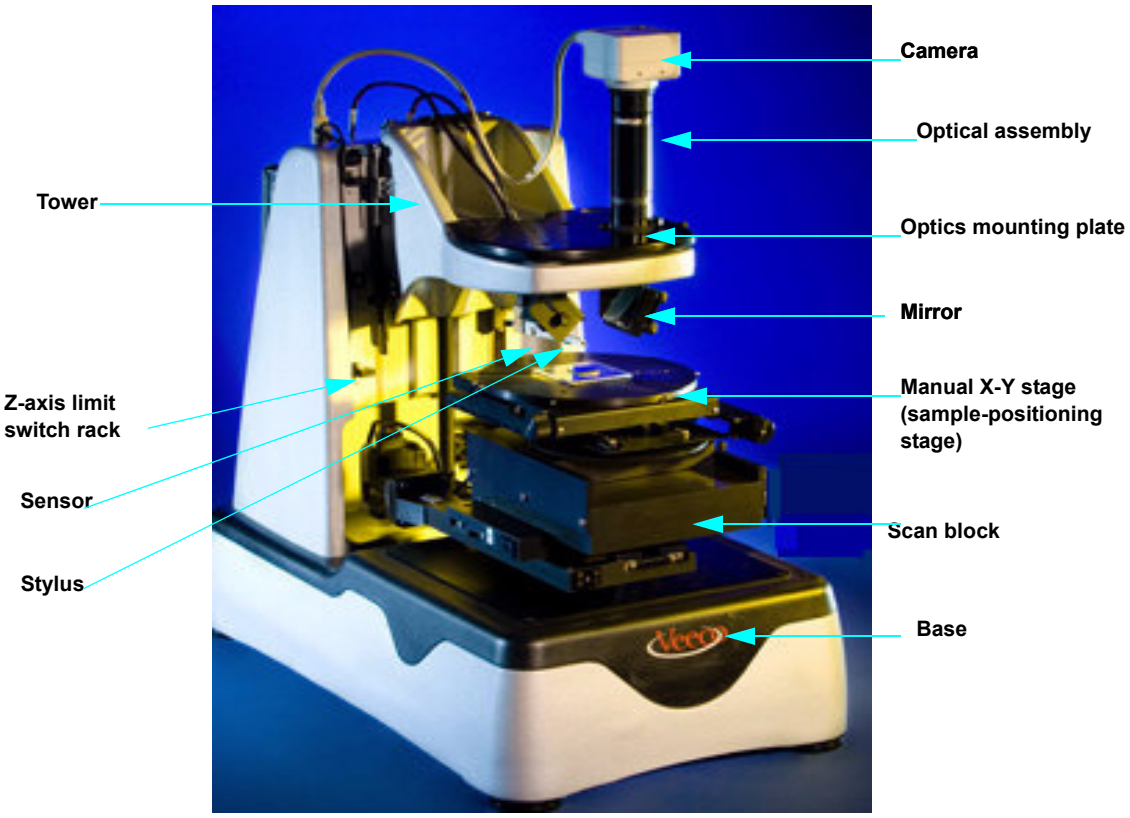
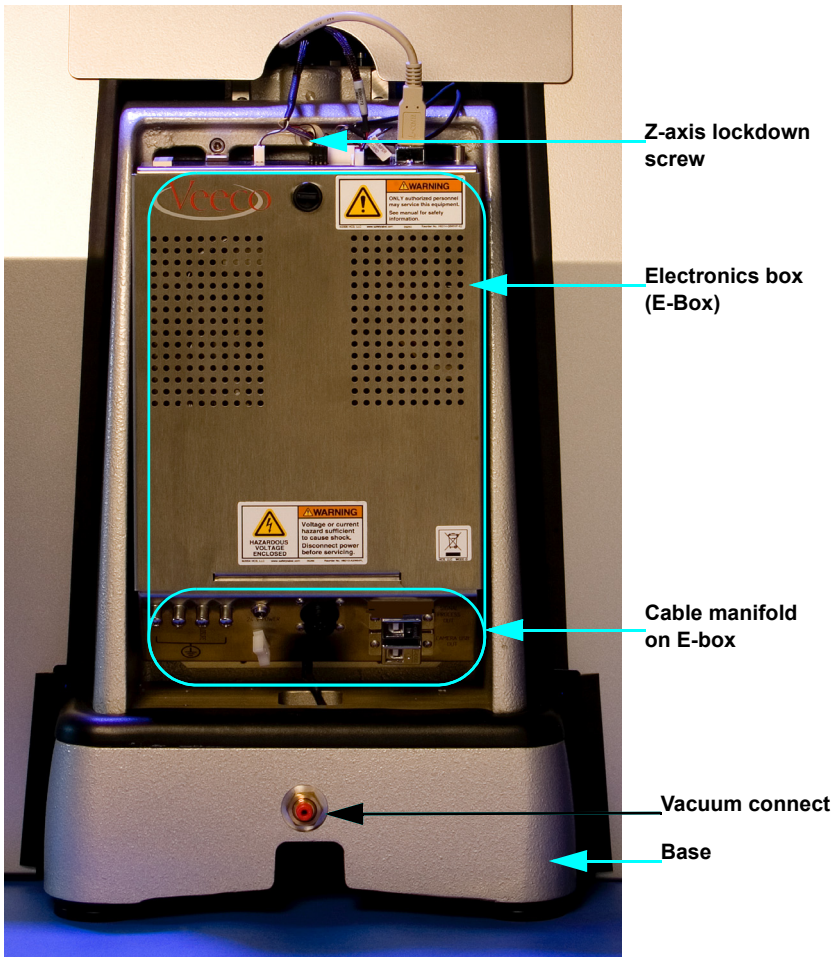


Figure 2-2: Back of the Dektak 150 Surface Profiler



PREPARING FOR INSTALLATION

This section tells you how to prepare an operating environment, unpack the Dektak 150 shipping boxes, and remove the shipping brackets on the surface profiler. For instructions on installing the system, see Installing the System on page 2-9.

Preparing Your Location

Prior to unpacking the system, you must make sure that your operating environment meets the requirements outlined in Appendix A, Facilities Specifications. At the minimum, you must:

- Ensure that the location is free from excessive air turbulence, vibration from machinery, dust and dirt, or other environmental contaminants.

IMPORTANT! The above factors will affect the profiler's performance.

- Ensure that the electrical service at your location meets the following power requirements:
  - 100-120~ (+/-10%) at 5 amps, 1 Phase, 50/60 Hz)
  - 220-240~ (+/-10%) at 3 amps, 1 Phase, 50/60 Hz
- Determine how you are going to arrange the modular Dektak 150 components and obtain the required support furniture. The surface profiler must sit on a sturdy, rigid surface that is at least 11-1/2 inches wide and 20 inches deep (with the environmental enclosure, 16-1/2 inches wide and 22 inches deep). Be sure that the surface also includes room for the 3” x 4” EMO box (see Figure 2-9). The surface must be level to within 1/4 degree. For more information see Appendix A, Facilities Specifications.
- To achieve optimal performance, purchase the vibration isolation table or platform listed in Appendix B, Technical Specifications and Purchased Options. If you do this, install the table or platform prior to unpacking the Dektak 150 system. For more information, see Installing the Optional Vibration Isolation Table on page 2-28.

Inspecting and Unpacking the Boxes

WARNING

To unpack Box 2, which contains the Dektak 150 surface profiler, follow the instructions in Unpacking the Surface Profiler on page 2-6. Failure to follow those instructions exactly can result in damage to the profiler.

The Dektak 150 ships in multiple boxes. Before unpacking any of them, check the entire shipment for signs of damage or mishandling. Inspect the shock indicator on Box 2 (see Figure 2-3) to verify that the system has not been roughly handled. Report any suspected damage immediately to the shipper and to Dektak 150 Technical Support at 520-741-1044, extension 1220.

Figure 2-3: Shock Indicator on Shipping Box 2

The number of boxes varies, depending upon options purchased with your system. However, the typical system includes:

- **Box 1:** Dell computer, keyboard, mouse, cables and operating system software; Veeco software installation and backup disks, this manual on CD, complete packing list, and quality acceptance documents.

- **Box 2:** Surface profiler main unit.
- **Box 3**: Installation tool kit, universal power strip, optical assembly, power cords, USB cable, serial cable, stage, calibration standard(s), styli, and stylus shield.
- **Box 4**: Environmental enclosure.
- **Box 5**: Optional video monitor and cables.
- **Box 6**: Optional vibration isolation table or platform.

Unpacking Guidelines

As you unpack the other boxes, bear in mind:

- The complete shipping list for your system is included in Box 1. Verify the contents of the complete set of boxes against that list.
- As you unpack the boxes, collect the following items and store them in a safe place:
  - Extra stylus tips
  - Stylus exchange tool
  - Calibration standard(s)
  - Veeco software
  - Operating system software
- In case the system must be transported, save all boxes and packing materials until acceptance.
- After acceptance, save Box 2 to safely ship the profiler should that prove necessary.

Unpacking the Surface Profiler

1. Move Box 2 as close as possible to the work surface on which the profiler will sit.
2. Open the top of the box, and remove the top foam and middle foam inserts.

WARNING: Attempting to lift the system without assistance may result in personal injury and/or damage to the equipment.

AVERTISSEMENT: Soulever le système sans assistance pourrait entrainer des blessures et/ou endommager les équipements.

WARNUNG: Der Versuch, das Gerät ohne Hilfe zu heben, könnte zu körperlicher Verletzung und/ oder Beschädigung des Gerätes führen.

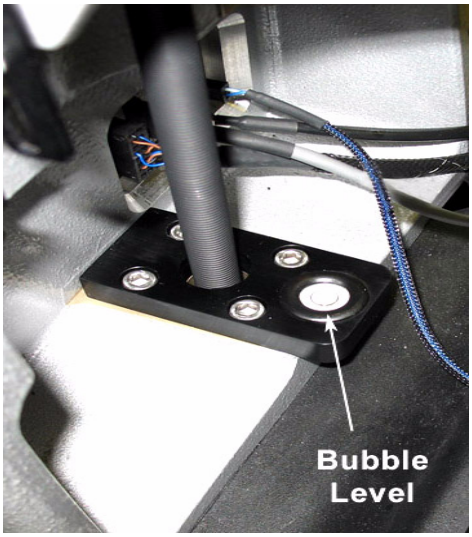
3. The system is shipped in a plastic bag. Open the top of the bag and push it down to expose the profiler.
4. With at least two people, lift the profiler by placing your hands under its base at either end of the casting (see Figure 2-4). Do not lift from the top of the system.

Figure 2-4: Lifting the Profiler by Its Base

5 Place the system on the work table or vibration isolation table, with the Veeco logo facing forward.

6 Use the bubble gauge at the base of the tower to verify that the work surface is level (see Figure 2-5). Adjust the work surface if necessary.

Figure 2-5: Verifying that the Work Surface Is Level



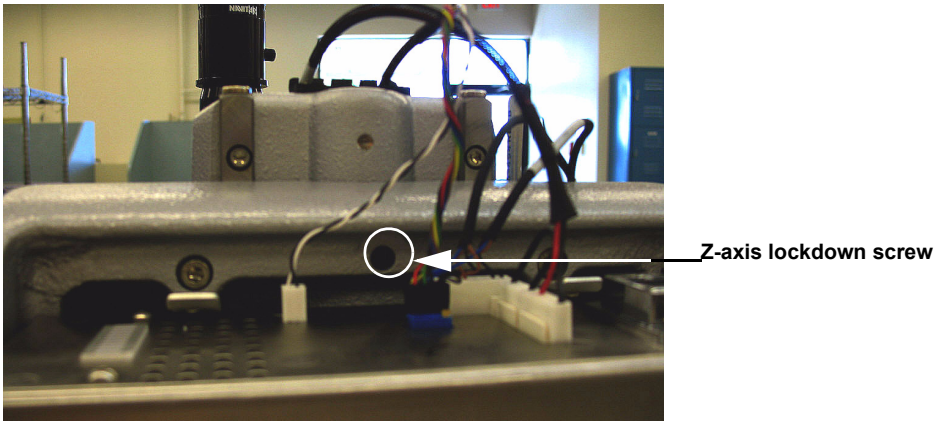
NOTE – The scan block on the base of the system is covered with lint-free tissue. Leave this tissue in place during installation to protect the precision surface.

Removing the Shipping Brackets from the Profiler

CAUTION:	Neglecting to remove any or all of the shipping brackets prior to operation may result in damage to the equipment.
ATTENTION:	Oublier d'enlever une ou toutes les pinces de maintien avant utilisation pourrait endommager les équipements.
VORSICHT:	Vor Inbetriebnahme müssen alle Transportklammern entfernt werden, um eine Beschädigung des Gerätes zu vermeiden.

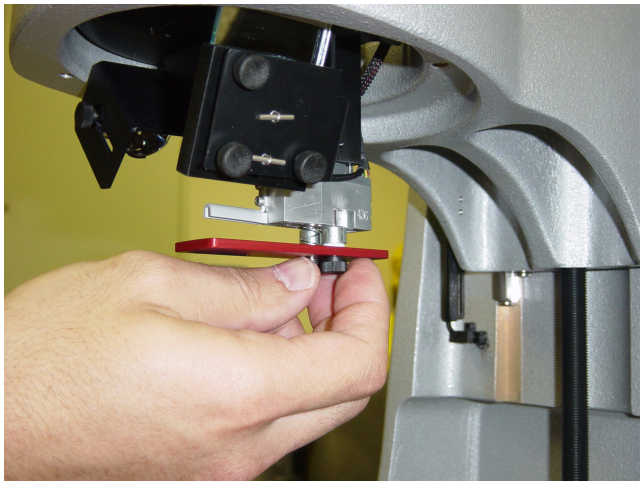
1 Using the 2.5 mm hex wrench (included in the installation tool kit), loosen the Z-axis lockdown screw on the upper rear of the system (see Figure 2-6). The screw needs to be loosened by only a few turns. It should remain in the system, to be tightened again should the profiler need to be transported.

Figure 2-6: Z-Axis Lockdown Screw



2 Locate the red sensor shipping bracket attached to the bottom side of the sensor (see Figure 2-7). Loosen the thumb screws and remove the bracket. Be sure to keep the bracket for future use.

Figure 2-7: Removing the Red Sensor Shipping Bracket



INSTALLING THE SYSTEM

This section tells you how to install the Dektak 150 system.

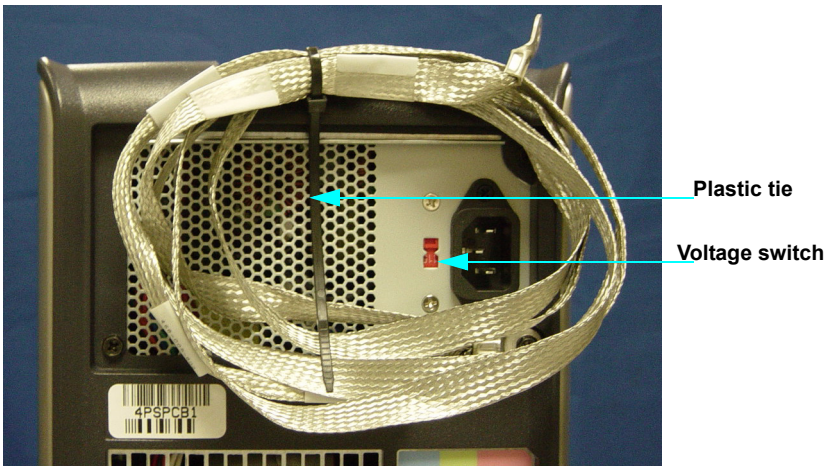
Setting Up the Computer

1. Locate the installation tool kit in Box 3. Keep the tools nearby throughout the installation.
2. Locate the power strip in Box 3, and plug it into your building's AC power outlet. You must connect all computer and profiler power cords to this strip.
3. Verify that the voltage setting on your Dell computer is set to match the AC power in your building (110VAC or 220VAC). The voltage switch is located next to the power cord outlet on the back of the computer (Figure 2-8). The default setting is 220VAC. For instructions on changing the voltage, see Changing the Voltage Setting on page 2-29.

> **WARNING**
> Damage can occur if the voltage is not set properly.

4. The ground strap is installed on the back of the computer (Figure 2-8). Cut the plastic tie that holds the strap in place.

Figure 2-8: Ground Strap Installed on the Computer



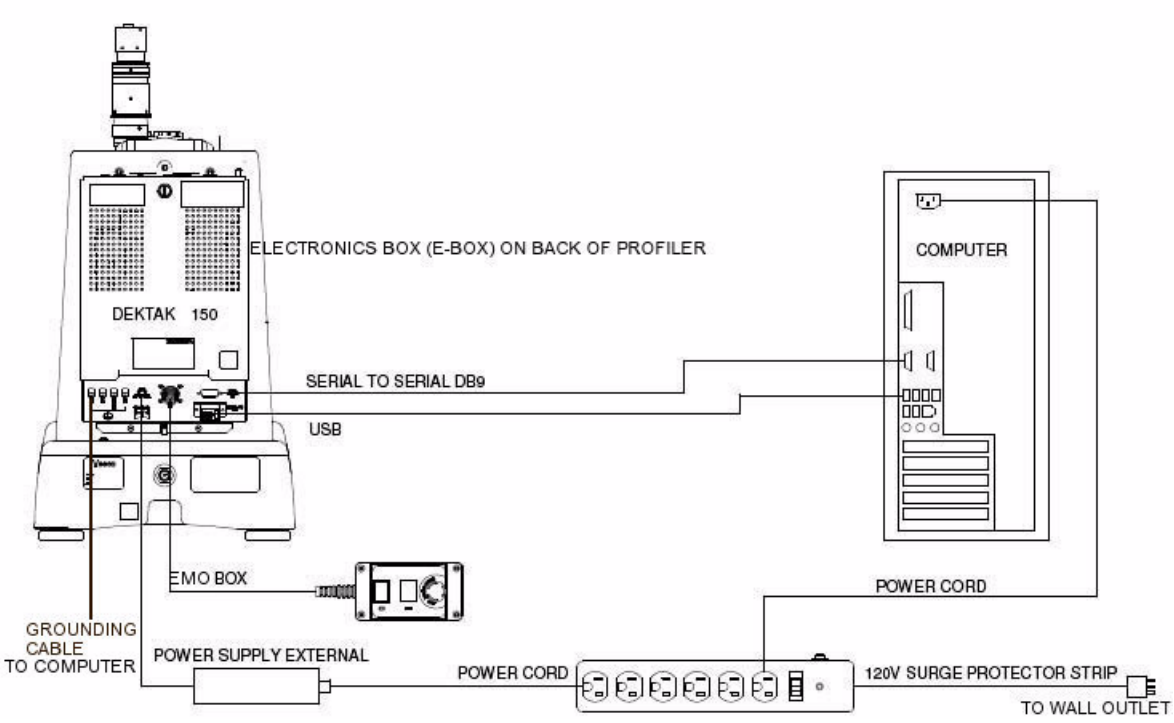
5. Using the Dell instructions located in Box 1, set up the computer, mouse and keyboard.

> **NOTE –** Do not place the computer on the same surface that you are using to support the surface profiler.

6. For instructions on installing the optional monitor, see Installing the Optional Video Monitor on page 2-28.

Connecting the Cables

Figure 2-9: Dektak 150 Cabling Diagram



	**CAUTION:**	Do not connect or disconnect any cables while the power is on.
	ATTENTION:	Ne pas connecter ou déconnecter de cables lorsque l'appareil est branché.
	VORSICHT:	Während die Spannungsversorgung eingeschaltet ist, dürfen Kabel weder vom Gerät getrennt, noch angeschlossen werden.

	**CAUTION:**	Always use a surge protector; the surge protector allows all of the components to power-up simultaneously via the single master power switch.
	ATTENTION:	Toujours utiliser un protecteur de circuit. Le protecteur de circuit sert à mettre sous tension tous les éléments du circuit simultanément via le connecteur central.
	VORSICHT:	Benutzen Sie stets einen Überspannungsbegrenzer (“surge protector”). Der Überspannungsbegrenzer ermöglicht das gleichzeitige Einschalten aller Geräteteile mittels eines einzelnen Hauptschalters.

1 Locate the USB cable, serial cable, power supply cable, EMO (Emergency Machine Off) box and AC power cord in Box 3.

2 Connect the USB cable to the USB port in the Cable Manifold (see Figure 2-11, left) on the back of the profiler. Then connect it to any USB port on the back of the computer. (see Figure 2-11, right).

Figure 2-10: Blank Cable Manifold

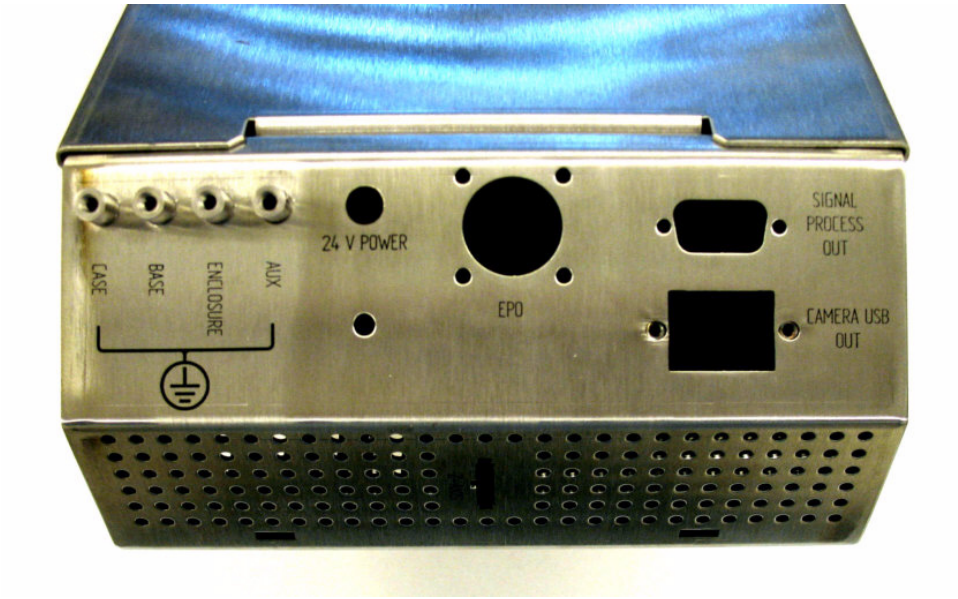
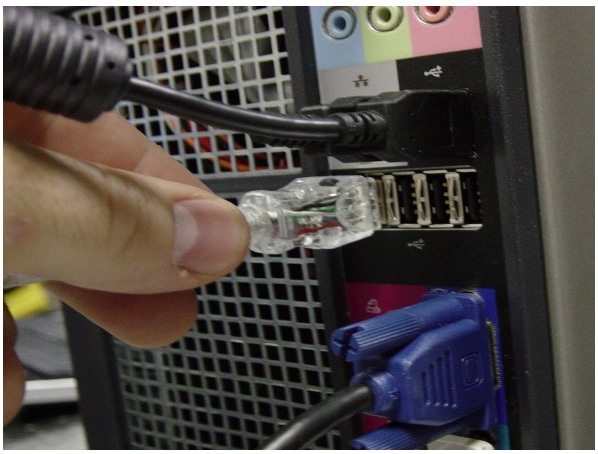


Figure 2-11: Connecting the USB Cable

Connecting the USB cable to the profiler



Connecting the USB cable to the computer

3 Connect the serial cable to the serial port in the cable manifold (see Figure 2-2) on the back of the profiler (Figure 2-2). Then connect the other end to the serial port on the back of the computer. Tighten the screws on both ends of the cable (see Figure 2-12).

Figure 2-12: Connecting the Serial Cable

Connecting the serial cable to the profiler

Connecting the serial cable to the computer

4 Connect the power supply cable to its port in the cable manifold (see Figure 2-10) on the back of the profiler (see Figure 2-13).

Figure 2-13: Connecting the Power Supply Cable

5 Connect the AC cord from the power supply (see Figure 2-14) to the power strip.

Figure 2-14: Connecting the AC Power Cord to the Power Supply

6 Connect the ground strap from the back of the computer to the CASE screw on the back of the profiler (see Figure 2-15). Use the 3mm hex wrench to tighten the strap in place.

Figure 2-15: Connecting the Ground Strap

7 Connect the EMO box to the back of the system, and hand-tighten the black connector (see Figure 2-16).

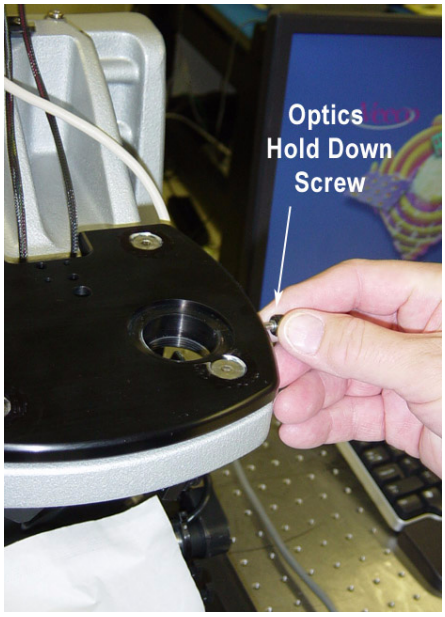
Figure 2-16: Connecting the EMO Box

Installing the Optical Assembly

1 Locate the optical assembly in Box 3.

2 Loosen the optics hold-down screw on the optics mounting plate (see Figure 2-17).

Figure 2-17: Loosening the Optics Hold-Down Screw



3 Insert the optical assembly, camera-end up, into the optics mounting plate. Screw the assembly into the mounting plate until it is hand tight (see Figure 2-18). Do not overtighten.

Figure 2-18: Screwlng the Optical Assembly into the Optics Mounting Plate

4 Rotate the optical assembly slightly such that the camera's USB port faces the rear of the system.

5 Tighten the optics hold-down screw.

6 Connect the USB cable from the system to the camera (see Figure 2-19).

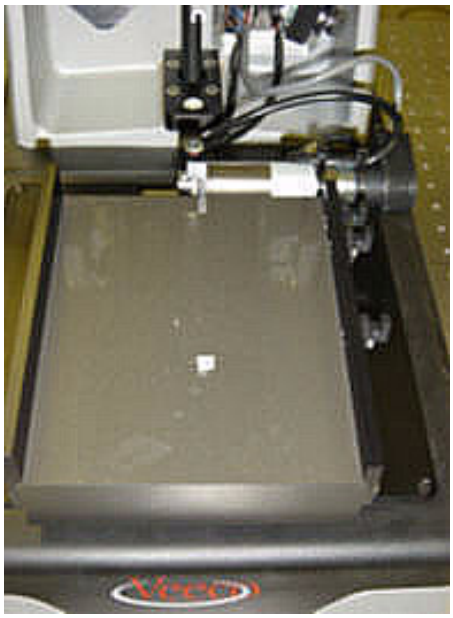
Figure 2-19: Plugging the USB Cable into the Camera

Installing the Stage

IMPORTANT! If you see dust or debris on the stage or the polished aluminum block, follow the cleaning instructions in Cleaning the X-Y Stage and Block on page 9-14.

1. Locate the X-Y stage in Box 3 and remove it from its plastic bag.
2. Remove the lint-free tissue from the polished aluminum block on the base of the system (see Figure 2-20).

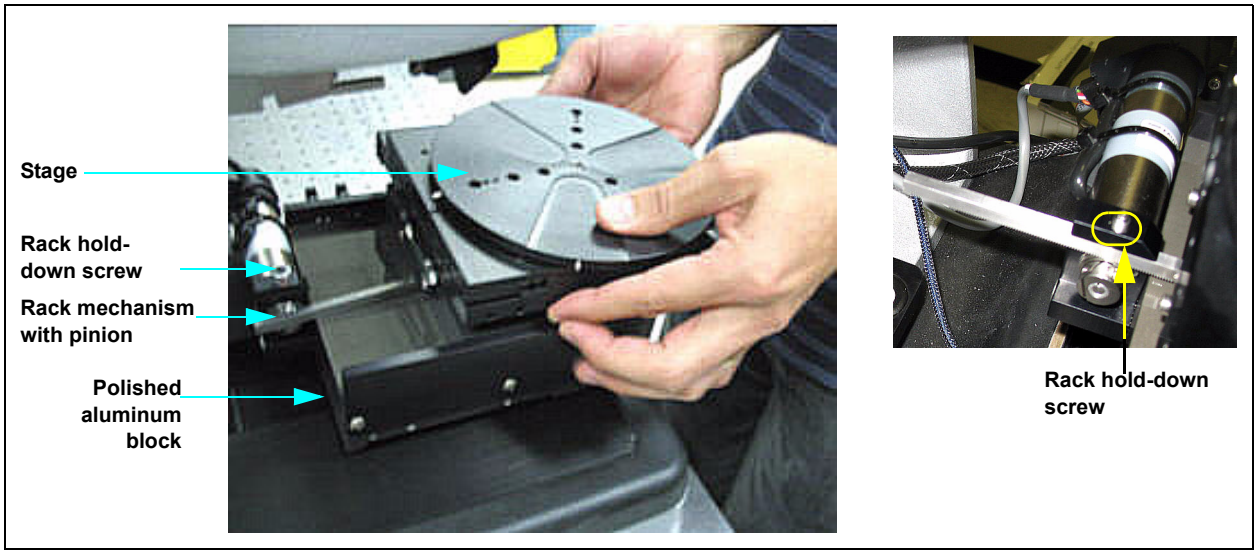
Figure 2-20: Polished Aluminum Block



3 Position the stage with the metal rack mechanism pointing to the rear of the system. This rack must pass over the pinion gear at the rear of the polished aluminum block . Slightly depress the spring-loaded guide on the left of the stage, then gently lower the stage between the rails and onto the polished aluminum block. All of these parts appear in Figure 2-21.

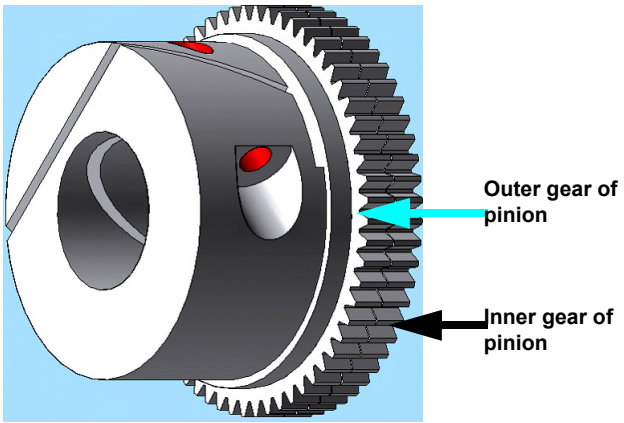
NOTE – Do not worry about the position of the scan drive. The Dektak 150 software will home it upon start-up.

Figure 2-21: Placing the Stage on the Polished Aluminum Block



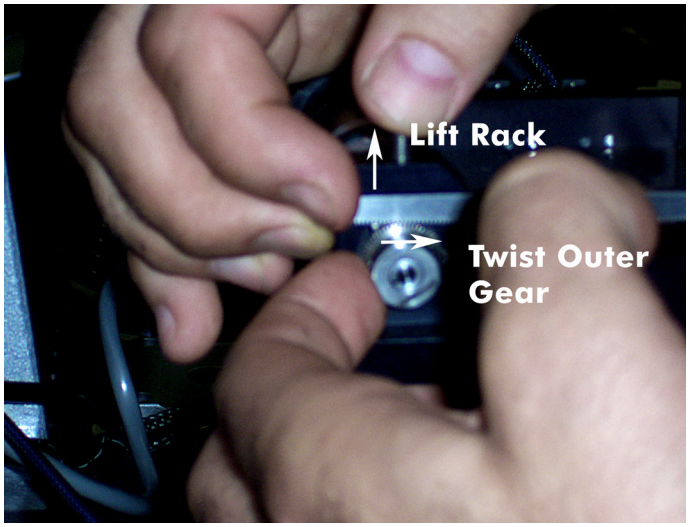
4 The pinion consists of two parallel gears (Figure 2-22). To take up backlash, lift the rack mechanism slightly with one hand, then turn the outer of the two gears clockwise, approximately the distance of at least two of the gear's teeth (Figure 2-23).

Figure 2-22: Gears of Pinion



5 While holding the gear in place, engage the rack with the pinion gears, then hand-tighten the rack hold-down screw (see Figure 2-21).

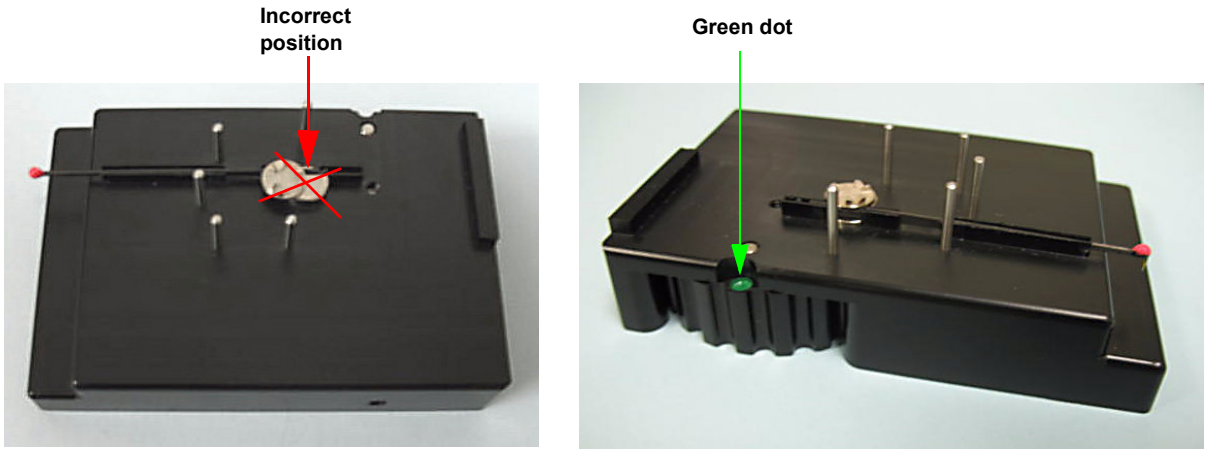
Figure 2-23: Adjusting the Anti-Backlash Gear Mechanism



Installing the Stylus

1. Locate the stylus and stylus exchange tool in Box 3. Each stylus is shipped in its own protective plastic case.
2. The exchange tool is designed to magnetically hold the stylus until it is seated in the sensor head. Turn the thumb wheel on the exchange tool so that the green dot (see Figure 2-24) is NOT visible (that is, the magnet is disengaged).
3. Open the stylus case, and gently remove the stylus. Lift the stylus by its central disk, not by the beam.
4. Place the stylus into the exchange tool, such that the round disk is aligned with the silver magnet on the tool. The stylus arm must be centered within the long trench (see Figure 2-24). The stylus tip should point down.

Figure 2-24: Alignment of Stylus and Stylus Exchange Tool



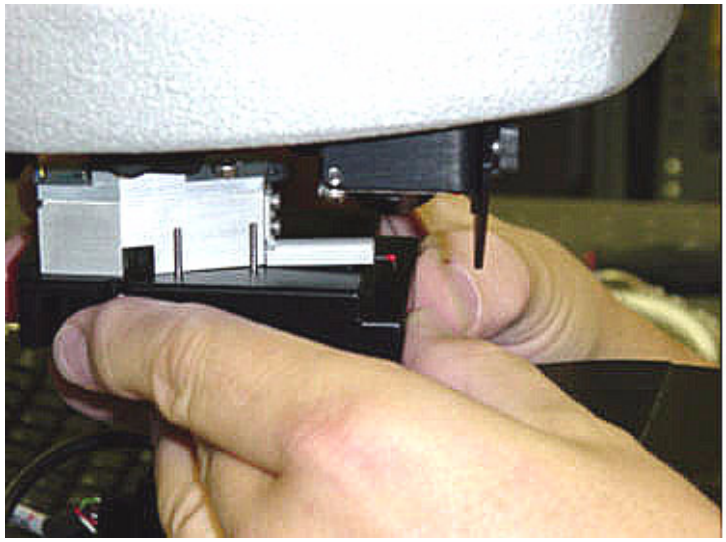
Stylus misaligned with exchange tool

Stylus correctly aligned with exchange tool

5 Turn the knob on the exchange tool so that the green dot is visible (Figure 2-24) and the magnet is engaged.

6 Holding the exchange tool from the edges, align its pins with the outside of the sensor. (Because this is a precision alignment, you may want to practice several times without the stylus in the way.) Push up until the tool is flush with the bottom of the sensor (see Figure 2-25).

Figure 2-25: Aligning the Exchange Tool with the Sensor

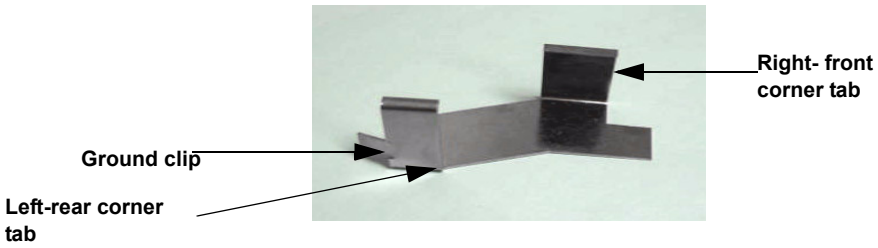


7 Turn the thumb wheel to disengage the exchange tool's magnet.

8 Carefully lower the exchange tool to remove it.

9 Locate the stylus shield in Box 3 (see Figure 2-26).

Figure 2-26: Stylus Shield



10 Place the shield around the sensor head, such that the right-front corner tab is engaged (Figure 2-27). Press in on the left -rear corner tab until the shield clicks into place (Figure 2-28).

Figure 2-27: Attaching the Right-Front Corner Tab

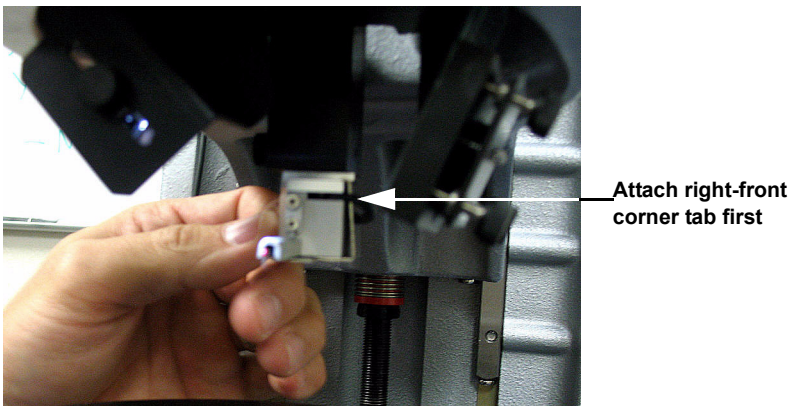
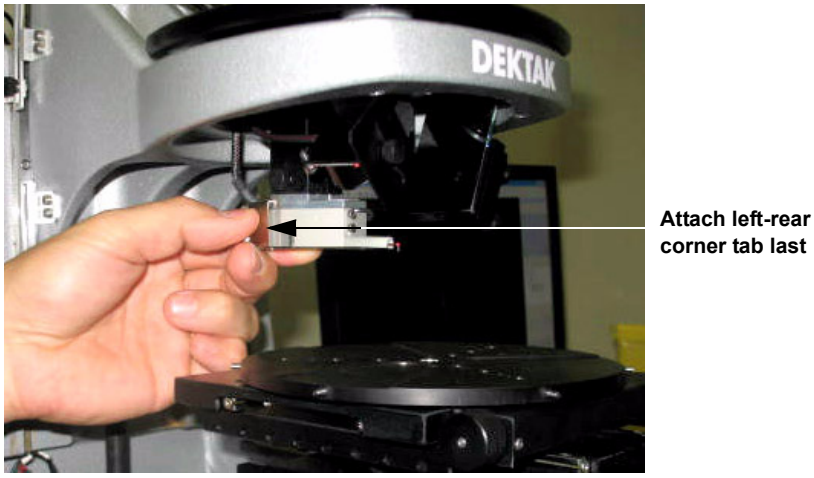


Figure 2-28: Attaching Left-Rear Corner Tab

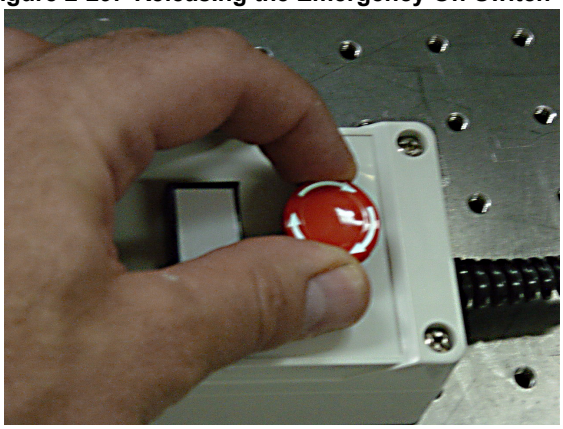


NOTE – As you use your Dektak 150 system, you may want to remove a stylus and install one of a different size. For more information, see General Care and Handling on page 9-6.

Turning on the Power and Checking Out the System

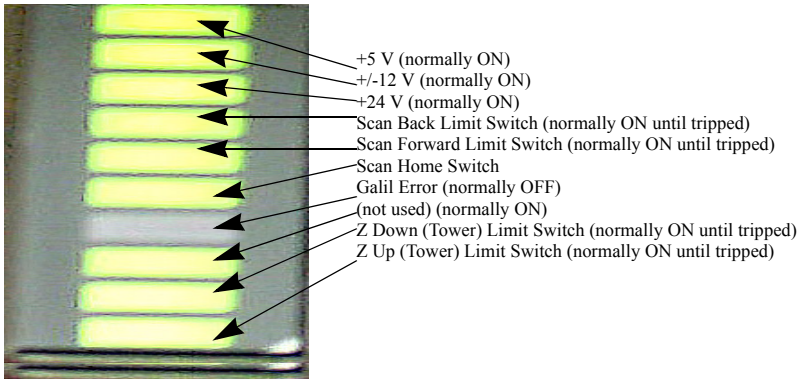
1. Verify that the power switches on the monitor and profiler EMO box are in the On position.
2. Make sure that the switch on the surge protector is turned on.
3. The EMO box contains three switches: a white On switch, a black Off switch, and a red Emergency Off switch. Release the Emergency Off switch by rotating it clockwise until it pops up (see Figure 2-29).

Figure 2-29: ReleasIng the Emergency Off Switch



4 Press the white On button to supply power to the system. After you do this, the button becomes illuminated. The X-Y stage limit switches also illuminate, along with the light bar on the top of the E-box. The light bar should be fully lit with the exception of one LED labeled "Galil Error" (see Figure 2-30).

Figure 2-30: Light Bar on the Top of the E-Box



5 Press and release the power switch on the front of the computer. The computer starts up to the Windows desktop.

6 Double-click the **Dektak** icon  to launch the Dektak 150 software. As the software starts up, the tower moves to its upper limit switch. The system stops with the stylus in the “tower up” position, allowing you to safely position a sample beneath it.

7 Select **Calibration > Stylus Force** from the menu bar to open the **Force Calibration** dialog box (see Figure 2-31). Use the slider in the **Force DAC** section to increase the DAC Value to maximum. Observe and verify the stylus swings to the down position. Use the slider to decrease the DAC Value to minimum. Observe and verify that the stylus moves to the up position. Then click **Cancel** to close the dialog box.

Figure 2-31: Force DAC Section of the Force Calibration Dialog Box

Position the slider at this end to move the stylus down.

Position the slider at this end to move the stylus up.

ATTENTION: If the Dektak 150 does not turn on following the power-on procedure outlined above, take these steps before contacting the Veeco service department:

- Verify all cables are properly connected and free of obvious damage.
- Verify the power switch on the front of the computer is in the ON (|) position.
- Verify all power cords are connected properly.
- Repeat the power-on procedure.

ATTENTION: Si le Dektak 150 ne s'allume pas lors du démarrage, suivre les indications suivantes avant de contacter Veeco:

- Vérifier que tous les cables sont correctement connectés et non endommagés.
- Vérifier que l'interrupteur à l'avant de l'ordinateur est en position 'ON' (|).
- Verifier que tous les fils électriques sont branches correctement aux prises de courant
- Répéter la procédure de démarrage

ATTENTION: Falls sich das Dektak 150 mit dem beshriebenen Verfahren nicht einschalten lassen sollte, überprüfen Sie die folgenden Punkte, bevor Sie sich mit Veeco Instruments in Verbindung setzen:

- Überprüfen Sie, ob alle Kabel korrekt installiert wurden, und daß sie keine offensichtlichen Schäden aufweisen.
- Vergewissern Sie sich, daß der Hauptschalter an der Frontseite des Computers eingeschaltet ist (|).
- Vergewissern Sie sich, daß alle Kabel zur Stromversorgung korrekt installiert wurden.
- Wiederholen Sie den Einschaltvorgang.

Adjusting the Optics

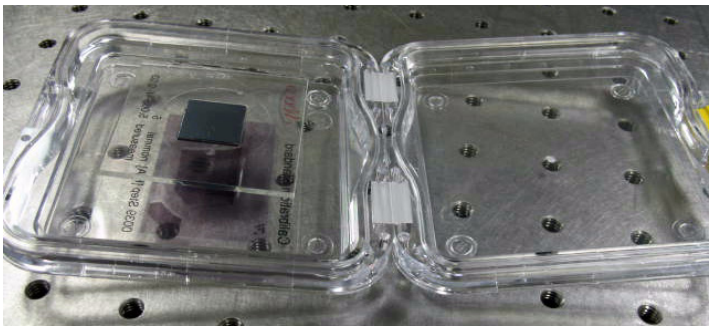
1 Locate the vertical standard in Box 3 and gently remove it from its case. Follow these steps:

a. Over a table or countertop, snap open the yellow clasp and spread the opened two parts of the case (see Figure 2-32).

b. Pick up the standard by the edges, and turn it over so that the blank is facing up.

c. Inspect the standard for dust. If dust is present, clean the standard with isopropyl alcohol and a lint-free tissue.

Figure 2-32: Vertical Standard Case Opened

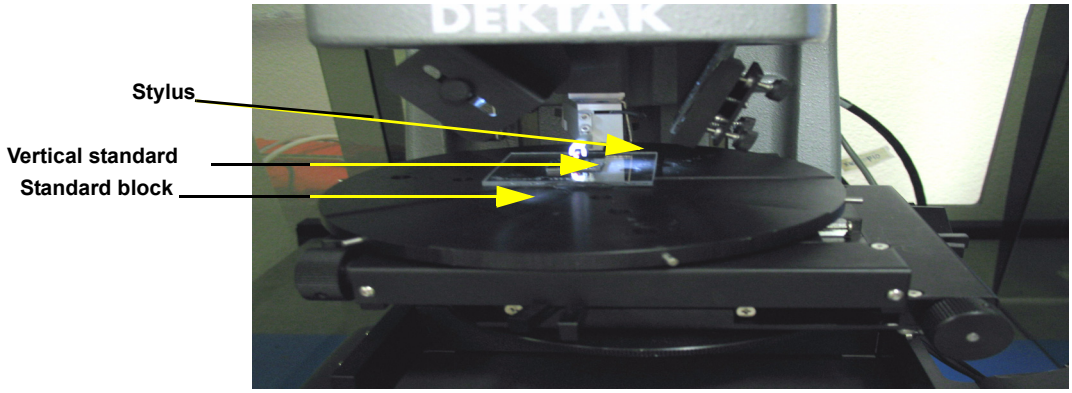


2 Position the standard on the stage beneath the stylus, with the printing facing the front of the system (see Figure 2-33). The system scans from front to back, so be sure there are at least a few millimeters of the standard located to the back of the stylus tip

NOTE – The above activity cannot damage the stylus/sensor. However, clipped data may appear on the monitor.

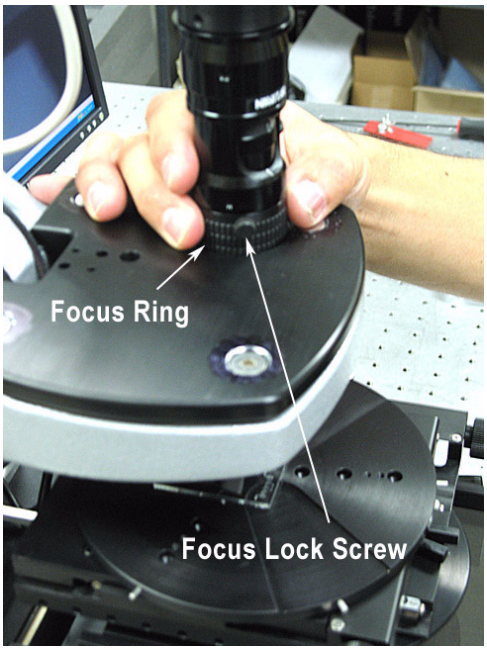
3 Press the **Stylus Down** button  to lower the stylus onto the standard (see Figure 2-33).

Figure 2-33: Stylus Lowered onto the Standard



4 Near the base of the optical assembly, loosen the zoom lock screw. Watching the computer monitor, turn the focus ring until the stylus tip on screen is as sharp as possible (see Figure 2-34). Finger-tighten the focus lock screw.

Figure 2-34: AdjustIng Focus



5 If your system is equipped with the optional zoom optics (see Figure 2-35), make the following adjustments:

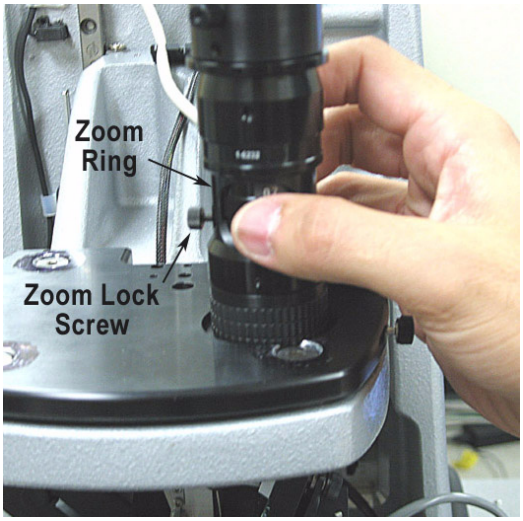
a. Loosen the zoom lock screw.

b. Rotate the zoom ring until you arrive at the desired position.

c. Tighten the zoom lock screw.

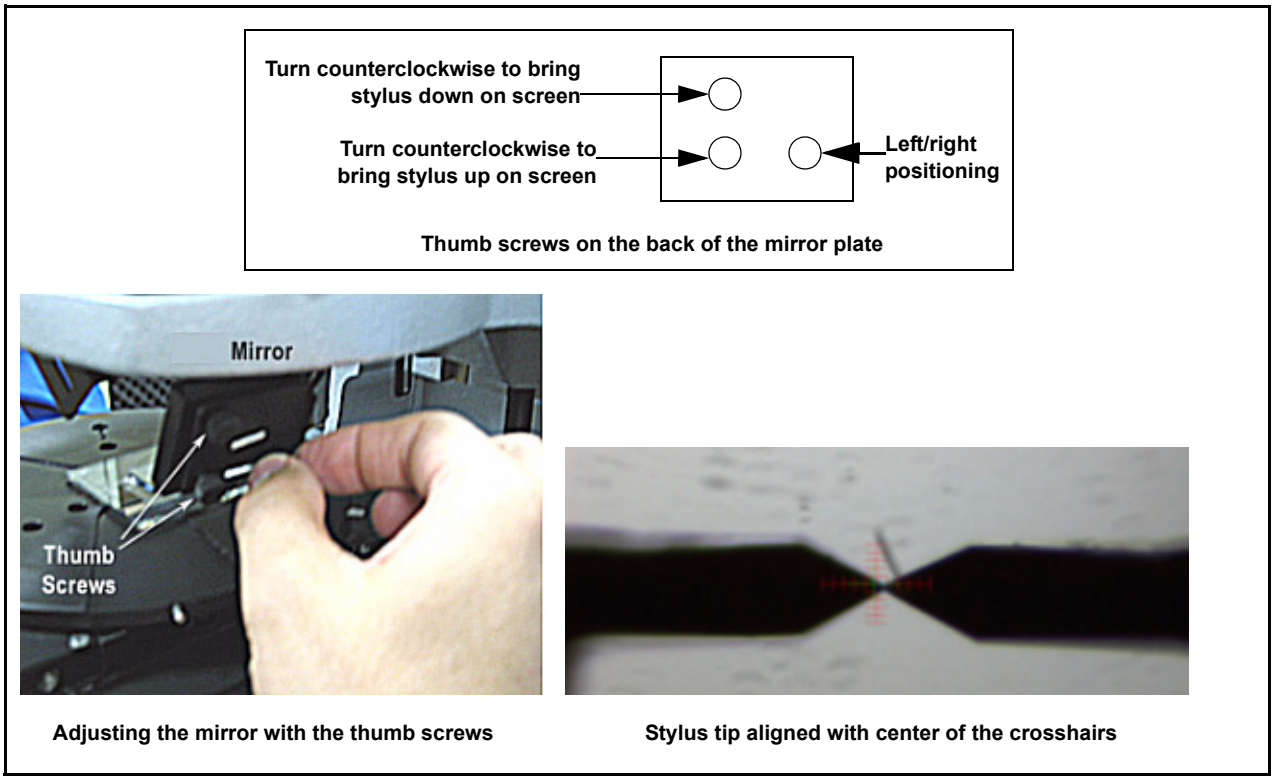
d. If necessary, refocus.

Figure 2-35: Adjusting the Optional Zoom Optics



6 Watching the computer monitor, turn the thumb screws on the back of the mirror plate (if necessary) to align the stylus tip with the center of the crosshairs (see Figure 2-36). This is a delicate adjustment, so turn the screw in increments of only half a turn.

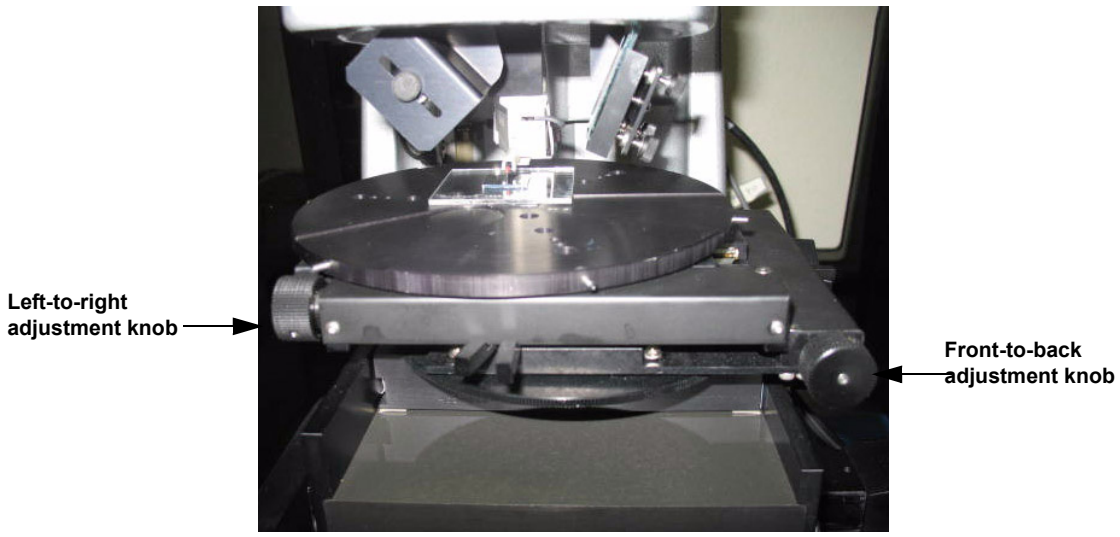
Figure 2-36: Adjusting the Mirror



Taking a Test Measurement

1 Using the adjustment knobs on the stage (see Figure 2-37), manually move the stage such that a flat area of the vertical standard is located beneath the stylus (see Figure 2-33).

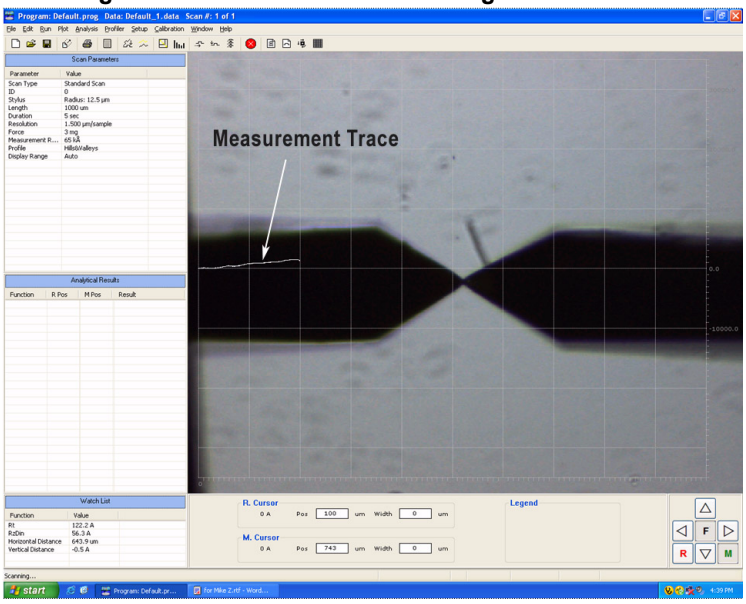
Figure 2-37: Adjustment Knobs on the Stage



2 Click the **Scan Here** button  to perform the factory-loaded measurement routine.

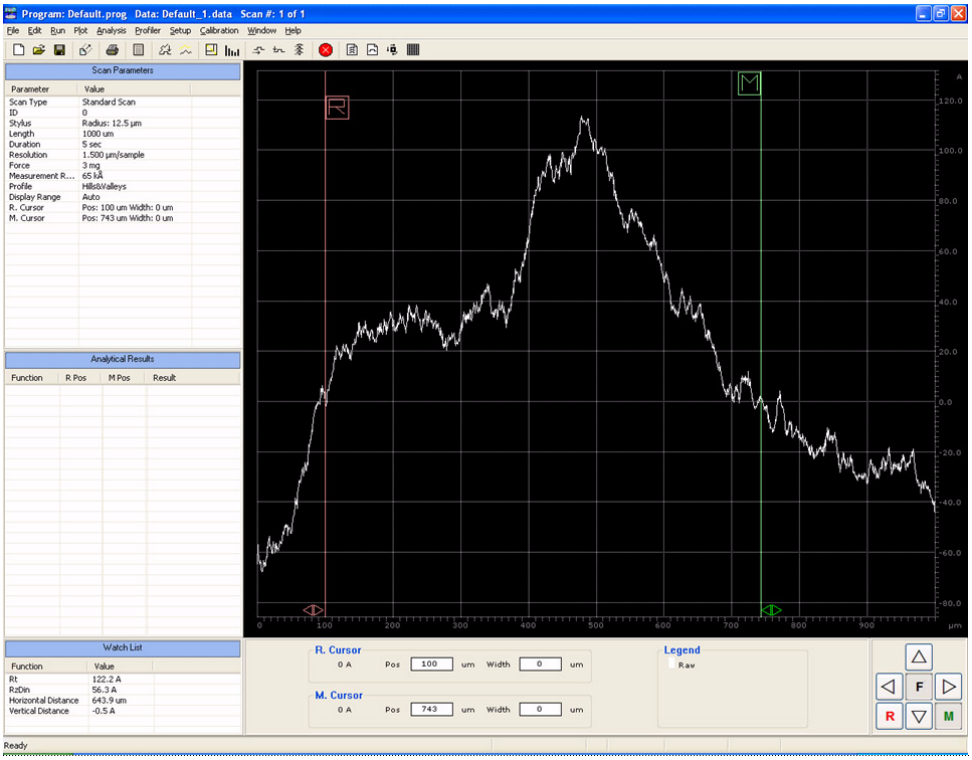
During the measurement, a measurement trace of the surface appears over the live video (see Figure 2-38).

Figure 2-38: The Scan Profile during a Measurement



At the end of the measurement, the **Data Plot** window appears (see Figure 2-39).

Figure 2-39: Typical Data Plot Window



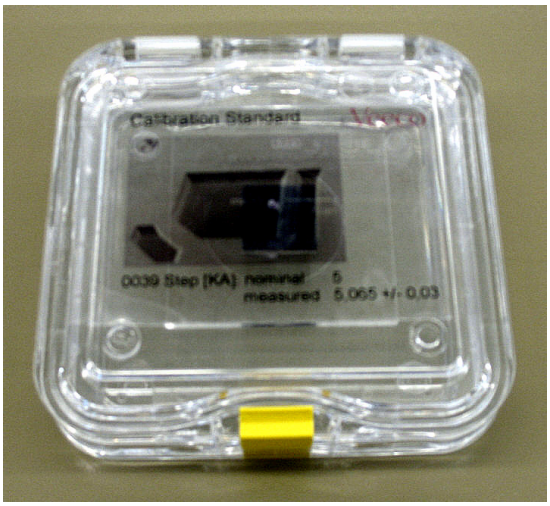
3 When you are ready to replace the vertical standard in its case:

a. Open the case.

b. With the block facing downward, place the vertical standard in the circular opening in the top.

c. Close the case and clasp it shut (see Figure 2-40).

Figure 2-40: Vertical Standard Case Closed



Turning Off the System

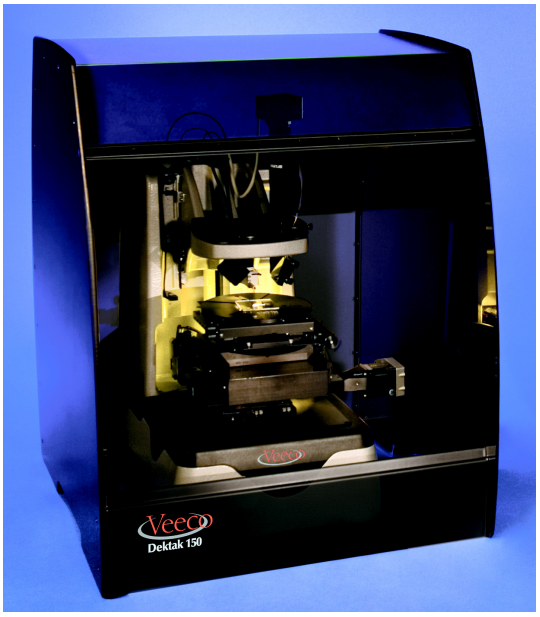
1. Shut down the software. The tower raises.
2. Press the black Off switch on the EMO box to turn off power to the system.

Installing the Environmental Enclosure

1. Remove the pre-assembled environmental enclosure from Box 4 and place it over the system.
2. Slide the cables slide through the rear slot.
3. Attach the enclosure's ground strap to the grounding screw on the back of the profiler.

NOTE – The enclosure that you receive may look different from the one shown here.

Figure 2-41: Environmental Enclosure



INSTALLING THE OPTIONAL VIBRATION ISOLATION TABLE

The optional floor-mounted vibration isolation table or benchtop-mounted vibration isolation platform significantly decreases vibration and enables more accurate profiling. The vibration isolation system must be installed and ready for the Dektak 150 when the profiler arrives at your site. Review the information in Appendix A, Facilities Specifications, and then refer to the manufacturer's instructions to install the platform or table.

INSTALLING THE OPTIONAL VIDEO MONITOR

You can supply your own monitor or purchase the optional 17-inch, high-resolution flat panel display color monitor from Veeco. The monitor cable connects to the video port on the back of the monitor and to the video board port on the computer. The power supply cable also connects to the back of the monitor and into an appropriate power outlet through the power bar (and then preferably through a surge protector).

INSTALLING A PRINTER

The Dektak 150 can transfer the data output to the computer printer port. Refer to the Microsoft Windows XP manual for a list of compatible printers and installation procedures. A LAN card is provided for connection to Local Area Network printers.

ESTABLISHING A NETWORK CONNECTION

The computer that comes with the Dektak 150 is equipped with a standard on-board Broadcom LAN port. Consult your IT department for instructions on how to connect to your network.

For access rights to all Dektak 150 directories and save settings, the login user must have Administrator rights to the computer used on the Dektak 150 system. This does not mean access rights to your network.

In the **User Name** field of the login screen, enter `dektak`. Leave the Password field blank and press ENTER.

NOTE – As an alternative to the network, you can save scan data to either the hard disk or portable media. The number of storable data files depends on the number of data points scanned. Each data point plotted requires five bytes of storage space. Therefore, a 13-second scan requires approximately 19,500 bytes of disk space.

CHANGING THE VOLTAGE SETTING

The Dektak 150 operates on 60Hz AC with either 110V or 220V. The Dektak 150 requires four power connections, two electronic power supplies, a monitor and a computer. If the unit is transferred to a facility where the voltage is different, the computer must be reset for alternate voltage.

CAUTION:	Ensure all cables that connect to the power source are accessible to the operator.
ATTENTION:	S'assurer que tous les cables connectés aux prises de courants sont accessibles par l'utilisateur.
VORSICHT:	Stellen Sie sicher, daß alle Spannungskabel für den Benutzer zugänglich sind.

CAUTION: Do not connect or disconnect any cables while the power is on.

ATTENTION: Ne pas connecter ou déconnecter de cables lorsque l'appareil est branché.

VORSICHT: Während die Spannungsversorgung eingeschaltet ist, dürfen Kabel weder vom Gerät getrennt, noch angeschlossen werden.

CAUTION: Always use a surge protector; the surge protector allows all of the components to power-up simultaneously via the single master power switch.

ATTENTION: Toujours utiliser un protecteur de circuit. Le protecteur de circuit sert à mettre sous tension tous les éléments du circuit simultanément via le connecteur central.

VORSICHT: Benutzen Sie stets einen Überspannungsbegrenzer ("surge protector"). Der Überspannungsbegrenzer ermöglicht das gleichzeitige Einschalten aller Geräteteile mittels eines einzelnen Hauptschalters.

To change the voltage setting:

1. Verify the main power switch located on the back of the computer console is turned off.
2. Verify the main power cable is disconnected from its primary power source and the computer console.
3. Verify the voltage setting displays the correct voltage once the main power cable is disconnected from the computer. If it does not, change the voltage setting.

NOTE – The voltage setting is located below the power inlet on the back of the computer (see Figure 2-8).

4. To change the voltage supply setting, use a small flat head screw driver to slide the voltage switch (see Figure 2-8) until the appropriate voltage setting appears.
5. Connect the power bar into an outlet that provides the appropriate voltage as shown on the voltage select card.

■ ■ ■

3

Basic User Interface and Stage Positioning Techniques

After explaining how to start up the system, this chapter provides an introduction to the basic elements of the Dektak 150 user interface. For a detailed description of the Dektak 150 menus and toolbars, see Chapter 8.

The user interface sections are followed by a step-by-step exercise that shows you how to position the sample stage to measure the vertical standard that came with your system or another appropriate sample. This exercise continues in Chapter 4, which describes single-scan operation, and Chapter 5, which describes multiple-scan operation. By completing the entire exercise, you will become comfortable the basic operational procedures of the Dektak 150 system.

START SEQUENCE

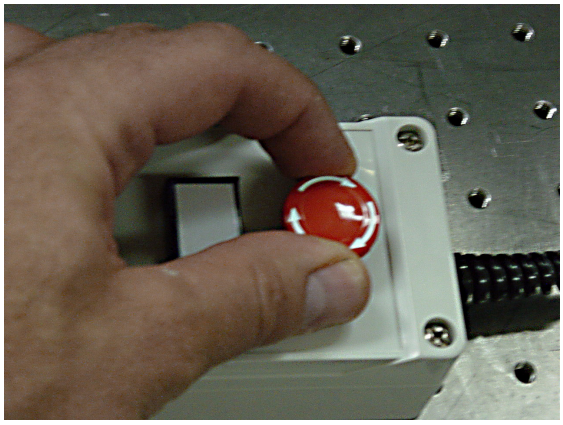
The following sections describe the basic procedure for starting the Dektak 150.

Power On

To power on the system:

1. Verify that all three Dektak 150 power cables are connected to an external power source.
2. Verify that the power switches on the monitor and profiler EMO box are in the On position.
3. Make sure that the switch on the surge protector is turned on.
4. Release the Emergency Off switch on the EMO box by rotating it clockwise until it pops up (Figure 3-1).

Figure 3-1: ReleasIng the Emergency Off Switch



5 Press the white On button on the EMO box. After you do this, the button becomes illuminated. The X-Y Stage limit switches also illuminate, along with the light bar on the top of the E-box.

6 Press and release the power switch on the front of the computer. The computer starts up to the Windows desktop.

7 Double-click the **Dektak Version 9** icon  to start the Dektak 150 software. As the software launches, the following events occur:

- The tower moves to its upper limit switch. The system stops with the stylus in the “tower up” position, allowing you to safely position a sample beneath it.
- The sample-positioning stage initializes.
- The Dektak 150 **Startup** window appears (Figure 3-3).
- When initialization is complete, the word “Ready” appears in the lower-left corner of the **Startup** window.

Figure 3-2: Ready Notation in the Startup Window

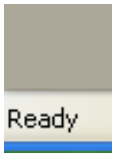
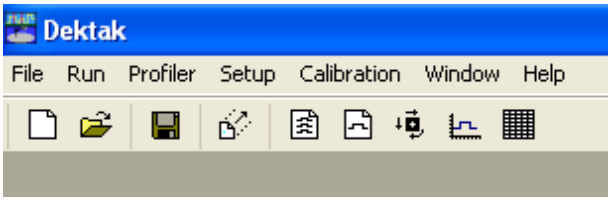


Figure 3-3: Dektak 150 Startup Window Toolbar



NOTE – When other Dektak 150 windows are displayed, click **Window** > **Close All Windows** to re-display the **Startup** window.

SOFTWARE INTERFACE AND STAGE CONTROLS

The Dektak 150 uses the following software interface and stage control devices.

Stage Control

The Dektak 150 has an optional automated X-Y stage that allows both automatic and semi-automatic sample positioning. Automatic or programmable positioning is described in detail in Chapter 5. Semi-automatic sample positioning is accomplished by using the mouse interactively with the various screens of the Microsoft® Windows® interface.

Manual X-Y Stage

After loading the sample on the stage, you coarse-position the measurement site to the center of the crosshairs using the quick-release clips. You then fine-position the scan site to the center of the crosshairs using the fine-positioning knobs. For fine-tuning the scan site, you may have to re-null the tower to adjust for skew (see Figure 2-1).

X-Y Auto Stage and Y Auto Stage

After loading the sample on the stage, you position the sample under the stylus using the icons in the **Stage Control Panel**. (Hold down the CTRL key for faster movement.) To fine-position the sample to the reticule, you can enter relative moves in the **Stage Control Panel** (Figure 3-6) or left-click in the **Sample-Positioning** window. The stage follows the movement of the mouse.

A template in the shape or a wafer or disk appears in the **Stage Control Panel**. Point the mouse to the desired location on the template, double-click the location, and the stage automatically translates to that approximate position.

Microsoft Windows XP

The Dektak 150 uses Microsoft Windows XP® as the operating environment, allowing integration of different tasks to increase efficiency and ease-of-use.

Dektak 150 operational tasks are organized into windows, pop-up dialog boxes and pull-down menus. Virtually all Windows commands have equivalent keyboard shortcuts to provide full Windows control, keyboard control, or a combination of both Windows and keyboard operation. The Dektak 150 user interface is described in detail in Chapter 8, Menu and Toolbar Descriptions.

When working under Windows XP, you can take advantage of the following features:

- Running multiple applications: You can run several applications under Windows at one time and easily switch between them, thus creating an integrated work environment.
- Data exchange between applications: You can transfer data between Dektak 150 and other standard Windows applications, files, directories, and disks. You can also control all Windows-related tasks such as directory or file management.

NOTE – Operating the Dektak 150 system under Windows XP indicates acceptance of the Microsoft software license agreement. “Microsoft” and “Windows" are registered trademarks of Microsoft Corporation. “Dektak” is a registered trademark of Veeco Instruments Inc.

Mouse Functions

The Dektak 150 ships with a mouse. Moving the mouse moves the pointer on the screen. To select a command, move the tip of the pointer until it rests on the desired command and click the left mouse button.

The following definitions are used throughout this manual:

- **Pointing Device:** Mouse/
- **Point**: Move the tip of the pointer until it rests on the item of interest.
- **Press**: Hold down the left mouse button.
- **Click** or **Select**: Quickly press and release the mouse button.
- **Drag**: Hold down the left button while moving the mouse.
- **Double-click**: Click the left mouse button twice in rapid succession.

Keyboard Shortcuts

Numerous shortcut keystrokes are provided in the Dektak 150 software. Many of these shortcuts are associated with menu items (see Chapter 8), while others perform the same functions as clicking the mouse button on certain items in the windows (see the tables below).

NOTE – Combination keystrokes are indicated by “**+**”. For example, “**Ctrl+N**” means hold down the **Ctrl** key, press and release the **N** key, and then release the **Ctrl** key.

Table 3-2: Keyboard Shortcuts for All Windows

Keyboard Key(s)	Function
Esc (or A)	Interrupts a scan or multi-scan program in progress. Aborts the tower-down and stage-rotation motions. Note that if you abort an operation while the stage is moving, you must reset the hardware. See X-Y Auto and Y Auto Stage Control Panel on page 3-8.

Table 3-3: Keyboard Shortcuts for the Data Plot Window

Keyboard Key(s)	Function
Ctrl+R	Selects the R cursor.
Ctrl+M	Selects the M cursor.
Ctrl+F	Toggles between fast and slow cursor movement speeds.
Ctrl+ (Right Arrow)	Moves the selected cursor to the right at the selected speed.
Ctrl+ (Left Arrow)	Moves the selected cursor to the left at the selected speed.
Ctrl+ (Up Arrow)	Increases the width of the selected cursor at the selected speed.
Ctrl+ (Down Arrow)	Decreases the width of the selected cursor at the selected speed.

Table 3-4: Keyboard Shortcuts for the Sample Positioning Window

Keyboard Key(s)	Function
(Up Arrow)	Increases illumination on the sample.
(Down Arrow)	Decreases illumination on the sample.
(Left Arrow)	Increases magnification.
(Right Arrow)	Lowers magnification.
Ctrl+Shift+L	Moves stage to center of rotation.
Ctrl+V	Moves stage to currently active scan routine's scan location.
Ctrl+Shift+U	Moves stage to unload position.
When Stage Tracking is active, press and hold Shift key for faster jogging movement.	
(Up Arrow)	Jogs stage to the right to move the image up.
(Down Arrow)	Jogs stage to the left to move the image down.
(Left Arrow)	Jogs stage to the back, moving the image to the left.
(Right Arrow)	Jogs stage forward, moving the image to the right.
+	Increases illumination on the sample.
-	Decreases illumination on the sample.
Ctrl+Shift+L	Moves stage to center of rotation.
Ctrl+V	Moves stage to currently active scan routine's scan location.

Table 3-5: Keyboard Shortcuts for Automation Program Summary Window

Keyboard Key(s)	Function
Ctrl+X	Permanently excludes selected scan.
Ctrl+U	Re-runs the selected scan.

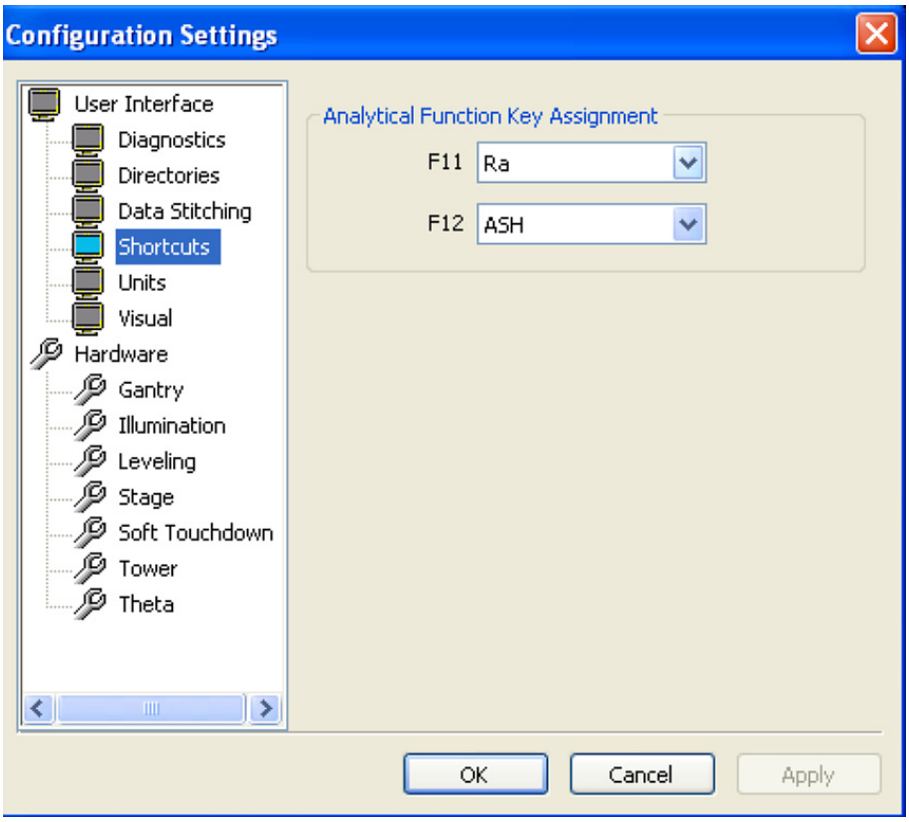
Assigning Analytical Functions to Keystrokes

Dektak 150 analytical functions (which are described in Chapter 6) can be assigned to the **F11** and **F12** function keys. This is useful for analytical functions that are are used frequently.

To assign an analytical function to a keystroke:

1. Click **Setup > Configuration Settings**.
2. Enter the password dektak32. to open the **Configuration Settings** dialog box.
3. In the **User Interface** section, click the **Shortcuts** icon to open the **Shortcuts** dialog box.

Figure 3-4: Configuration Settings Menu - Shortcuts Dialog Box



4. In the **F11** or **F12** field, select an analytical function from the drop-down list.
5. Click **Apply** and then click **OK** to assign the selected analytical function(s) to the function key(s) and close the dialog box.

NOTE – Click **Apply** instead of **OK** if you want to keep the dialog box open to assign an analytical function to another key.

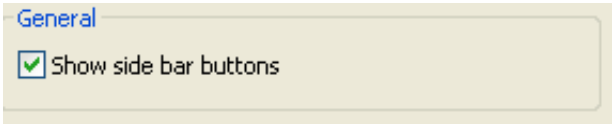
After you have run a scan and the profile appears in the the **Data Plot** window, you can run the selected analytical functions with the **F11** and **F12** keys. The results of all analytical functions performed appear in the **Analytical Results** area of the **Data Plot** window. For more information , see Measuring and Entering Analytical Functions on page 6-15.

Side Bar Buttons

Use the following procedure to display the large side bar buttons shown in Table 3-1. These buttons are especially convenient for production environments:

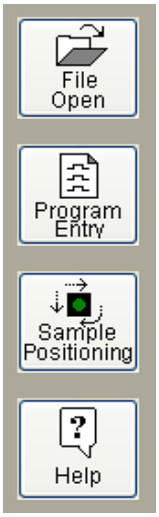
1. Select **Setup > Configuration Settings** and enter the password dektak32. The **Configuration Settings** dialog box appears.
2. In the **User Interface** section, click the **Visual** icon.
3. In the **General** section, select the **Show side bar buttons** check box.

Figure 3-5: Show Side Bar Buttons Check Box



4. Click **OK**.

Table 3-1: Side Bar Buttons

Window(s)	Description	Button
Startup	Open **Automation Program** file. Switch to **Automation Program** window. Switch to **Sample Positioning** window. Launch Dektak **Help** file.	
Sample Positioning and **Data Plot**	Execute the current scan routine. Run the automation program. Abort the current operation. (You must reset the hardware after you do this.)	

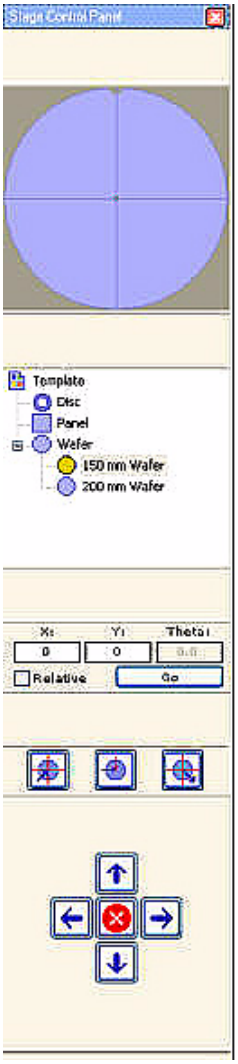
X-Y Auto and Y Auto Stage Control Panel

If your system includes the X-Y auto stage or the Y auto stage, the **Sample Positioning** window contains a **Stage Control Panel (**Figure 3-6**)**, which may be displayed at the right side of the window, or hidden in order to maximize the camera view pane. To display or hide the **Stage Control Panel**, do one of the following:

- Select **Profiler > Stage Control Panel** from the menu bar.
- Click the **Display/Hide Stage Control Window** icon.
- Press **CTRL+T** on the keyboard.

The three sections of the **Stage Control Panel** are explained following the figure.

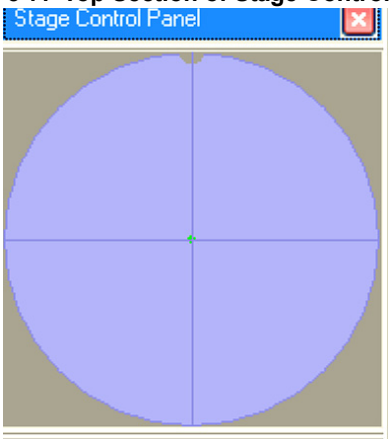
Figure 3-6: Stage Control Panel



Top Section of the Stage Control Panel

The top section of the **Stage Control Panel** (Figure 3-7) contains an illustration of the template you have chosen for your application (see Using the Templates Feature on page 3-13). The crosshairs provide a visual representation of the rotation (theta) of the stage. Any scan sites that you have defined are shown as red dots. The green dot shows the current location of the stylus on the sample.

Figure 3-7: Top Section of Stage Control Panel



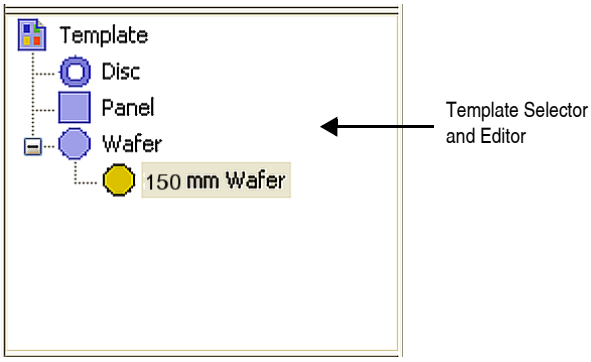
You can move the stage by placing the pointer at the desired location in the illustration of the template in the top section of the **Stage Control Panel** and double-clicking the left mouse button.

NOTE – The illustration of the template is always adjusted to fit in the display area in the top section, regardless of the actual template dimensions.

Center Section of the Stage Control Panel

The center section of the **Stage Control Panel** (Figure 3-8) contains three categories of templates—disc, wafer ,and panel—along with any templates that you have designed. (A 150-mm wafer is already provided.) Right-click in this section to open the **Template Editor** dialog box (see Figure 3-10), where you can modify and save existing templates and create new ones. Each template is saved to the configuration, so when you restart the Dektak 150 system, your template will still be available. For more information, see Working in the Template Editor on page 3-12 and Using the Templates Feature on page 3-13.

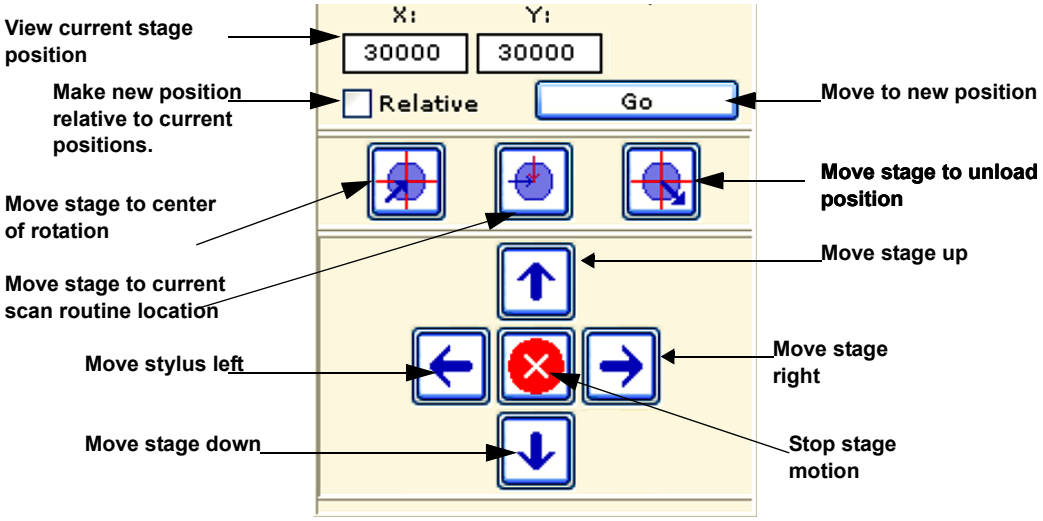
Figure 3-8: Center Section of Stage Control Panel



Bottom Section of the Stage Control Panel

The bottom section of the **Stage Control Panel** contains fields and buttons for monitoring and controlling the positions of the stage and stylus. The stage can be moved in the X and Y directions to place the stylus over any desired location on your sample.

Figure 3-9: Bottom Section of Stage Control Panel



In the bottom section of the **Stage Control Panel**, you can move the stage either by:

- Pressing the control buttons. (Holding down the CTRL key and a button moves the stage at an accelerated speed.)
- Typing new values in the **X** or **Y** fields and pressing **Enter** or clicking the **Go** button.

If you want the updated position to be relative to the current positions, select the **Relative** check box; otherwise, the movement will be to the absolute positions that you specify. The units are in microns.

NOTE – Since the camera is mounted on the X-Y auto stage at the right side of the stylus, the physical motions stage are at right angles to the motions of the image of your sample that you see in the camera view pane (see Table 3-2).

Table 3-2: Stylus Motions and Resulting Image Movement

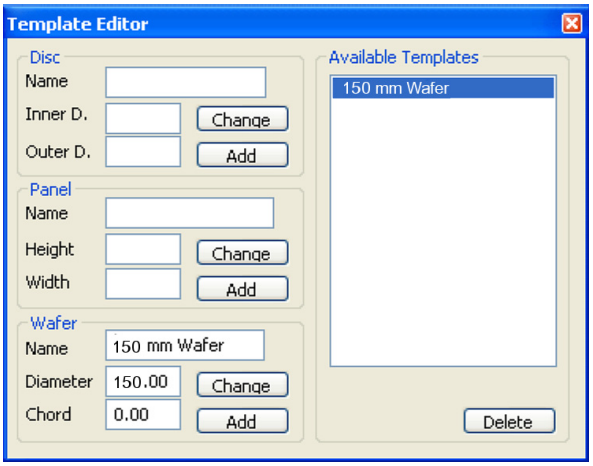
Button	Stylus Moves	Image Moves (for Gross Stylus Movements)
Move Stage Up	To the right	Up
Move Stage Down	To the left	Down
Move Stage Left	To the back	Left
Move Stage Right	Forward	Right

Working in the Template Editor

Right-click in the center section of the **Stage Control Panel** to open the **Template Editor** dialog box. You can use this dialog box to create custom templates for various size discs, wafers, or panels. The selected template serves to restrict access to just the area of the stage that is covered by your sample, as defined by the template.

The standard 150-mm wafer template gives access to any location on the sample stage. This is useful for efficiently navigating on smaller wafers.

Figure 3-10: Template Editor Dialog Box



To change an existing template:

1. Right-click in the center section of the **Stage Control Panel** and then click **Edit** to open the **Template Editor** dialog box.

> **NOTE –** Alternatively, double-click the name of the template you want to change.

2. Be sure the template you want to change is displayed in the fields at the left side of the dialog box. If not, click the name of the desired template in the **Available Templates** section.
3. Make your changes to the parameters of the selected template and click **Change**.
4. Click the close box at the upper right corner of the dialog box (or press the E**sc** key on the keyboard).

> **NOTE –** You cannot use the **Change** button if you change the name of a template. Use the **Add** button instead. Then select the previous name of the template in the **Available Templates** section and click **Delete**.

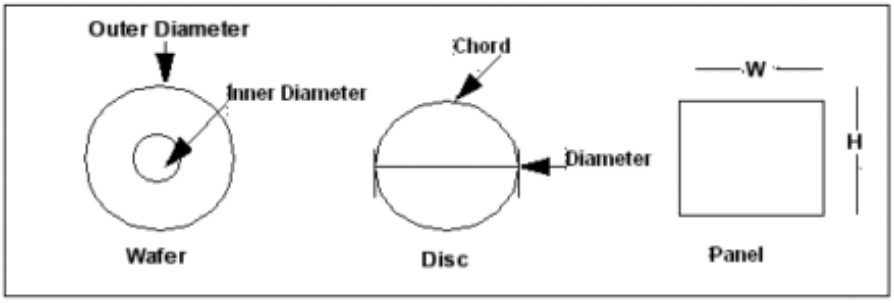
To create a new template:

1. Right-click in the center section of the **Stage Control Panel** to open the **Template Editor** dialog box.
2. Type a name for your new template in the appropriate field (**Disc**, **Panel** or **Wafer**).
3. Enter the parameters for your new template that correspond to your sample, and click **Add**.
4. Click the close box at the upper right corner of the dialog box or press the E**sc** key on the keyboard.

Using the Templates Feature

Choose the appropriate template from the center section of the **Stage Control Panel**. The 200-mm wafer template is the default template and can be used to determine the outer diameter of the sample stage table. You can use the **Template Editor** dialog box (see Figure 3-10) to create custom templates for various size wafers, discs or panels. The three types of templates appear in the figure that follows.

Figure 3-11: The Three Types of Templates



Template Selection

To select the desired template for your sample:

1. If the **Stage Control Panel** is not displayed in the **Sample Positioning** window, press **CTRL+T** or click the **Display/Hide Stage Control Window** icon.
2. Click the name of the desired template in the **Template Selection** section of the **Stage Control Panel**. (Double-click the name of a template type to display templates stored under that type.)
3. The selected template appears in the **Template** section of the **Stage Control Panel**.

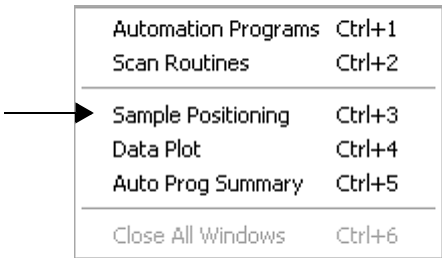
SAMPLE LOADING AND UNLOADING

The Dektak 150 automatically positions the stage to home (0.0).

To load a sample:

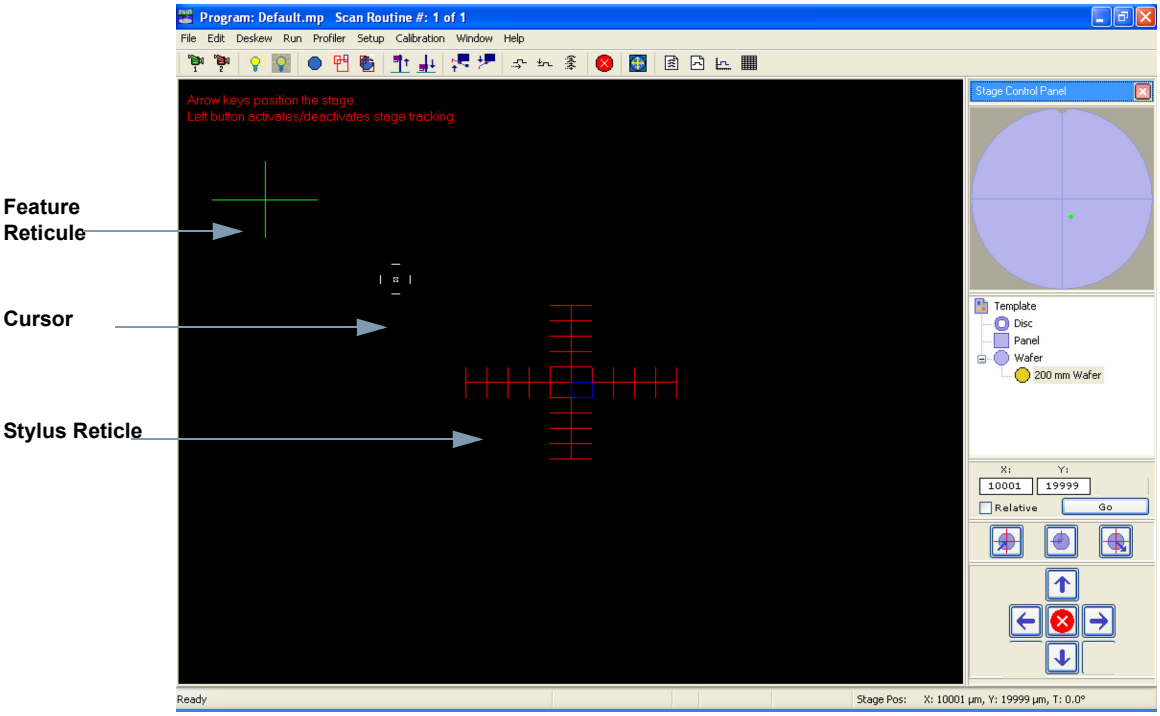
1. Verify that the tower is raised.
2. Open the door to the enclosure.
3. Select **Window > Sample Positioning** from the system menu bar or click the **Sample Positioning Window** icon  to display the **Sample Positioning** window (see Figure 3-13).

Figure 3-12: Window Menu, Sample Positioning



4 In the **Sample Positioning** window, verify that the **Stage Control Panel** is displayed. If not, select **Profiler** > **Stage Control Panel** from the system menu bar (or press **CTRL+T** on the keyboard).

Figure 3-13: Sample Positioning Window with Stage Control Panel



5 In the **Stage Control Panel**, select the **Tower Up** button.

ATTENTION: Raise the tower prior to loading samples to protect the stylus and the sample from damage.

ATTENTION: Remonter la tour avant d'installer les échantillons pour protéger le stylet et l'échantillon.

ATTENTION: Vor dem Auflegen einer Probe sollte die Abtastspitze nach oben gefahren werden, um Abtastspitze und Probe vor einer möglichen Beschädigung zu schützen.

6 Position the sample in the center of the stage below the stylus.

> **IMPORTANT!** if you are using the vertical standard that came with your system, position it according to the instructions in the next section.

7 If the Z-axis limit switch has been modified, you may need to adjust it. The Dektak 150 has four inches of clearance.

Positioning the Vertical Standard

You must position the vertical standard so that the scan travels over the hill, down into the calibration groove, and then back again, as shown in Figure 3-14. The scan must be at least 2500 µm long. When the vertical standard is correctly positioned on the stage, it appears as it does in Figure 3-15.

Figure 3-14: Vertical Standard Positioned for Scan

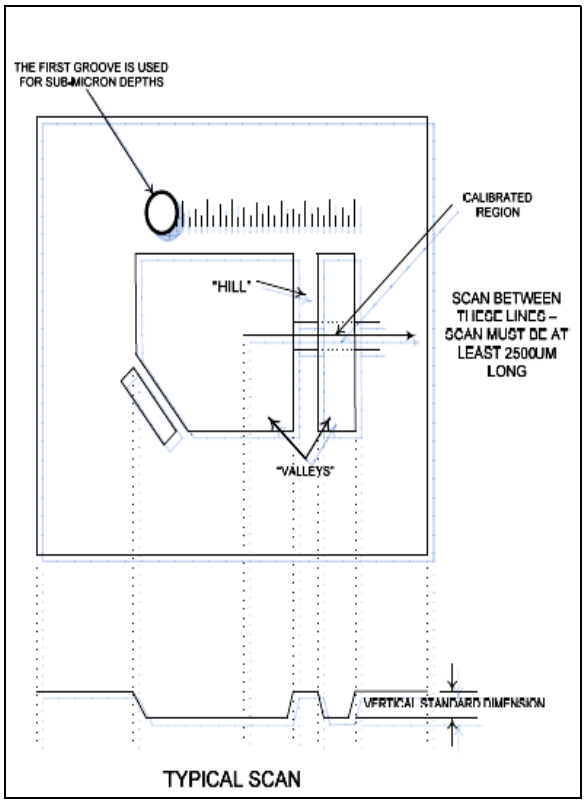
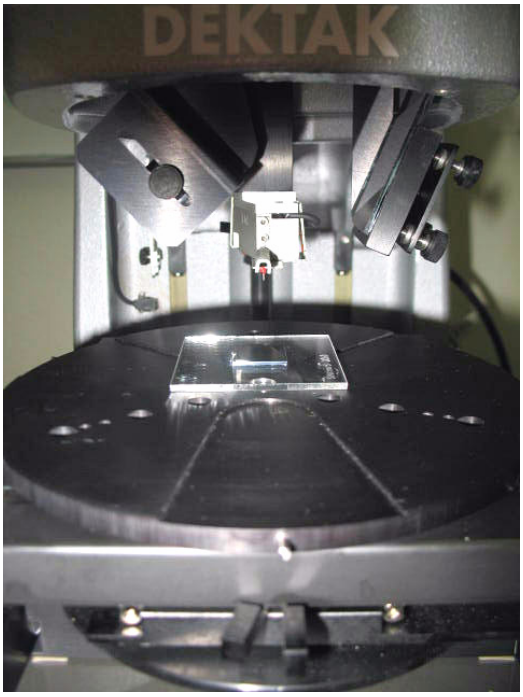


Figure 3-15: Vertical Standard Correctly Positioned on the Stage



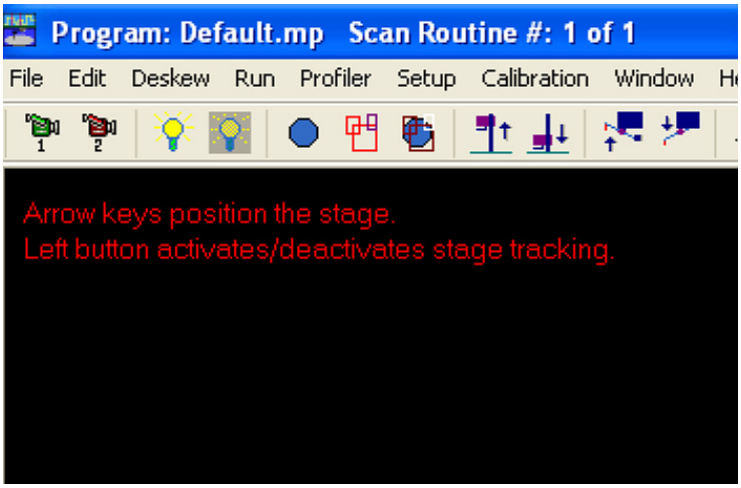
STAGE TRACKING

To use stage tracking to obtain fine stage movements:

1. Move the mouse pointer into the camera view pane (see Figure 3-16).
2. Left-click the mouse button once to activate Stage Tracking. You can now:
   - Watch the stage track the motion of the mouse along the X and Y axes.
   - Fine-position the stage with the arrow keys on the keyboard. (Hold down the CTRL key for faster motion.)
     - The left arrow key moves the stage to the left.
     - The right arrow key moves the stage to the right.
     - The up arrow key moves the stage to the front.
     - The down arrow moves the stage to the rear.
   - Adjust the illumination on the sample.
     - Press the Up arrow on the keyboard (or keypad) to increase illumination.
     - Press the Down arrow on the keyboard (or keypad) to decrease illumination.
3. Align the stylus with the sample measurement site.
4. Left-click again to deactivate Stage Tracking.

NOTE – The stylus automatically rises from the sample surface when Stage Tracking is on.

Figure 3-16: Camera View Pane (Partial View)



5 Select **Profiler** > **Tower Down** to lower the optical assembly toward the sample.

> **NOTE –** When using a 200-mm template, you have access to an entire 8-inch wafer. However, the Z-axis limit switch should keep the stylus from touching down directly onto the stage (unless you have moved the switch).

VIEWING THE SAMPLE

Once the sample is loaded, you can make a few adjustments for optimal viewing.

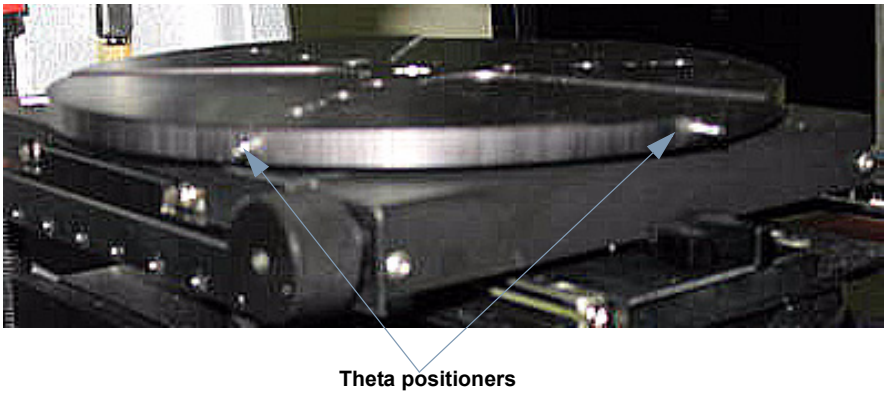
Manual Theta Rotation

You can alter positioning manually by rotating the stage to obtain a better view of the sample.

1 Ensure the stylus is not touching the sample surface. Select **Profiler** > **Stylus Up** or click the **Stylus Up**  icon to protect the sample and stylus from damage.

2 Use the theta positioners along the circumference to rotate the stage in the desired direction.

Figure 3-17: Theta Positioners



NOTE – Prior to making a scan measurement, you may need to level the stage according to the procedures in Manual Stage Leveling on page 4-12 of Chapter 4

LOWERING/RAISING THE STYLUS

Lowering the stylus onto the sample surface nulls the stylus LVDT and brings the sample into focus. When the stylus is lowered, it should make contact with the surface at the center of the reticule for easy sample positioning.

1 Raise or lower the stylus using the toolbar icons (see Figure 3-18) or the **Profiler** menu. Click **Profiler** > **Stylus Up** or **Profiler** > **Stylus Down** (see Figure 3-19).

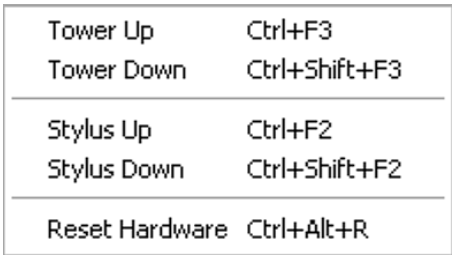
NOTE – The **Tower Up** and **Tower Down** commands raise or lower the entire tower assembly, which includes the USB camera, illuminator and stylus mechanism. The **Stylus Up** command lifts the stylus only. The **Stylus Down** command slightly raises and then lowers the entire tower assembly until the stylus touches the sample surface.

Figure 3-18: Stylus Movement Icons


Stylus Down


Stylus Up

Figure 3-19: Profiler Menu



OPTICS ILLUMINATION ADJUSTMENT

After lowering the optics tower to focus the camera, adjust the illumination level of the video image displayed on the Dektak 150 monitor using the toolbar icons (see Dektak Database Window on page 8-27), or the Up and Down arrow keys on the keyboard.

You can change the increment by which the illumination changes at each click. See **Illumination Folder** in Setup Menu on page 8-7.

The sample should be in focus whenever the system is nulled by lowering the stylus onto the sample surface. If not, see Adjusting the Optics on page 9-17.

STYLUS RETICLE ALIGNMENT

NOTE – If the stylus is on the surface and is not close to the center of the field of view, then first try adjusting the optics (a much easier procedure) before attempting to adjust the reticule. To adjust the camera position, see Adjusting the Optics on page 9-17.

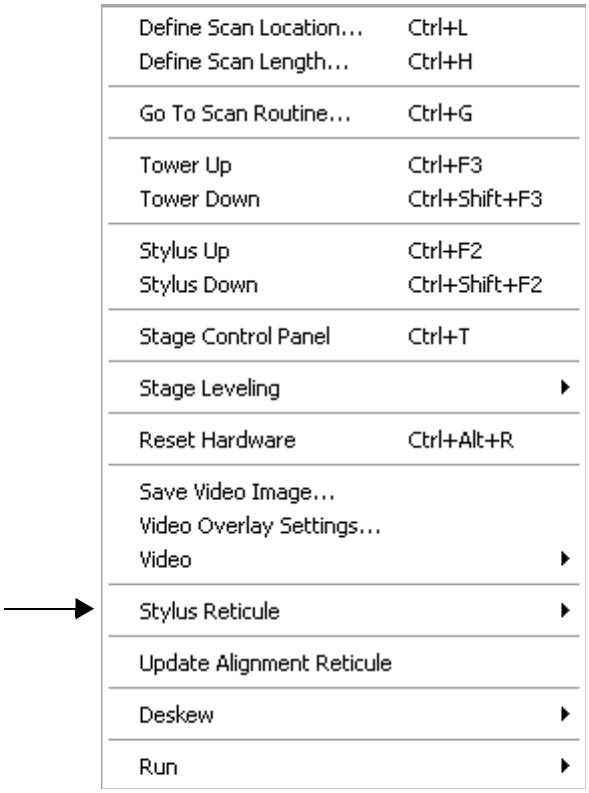
The stylus reticle can be aligned to a newly installed stylus, or to allow for tolerances in the stylus head. If the stylus tip is not properly aligned with the reticle in the camera view pane, adjust the reticle position. The reticle provides a reference point when positioning the sample stage. Because the stylus is raised off the surface during stage positioning, the reticle indicates where the stylus will touch on the surface.

NOTE – During initial set up, you may need to adjust the camera position to move the stylus within the stylus crosshair box. To adjust the camera position, see Adjusting the Optics on page 9-17.

Complete the following steps to align the reticle with the stylus tip.

1 In the **Sample Positioning** window, right-click the mouse button to display the pop-up menu (see Figure 3-20).

Figure 3-20: Sample Positioning Window Pop-up Menu



2 In the pop-up menu, click **Stylus Reticule** to display two options: **Align** and **Reset**.

- **Align** allows you to manually reposition the reticle.
- **Reset** repositions the reticule to the original default location in the center of the screen.

3 Select **Align** to display the crosshair box (Figure 3-21). The stylus touches down on the surface, ready for alignment.

4 Align the crosshair with the stylus tip (Figure 3-22), and then double-click the left mouse button.

5 In the dialog box that appears, click **Yes** to update the stylus reticule location, **No** to retry the alignment, or **Cancel** to close the dialog box and return to the **Sample Positioning** window.

Figure 3-21: Stylus Reticle Alignment

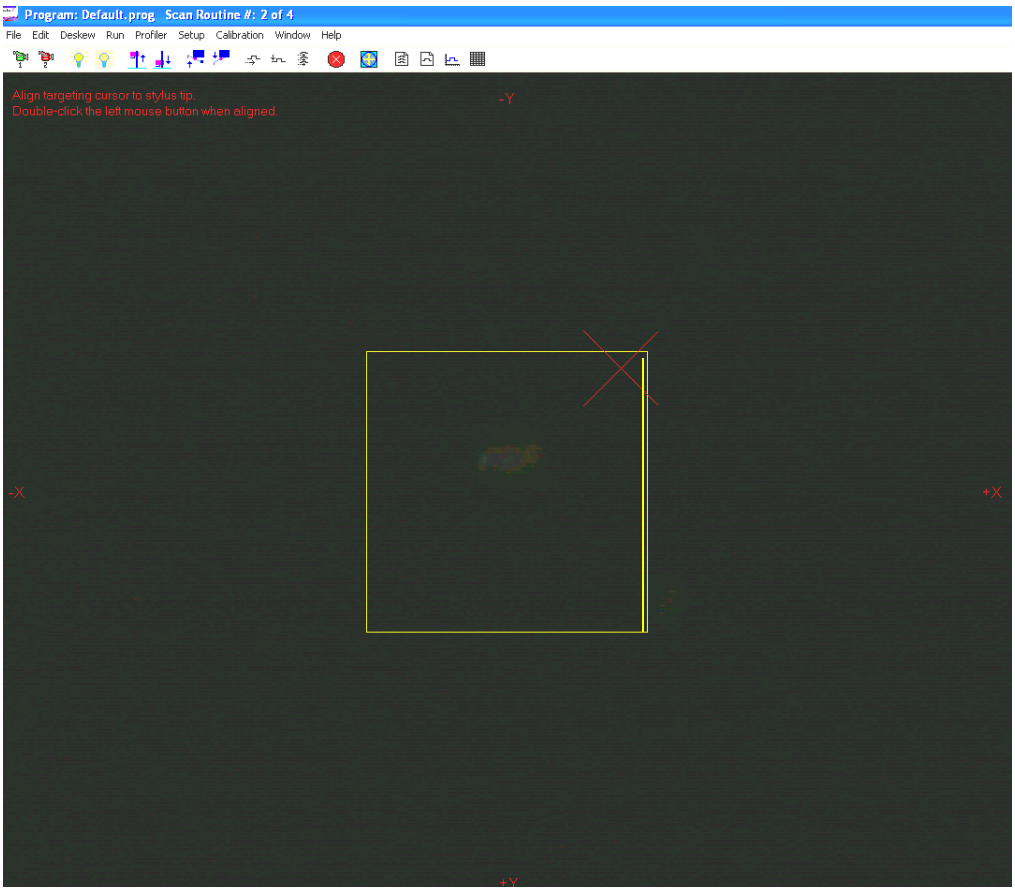
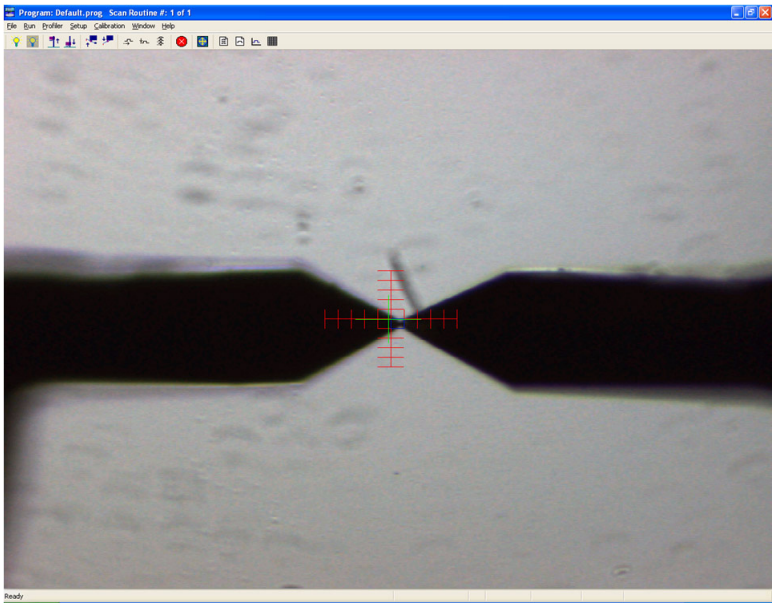


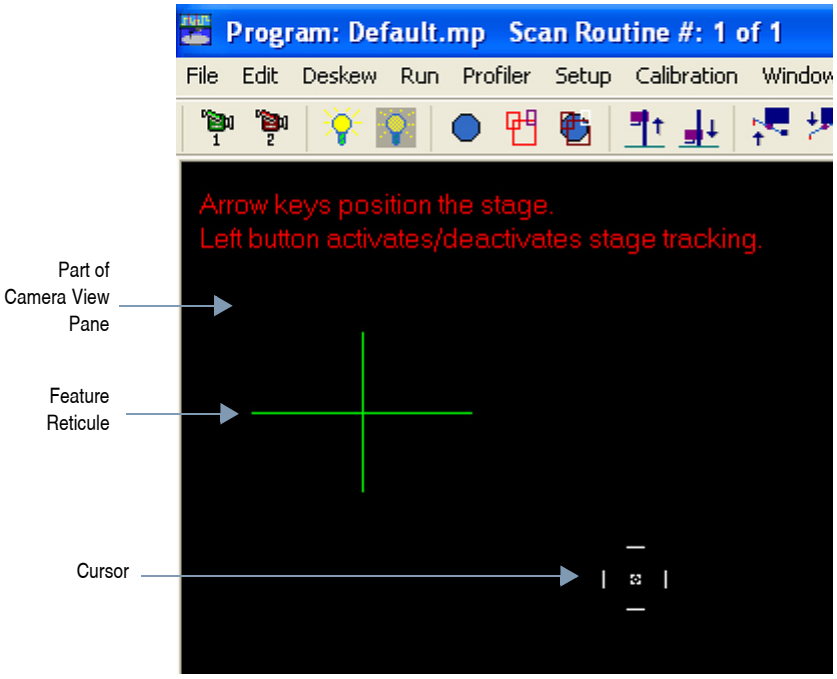
Figure 3-22: Stylus Tip Aligned with Crosshair



FEATURE RETICLE ALIGNMENT

The feature reticle is the smaller green reticle displayed in the camera view pane of the **Sample Positioning** window.

Figure 3-23: Feature Reticle Alignment



Align the feature reticle with surface features to more accurately position the sample prior to scanning.

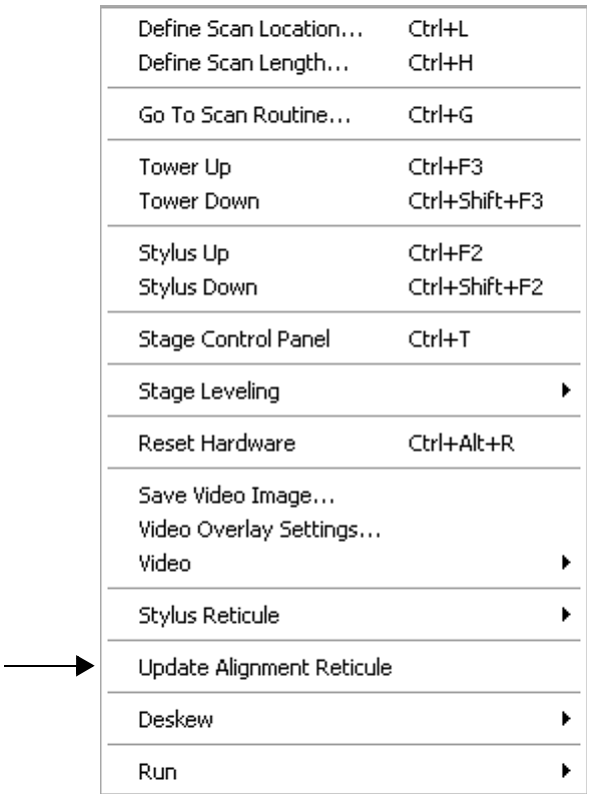
Complete the following procedure to realign the feature reticle:

1. Touch down to bring the optics into focus.
2. In the camera view pane, move the mouse pointer to the desired location.

> **NOTE –** For best results, align the feature reticle with a unique, easily recognizable surface feature.

3. Once the cursor is properly aligned with the desired feature, click the right mouse button.
4. Click **Update Alignment Reticule** in the pop-up menu that appears.

Figure 3-24: Update Alignment Reticule



5 Click **Yes** in the **Confirmation** pop-up box to update the feature reticule alignment. The feature reticule moves to the new location.

POWERING DOWN

To power down the Dektak 150 system:

1 Select **File** > **Exit** from the Dektak menu bar to exit the Dektak software.

2 Select **Start** > **Shut Down** from the Windows XP **Start** menu, and then click **Shut Down** in the dialog box that appears. This exits Windows XP.

3 Turn off the power by pressing the black button on the EMO box.

4 Turn off the computer.

5 Turn off the power switches on the optional printer and the monitor.

■ ■ ■

4

SINGLE SCAN OPERATION

This chapter provides step-by-step exercises for programming and running a single-scan routine. It continues the exercises begun in Chapter 3 of this manual.

NOTE – If you have not already done so, you may want to familiarize yourself with the Dektak 150 user interface by reading Chapter 3 and Chapter 8.

LOADING THE SAMPLE

Before you begin the exercises in this chapter, you must:

- Procure an appropriate sample for measurement. If you want to use the vertical standard that came with your system, remove it from its case according to the instructions in Adjusting the Optics on page 2-23.
- Load the vertical standard or another sample on the stage according to the instructions in Sample Loading and Unloading on page 3-13.

MAKING YOUR CONFIGURATION SETTINGS

This section tells you how to change your configuration settings prior to a scan.

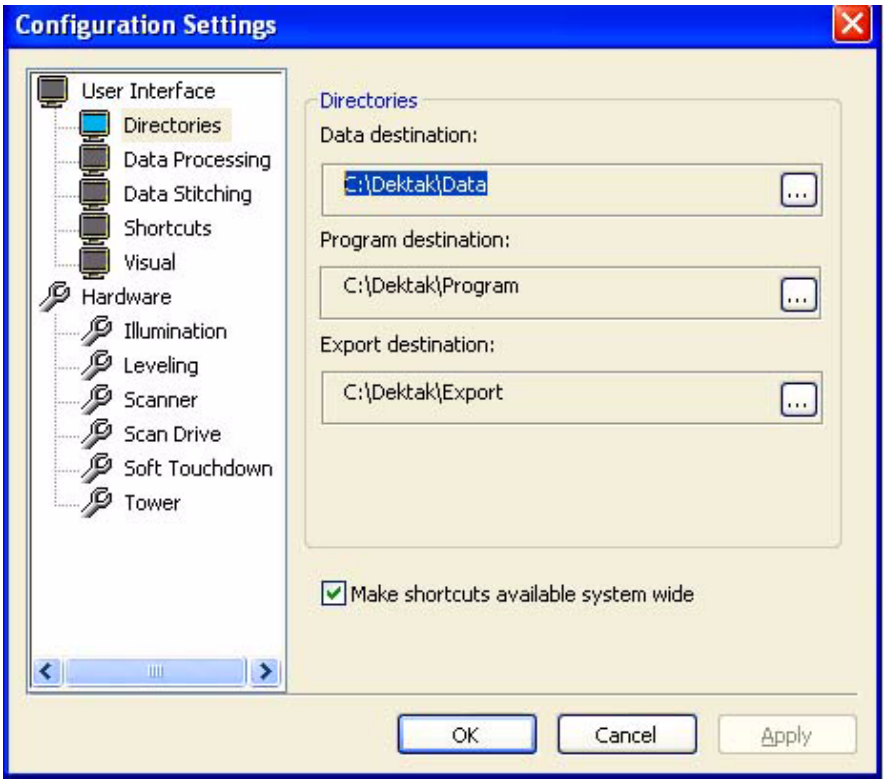
NOTE – For a full explanation of all Dektak configuration settings, see Setup Menu on page 8-7.

To change the configuration settings prior to a scan:

1 On the **Setup** menu, click **Configuration Settings** and enter the password `Dektak32` in the dialog box. The **Configuration Settings** dialog box appears.

2 Click the icons in the **User Interface** section (Figure 4-1) to make settings that affect the Dektak program's user interface. For example, click **Directories** to specify the locations in which you want to store your data, programs, exported files, and 3D maps (Figure 4-1).

Figure 4-1: Directories Section of Configuration Settings Dialog Box



NOTE – With the exception of the **Illumination** and the optional **Soft Touchdown** settings, the settings available from the icons in the **Hardware** section of the **Configuration Settings** window should *not* be changed by the user. For help, contact Veeco Technical Support.

CREATING A SINGLE-SCAN AUTOMATION PROGRAM

Prior to running a scan routine, you must first create an automation program. Automation programs are files that contain all the necessary information for performing single- or multiple-scan routine sequences.

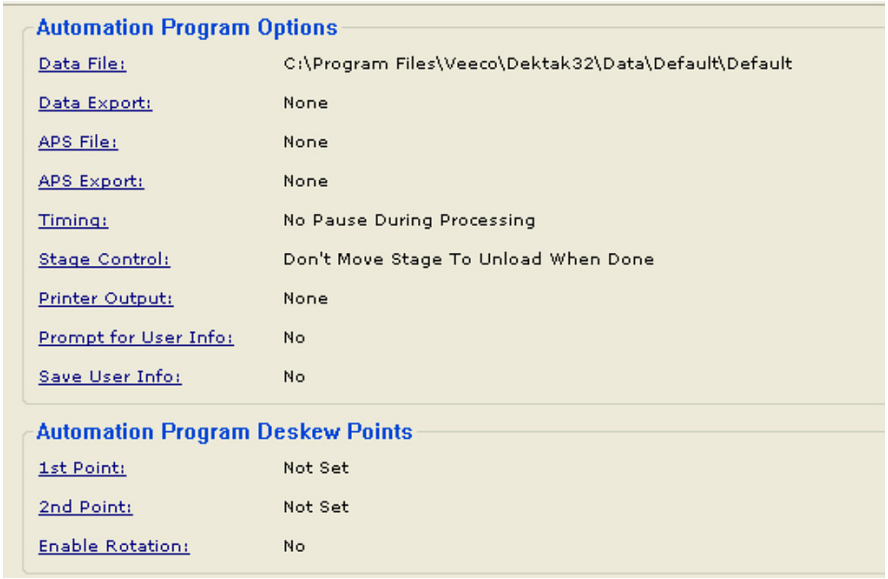
1 In the **Startup** window, select **File > New** from the system menu bar or click the **Create New Automation Program** icon  to display the **Automation Programs** window containing the default automation program (**default.mp**). See Figure 4-2.

2 If you are currently in an automation program that has had changes made to it, a dialog box asks if you want to save your changes to the current automation program. Click **Yes** to save the current automation program.

> **NOTE –** Be aware that if the current automation program was previously loaded and then modified, it will be saved under its original file name. If you want to preserve the original automation program, first select **File > Save As...** on the menu bar and enter a new file name for the modified program. Then select **File > New**.

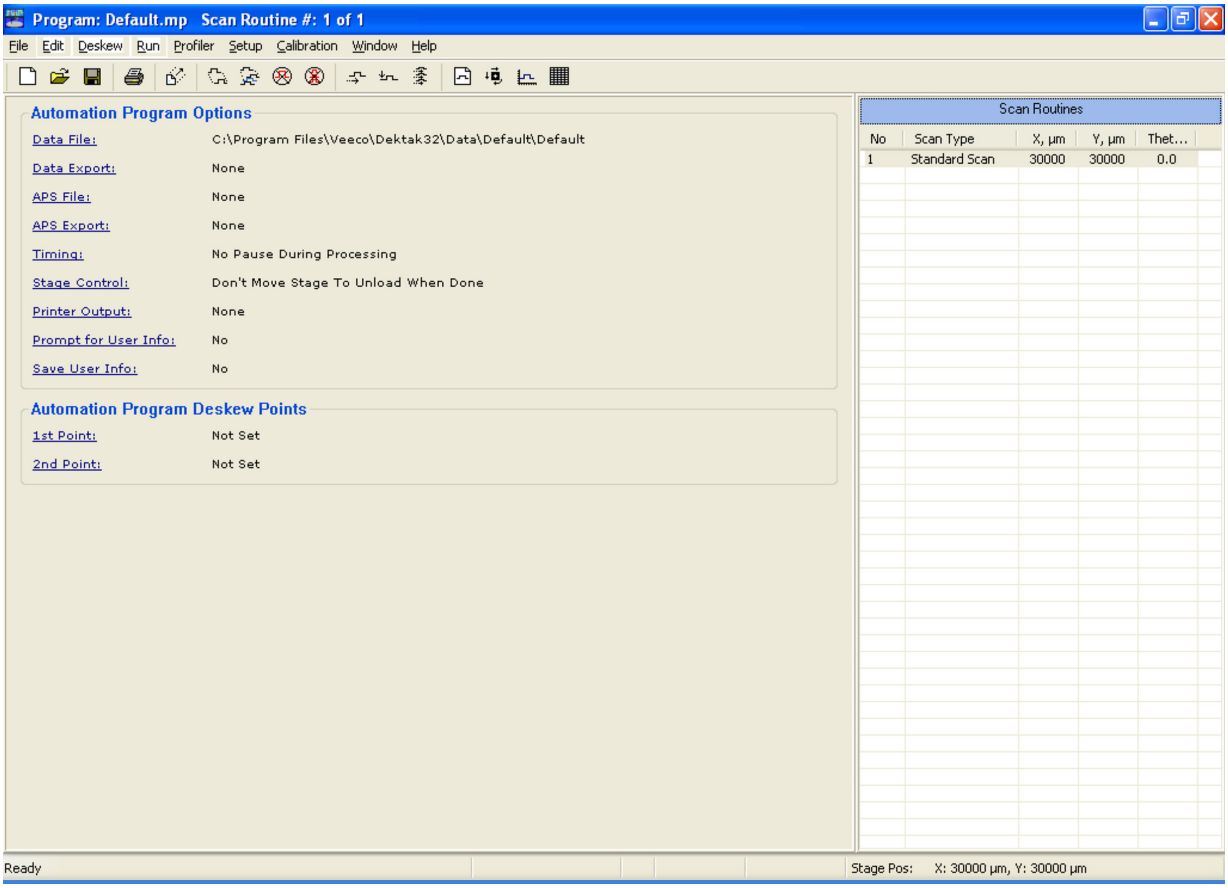
> **NOTE –** If you select **Window** > **Automation Programs** from the system menu bar, the current automation program opens (if there is one); otherwise, the default automation program opens.

Figure 4-2: New Automation Program



The **Automation Program** window contains a default scan routine. You can double-click the highlighted scan routine (or select **Window > Scan Routines** from the system menu bar; or click the **Switch to Scan Routines Window** icon) to display the parameters for the scan routine in the **Scan Routines** window.

Figure 4-3: Scan Routines Window with Default Scan Routine



You can edit the options for this automation program and add or modify scan routine parameters (see Chapter 7).

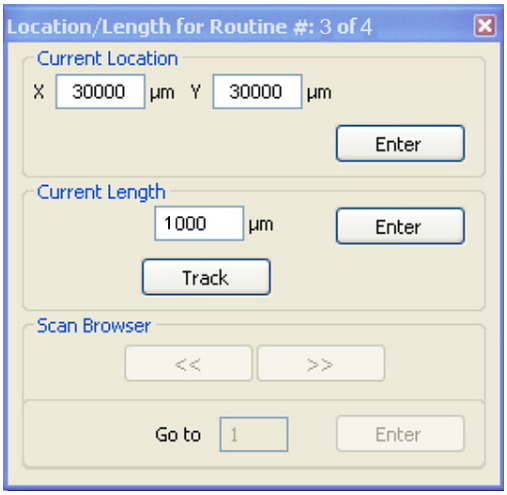
Save the automation program according to the instructions in Saving an Automation Program on page 4-20.

Defining Scan Location and Length

This procedure entails determining the appropriate scan starting location and length for measuring the sample.

1. Select **Window** > **Sample Positioning** from the menu to display the **Sample Positioning** window.
2. Select **Profiler** > **Tower Down**.
3. Use the **Illumination Adjustment** icons to adjust the illumination to view the sample.
4. With the stylus tower down, initiate Stage Tracking (left-click in the camera view pane) for fine sample positioning. The image should now track the motion of the mouse.
5. With the stylus reticle properly positioned on the sample, click the mouse button a second time to deactivate Stage Tracking. This is your starting point.
6. Select **Edit** > **Define Scan Location/Length**. The **Location/Length for Routine #: 1 of 1** dialog box appears (see Figure 4-4). The **X**, **Y**, and **T** fields display the current X-Y stage position.

Figure 4-4: Scan Location/Length Dialog Box



7 Click the **Enter** button in the **Current Location** section to assign the coordinates to the scan routine.

8 Initiate Stage Tracking (left-click in the camera view pane), and roll the mouse until the stylus reticle is at the end of the scan. Note that this time Stage Tracking tracks only the left and right motion of the mouse to allow you to determine the distance you want to scan.

9 Roll the mouse until the stylus reticle is at the end of the desired scan, and then click the left mouse button to deactivate Stage Tracking. The **Current Length** section of the **Location/Length for Routine #: 1 of 4** dialog box now shows the length of the scan that you just determined with Stage Tracking.

10 For the purposes of this exercise, click the **Enter** button in the **Length** section to assign the length determined with Stage Tracking to this scan routine. Note that it is also possible to edit the value with the keyboard.

11 In the **Current Length** field (which shows the length that you determined with Stage Tracking), change the length to **1000 µm.** Click **Enter** to assign the new length value to the scan routine.

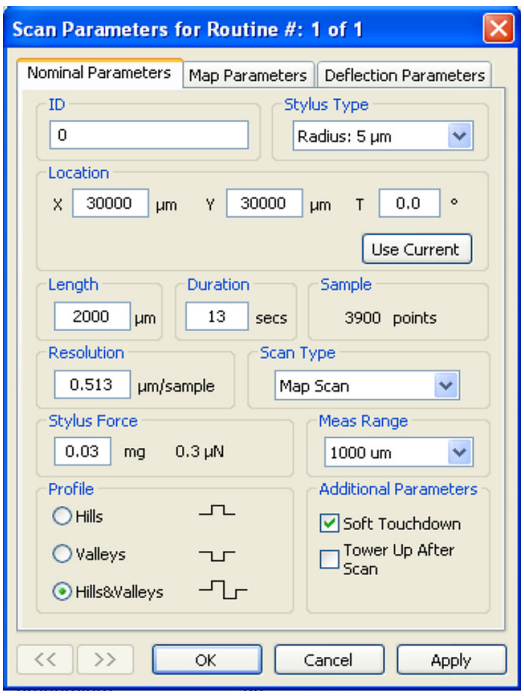
> **NOTE –** A scan is always performed by moving the stage toward the front of the instrument. During the scan, the sample image appears to be moving from right to left, while the scan itself appears to be moving from left to right.

12 Click the close box at the upper right corner to close the dialog box.

13 Select **Window > Scan Routines** from the system menu bar or click the **Switch to Scan Routines Window** icon to display the **Scan Routines** window (see Figure 4-3).

14 Click any of the underlined items in the **Scan Parameters** section of the window to open the **Scan Parameters** dialog box.

Figure 4-5: Scan Parameters Dialog Box



15 If desired, adjust the scan parameters in the dialog box, such as scan **ID**, **Duration**, horizontal **Resolution**, **Stylus Force**, **Measurement Range, Soft Touchdown** (optional) and **Tower Up After Scan**. For more information, see Chapter 7, Scan Routine Parameters.

16 Click **Apply** and then click **OK** to accept your entries and close the dialog box.

> **NOTE –** If you want to make other changes, you can click **Apply** only to accept an entry and keep the **Scan Parameters** dialog box open.

RUNNING A SCAN ROUTINE

To run a scan routine, click the **Run Currently Active Scan Routine** icon  . Alternatively, press the **F4** key or select **Run** > **Scan** from the menu to run a scan routine.

The following sequence of events occurs after you initiate a scan:

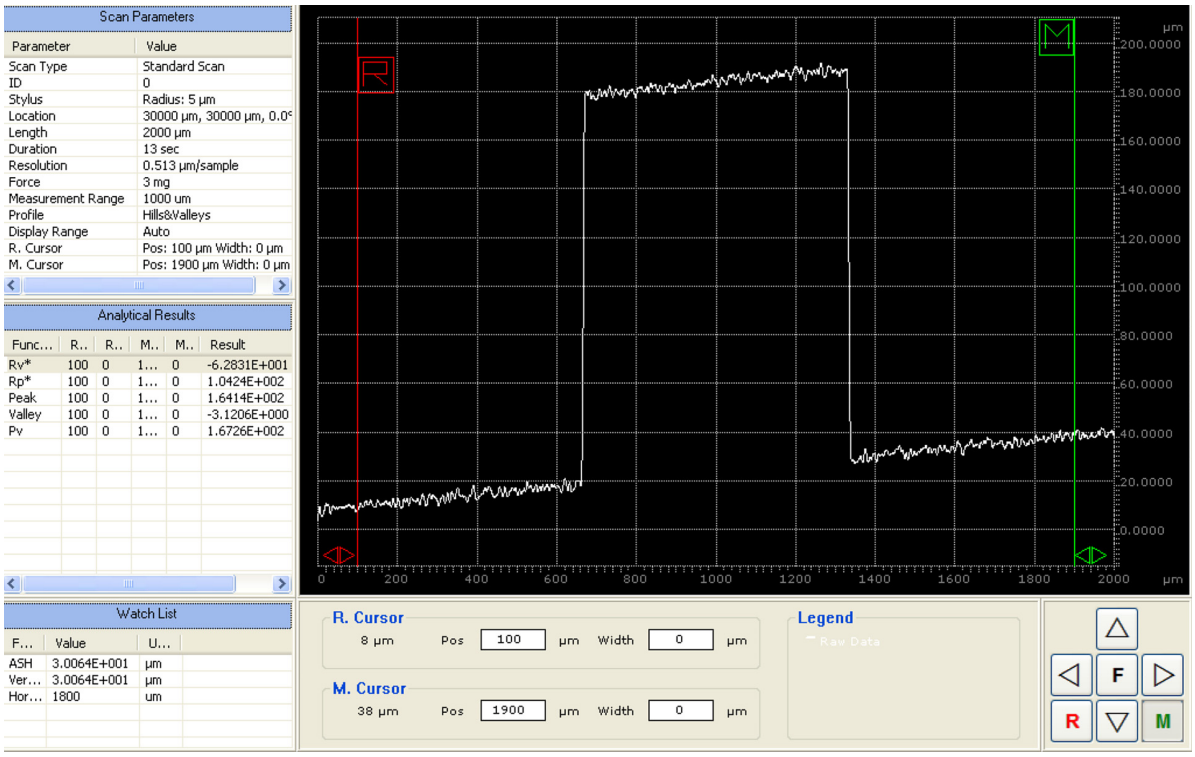
- The **Data Plot** window appears with the scaled grid superimposed over the camera view pane of the stylus and calibration standard.
- The stylus lowers onto the sample surface. After a brief pause, the scan commences. As the stylus scans across the sample, the full scale profile trace plots on the scaled grid in real time.

NOTE – Because the camera is mounted at the right side of the stylus, during a scan the video image shows the sample moving from right to left below the stylus. In actuality, during a scan the stage is moving from back to front.

- After the scan is complete, the stylus lifts off the surface, and the stage returns to the location where the scan originated. The profiler then automatically replots and rescales. The image displayed on the monitor should resemble Figure 4-6, which includes the following elements in addition to scan profile and reference/measurement cursor functions:
  - List of user-set scan parameters
  - List of analytical results (if any analytical functions were selected for this scan)
  - A Watch List, which provides real-time monitoring of ASH (delta average step height), horizontal distance, and vertical distance.

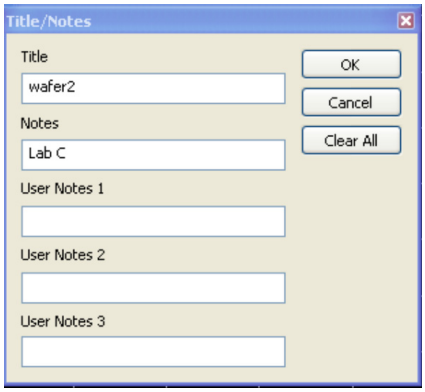
NOTE – On all grids in the **Data Plot** window, you can move a column margin by double-clicking and dragging the compass-shaped cursor to the desired position. Double-click, and the system auto-sizes the column.

Figure 4-6: Data Plot Window after Scan Completion



NOTE – You can add user notes to the scan parameters, which are listed to the left of the plot. To do this, right-click a parameter, click **Edit User Information**, make your notes in the **Title/Notes** box, and then click **OK**.

Figure 4-7: Title/Notes Dialog Box



CHANGING UNITS BEFORE OR AFTER A SCAN

You can specify different units before or after a scan. After you have done this, the data plot, scan parameters, measurement parameters, ranges, and analytical function calculations all appear in the new units that you have specified.

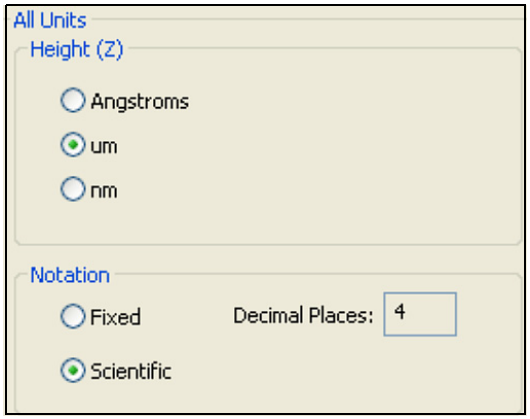
You can toggle the type of notation between **Fixed** and **Scientific**. The system automatically determines the number of decimal places as follows:

- **Angstroms** - no decimal places
- **Microns** - four decimal places
- **Nanometers** - one decimal place

To change units before or after a scan:

1. On the **Setup** menu, select **Configuration Settings**. In the **Password** field, type `Dektak32` and click **Enter**. The **Configuration Settings** window appears (see Figure 4-1).
2. Under **User Interface**, click **Units**. The **All Units** dialog box appears.

Figure 4-8: All Units Dialog Box



3 Make your changes to the **Height (Z)** and **Notation** settings.

4 Click **Apply**, and then click **OK**.

REFERENCE/MEASUREMENT CURSORS

The reference (**R**) cursor and measurement (**M**) cursor define the portion of the profile trace for leveling or performing analytical functions. You can adjust the bandwidth at each cursor to average the data points within the cursor's bandwidth. This is useful for leveling and average step height measurements.

NOTE – Veeco recommends that you do *not* use zero (0) bandwidths unless you want point-to-point measurements. Such measurements can vary substantially from the averaged results that you get with non-zero bandwidths.

BASIC CURSOR POSITIONING

Cursor positioning is critical for obtaining accurate results. The simplest way to reposition the cursors is to use the mouse to drag the **R** and **M** cursor flags at the top of the cursors to new positions in the data plot.

Selecting both **R** and **M** cursors allows you to reposition the cursors while maintaining the same distance between them. Hold down the **CTRL** key while dragging with the left mouse button on the **R** or **M** cursor flag. Now dragging either flag causes both cursors to move simultaneously.

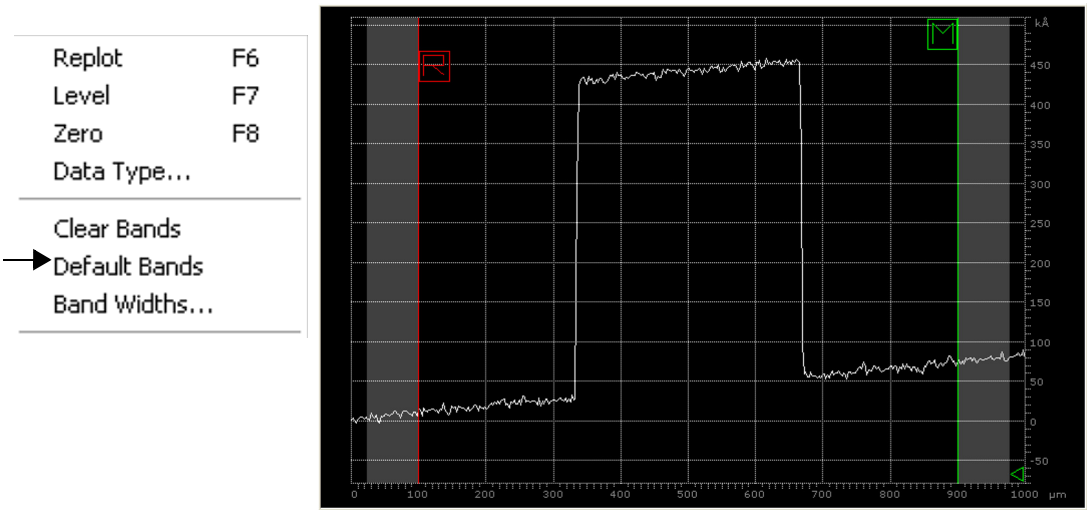
Refer to the following sections for alternate procedures to position the cursors and increase/decrease cursor bandwidth:

- Cursor Positioning with Arrows on page 4-11
- Numeric Entry Cursor Positioning on page 4-12

For this exercise, use the default cursor band widths for leveling and measuring. To activate the default cursor bands select **Plot** > **Default Bands** from the menu bar (see Figure 4-9).

NOTE – To clear the cursor bandwidths, select **Plot** > **Clear Bands**

Figure 4-9: Setting Default Cursor Band Widths



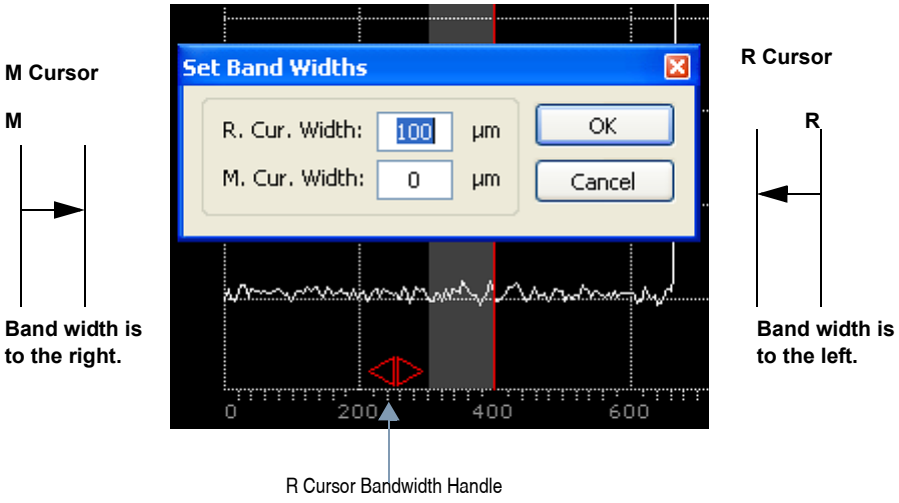
SETTING CURSOR BANDWIDTHS

The simplest way to change the bandwidth of the cursors is to use the mouse to drag the **double-triangle handles** at the bottom of the cursors to new widths in the data plot (see Figure 4-10).

NOTE – When the cursors are near the edges of the plot, the handles might not be visible.

To specify numerical values for the bandwidths, select **Plot** > **Band Widths...** from the menu bar (see Figure 4-10). Enter the desired values for the R and M cursor widths in the **Set Band Widths** dialog box and then click **OK**. Alternatively, you can change the bandwidth values as explained in Numeric Entry Cursor Positioning on page 4-12**.**

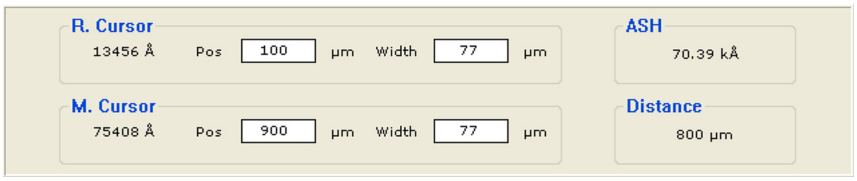
Figure 4-10: Setting Cursor Band Widths: Handle and Dialog Box



Cursor Positioning with Arrows

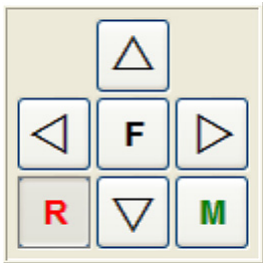
The **R. Cursor** and **M. Cursor** sections in the **Data Plot** box at the bottom center of the window indicate the locations of the cursors and their bandwidths (see Figure 4-11). The Å numbers in the box indicate the points at which the cursors intercept the profile trace in relation to the vertical scale.

Figure 4-11: Data Plot Box



Special cursor-control arrow buttons at the bottom-right of the **Data Plot** display allow you to work with the cursors (see Figure 4-12). You can position the cursors by selecting a cursor, and then clicking and holding the left and right arrow buttons. Similarly, you can increase or decrease the selected cursor's bandwidth by clicking the up and down arrow buttons.

Figure 4-12: Cursor-Control Arrows



NOTE – You can also use the arrow keys on the keyboard to position the selected cursor and change its bandwidth. Hold down the **CTRL** key while you press the arrow keys to increase speed.

1. Click the red **R** button (or press **CTRL+R**) to select the reference cursor.
2. Click the green **M** button (or press **CTRL+M**) to select the measurement cursor.
3. Press the **F** button (or press **CTRL+**F) to move the cursors or change their bandwidths at high speed. Press the **F** button (or press **CTRL+**F) again to move the cursors or change their bandwidths at slow speed.

NOTE – After you have selected a cursor with the right or left cursor-control arrow, you can double-click in the data plot pane to snap the selected cursor to the horizontal location of the mouse pointer.

Numeric Entry Cursor Positioning

The white boxes in the **Data Plot** box display the cursor position (**Pos**) in relation to the horizontal scale, and their bandwidths (**Width**) (see Figure 4-10). Another way to alter cursor locations and bandwidths is by using the keyboard to numerically enter new values in these boxes.

NOTE – For this exercise, the location of the **R** cursor should be set at **100 µm** with the **M** cursor at **900 µm**.

1. Click in the upper white box indicating the **R** cursor horizontal **Pos**ition. A blinking prompt appears in the box.
2. Enter **100** using the keyboard and press **ENTER**. The **R** cursor repositions at 100 µm.
3. Click in the lower white box indicating the **M** cursor horizontal **Pos**ition. A blinking prompt appears in the box.
4. Enter **900** and press **ENTER**. The **M** cursor repositions at 900 µm.

The **ASH** section displays the vertical difference between the points at which the R and M cursors intercept the profile trace. The **Distance** section below it displays the horizontal distance between the cursors.

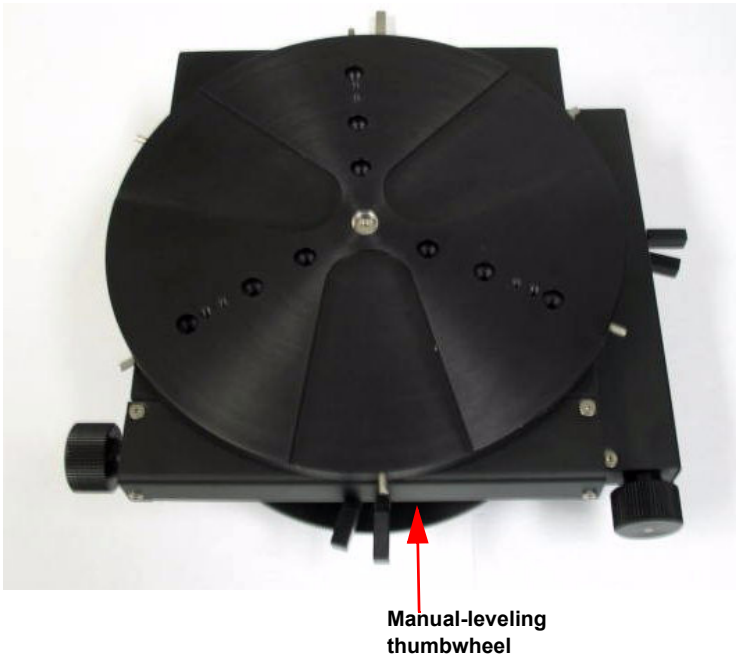
MANUAL STAGE LEVELING

All configurations of the Dektak 150 allow you to manually level the stage by turning the leveling thumbwheel below the it (see Figure 4-13). The closest possible manual leveling ensures the best instrument performance. The manual leveling thumbwheel levels the stage about a pivot axis at the front of the stage.

Leveling the stage must be accomplished using a sample that has a known horizontal surface. The Dektak 150 system is adjusted to measure the horizontal surface as a level surface. This allows for

sample surfaces that are not parallel to the reference surface block to be leveled using the procedure described after Figure 4-13.

Figure 4-13: Manual-Leveling Thumbwheel



1. Perform stage leveling while a scan is in progress to view the affect of leveling on the profile trace in real time. To run a new scan, click **Run** > **Scan**.
2. As the stage is moving and a trace is being generated on the screen, turn the leveling thumbwheel until the profile trace is tracking in a horizontal line. Clockwise rotation raises the trace and counter-clockwise lowers the trace profile.
3. Again click **Run > Scan**. The profile must appear totally within the graphic boundaries to achieve the minimum acceptable manual leveling. If not, repeat the manual leveling procedure above.

> **NOTE –** For maximum performance of the Dektak 150, it is important to position the sample surface to within +/- 0.01º of level. Use the formula **tan-1 (slope of leveled trace)** to determine the level accuracy.

To verify that the maximum possible level has been obtained, place the cursors to intersect the same horizontal plane.

The slope analytical function can be used to determine to what degree the stage is out of level. The slope of the trace between the cursors will be displayed in degrees. This angle indicates the amount that the trace is out of level. If the angle is greater than +/- 0.01º, repeat the above steps to obtain minimum possible slope/maximum possible level.

NOTE – If the profile trace is extremely out of level, change the measurement range to the maximum range of 2,620kÅ. Level the trace as described above, change to the intermediate range and repeat the procedure until leveled. The best level is achieved by using the 65kÅ range.

SOFTWARE LEVELING

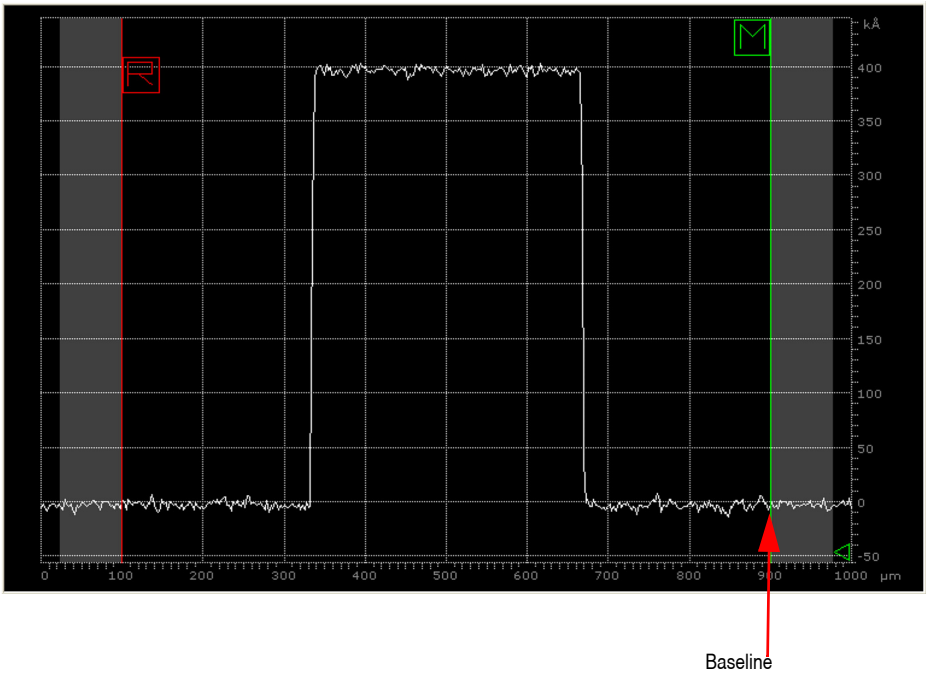
Although you have manually adjusted the stage, ensuing scans may show the profile trace slightly tilted. Software leveling allows the system to quickly level the profile trace without actually having to completely level the stage. You must software level the stage in order to obtain accurate step height measurements or accurate readings from analytical functions. Software leveling sets the reference and measurement cursors at zero to establish a reference for measurements.

Complete the following steps to software level a trace:

1. Position the **R** and **M** cursors along the baseline of the step.
2. Click the **Level** icon, press **F7**, or select **Plot** > **Level** from the system menu bar. The profile trace replots and levels with the R and M cursor intercepts at zero (see Figure 4-14).

You can also program software leveling into the scan routine to level the trace automatically at the conclusion of the scan by selecting **Edit** > **Enter Software Leveling**.

Figure 4-14: Cursor Positioning for Software Leveling



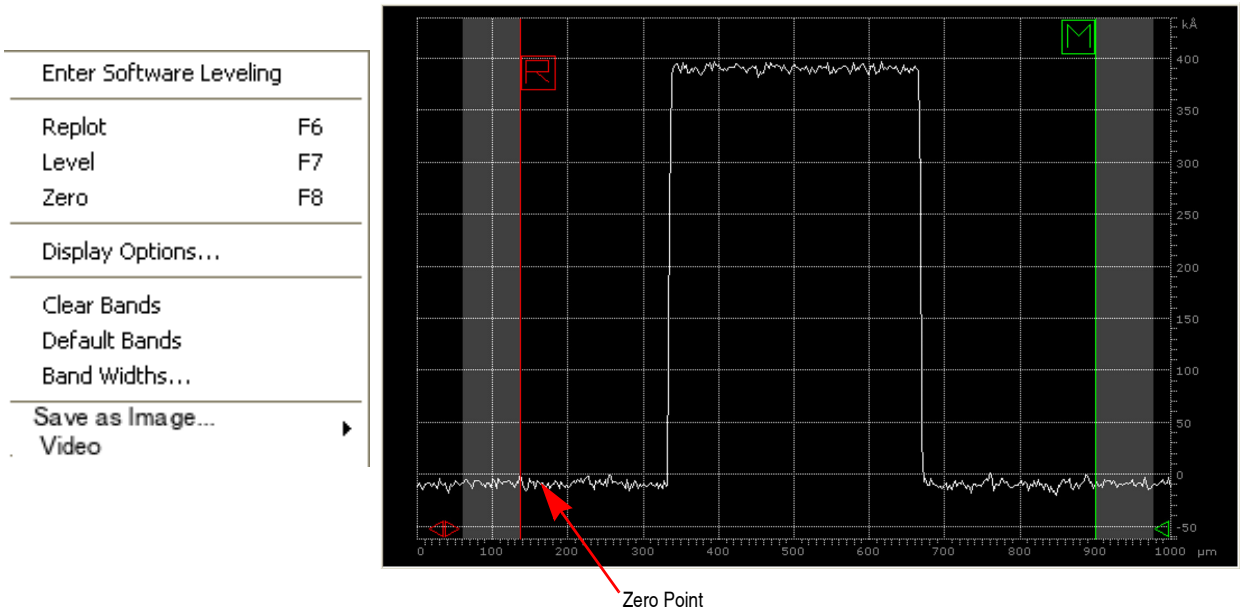
SETTING THE ZERO POINT

You may select any point on the profile trace as the zero point. The zero point is the point of reference from which all measurements are taken. Software leveling sets both the **R** and **M** cursor intercepts at zero. However, when the **Zero** function is activated, it sets the zero point only at the R cursor intercept.

To set the zero point:

1. Position the **R** (reference) cursor at the desired zero location.
2. Select **Plot** > **Zero** (or press **F8** on the keyboard) to automatically replot the profile trace and establish the zero point at the **R** cursor intercept (see Figure 4-15).

Figure 4-15: Setting the Zero Point

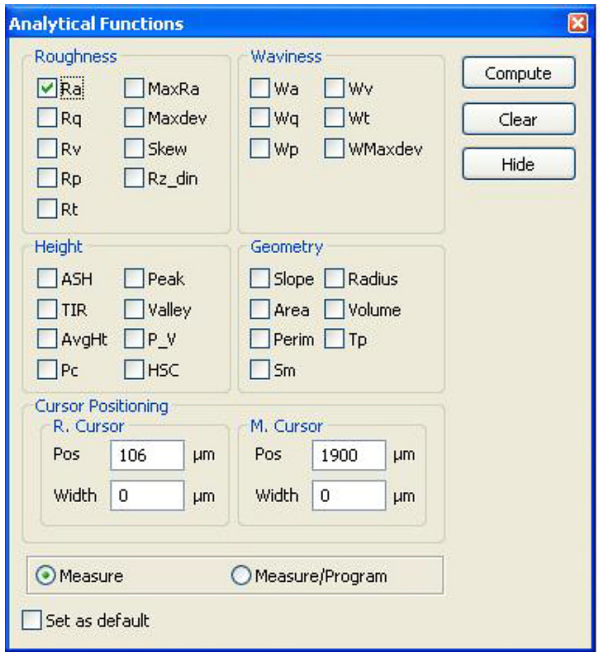


MAKING A DELTA AVERAGE STEP HEIGHT MEASUREMENT

Once you run the scan routine and leveled the profile, you can obtain an accurate vertical measurement of the calibration standard using the Delta Average Step Height analytical function. Analytical functions are calculated using the **R** and **M** cursors.

1. In the **Data Plot** window, click the **Analytical Functions** icon  or select **Plot**> **Analytical Functions**. Alternatively, right-click on the plot and select **Analytical Functions....Insert**. The **Analytical Functions** dialog box appears.

Figure 4-16: Analytical Functions Dialog Box



2 In the **Height** section, select **ASH** to activate the delta average step height function.

3 In the **Cursor Positioning** section, change the cursor bandwidth values if appropriate. The cursor positions normally should be within 20 to 50 microns of the step, on each side.

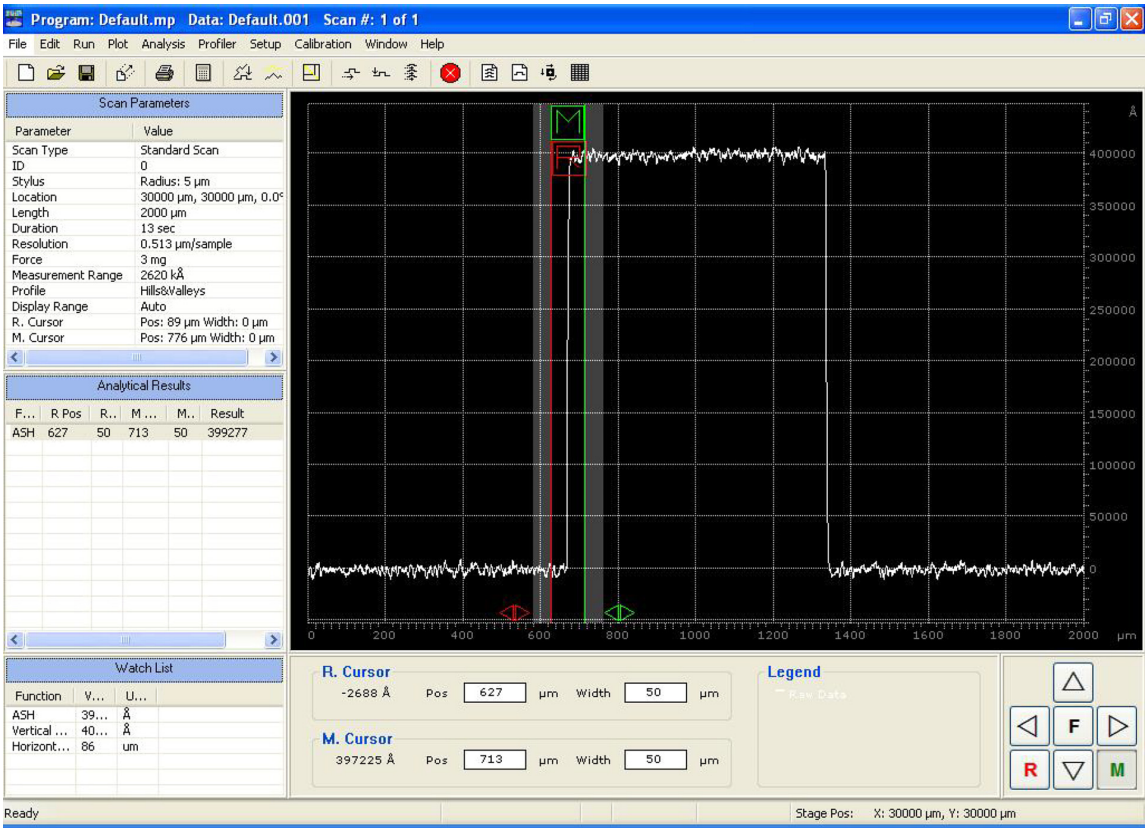
4 Click the **Measure** button located at the bottom of the **Analytical Functions** dialog box.

> **NOTE –** The **Measure** and **Measure/Program** buttons enter the ASH function into the current scan routine to be performed automatically when the current scan routine runs again.

5 Click **Compute** to calculated the average step height. The value appears in the **Analytic Results** area at the left side of the **Data Plot** window.

6 Click the **Run Currently Active Scan Routine** icon , the **F4** key, or select **Run** > **Scan from the menu** to run a scan routine. The ASH value now appears in the **Analytic Results** area to the left of the **Data Plot** window (see Figure 4-17). It also appears in the real-time Watch List, where it is dynamically updated during the scan.

Figure 4-17: Step Height Measurement



CHANGING THE PLOT MAGNIFICATION

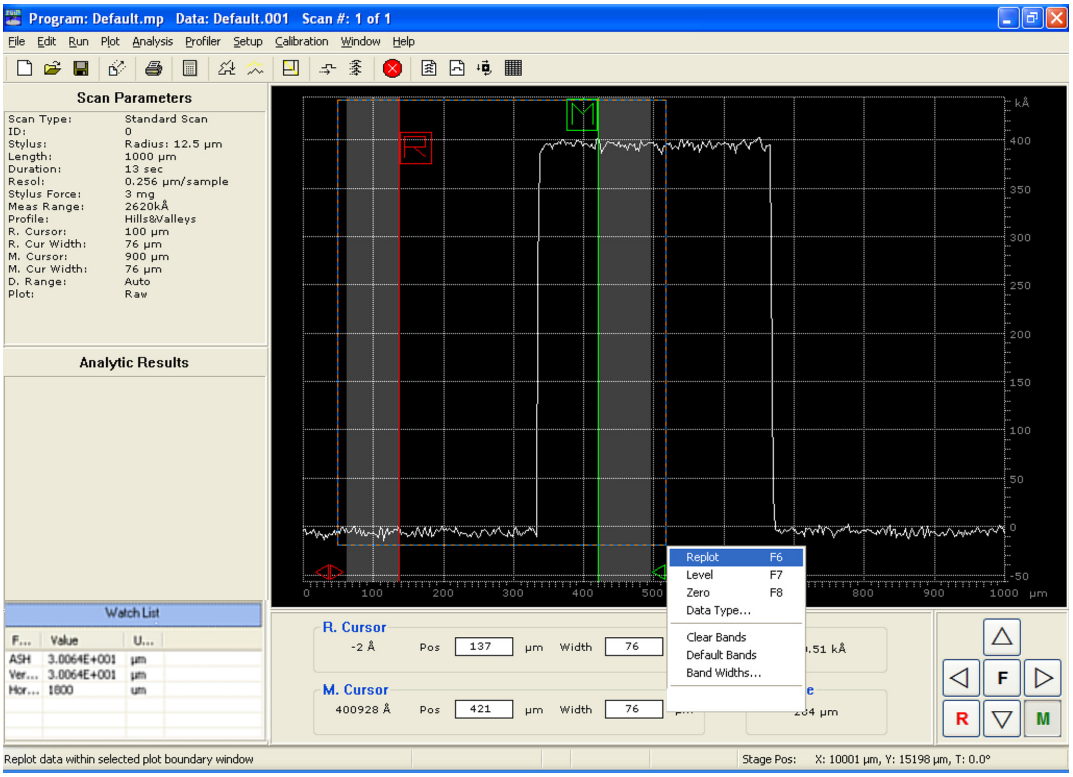
Once you run the scan and plot the profile trace, you can isolate and magnify a portion of the **Data Plot** window for more detailed analysis of the profile trace.

To isolate and magnify an area of interest:

1. Move the mouse pointer into the data plot grid.
2. Move the pointer to one corner of the area of the **Data Plot** window you want magnified and left-click on that location. Hold down the mouse button.
3. Drag the mouse away from the first corner at a diagonal to expand the box.
4. Release the mouse button when the box covers the area of interest. For this exercise, the boundaries should look similar to those shown in Figure 4-18. In the **Plot** menu that appears, you can choose **Replot** to replot the profile trace with the new boundaries (similar to Figure 4-18).

NOTE – Click the **Replot** icon or select **Plot** > **Replot** from the menu bar if you want to replot and display the original profile trace.

Figure 4-18: Plot Magnification

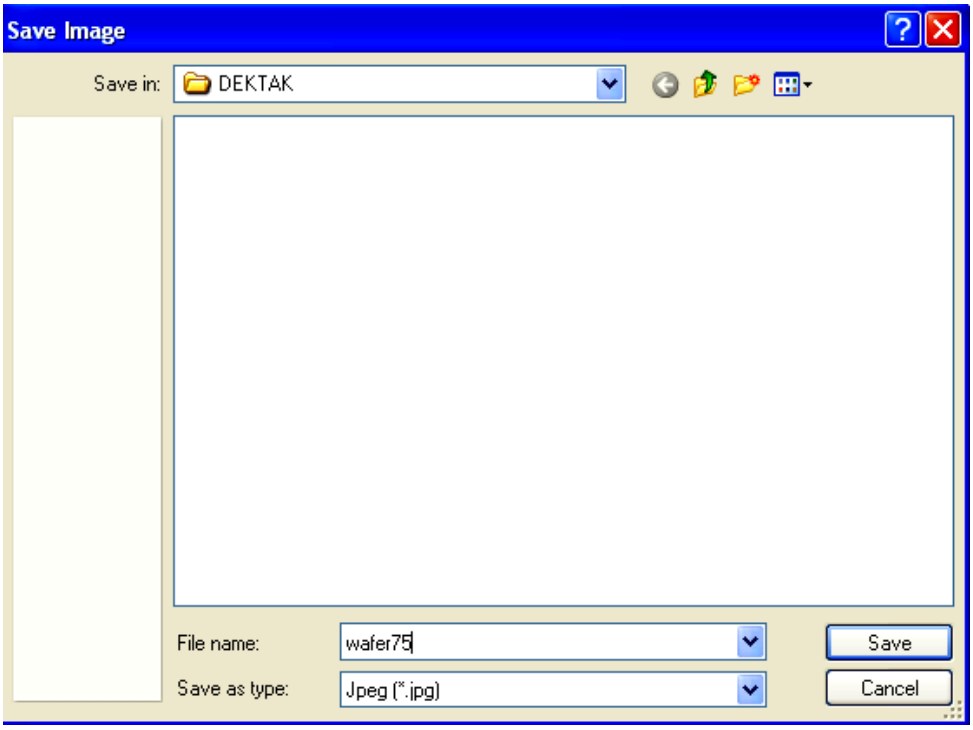


SAVING THE DATA PLOT

Right-click on the data plot. The pop-up menu that appears provides two options: **Save as Image** and **Video.** The **Video** option includes two choices: **Graphics Only** and **Video and Graphics**. Do one of the following:

- Select the **Save as Image** option to open a dialog box that allows you to save the currently displayed data plot in your desired graphics format (Figure 4-19).
- Select **Video > Graphics Only** to save only the data plot.
- Select **Video > Video and Graphics** to display the live video behind the data plot. After viewing this display, select **Save as Image** to save the currently displayed data plot in your desired graphics format.

Figure 4-19: Save Image Dialog Box



PRINTING THE SCAN DATA

You can obtain a printout of all the scan data with the plotted profile, a summary of the scan data, the scan routine information, the automation program information, the Automation Program Summary Report, and the Watch List using a Windows-compatible printer.

- Select **File** > **Print**, press **CTRL+P**, or press the **F10** key, to display a standard Windows dialog box listing various printer options.

or

- Click the **Print Scan Data and Parameters** icon  to produce a printout on the currently active printer.

NOTE – Drivers for the Windows-compatible printer must be installed before use.

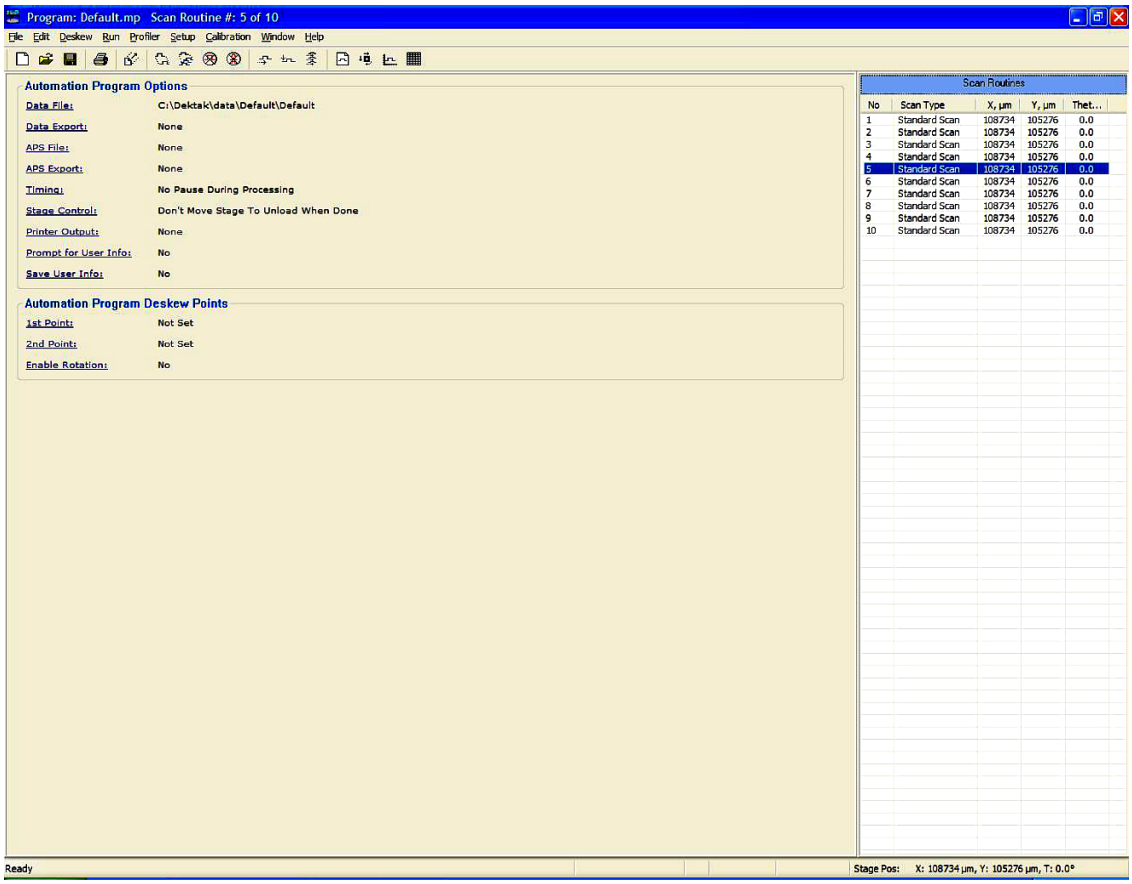
SAVING AN AUTOMATION PROGRAM

You may store an automation program on your hard drive, the network, or portable media. For the purpose of this exercise, follow the procedure described below to save the automation program created in this chapter exercise onto the C drive.

NOTE – If you create or modify an automation program but do not save it according to the steps in this section, you will be asked if you want to save it when you exit the program. For more information, see Saving upon Exiting the Dektak Program on page 4-23.

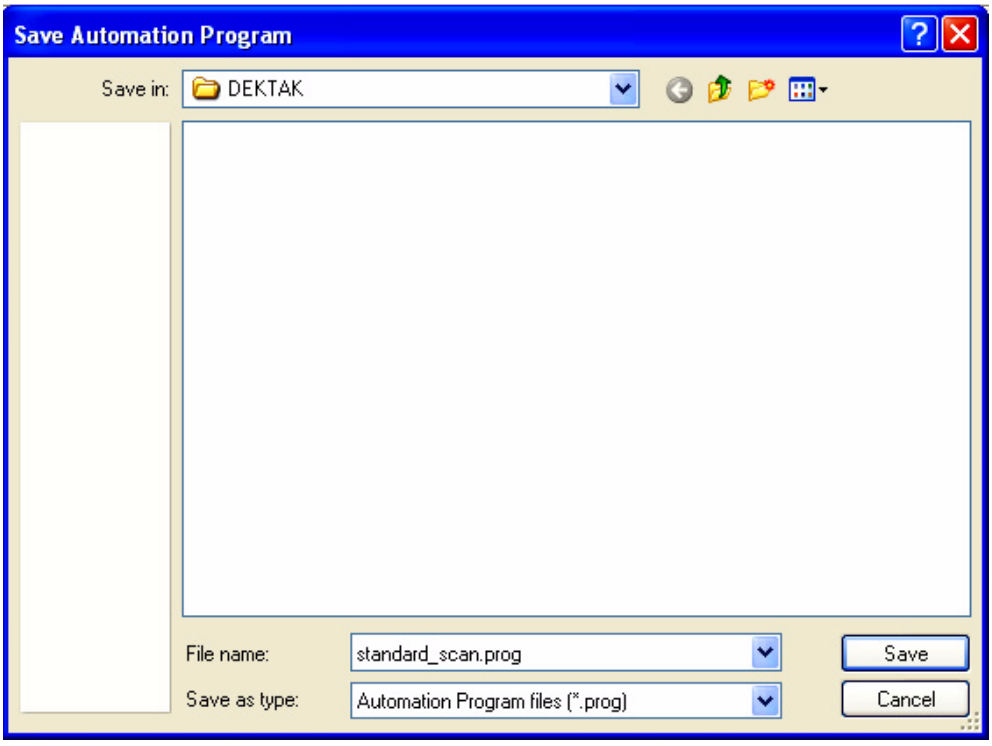
1 Click the **Automation Program** icon or select **Window** > **Automation Programs** from the menu bar to display the **Automation Programs** window (see Figure 4-20).

Figure 4-20: Automation Programs Window



2 Select **File** > **Save As** from the **Automation Programs** menu bar to display the **Save Automation Program** dialog box.

Figure 4-21: Save Automation Program Dialog Box



3 Enter the file name and file type.

4 Click **Save**.

> **NOTE –** The dialog box closes, and the automation program is now saved on the hard disk under the designated file name.

ABORTING AN OPERATION

To abort a Dektak 150 operation, select an **Abort** icon or press the **Esc** or **A** key on the keyboard.

> **NOTE –** If you abort an operation while the stage is rotating, you must reset the hardware by selecting **Profiler > Reset Hardware** from the menu, or pressing **CTRL+ALT+R** on the keyboard.

OPENING A DEKTAK 150 SCAN IN VISION

NOTE – For non-automated configurations of the Dektak 150 system, Vision is a purchased option that must be installed before you can open a Dektak scan as described here.

When you open the results of a Dektak 150 scan in Vision, the program analyzes the data and displays it as a 2D plot. You then can analyze and manipulate this plot with routines such as:

- Terms Removal (Tilt, Curvature, Sphere, and others)
- Masking (both Analysis and Terms)
- Histogram Plot
- Bearing Ratio Plot
- Processed Options

For illustrations and explanations of the above routines, see Appendix E.

To open a Dektak 150 scan in Vision:

1. Open Vision.
2. From the **File** menu, select **File > Open Stored Dataset**.
3. Navigate to the Dektak Data folder and click the file that you want to open.
4. To modify the way in which 2D datasets are displayed, click **Analysis > Processed Options**, and then click the **Dektak** tab.

Figure 4-22: Dektak Tab of Processed Options Dialog Box

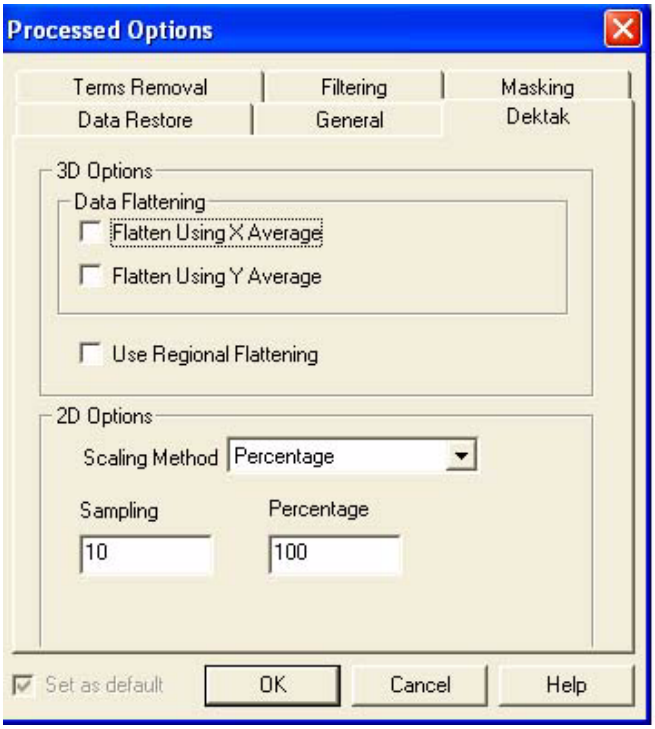
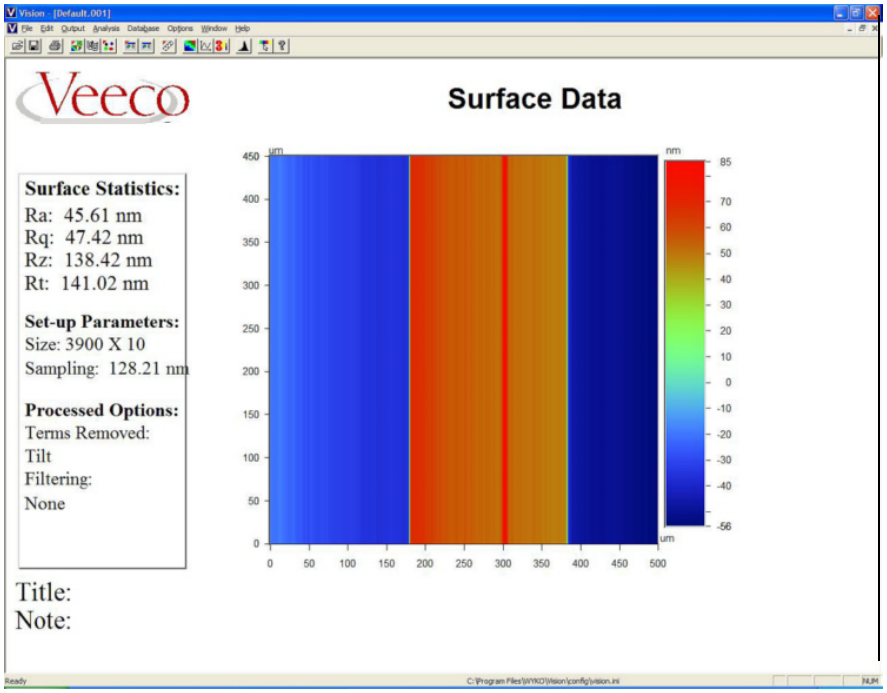


Figure 4-23: 2D Contour Plot of a Dektak 150 Scan in Vision with 100% Scaling



NOTE – For complete information about opening and analyzing Dektak 150 scans in Vision, see Appendix E.

SAVING UPON EXITING THE DEKTAK PROGRAM

When you exit the Dektak program, one or more of the following prompts may appear.

- Do want to store analytical results to the scan routine?
- Do you want to save the current scan data and analytical functions results?
- Do you wish to save your changes to the current automation program?

If you click **Yes** at the last two prompts, a **Save File** dialog box appears. Use this dialog box to name your file and specify where you want to save it.

NOTE – For more information, see Exporting a Scan Data Plot on page 5-41 and Opening a Saved Scan Data Plot on page 5-42.

5

MULTIPLE SCAN OPERATION

This chapter continues the exercise introduced in earlier chapters. By building on the experience that you gained in positioning the stage (described in Chapter 3) and performing a single-scan operation (described in Chapter 4), you can use the Dektak 150 to perform complex multi-scan sequences.

NOTE – If you have not already done so, you may want to familiarize yourself with the Dektak 150 user interface by reading Chapter 3 and Chapter 8.

LOADING THE SAMPLE

Before you begin the exercises in this chapter, you must:

- Procure an appropriate sample. If you want to use the vertical standard that came with your system, remove it from its case according to the instructions in Adjusting the Optics on page 2-23.
- Load the vertical standard or another sample on the stage according to the instructions in Sample Loading and Unloading on page 3-13.

ABOUT THE AUTOMATION PROGRAM

The automation program is the basis for all operations performed on the Dektak 150. The **Automation Program** window displays the current scan routines, along with their X and Y locations, as well as data destination options.

The **Automation Program** window allows you to program the Dektak 150 for performing multi-scan operations at a single location or multiple locations. When you want to modify a saved automation program to make on-the-fly measurements, this window gives you a quick review of the program routines, scan type and location, which you can copy and then modify. You can also view and modify what is being saved and where. Furthermore, you can set up other pre- and post-scan actions in the **Automation Program** window.

The **Automation Program** menu bar contains **File** and **Edit** menus items that are not available in other windows. These menus are described in further detail in Chapter 8.

OPENING A NEW AUTOMATION PROGRAM

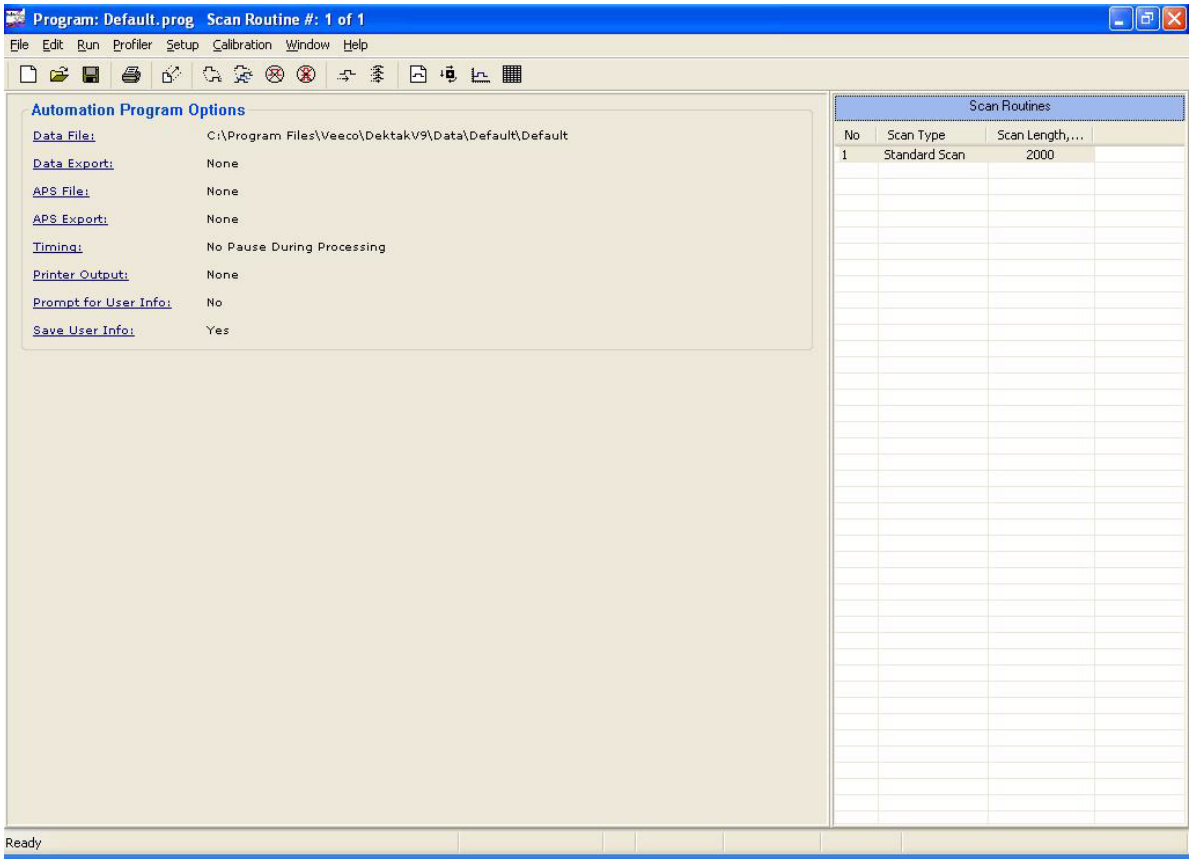
This exercise explains how to open a new automation program to create a multi-scan automation program.

1. In the **Startup** window, select **File > New** from the menu bar or type **CTRL+ N**. Alternatively, select **Window > Automation Programs** (**CTRL + 1**). The **Automation Program** window appears with the default automation program (**default.prog**) displayed (see Figure 5-1).
2. If an automation program to which you have made changes is currently open, a dialog box asks if you want to save those changes. Click **Yes** to save your changes to the current automation program.

> **NOTE –** Be aware that if the current automation program was previously loaded and then modified, it will be saved under its original file name. If you want to preserve the original automation program, first select **File > Save As** on the menu bar and choose a new file name for the modified program. Then select **File > New**.

If you select **Window** > **Automation Programs** from the menu bar, the current automation program opens (if there is one). Otherwise, the default automation program opens.

Figure 5-1: Automation Program Window



COPYING AN AUTOMATION PROGRAM

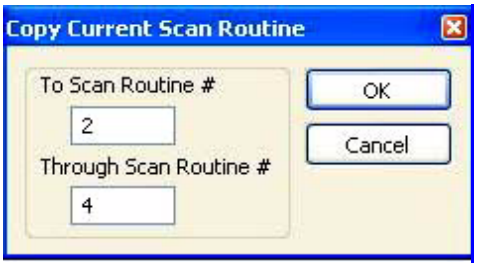
This section explains how to copy a current scan routine to create an automation program containing multiple scan routines. An automation program may contain up to 10,000 scan routines. However, in this exercise, you will create an automation program containing only four scan routines.

1 Click the **Copy Currently Selected Scan Routine to a Range of Scan Routines** icon  or select **Edit** > **Copy Currently Selected Scan Routine to a Range of Scan Routines** to display a dialog box for entering the lower and upper limits of the range (see Figure 5-2).

NOTE – You can also open this dialog box by pressing the **CTRL+SHIFT+C** key combination or by right-clicking on the scan routine and selecting **Copy to Range**.

Furthermore, you can open a dialog box that allows you to copy a single scan routine by clicking the **Copy Currently Selected Scan Routine** icon, selecting **Edit** > **Copy Currently Selected Scan Routine**, pressing the **CTRL+C** key combination, or right-clicking on the scan routine in the box on the right side of the window and selecting **Copy To**.

Figure 5-2: Copy to Range Dialog Box



2 Enter a numerical value into the **To Scan Routine #** field (enter **2** for this exercise).

3 Click on the field labeled **Through Scan Routine #**.

4 Enter a numerical value into the field (enter **4** for the exercise).

5 Click **OK**.

NOTE – The current scan routine 1 copies to scan routines 2, 3 and 4 (listed in the **Scan Routines** area at the right side of the **Automation Program** window). Scan routine 2 is now the current scan routine.

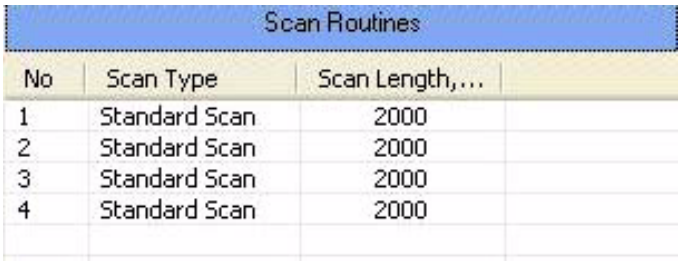
PROGRAM ENTRY

NOTE – The procedure in this section applies only to systems that include the X-Y auto stage.

The scan routine is identified in the **Scan Routines** area by three entries: the left number is the scan number; the center entry is the **Scan Type** and the number to the right is the scan length (see Figure 5-3).

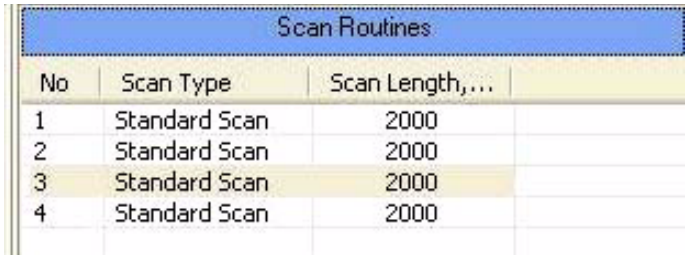
NOTE – After you have defined the X location and Y location according to the instructions in Defining Scan Location and Length on page 5-4, the **Scan Routines** area also shows the X location and Y location in µm .

Figure 5-3: Scan Routines Area



Double-click any one of the scans listed in the **Scan Routines** area to open the **Scan Routines** window, which displays the parameters for that scan routine (see Figure 5-4).

Figure 5-4: Scan Routines Area with Scan Routine Selected



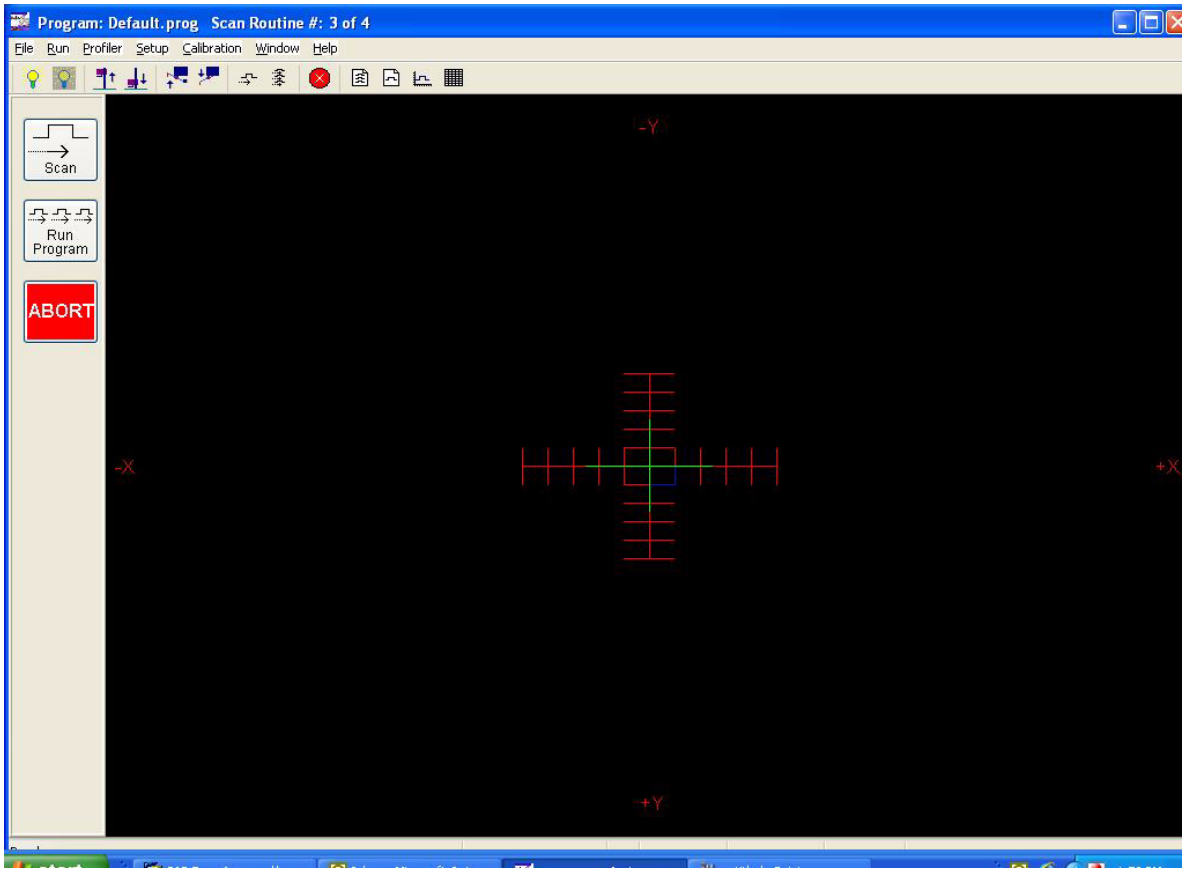
At this point, all four scan routines in your current automation program have the same values. You can use the functions described in the next section to determine new values for the location and length of each scan routine in the **Sample Positioning** window. Furthermore, you can adjust or edit values for each scan routine in the **Scan Routines** window, using the functions described in Editing Scan Routines on page 5-11.

Defining Scan Location and Length

This procedure determines the appropriate scan starting location and scan length for measuring the vertical standard that came with your system or another sample. You define the scan location and scan length from the **Sample Positioning** window.

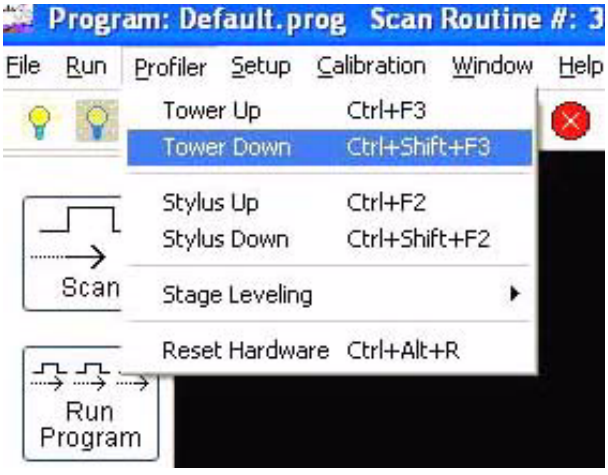
1 Select **Window** > **Sample Positioning** from the menu to display the **Sample Positioning** window (see Figure 5-5).

Figure 5-5: Sample Positioning Window for Default Program, Routine 3



2 Select **Profiler** > **Tower Down (see** Figure 5-6) or click the **Tower Down to Null Position - Stylus Up** icon  .

Figure 5-6: Profiler Menu with Tower Down Selected



3 Use the **Illumination Adjustment** icons   to adjust the illumination to adequately view the sample.

4 With the tower down (stylus up), initiate Stage Tracking (left-click in the camera view pane) for fine sample positioning. The image now tracks the motion of the mouse.

5 Position the stylus reticle just to the left of the feature that you want to measure.

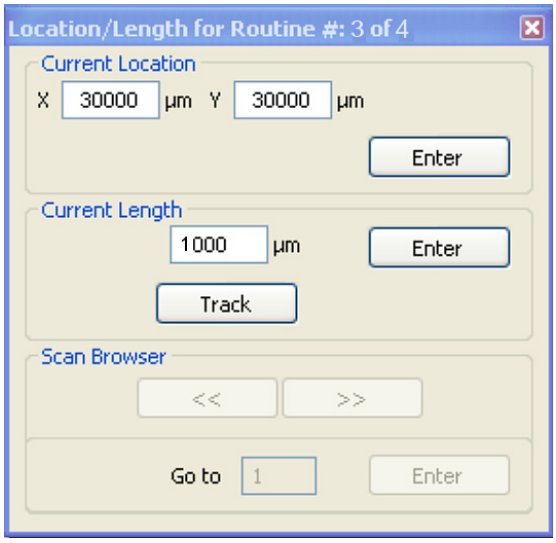
> **NOTE –** For optimal repeatability in stage positioning, always select left for scan locations (that is, move the stylus to the left of the position desired and approach the position from that side before selecting it). This eliminates repeatability errors due to backlash in the gears.

6 With the stylus reticle properly positioned, click the mouse button a second time to deactivate Stage Tracking.

7 Select **Edit** > **Define Scan Location/Length** (or press **CTRL+L** on the keyboard). The **Location/Length for Routine #: 3 of 4** dialog box appears (see Figure 5-7). The X and Y fields display the current X-Y auto stage position. Do one of the following:

- Click **Enter** to store the current location.
- Change the position of the stage by using the mouse, keyboard or **Stage Control Panel**, and then click **Enter**.

Figure 5-7: Scan Location/Length Dialog Box



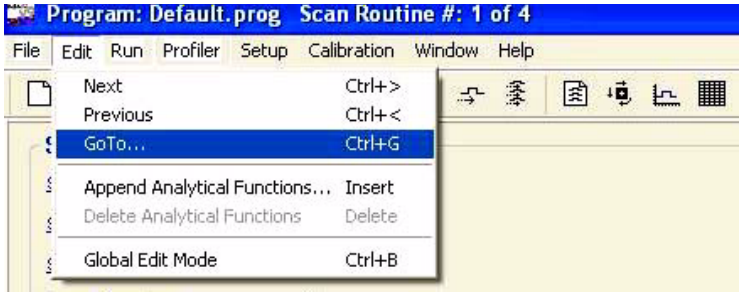
8 Click the **Enter** button in the **Current Location** section to assign the coordinates to Scan Routine #3.

At this point, there are two ways you can proceed: (a) define the location for each of the scan routines in your automation program, and then go back and define the length of each of the scan routines; or (b) define the location and then the length of each scan routine in turn. Choose the method that is appropriate for your particular scan routines. The following steps assume you want to define all of the scan-routine locations first.

9 To define the location and length of all scan-routine locations:

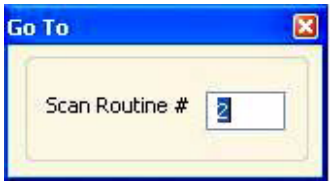
a. Select **Edit > Go To** (see Figure 5-8) or press **CTRL+G** on the keyboard).

Figure 5-8: Edit Menu with Go To Scan Routine Selected



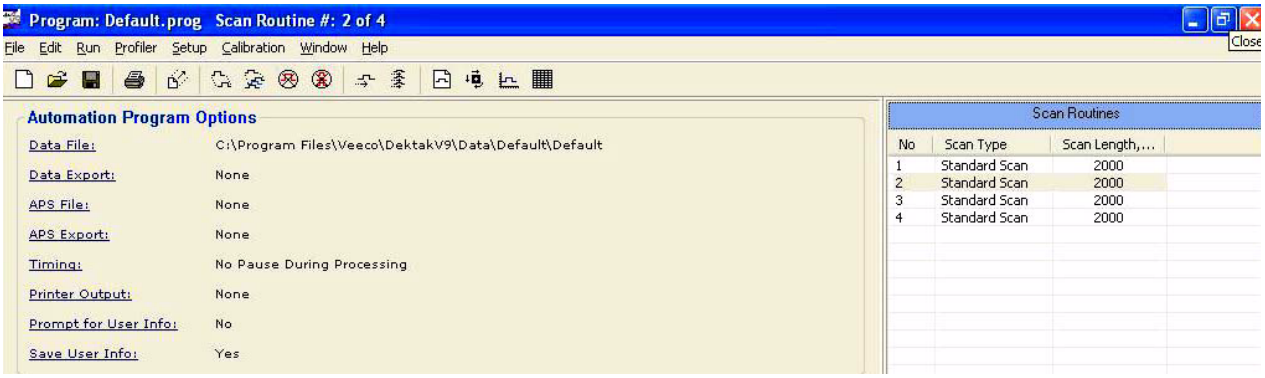
b. Type **2** in the pop-up dialog box (see Figure 5-9) and press the **ENTER** key on the keyboard. This makes Scan Routine #2 the currently active scan routine in the **Automation Program** window (see Figure 5-10).

Figure 5-9: Go to Scan Routine Dialog Box



NOTE – A scan is always performed by moving the stage towards the front of the instrument. With most camera setups, the image on the monitor appears to be moving from the bottom to the top during the scan.

Figure 5-10: Automation Program Window with Parameters for Routine 2



c. Click the **Enter** button in the **Scan Browser** section or use the **>>** button to select the next scan routine as the currently active scan routine.

d. Select **Profiler** > **Tower Down**.

e. With the stylus tower down, initiate Stage Tracking (left-click in the camera view pane) for fine sample positioning. The image now tracks the motion of the mouse.

f. Position the stylus reticle just to the left of the feature that you want to measure.

g. With the stylus reticle properly positioned, click the mouse button a second time to deactivate Stage Tracking.

h. Either accept the values shown in the dialog box, or edit the values with the keyboard. Click the **Enter** button in the **Current Location** section to assign the coordinates to this scan routine.

i. Repeat the above steps to define scan locations for each of the remaining scan routines.You are now ready to define a length for each of the scan routines.

j. In the **Scan Browser** section of the **Location/Length** dialog box, click the left arrows or type the number 1 in the **Go To** field. This makes Scan Routine #1 the currently active scan routine.

k. Press **CTRL+V** on the keyboard to move the stylus to the location you defined for the currently active scan routine.

l. Initiate Stage Tracking (left-click in the camera view pane), and roll the mouse until the stylus reticle is at the end of the scan. Note that this time Stage Tracking tracks only the left and right motion of the mouse to allow you to determine the distance you want to scan.

m. Roll the mouse until the stylus reticule is at the end of the scan, and then click the left mouse button to deactivate Stage Tracking. The **Current Length** section **Location/Length for Routine #: 1 of 4** dialog box now shows the length of the scan that you determined with Stage Tracking. You can accept the value shown, or edit the value with the keyboard. Click the **Enter** button in the **Current Length** section to assign the length to this scan routine.

n. Click the **Enter** button in the **Scan Browser** section to select the next scan routine.

o. Repeat the above steps to define scan lengths for each of the remaining scan routines.

p. Click the close box at the upper right corner to close the dialog box.

SETTING OTHER SCAN ROUTINE OPTIONS

You can set scan routine options by clicking one of the underlined items in the **Automation Program** window (see Figure 5-10). When you do this, either the **General** tab (see Figure 5-12) or **Extended** tab (see Figure 5-13) of the **Automation Program Options** dialog box appears. For descriptions of these options, see Automation Program Options on page 5-22.

Figure 5-11: Scan Routines Area of the Automation Program Window

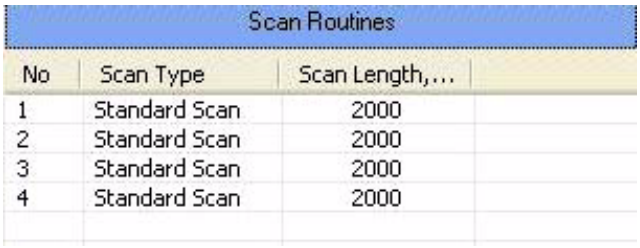


Figure 5-12: General Tab of the Automation Program Options Dialog Box

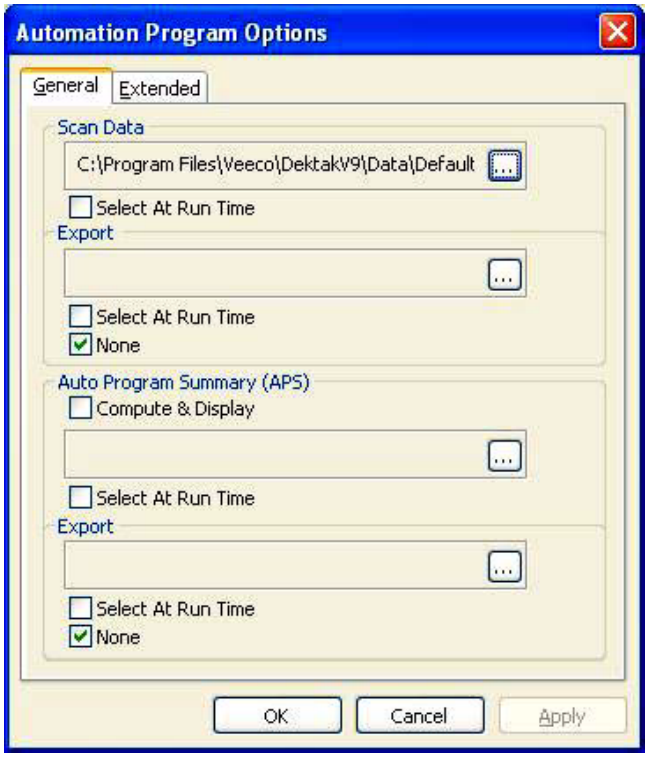
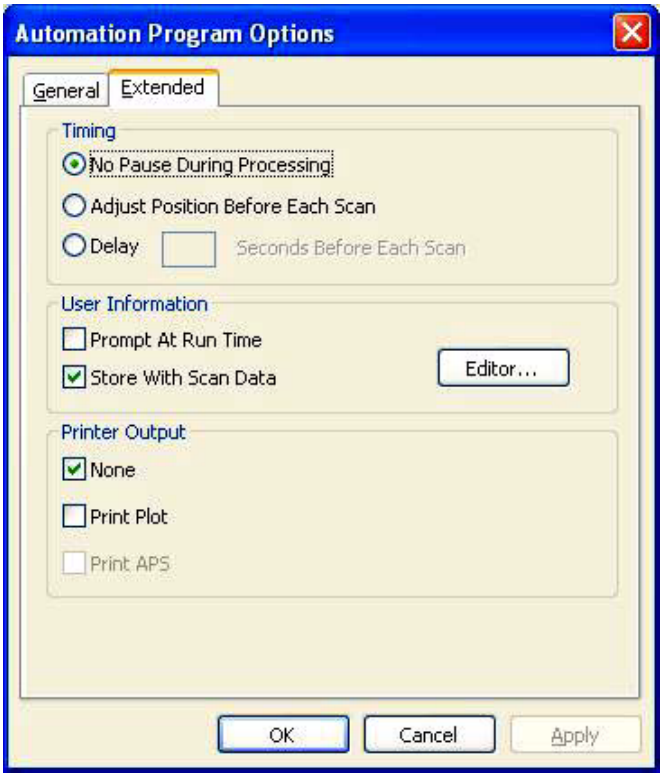


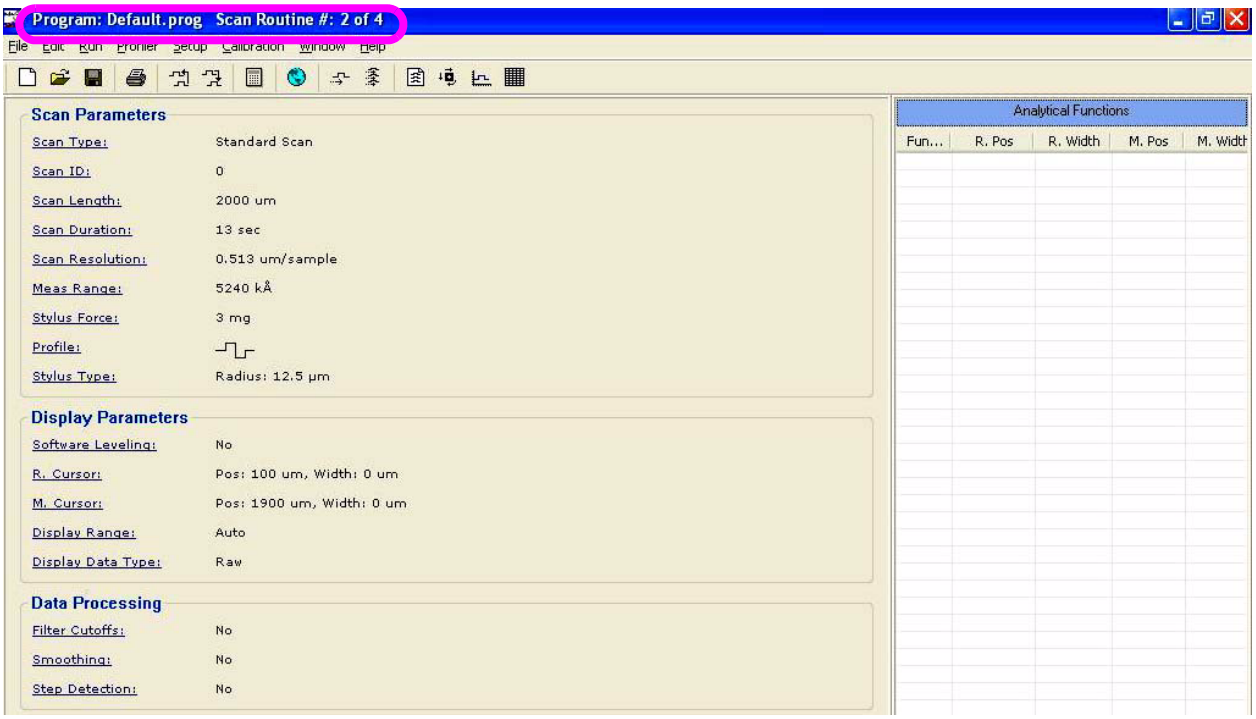
Figure 5-13: Extended Tab of the Automation Program Options Dialog Box



About the Scan Routines Window

The **Scan Routines** window allows you to edit the scan parameters, modify the display parameters, and choose data-processing settings for each scan routine in your automation program (see Figure 5-14). The scan routine number appears in the title bar at the top of the window, along with the total number of scan routines in the automation program (see items circled in magenta in Figure 5-14).

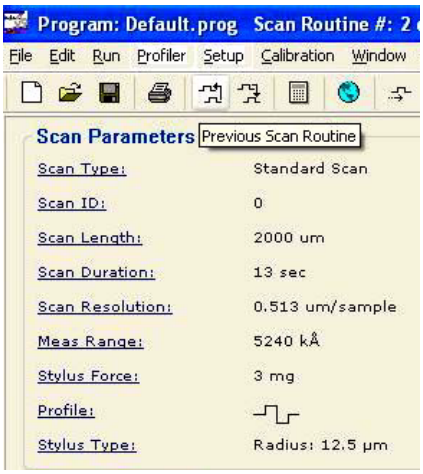
Figure 5-14: Scan Routines Window



The scan routine shown in the **Scan Routines** window is the routine that you selected in the **Automation Program** window. There are several ways to display the other scan routines in this window without returning to the **Automation Program** window:

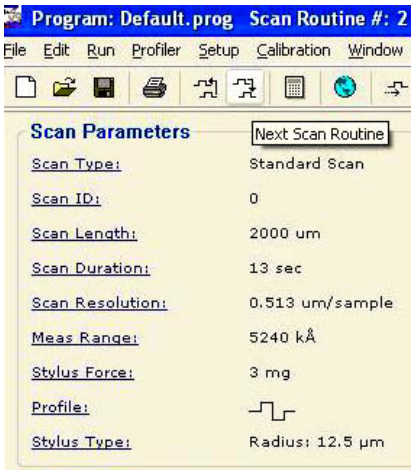
- Click the **Previous Scan Routine** icon  to display the previous scan routine.

Figure 5-15: Previous Scan Routine in the Scan Routines Window



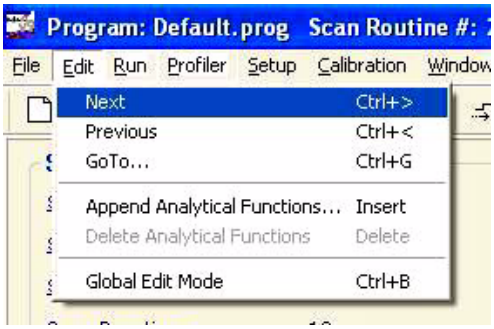
- Click the **Next Scan Routine** icon  to display the previous or next scan routine.

Figure 5-16: Next Scan Routine in the Scan Routines Window



- Select **Edit > Previous** or **Edit > Next** on the menu bar to display the previous or next scan routine.

Figure 5-17: Edit Menu with Next Selected



- Press **CTRL+<** or **CTRL+>** on the keyboard to display the previous or next scan routine, respectively.
- Select **Edit > Go To** at the menu bar (or press **CTRL+G**) to open the **Go To Scan Routine** dialog box (see Figure 5-9), where you can type a scan routine number. Then press the **Enter** key.

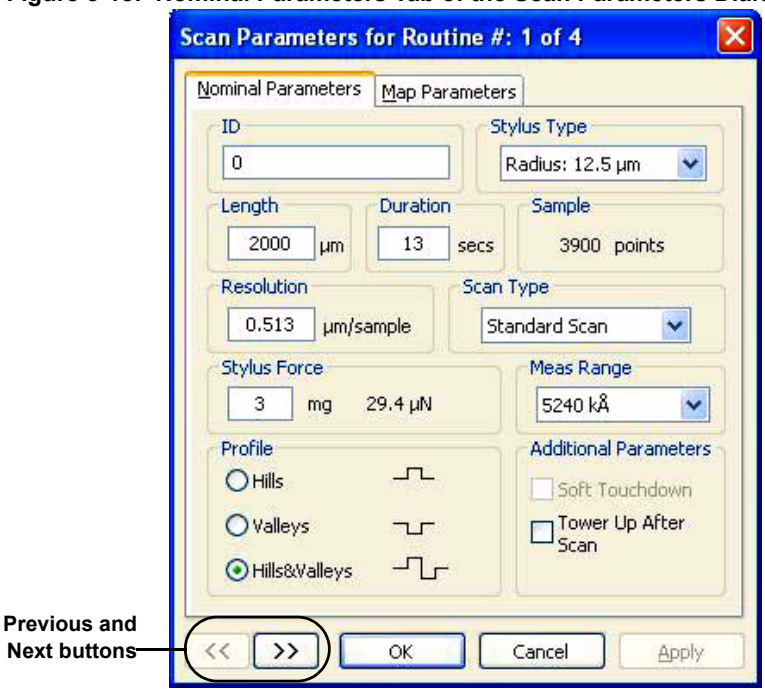
Editing Scan Routines

You can edit a scan routine by clicking any underlined parameter in the **Scan Routines** window (see Figure 5-14).

Scan Parameters

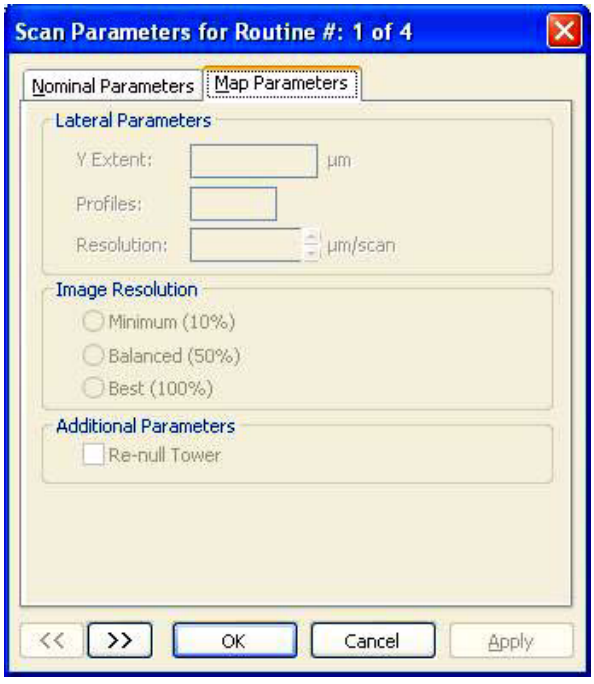
Click any of the underlined parameters in the **Scan Parameters** section to open the **Nominal Parameters** tab of the **Scan Parameters** dialog box (see Figure 5-18). Use this dialog box to adjust existing or enter new values such as the scan length or duration of the scan routine. You can use the << and >> buttons to display and change the parameters for the previous and next scan routines.

Figure 5-18: Nominal Parameters Tab of the Scan Parameters Dialog Box



A **Map Parameters** tab is available only if the 3D Mapping option has been installed. Use it to set the parameters for a 3D map scan. The Dektak 150 software allows you to include both standard scans and map scans in a single automation program. For more information, see Appendix E.

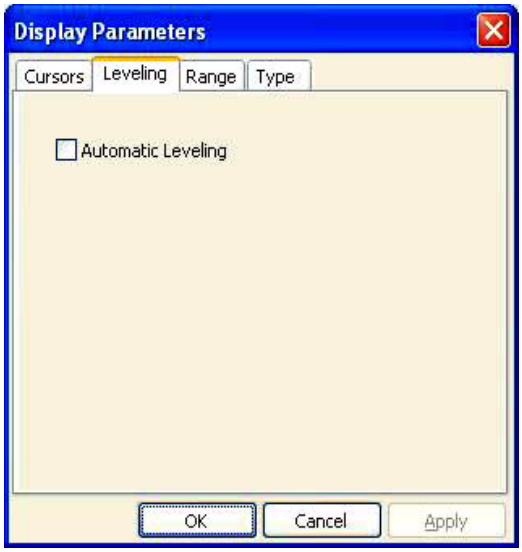
Figure 5-19: Map Parameters Tab of the Scan Parameters Dialog Box



Display Parameters

- Each of the items in the **Display Parameters** section of the **Scan Routines** window opens a different tab of the **Display Parameters** dialog box .
- Click **Software Leveling** to open the **Leveling** tab (see Figure 5-20).

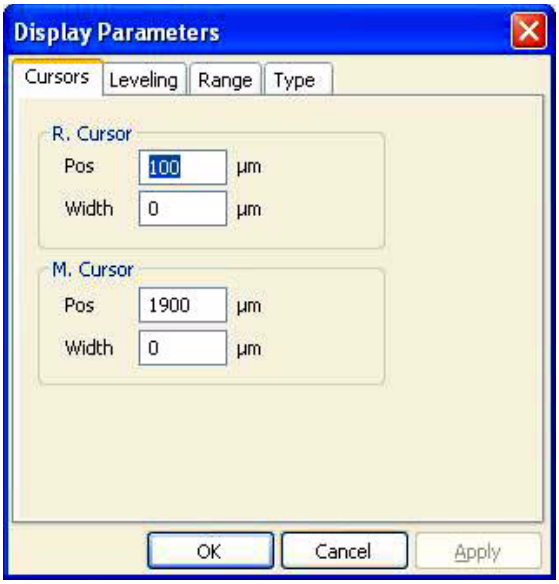
Figure 5-20: Leveling Tab of the Display Parameters Dialog Box



Use the **Leveling** tab to determine whether or not the system should automatically remove tilt from the trace based on the defined cursor location and width.

Click **R. Cursor** or **M. Cursor** to open the **Cursors** tab (see Figure 5-21).

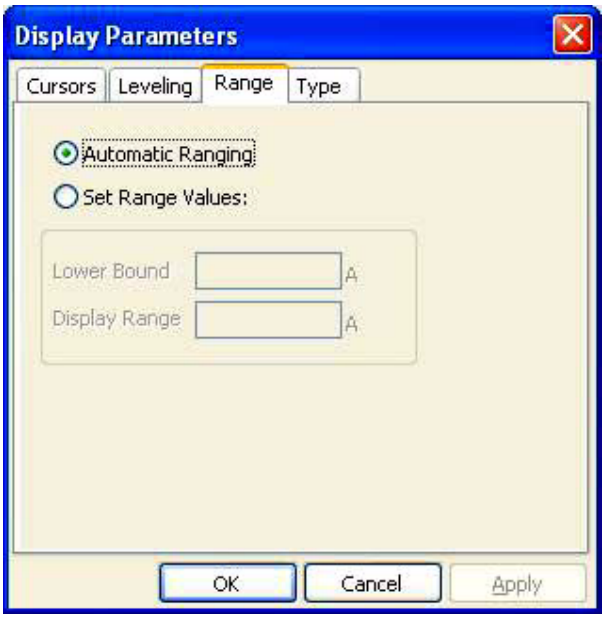
Figure 5-21: Cursors Tab of the Display Parameters Dialog Box



Use the **Cursors** tab to set new values for cursor positioning during software leveling.

Click **Display Range** to open the **Range** tab (see Figure 5-22)—or just click the **Range** tab itself.

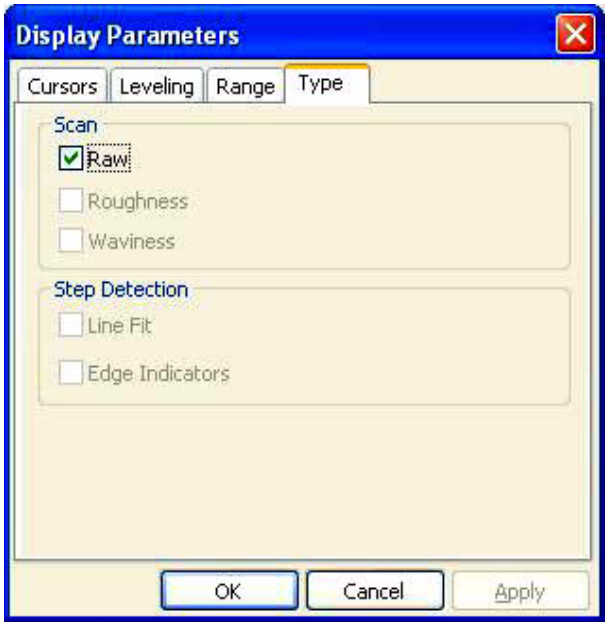
Figure 5-22: Range Tab of the Display Parameters Dialog Box



Use the **Range** tab to enable the system to automatically determine the vertical range or to select **Set Range Values** and enter your own **Lower Bound(ary)** and **Display Range** values. When you enter values in the **Lower Bound(ary)** and **Display Range** fields, the scan shown in the **Data Plot** window updates on the fly.

Click **Display Data Type** to open the **Type** tab (see Figure 5-23).

Figure 5-23: Type Tab of the Display Parameters Dialog Box



Use the **Type** tab to determine if you want display the data in raw form, with roughness included, and/or with waviness included.

> **NOTE –** You cannot select the roughness data type unless you first activate the short pass filter on the **Filter Cutoffs** tab of the **Data Processing Parameters** dialog box (see Figure 5-25). Likewise, you cannot select the waviness data type unless you activate the long pass filter in that same dialog box. For more information, see the section that follows.

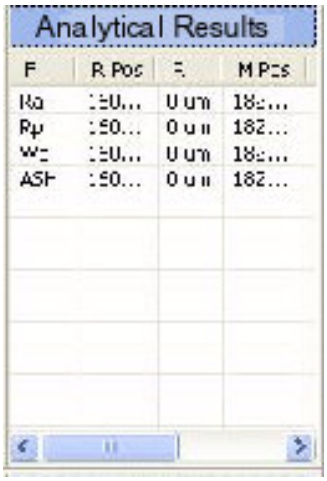
Data Processing Settings

Select one of the entries in the **Data Processing** section of the **Scan Routines** window to open the corresponding tab of the **Data Processing Parameters** dialog box.

When you enter your data processing filtering settings as a scan parameter, the system automatically performs data processing filtering during a scan. You can change these data processing filtering parameters at the end of a scan.

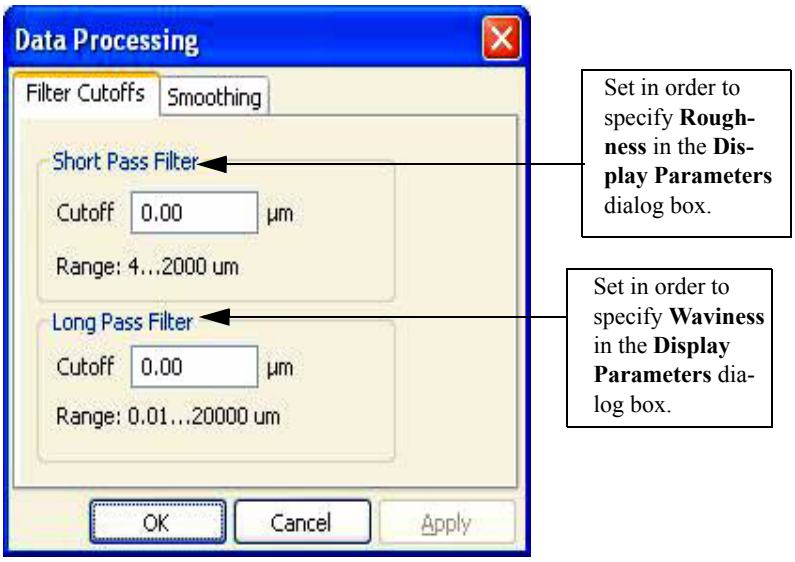
> **NOTE –** In the **Analytical Results** display in the **Data Plot** window (see Figure 5-24), analyzed raw data is denoted by an asterisk. Analytical results of filtered data have no asterisk.

Figure 5-24: Analytical Results Display Showing Filtered Data



Click **Filter Cutoffs** to open the **Filter Cutoffs** tab of the **Data Processing** dialog box (see Figure 5-25).

Figure 5-25: Filter Cutoffs Tab of the Data Processing Parameters Dialog Box

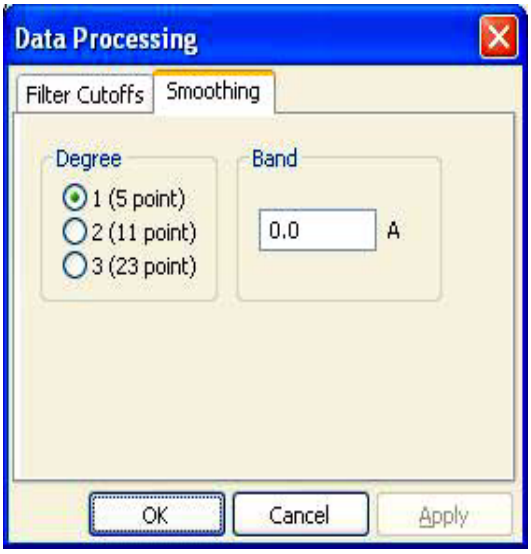


Enter values for the **Short Pass Filter** cutoff and the **Long Pass Filter** cutoff, or enter a value of zero (0) to disable the Filter Cutoffs function.

> **NOTE –** The data processing filter cutoffs are automatically applied to each analysis that is run under a scan routine that includes them. For information about the wavelength filter cutoffs, see Determining the Cutoff Wavelength on page 6-10.

Click **Smoothing** to open the **Smoothing** tab of the **Data Processing Parameters** dialog box (see Figure 5-26).

Figure 5-26: Smoothing Tab of the Data Processing Parameters Dialog Box



Select the degree of smoothing that you want the system to perform on the data. If desired, enter a width for the smoothing band..

For details on filters, see:	For details on smoothing, see:
Determining the Cutoff Wavelength on page 6-10	Using the Smoothing Function on page 6-18
Activating the Cutoff Filters on page 6-11	Activating the Smoothing Function on page 6-19
Entering Filter Cutoffs into a Scan Routine on page 6-12	Entering Smoothing into a Scan Routine on page 6-19

Analytical Functions

Select **Edit** > **Append Analytical Functions** (see Figure 5-27) to open the **Analytical Functions** dialog box (see Figure 5-28). Use this dialog box to select the analytical functions to be appended to the scan routine. See Chapter 6 for details.

Figure 5-27: Edit Menu with Append Analytical Functions Selected

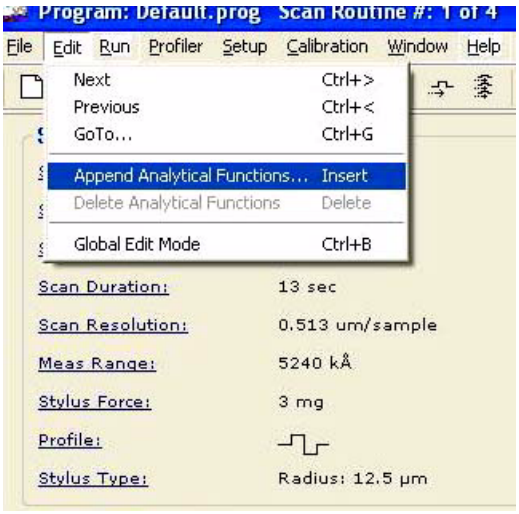
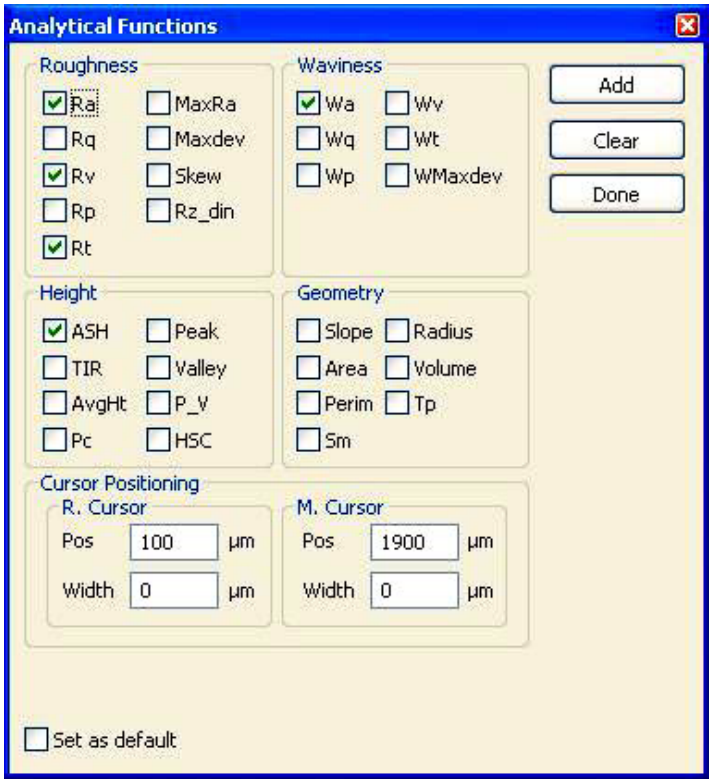


Figure 5-28: Analytical Functions Dialog Box



If you want to append the same analytical functions to all of the scan routines in your automation program, you can save time by using the **Global Edit Mode** described in the next section.

> **NOTE –** If you want to use the APS Report function, you must use **Global Edit Mode** to set identical parameters for all analytical functions in a scan routine. For more information, see Working with APS Reports on page 5-27.

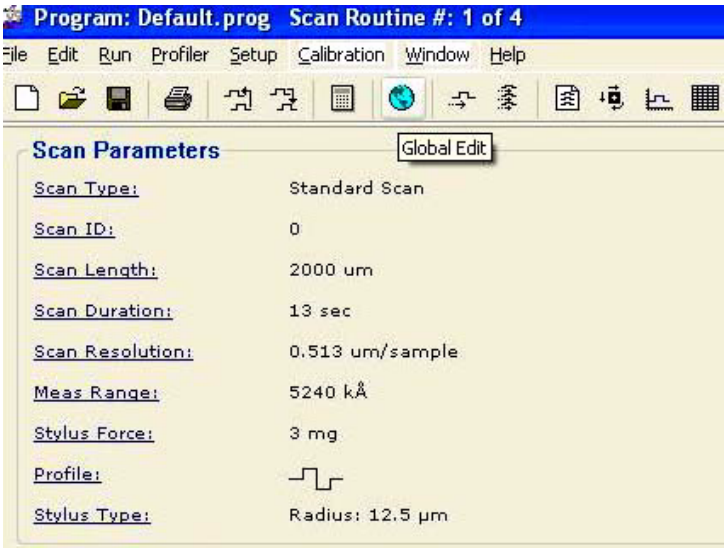
Global Editing of Scan Routine Parameters

You can change individual scan parameters within each scan routine of an automation program at any time. Use the **Global Edit Mode** to edit the parameters of *all* the scan routines simultaneously within the automation program.

To become familiar with the **Global Edit Mode**, follow the steps below. It is assumed you are still working with your new automation program containing four scan routines.)

1. Select **Window** > **Scan Routines** to display the **Scan Routines** window (see Figure 5-29). The highlighted scan routine appears. (It does not matter which one.)
2. Click the **Global Edit** icon  or select **Edit** > **Global Edit Mode**.

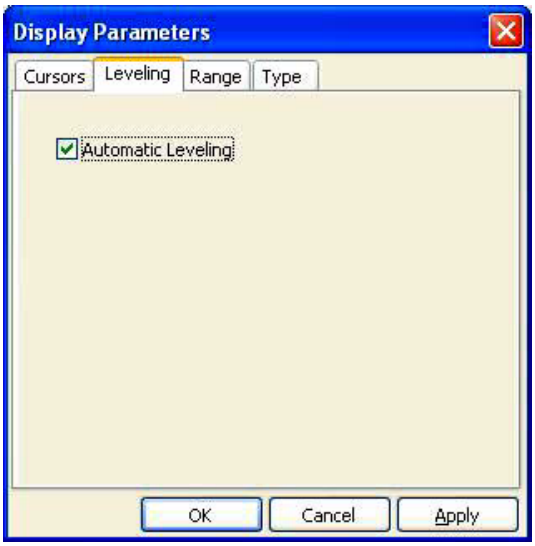
Figure 5-29: Scan Routines Window in Global Edit Mode



A **Global Edit Warning** dialog box emphasizes that **Global Edit Mode** affects all of the scans in the current automation program. Click **YES** to continue. A global edit symbol similar to the one shown in Figure 5-29 appears. Click an entry in the **Display Parameters** section to open the **Display Parameters** dialog box .

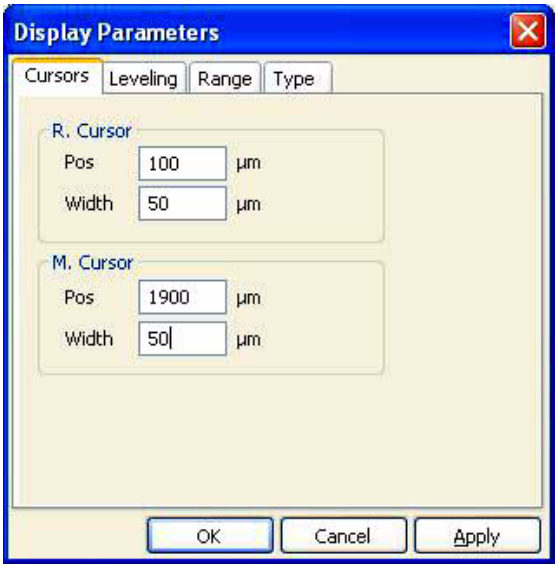
3 On the **Leveling** tab, select the **Automatic Leveling** check box (see Figure 5-30).

Figure 5-30: Leveling Tab with Automatic Leveling Selected



4 On the **Cursors** tab, enter **50** into each **Width** field (see Figure 5-31).

Figure 5-31: Cursors Tab

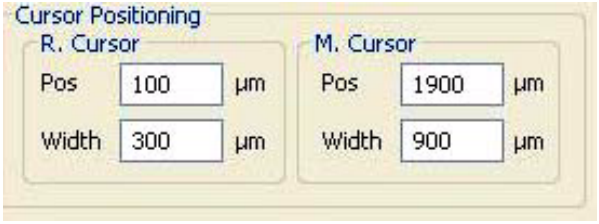


5 Click **Apply** and then click **OK**.

6 Select **Edit > Append Analytical Functions** or right-click in the window to display the **Analytical Functions** dialog box.

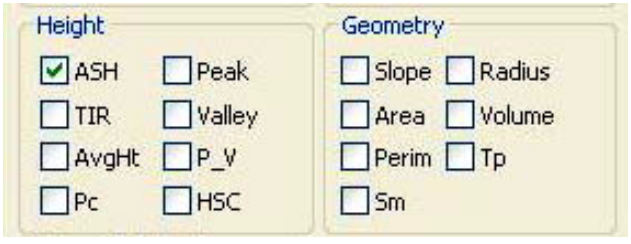
7 Enter 300 in the **R. Cursor Width field** and enter 900 in the **M. Cursor Width** field (see Figure 5-32).

Figure 5-32: Cursor Positioning Section of the Analytical Functions Dialog Box



8 In the **Height** section of the **Available** panel, select **ASH** (see Figure 5-33).

Figure 5-33: Height Section with ASH Selected



9 Click **Add** and then click **Done** (see Figure 5-34) to append the analytical function (see Figure 5-35).

Figure 5-34: Analytical Functions Dialog Box

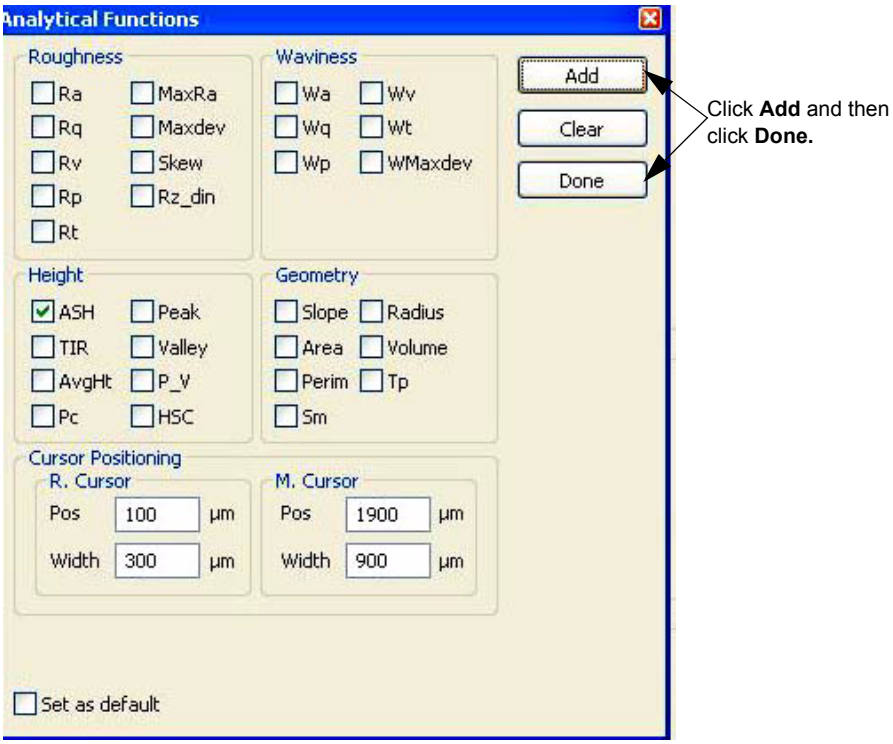
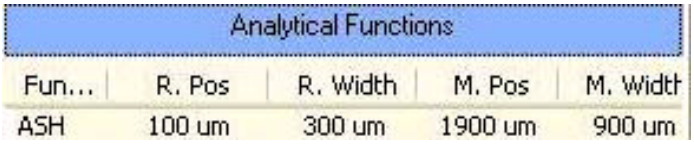


Figure 5-35: Analytical Function Appended



10 To disable **Global Edit Mode**, either:

- Click the **Global Edit** icon  .
- Select **Edit** > **Global Edit Mode** from the menu bar (see Figure 5-36).
- Right-click in the window and clear the check from the **Global Edit Mode** option (Figure 5-37).

Figure 5-36: Edit Menu with Global Edit Mode Selected

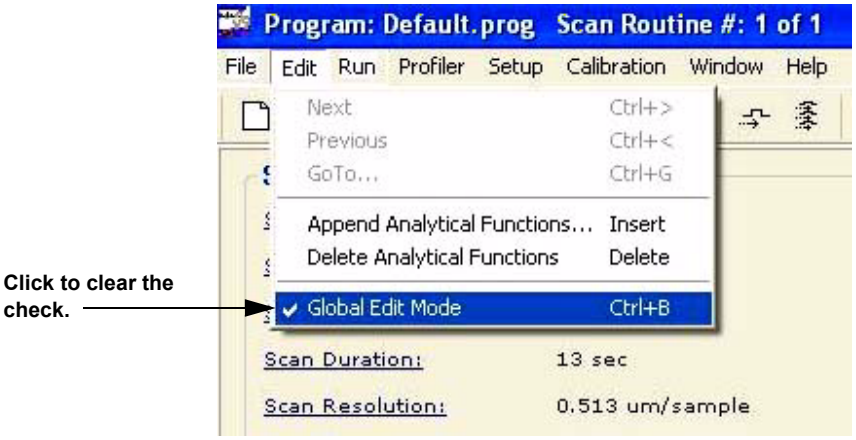
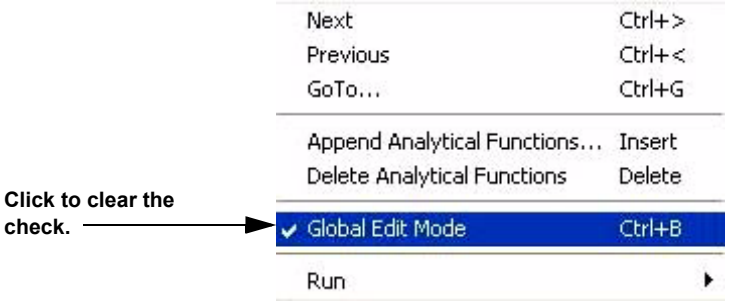


Figure 5-37: Pop-up Menu with Global Edit Mode Selected



11 Display each scan routine in turn, and notice that all four scan routines have been modified.

12 Select **File** > **Save As.**

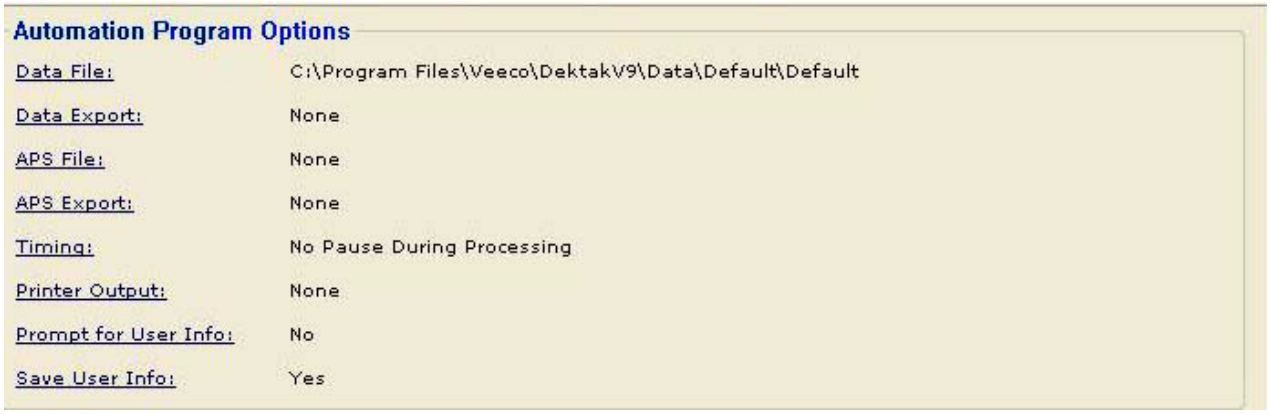
13 Enter the desired file location and file name. The path of the file location is C:\Program Files\Veeco\DektakV9\Program\, unless you have changed it (see Setup Menu on page 8-7).

NOTE – Your file name cannot have cannot contain more than 80 characters and must include the extension ".prog".

AUTOMATION PROGRAM OPTIONS

You can select various options for the automation program to be performed at the conclusion of each scan routine (see Figure 5-38).

Figure 5-38: Automation Program Window: Automation Programs Options Section



Choose from the following data-destination options:

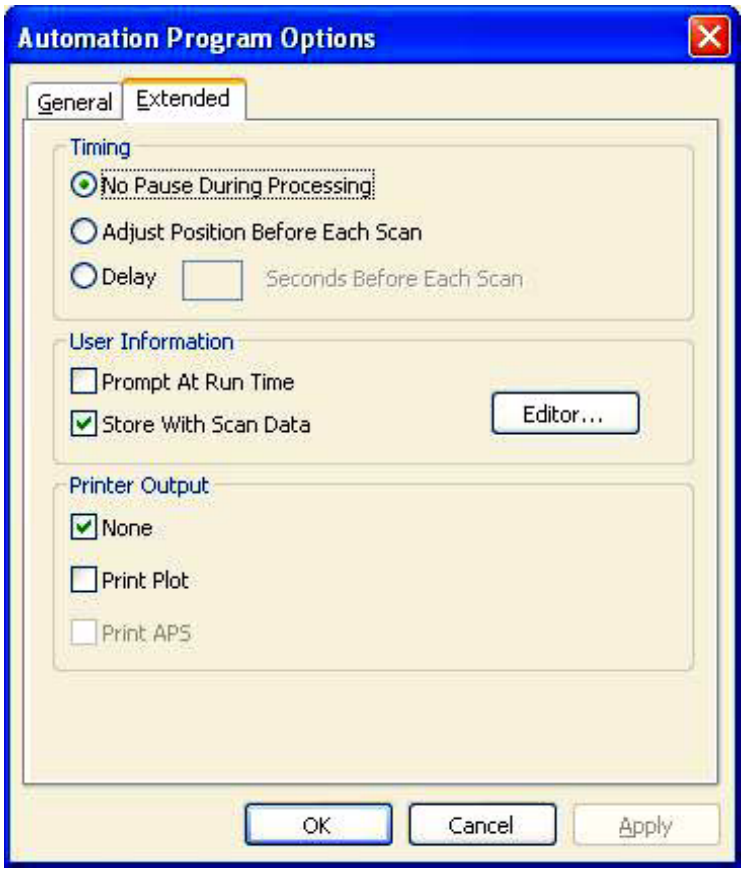
- **Data File**
- **Data Export**
- **APS File**
- **APS Export**
- **Printer Output**

In addition, the **Automation Programs Options** dialog box contains the following options on the **Extended** tab (see Figure 5-39):

- A **Timing** option that allows you to pause before each scan until you decide to continue, specify a time delay between scans, or specify no pause between scans.
- A **Prompt at Run Time** option that allows you to display the **Title/Notes** dialog box at the beginning of each scan.
- A **Store with Scan Data** option that directs the system to automatically save the **Title/Notes** dialog box along with the scan data. If you do not select this option, the **Title/Notes** dialog will not be saved.

Each of the data-destination options is described in the following sections.

Figure 5-39: Extended Tab of the Automation Program Options Dialog Box)



Data File/Data Export

When you save your scan data using the **Data File** option, the system always saves it as a *.data file (see Figure 5-41). This file type, which is not user-definable, allows you to open the file in the Dektak 150 application.

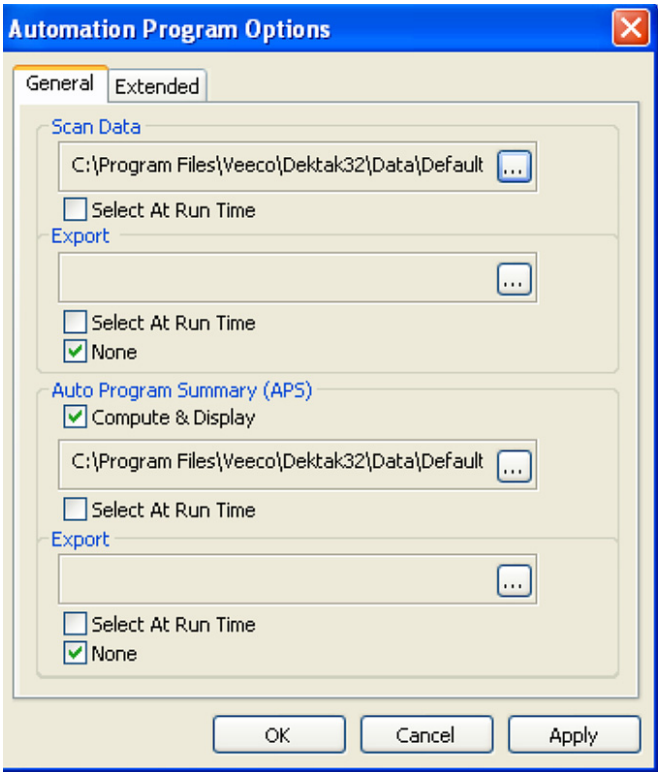
When you save your data using the **Data Export** option, you can export it as a *.csv file that can be opened in other data-processing programs.

> **NOTE –** You can also save scan data using the **Export ASCII Data** dialog box as described in Exporting a Scan Data Plot on page 5-41.

To save and export your scan data as a Data file:

1 In the **Automation Program Options** section of the **Automation Program Window**, click **Data File or Data Export** to display the **General** tab of the **Automation Program Options** dialog box (see Figure 5-40).

Figure 5-40: Automation Program Options General Tab



2 In the **Scan Data** section (see Figure 5-40), do one of the following:

- Accept the default file to save the scan data.

> **NOTE –** Unless otherwise specified, data automatically saves to the Default data file in the DektakV9\Data\Defaul\Default folder on the C: drive.

- Click the  button on the right to open the **Select Data File** dialog box (see Figure 5-41), where you can select a data file or specify a new one. For this exercise, enter **Exercise** in the file name field. Then click **Select** to close the dialog box. Leave the other options at their default settings.

Figure 5-41: Scan Data Saved as a Dataset File

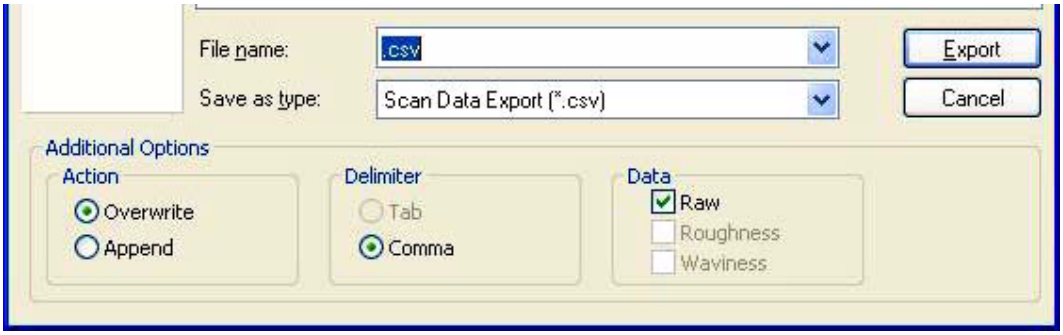
- Select the **Select At Run Time** check box to wait until the scan has run before you choose the file to save the scan data.

3 In the **(Scan Data) Export** section (see Figure 5-40), do one of the following:

- Select the **None** check box, which prevents ASCII scan data from being exported.
- Select the **Select At Run Time** check box to wait until the completion of a scan before choosing the file to save the exported ASCII scan data.

- Click the ... button to open the **Specify File** dialog box (see Figure 5-42), where you can select a text file or specify a new one for your exported ASCII scan data. The **Additional Options** section in this dialog box allows you to choose either tabs or commas as data delimiters, and to specify whether to overwrite or append data when using an existing file. It also allows you to select the Data Type.

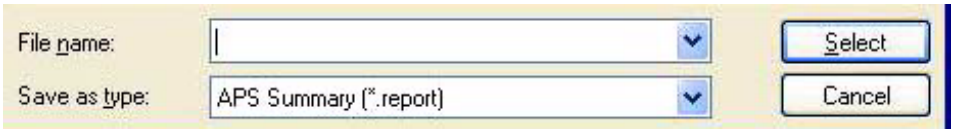
Figure 5-42: Specify File Dialog Box for Exporting ASCII Data



4 In the **Auto Program Summary (APS)** section (see Figure 5-40), do one of the following:

- Leave both check boxes cleared, which prevents the APS Report from being computed and saved.
- Select the **Compute & Display** check box, which directs the Dektak 150 software to compute the APS Report.
- Click the button to open the **Specify File** dialog box (see Figure 5-43), where you can select a .report file or specify a new one for your APS Report.
- Select the **Select At Run Time** check box to wait until the completion of a scan before choosing the file in which to save the APS Report.

Figure 5-43: Specify File Dialog Box for APS Summary Report

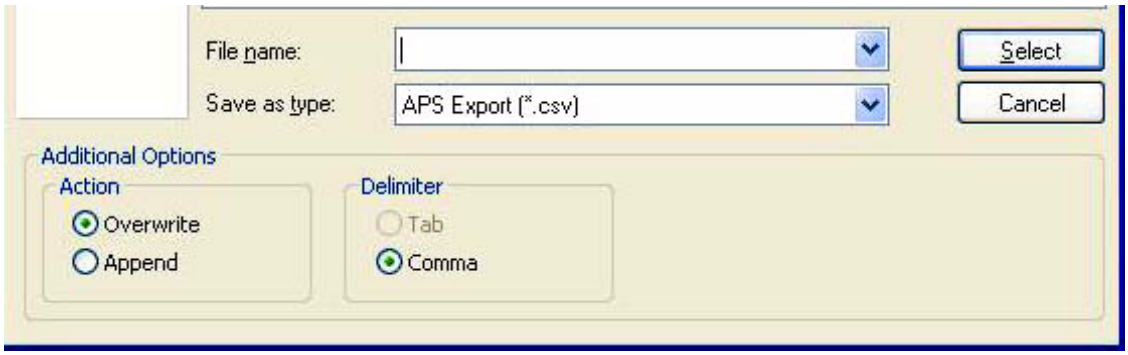


NOTE – For more information about APS Reports, see the section that follows.

5 In the **(APS) Export** section, you have the following choices:

- Select the **None** check box, which prevents ASCII APS data from being exported.
- Select the **Select At Run Time** check box to wait until the completion of a scan before choosing the file in which to save the exported ASCII APS data.
- Click the ... button to open the **Specify File** dialog box, where you can select a text file or specify a new one for your exported ASCII APS data.

Figure 5-44: Specify File Dialog Box for ASCII APS Report Data



6 When you have finished, click **Apply** and then click **OK** to close the **Automation Program Options** dialog box.

WORKING WITH APS REPORTS

The Automation Program Summary (APS) Report contains the following items:

- A grid that summarizes the results of each analytical function in the automation program.
- A graphical plot of each analytical function.

The grid and plot appear in a window that pops up in the lower left corner of the **Data Plot** window (see Figure 5-49). During the scan, the plot (shown in the lower left corner of Figure 5-49) updates on a real-time basis.

> **NOTE –** The Dektak 150 application generates a plot for all analytical functions in the automation program. It cannot plot only selected analytical functions.

At the end of the scan run, you can use the APS Report to select and rerun only certain scan routines. For instructions, see Rerunning Selected Scans in the APS Report on page 5-32.

Activating the APS Report Function

1 Make sure that all of the scan routines in the automation program have identical parameters. To do this, use the **Global Edit Mode** in the **Scan Routines** window. For instructions, see Global Editing of Scan Routine Parameters on page 5-18.

2 Click the **Automation Programs** icon or select **Window** > **Automation Programs** to display the **Automation Program** window.

3 In the **Automation Programs Options** section, click **APS File** to display the **General** tab of the **Automation Program Options** dialog box (see Figure 5-45).

Figure 5-45: General Tab of the Automation Program Options Dialog Box

4 In the **Auto Program Summary (APS)** section, select the **Compute & Display** check box.

5 If you want the Dektak 150 application to automatically save the APS Report to a text file upon completion of each scan routine:

   a. Click the ... button to open the **Specify File** dialog box (see Figure 5-43).

   b. In the **File name** field, select an existing text file or specify a new one. (The extension .report is automatically added.)

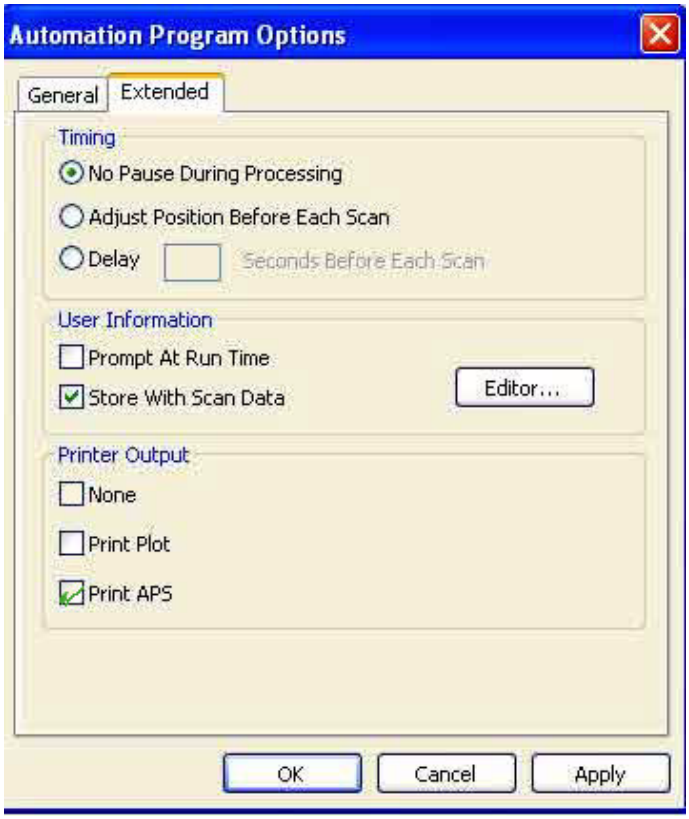
   c. Click **Select**, and then click **Apply**.

6 If you want to specify the file in which to save the APS Report at the end of each scan run, select the **Select At Run Time** check box.

7 If you want the Dektak 150 application to automatically print the APS Report in landscape orientation on a single page, click the **Extended** tab. In the **Printer Output** section, select the **Print APS** check box, click **Apply**, and then click **OK**.

Figure 5-46: Printer Output Section of the Extended Tab

Figure 5-47: Extended Tab of the Automation Program Options Dialog Box



8 In the **Automation Program** window, select **Run** > **Auto Program** (see Figure 5-48). The APS Report for the current analytical function appears over the **Data Plot** window (see Figure 5-49). For more information, see Contents of the APS Report on page 5-30.

Figure 5-48: Run Menu with Auto Program Selected

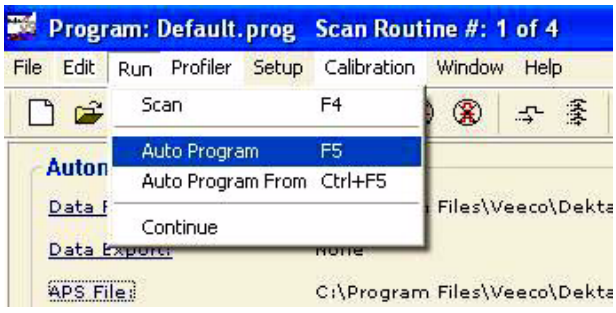
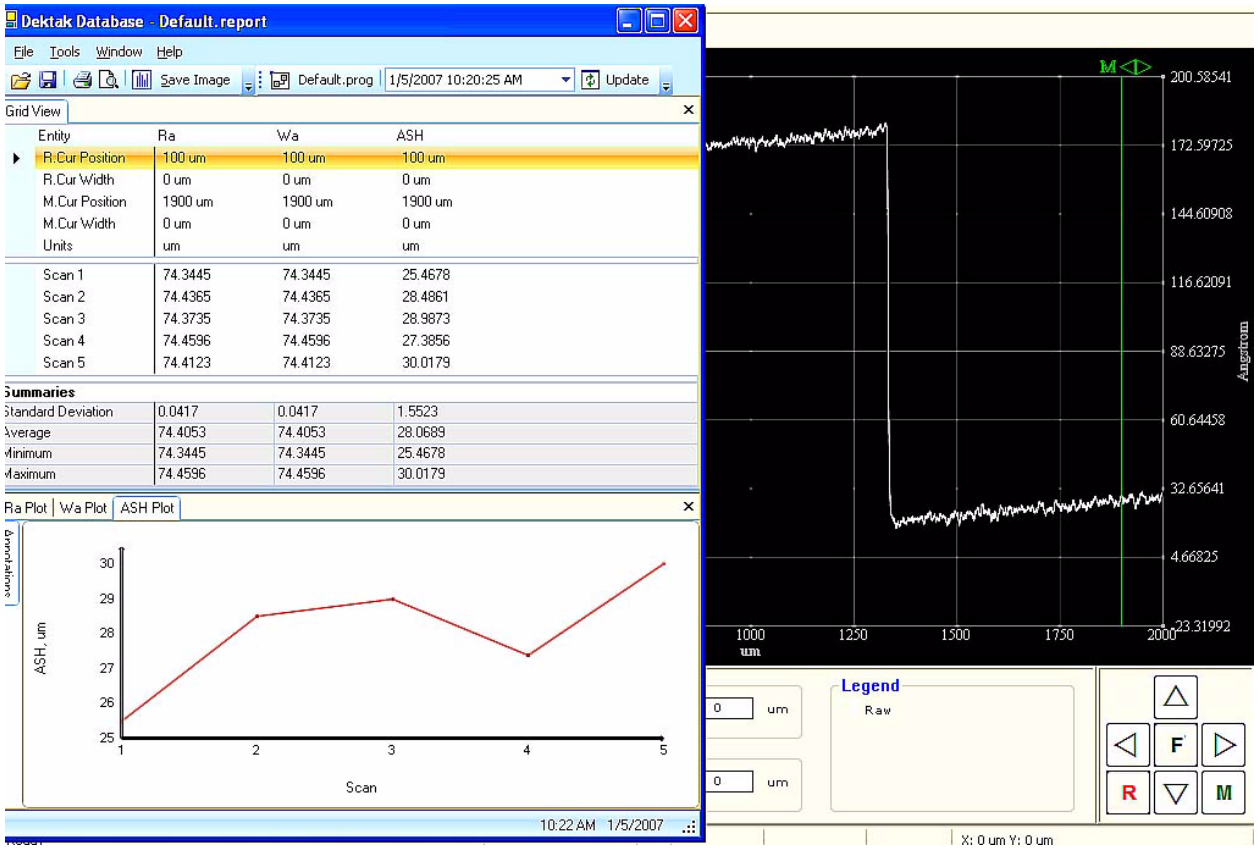


Figure 5-49: APS Report Superimposed Over the Data Plot Window



9 If you did not choose to automatically export and/or print the APS Report:

- Click the **Save** icon on the **APS Report** toolbar. Alternatively, select **File** > **Save** or **File** > **Save As** from the **Automation Program Window** menu bar.
- Enter a file name in the dialog box and click **Save.** The .report extension is automatically appended.
- To print an APS Report, click the **Print** icon on the **APS Report** toolbar. Alternatively, select **File** > **Print** > **Auto Program Summary (APS)**.

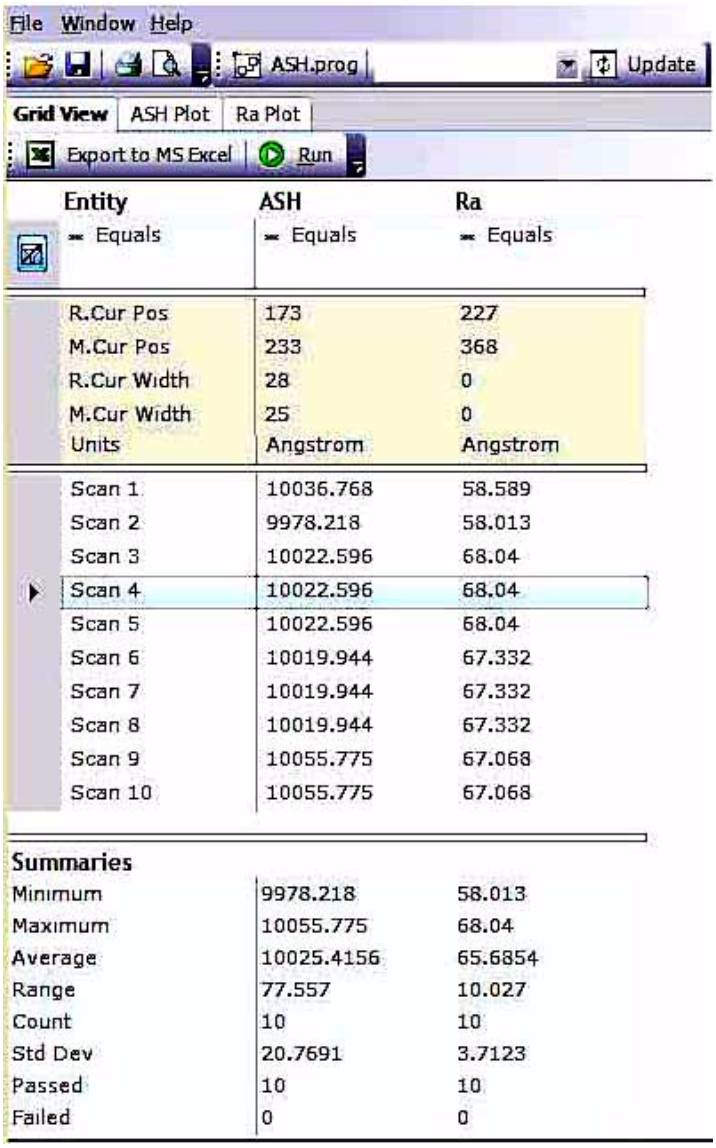
Contents of the APS Report

The APS Report includes a **Grid View** tab (see Figure 5-50) providing information about all of the scan routines that have run in this animation program. It also contains tabs displaying the final graphical plot of each analytical function that has run.

Grid View Tab of the APS Report

The statistics shown on the **Grid View** tab are described after Figure 5-50.

Figure 5-50: Grid View Tab of the APS Report



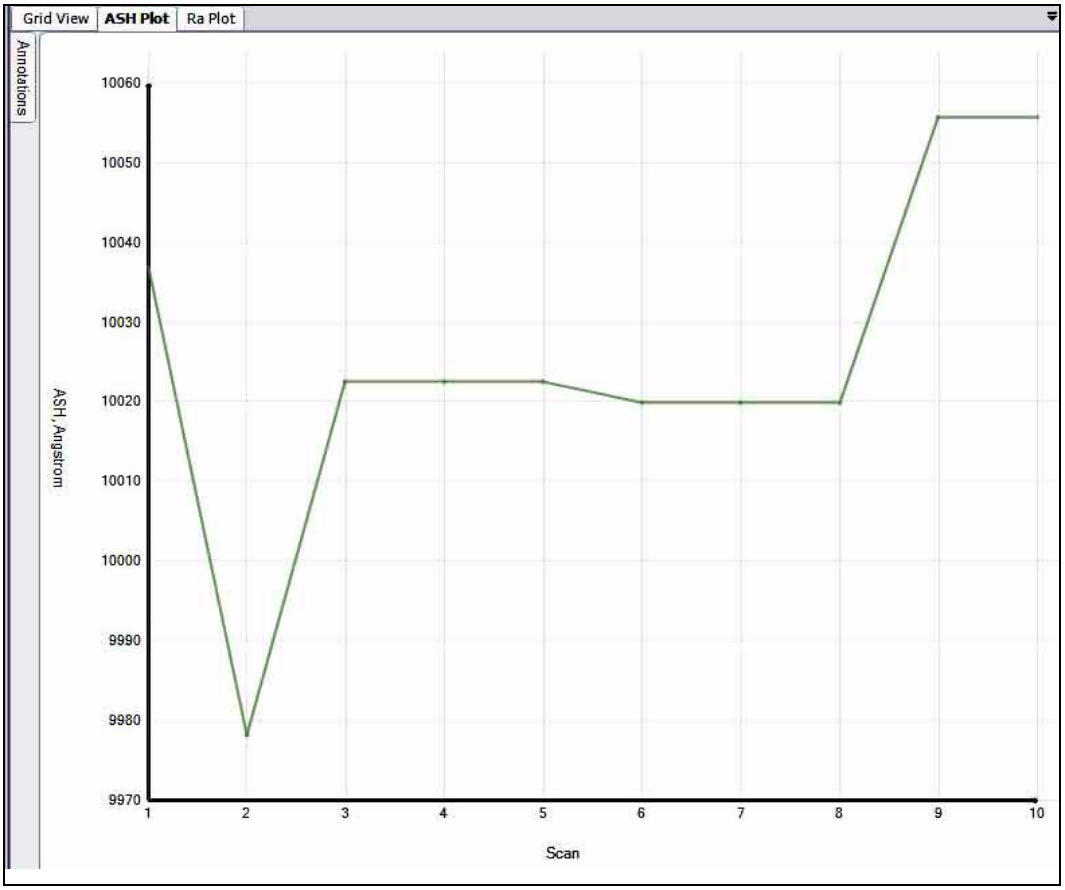
Entity	ASH	Ra
= Equals	= Equals	= Equals
R.Cur Pos	173	227
M.Cur Pos	233	368
R.Cur Width	28	0
M.Cur Width	25	0
Units	Angstrom	Angstrom
Scan 1	10036.768	58.589
Scan 2	9978.218	58.013
Scan 3	10022.596	68.04
Scan 4	10022.596	68.04
Scan 5	10022.596	68.04
Scan 6	10019.944	67.332
Scan 7	10019.944	67.332
Scan 8	10019.944	67.332
Scan 9	10055.775	67.068
Scan 10	10055.775	67.068
Summaries		
Minimum	9978.218	58.013
Maximum	10055.775	68.04
Average	10025.4156	65.6854
Range	77.557	10.027
Count	10	10
Std Dev	20.7691	3.7123
Passed	10	10
Failed	0	0

- The items in the bar above the grid include the automation program file name as well as the automation program start time and date.
- The first section lists information about the reference and measurement cursors for each analytical function.
- The second section lists the individual analytical function results for each scan routine.
- The **Summaries** section summarizes the mean, standard deviation, minimum, maximum and range of the analytical function for all the scan routines.

Plot Tabs of the APS Report

Each **Plot** tab (see Figure 5-50) of the APS Report shows the final plot that was generated for that analytical function during the scan. You can click and drag to resize each plot (see Figure 5-51).

Figure 5-51: ASH Plot Tab of an APS Report



Rerunning Selected Scans in the APS Report

You can select and rerun certain scan routines in the APS Report. After a rerun, you can exclude some of the scan routines that you selected and run the automation program again.

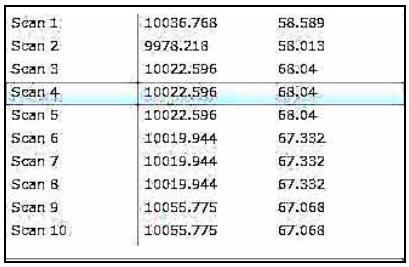
To rerun selected scans in the APS Report:

1 In the list of scan routines on the **Grid View** tab (Figure 5-52), do one of the following:

- Left-click the mouse on the left button to select an entire row.
- Use the CTRL key on the keyboard along with the left mouse button to select multiple rows.
- Use the SHIFT key on the keyboard along with the left mouse button to select two rows and all of the rows in between.
- Press CTRL+A on the keyboard to select every scan row.

The selected scan row(s) appear highlighted.

Figure 5-52: Scan Routines List with One Selected Scan



Scan 1	10036.768	58.589
Scan 2	9978.218	58.013
Scan 3	10022.596	68.04
Scan 4	10022.596	68.04
Scan 5	10022.596	68.04
Scan 6	10019.944	67.332
Scan 7	10019.944	67.332
Scan 8	10019.944	67.332
Scan 9	10055.775	67.068
Scan 10	10055.775	67.068

2 Click the **Run** button on the **Grid View** toolbar.

3 To exclude one or more of the scan routines from another rerun:

a. Right-click the mouse on a selected row and select **Exclude** from the pop-up menu. The excluded scan rows are hidden, and the calculations will not include the excluded rows.

b. To change any rows from Excluded to Included status, right-click the mouse on any row and select **Include** from the pop-up menu or press **CTRL+I** on the keyboard.

The automation program runs only the selected scan routines, and the new data appears in the APS Report in the selected rows. The **Summary** statistics are also updated.

Selecting a Rerun Scan for Viewing

When the APS Report for each rerun scan is saved, it does not overwrite the APS Reports for the previous reruns. Instead each report is given a Date/Time stamp and saved individually.

To display a selected APS Report:

1 Select the desired time stamp from the drop-down list to the left of the **Update** button.

2 Click the **Update** button (see Figure 5-53).

Figure 5-53: Update Button and List

Opening a Saved APS Report

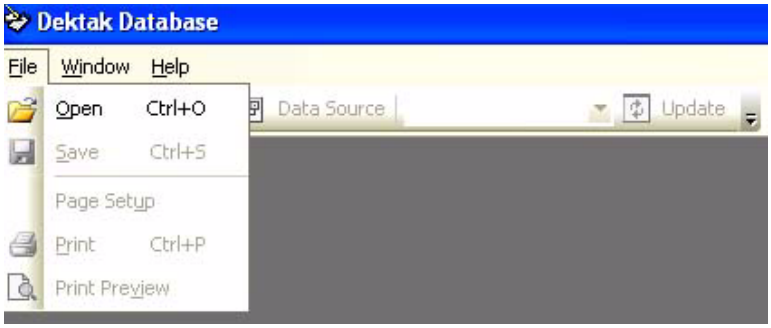
You can open an APS Report inside or outside of the Dektak 150 application.

To open a saved APS Report within the Dektak 150 application:

1 Click the **Open** icon on the **APS Report** toolbar. Alternatively, select **Window > Automation Program Summary**. The **Dektak Database** window appears (see Figure 5-54).

2 Click **File > Open** (see Figure 5-54). The **Open File** dialog box appears with a list of files saved under the .report extension.

Figure 5-54: Dektak Database Window with File > Open Selected



3 Select the desired APS Report file and click **Open**.

To open a saved APS Report when Dektak is not running:

1 Click the desktop shortcut to the Dektak database or navigate to C:\Program Files\Veeco\DektakV9\Data\dektakdatabase.exe.

2 Double-click the APS Report file that you want to open.

Exporting an APS Report to Excel

To export an individual APS Report to Microsoft® Excel®:

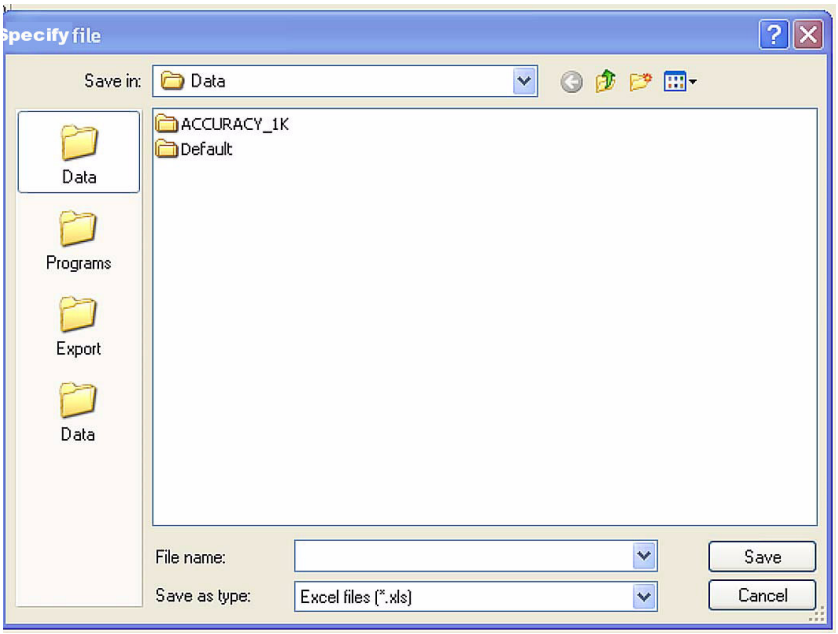
1 Do one of the following:

- Click the **Export to Excel** icon 

on the **APS Report** toolbar.
- Right-click the **APS Grid** tab (see Figure 5-50) and point to **Export to Excel**.

The **Specify File** dialog box appears.

Figure 5-55: Specify File Dialog Box



2 In the **Save in** field, navigate to the location where you want to save the file.

3 In the **File name** field, enter a file name.

4 In the **Save as type** list, select **Excel Files (*.xls)**.

5 Click **Save**.

NOTE – Within Excel, all exported values are stored as text only. If you want to manipulate these values, you must first manually convert each cell to the Excel number format.

ENABLING MICROFORM MEASUREMENT

The MicroForm measurement algorithm adjusts the X axis to compensate for the arcing motion of the stylus. This increases the accuracy for the slope calculation, the area and volume calculations, and any other analysis that requires a highly accurate lateral and slope calculation.

The algorithm is based on the length of the stylus tip and the length of the stylus area added to the privot point in the sensor. These values are controlled tightly in production and do not vary by more than 0.005” during calibration.

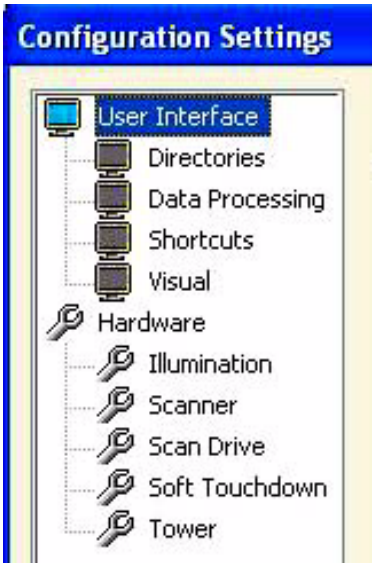
To enable MicroForm measurement:

1 From the **Setup** menu, select **Configuration Settings**.

2 In the **Password** field, enter `Dektak32` and click **Enter** (see Figure 5-56). The **Configuration Settings** menu appears (see Figure 5-57).

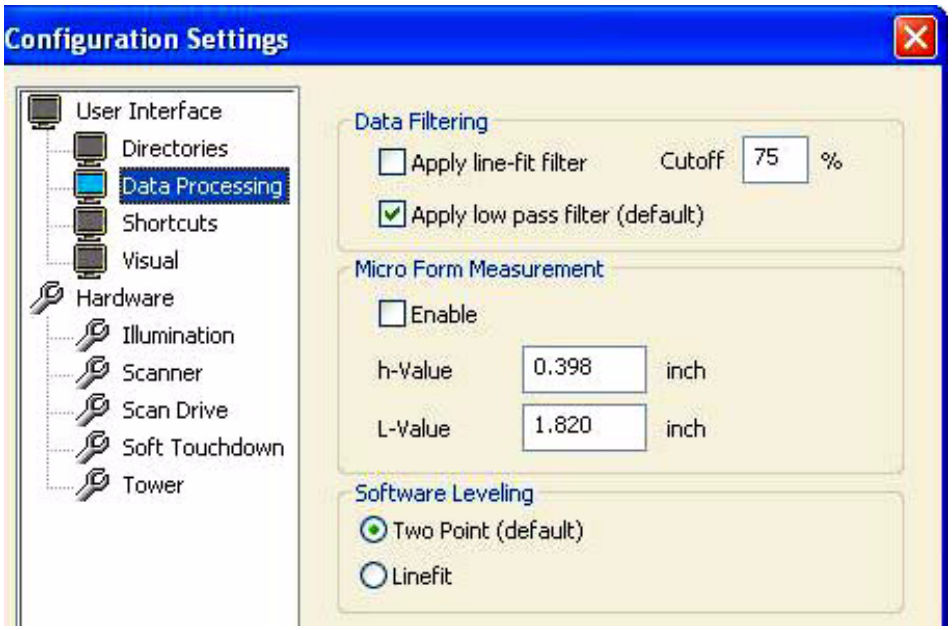
Figure 5-56: Password Required Dialog Box

Figure 5-57: Configuration Settings Menu



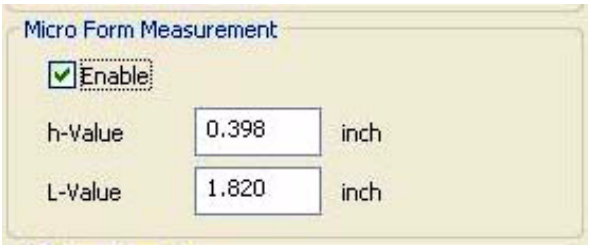
3 In the **User Interface** section, click **Data Processing**. The **Data Processing** settings appear. (see Figure 5-58)

Figure 5-58: Configuration Settings Dialog Box with Data Processing Settings Displayed



4 In the **Micro Form Measurement** section, select the **Enable** check box (see Figure 5-59).

Figure 5-59: Micro Form Measurement Section



5 Click **Apply**, and then click **OK**.

> **NOTE –** The h and L values in the **Micro Form Measurement** section are factory-set. If there is a problem with these settings, call Veeco.

SETTING PRINTER OPTIONS

In the **Automation Program** window, click **Printer Output** in the **Automation Program Options** section. This opens the **Extended** tab in the **Automation Program Options** dialog box (see Figure 5-13). You have three printer options: **None**, **Print Plot**, and **Print APS** (see Figure 5-60).

Figure 5-60: Printer Output Section of the Extended Tab

Make one or more of the following selections:

- Select **None** to prevent the printer from producing any printouts.
- Select **Print Plot** to print the plotted profile trace after each completed scan routine, along with the scan data. The plot prints on a single page.
- Select **Print APS** to print the Automation Program Summary Report in landscape orientation on a single page. For more information, see Activating the APS Report Function on page 5-27.

SETTING THE TIMING OPTIONS

In the **Automation Program** window, click **Timing** in the **Automation Program Options** section to display the **Extended** tab of the **Automation Programs** dialog box (see Figure 5-13).

Select one of the following options in the **Timing** section (see Figure 5-61):

- Select **No Pause During Processing** to direct the system to run all scan routines within the automation program one right after another.
- Select **Adjust Position Before Each Scan** to direct the system to stop after each scan routine. This allows the operator to make any necessary adjustments to the sample position between scans.

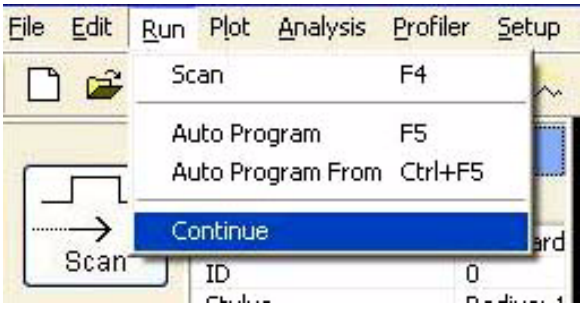
Figure 5-61: Timing Section of the Extended Tab

- Select **Delay** to open the **Pause Automation Program** dialog box (see Figure 5-62) and enter the number of seconds for a time delay that will occur between scans.

Figure 5-62: Pause Automation Program Dialog Box

Select **Run** > **Continue** (see Figure 5-63) from the menu bar to move to the next scan routine in the sequence contained in the automation program.

Figure 5-63: Run Menu with Continue Selected



ADDING USER INFORMATION

You can add up to five user notes to each set of scan data. Each note can be up to 80 characters long. You can either preset the user notes when creating an automation program or require the system to

prompt the user to enter notes prior to running a scan. In any set of scan data, new notes can be added, and existing notes can be edited.

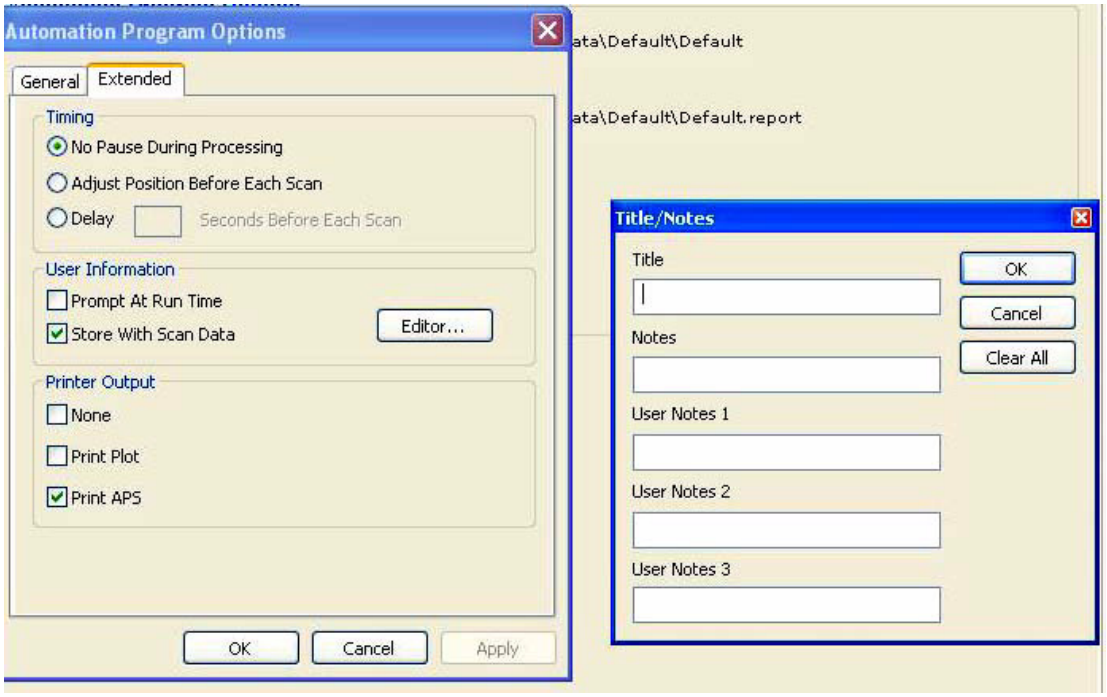
In the **Automation Program** window, click **Prompt for User Info** or **Save User Info** to open the **Extended** tab of the **Automation Program Options** dialog box (see Figure 5-13).

In the **User Information** section (see Figure 5-64), make the following selections:

- Select or clear the **Prompt at Run Time** check box to indicate whether or not you want the system to display the **Title/Notes** dialog box at the beginning of each scan that you run using an automation program.
- If desired, enter information in the **Title/Notes** dialog box that will appear by default at the beginning of each scan. To do this, click **Editor** and enter your information in the **Title** and **Notes** fields (see Figure 5-65). Typically, this information indicates the part, the operator, the tool, the process, or other measurement specifics.
- Select or clear the **Store with Scan Data** check box to indicate whether or not you want the system to automatically save the **Notes/Title** dialog box along with the scan data.

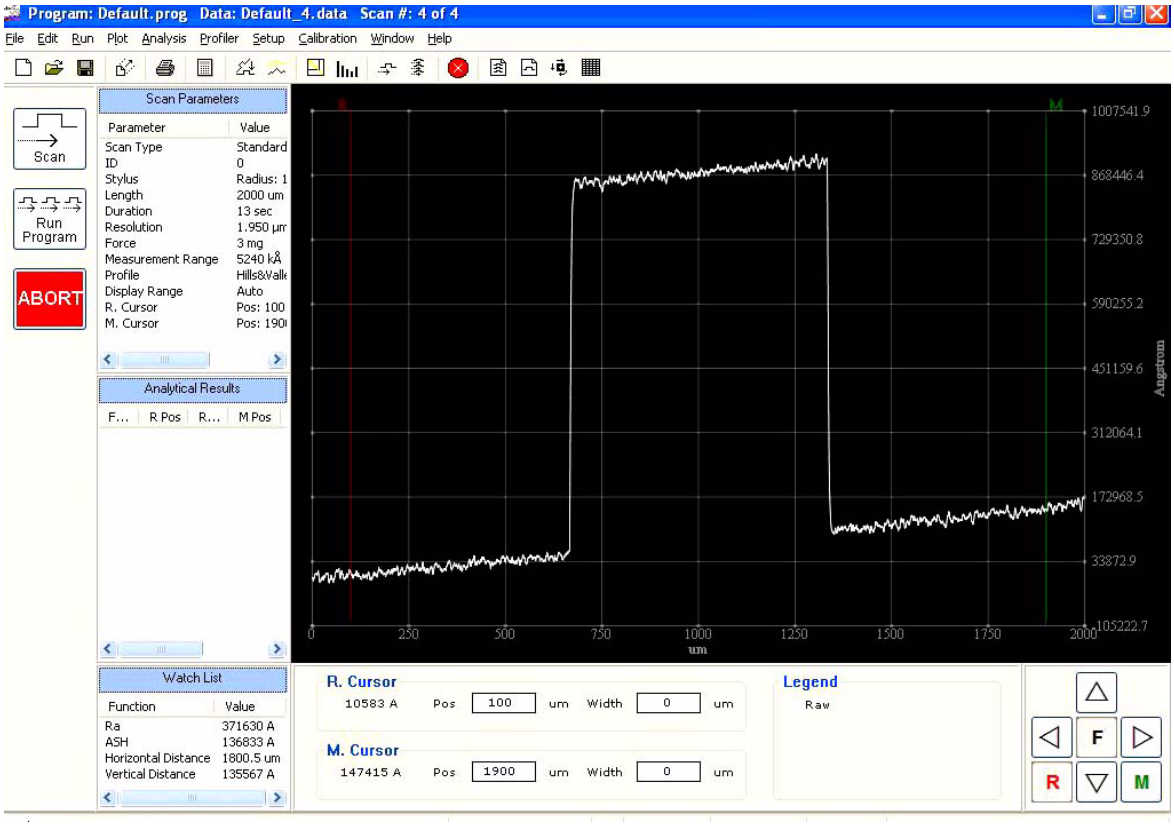
Figure 5-64: User Information Section of the Extended Tab

Figure 5-65: Extended Tab with the Title/Notes Dialog Box Displayed



RUNNING A MULTIPLE SCAN ROUTINE

Figure 5-66: Data Plot Window Showing a Multiple Scan Routine



1 Click **Run** > **Auto Program**. The following sequence of events occurs:

- The **Data Plot** window appears with the scaled grid superimposed over the camera view pane of the stylus and calibration standard.
- The stylus lowers onto the sample surface. After a brief pause, the scan commences. As the stylus scans across the calibration standard, the full scale profile trace plots on the scaled grid in real time (see Figure 5-66).

> **NOTE –** With many camera setups, during a scan the video image shows the sample moving from right to left below the stylus. In actuality, the stage is moving from back to front.

- Once the first scan is complete, the stylus lifts off the surface, and the stage resets to the starting point of the next programmed scan.
- When the final scan is complete, the stylus lifts, and the stage returns to the location where the scan originated. The profiler then automatically replots and rescales.

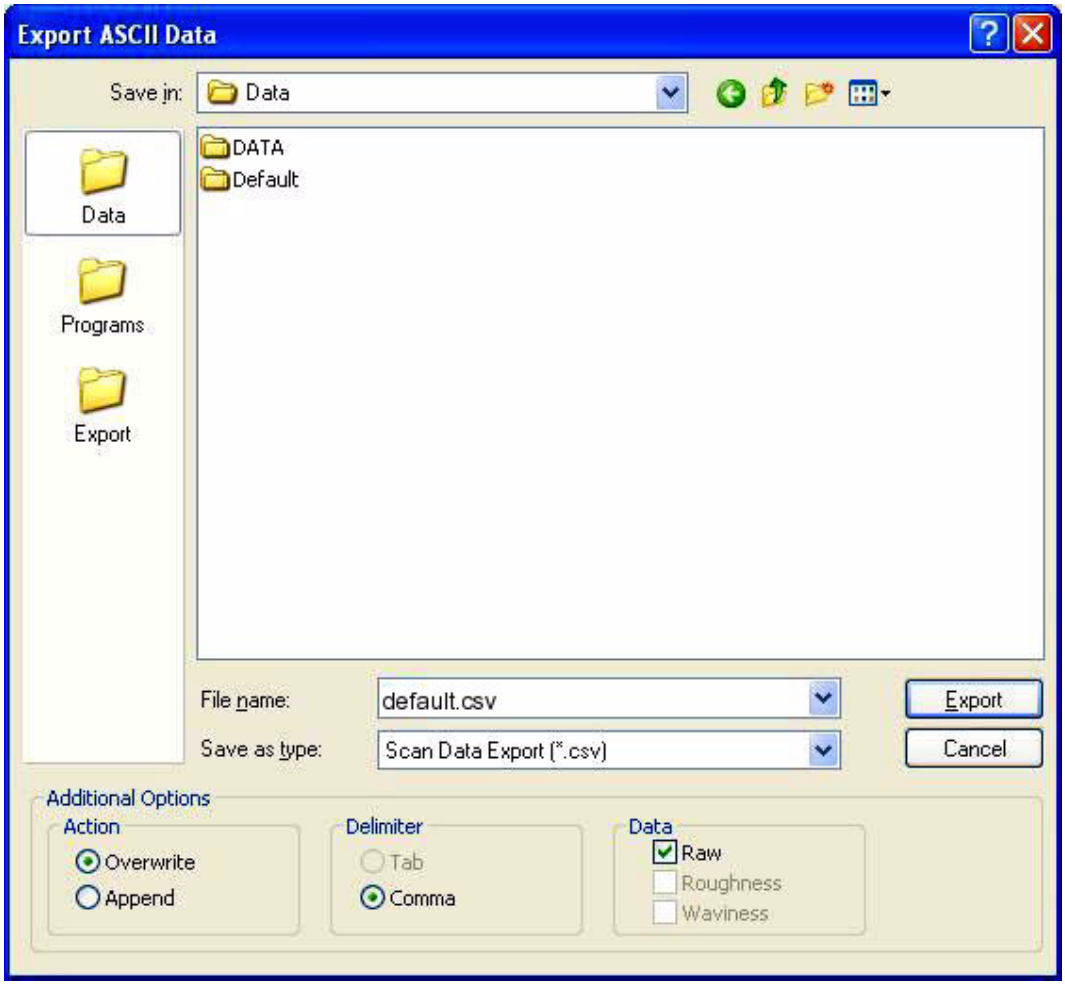
> **NOTE –** If problems occur during a scan, you can log them and send them to Veeco. If you need to abort a scan, see Aborting an Operation on page 4-21.

EXPORTING A SCAN DATA PLOT

Rather than using the automation program export functions as described in Data File/Data Export on page 5-24, you can export one or more data plots using the **Export ASCII Data** dialog box. If you specify the short pass filter and the long pass filter that generate roughness and waviness scan data, you can export that data along with the raw data. For more information, see Display Parameters on page 5-13.

1. Click the **Export Scan Data** icon or select **File > Export**. The **Export ASCII Data** dialog box appears.
2. Click the **Data** folder and navigate to the file(s) you want to export.
3. In the **Save in** field, navigate to the location where you want to save the files.
4. Make your selections in the **Additional Options** section.
5. Click **Export**.

Figure 5-67: Export ASCII Data Dialog Box



OPENING A SAVED SCAN DATA PLOT

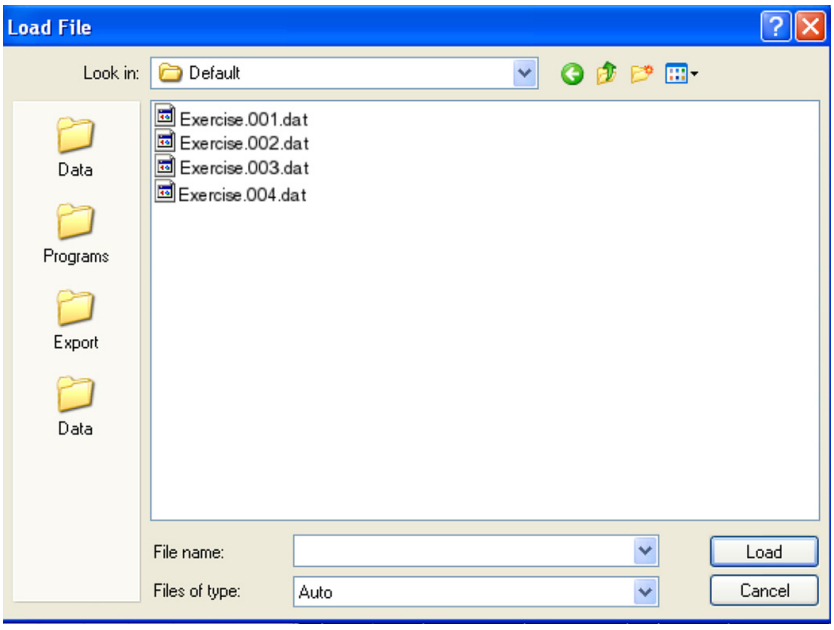
In this exercise, you will run the current automation program to demonstrate how the data file option saves data plots to the selected file name.

1. Click the **Run Automation Program** icon or select **Run** > **Auto Program** to run the automation program and save the data plot.
2. Select **File** > **Open** at the conclusion of the automation program to retrieve the data plots through the **Load File** dialog box (see Figure 5-68).
3. Under **Files of type**, confirm that **Auto** has been selected. This displays all stored Dektak 150 files, including data and program files.

> **NOTE –** The data plot from scan routines 1, 2, 3 and 4 are filed under Exercise.001.dat, Exercise.002.dat, Exercise.003.dat, and Exercise.004.dat, respectively.

4. Select **Exercise.001.dat** and click **OPEN** to replot and redisplay the data plot from the first scan routine.

Figure 5-68: Load File Dialog Box.



POST-SCAN PROCESSING

To learn how to work with the automation program and scan data after the scan, see the following sections:

- Printing the Scan Data on page 4-19
- Saving an Automation Program on page 4-20
- Opening a Dektak 150 Scan in Vision on page 4-22
- Saving upon Exiting the Dektak Program on page 4-23

6

ANALYTICAL FUNCTIONS

The analytical functions that are included as part of the standard Dektak 150 software allow you to perform complex analytical computations on the profile data.

ABOUT ANALYTICAL FUNCTIONS

The Dektak 150 application has many different analytical functions for measuring surface texture and other parameters. The following section provides the abbreviation for each function as it appears on the screen, along with a brief description of the parameter. By using these functions to analyze the profile data, you can obtain valuable information for controlling and monitoring a production process.

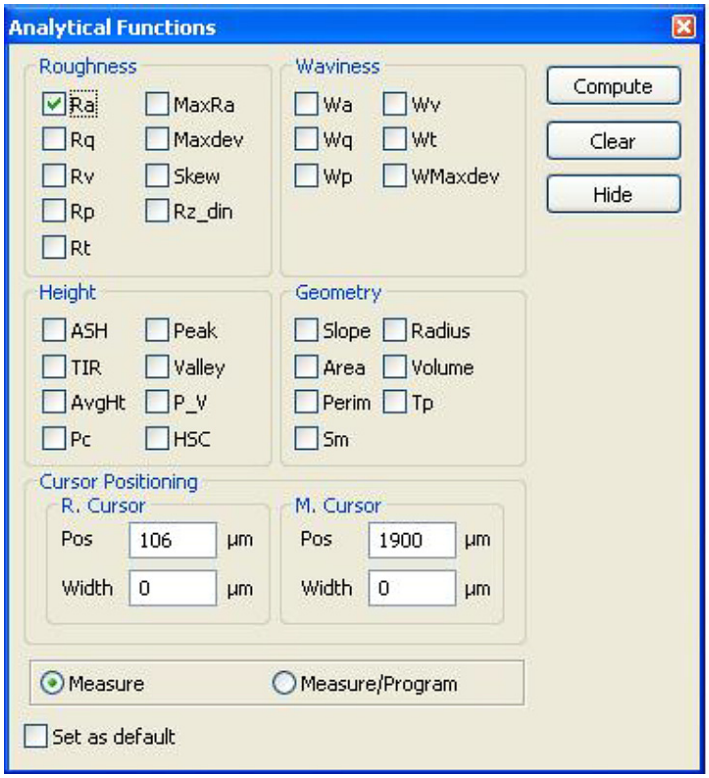
The analytical functions are grouped by applications: roughness, waviness, height, and geometrical parameters.

There are two similar versions of the **Analytical Functions** dialog box, depending on the window that is active when the dialog box is opened.

- To open the **Analytical Functions** dialog box from the **Scan Routines** window, click the **Append Analytical Functions to Current Scan Routine** icon, or select **Edit** > **Append Analytical Functions** from the menu bar. See Figure 6-16. (For further information on this version of the **Analytical Functions** dialog box, see Entering Filter Cutoffs into a Scan Routine.)
- To open the **Analytical Functions** dialog box from the **Data Plot** window, click the **Display Analytical Functions Dialog Box** icon, or select **Analysis** > **Analytical Functions** from the menu bar. See Figure 6-15 at the right. (For further information on this version of the **Analytical Functions** dialog box, see Measuring and Entering Analytical Functions on page 6-15.)

NOTE – To speed up your work, you can assign analytical functions to keystrokes. For instructions, see Assigning Analytical Functions to Keystrokes on page 3-6.

Figure 6-1: Analytical Functions Dialog Box from Data Plot Window



If you plan to conduct extensive surface texture analysis, refer to the ANSI B46.1 specification on surface texture. You can obtain a copy of this specification from the American Society of Mechanical Engineers, 345 East 47th Street, New York, NY 10017, telephone number: 1-800-843-2763, web site: www.asme.org.

ROUGHNESS PARAMETERS

The following parameters are listed alphabetically.

Maxdev (Maximum Deviation)

Calculates the furthest data point above or below the mean line.

MaxRa (Maximum Ra)

Identifies the portion of the assessment length that has the highest Ra. The assessment length, defined by the cursors, divides into nineteen overlapping segments. Each segment is equal to one-tenth of the assessment length distance. The Ra is calculated for each segment. The R cursor positions in the center of the segment with the highest Ra. You can program only one MaxRa into a scan program.

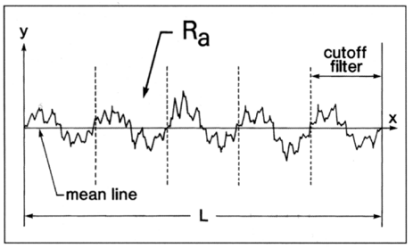
MaxRa (Maximum Roughness)

Identifies the portion of the assessment length that has the highest Ra. The assessment length, defined by the cursors, divides into nineteen overlapping segments. Each segment is equal to one-tenth of the assessment length distance. The Ra is calculated for each segment. The R cursor positions in the center of the segment with the highest Ra. You can program only one MaxRa into a scan program.

Ra (Average Roughness)

Formerly known as Arithmetic Average (AA) and Center Line Average (CL), Ra is the universally recognized, and most used, international parameter of roughness. It is the arithmetic average deviation from the mean line within the assessment length.

Figure 6-2: Ra Roughness Analytical Function



R_a is the arithmetic average deviation from the mean line within the assessment length (L).

$$R_a = \frac{1}{L} \int_{x=0}^{x=L} |y|\, dx$$

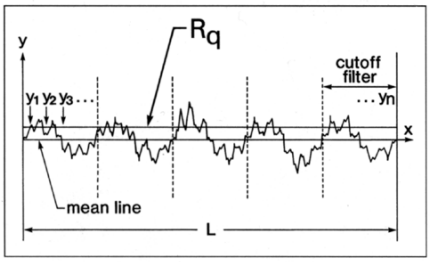
RP (Maximum Peak)

The maximum height or the highest peak of the profile roughness above the mean line, within the assessment length (see Figure 6-2).

Rq (Root-Mean-Square (RMS))

Determines the root-mean-square value of roughness corresponding to Ra (see Figure 6-3). Rq has the greatest value in optical applications where it is directly related to the optical quality of a surface.

Figure 6-3: Rq Roughness Analytical Function



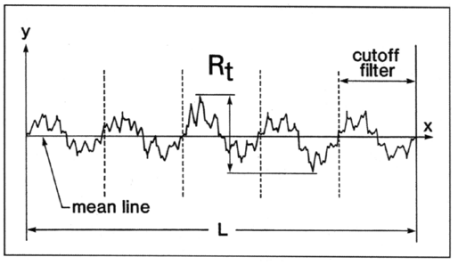
R_q is the corresponding parameter to Ra and is the RMS value of roughness.

$$R_q = \sqrt{\frac{1}{L}\int_o^L y^2\,(x)dx}$$

Rt (Maximum Peak to Valley)

The sum total of the maximum peak and maximum valley measurements of roughness within the assessment length (Rt = Rp + Rv) (see Figure 6-4).

Figure 6-4: Rt Roughness Analytical Parameters



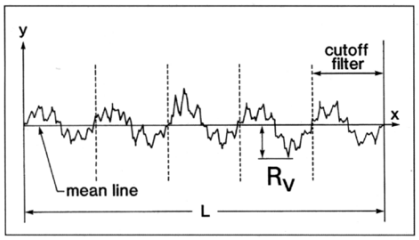
R_t is the sum total of the maximum valley and maximum peak of roughness.

$R_t = R_p + R_v$

Rv (Maximum Valley)

The lowest point, or the maximum depth of the profile roughness below the mean line, within the assessment length (see Figure 6-5).

Figure 6-5: Rv Roughness Analytical Function

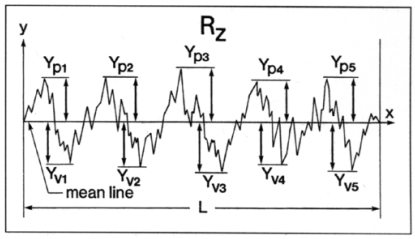


R_v is the maximum depth or the lowest point of roughness below the mean line.

RZ_din (Ten Point Height Average)

The average height difference between the five highest peaks and the five lowest valleys in accordance with DIN 4768/1 specification published by the Deutsche Institut fuer Normung c.v. (see Figure 6-6).

Figure 6-6: Rz Roughness Analytical Parameter



R_z is the average height difference between the five highest peaks and the five lowest valleys of roughness.

$$R_{z\ (ISO)} = \frac{1}{5}\left(\sum_{i=1}^{5} Y_{pi} + \sum_{i=1}^{5} Y_{vi}\right)$$

Skew (Skewness)

The symmetry of the profile about the mean line. It distinguishes between asymmetrical profiles of the same Ra or Rq. Skewness is non-dimensional.

NOTE – For best results, software level the scan trace prior to calculating any analytical functions.

$$R_{SK} = \frac{1}{LR_q^3}\int_0^L r^3(x)dx$$

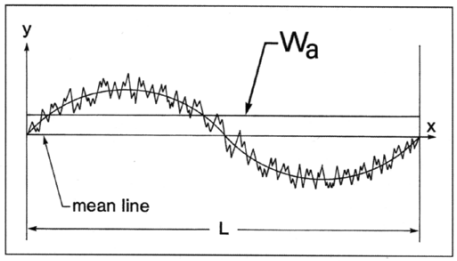
WAVINESS PARAMETERS

The following parameters are listed alphabetically.

Wa (Arithmetic Average of Waviness)

The average deviation of waviness from the mean line (see Figure 6-7). (Corresponds to Ra.)

Figure 6-7: Wa Waviness Analytical Function



W_a is the arithmetic average deviation of waviness from the mean line.

WMaxdev (Maximum Deviation of Waviness)

Measures the distance of the furthest data point above or below the mean line of the waviness profile. (Corresponds to Maxdev.)

Wp (Maximum Peak of Waviness)

Measures the maximum height of the highest peak of the waviness profile above the mean line. (Corresponds to Rp.)

Wq (Root-Mean-Square of Waviness)

Determines the root-mean-square (RMS) value of waviness. (Corresponds to Rq.)

Wt (Maximum Peak to Valley of Waviness)

The sum total of the maximum peak and maximum valley measurements of waviness (Wt=Wp+Wv). (Corresponds to Rt.)

Wv (Maximum Valley of Waviness)

The lowest point, or the maximum depth of the waviness profile below the mean line. (Corresponds to Rv.)

NOTE – Waviness calculations are performed on raw profile data unless you activate the low pass waviness filter.

HEIGHT PARAMETERS

The following parameters are listed alphabetically.

ASH (Delta Average Step Height)
Used to obtain a step height measurement in applications where roughness or noise is present on the profile trace. It computes the difference between two average height measurements.

Avg Ht (Average Height)
Calculates the average height of a step with respect to the zero line, using the R and M cursors to define the area of measurement.

HSC (High Spot Count)

The number of peaks per inch (or cm) that project above a line that is parallel to the mean line. A peak must cross above the threshold and then back below it.

Pc (Peak Count)
The number of peaks that project through a selectable band centered about the mean line of the assessment length. Pc is expressed in peaks/inch or peaks/cm.

Peak (Maximum Peak)
Calculates the maximum height above the baseline as determined by the cursor/trace intercepts.

P_V (Maximum Peak to Valley)
Calculates the vertical distance between the maximum peak and maximum valley.

TIR (Total Indicated Reading)
Calculates the vertical distance between the highest and lowest data points between the cursors.

Valley (Maximum Valley)
Calculates the maximum depth below the baseline determined by the cursor/trace intercepts.

GEOMETRY PARAMETERS

The following parameters are listed alphabetically.

Area (Area-Under-The-Curve)
Computes the area of a profile between the R and M cursors with respect to the horizontal zero grid line. You must level the profile for accurate results. If the profile is above the zero line, area is expressed as a positive value in square µm. If the profile is below the zero line, the result will be a negative value.

Perim (Perimeter)

Calculates the outside perimeter of a profile between the R and M cursors. A horizontal reference line is created using the R and M cursor intercepts. You must level the profile for accurate results.

Radius

A least-squares-arc is fitted to the data points and the radius is calculated from the equation for a circle. The algorithm does not distinguish between concave and convex shapes. To maximize the accuracy of the results, the following factors must be considered: (1) the sample shape must approximate a sector of a circle, and (2) the stylus tip must traverse the apex of the sample if it is a sphere. Using the largest radius stylus possible helps minimize the error. (3) Repeatability errors may dominate the measurement if the chord rise is less than 100Å for scans longer than 1 mm.

Slope

Calculates the arc tangent of the ratio of the vertical distance to the horizontal distance between the R and M cursor/trace intercepts. The result is expressed in degrees. Slope is useful only for relatively shallow slopes. If the stylus radius is too large or the step too steep, the stylus contacts the upper edge of the step before the lower edge and the slope measurement will be inaccurate.

Sm (Mean Spacing Between Peaks)

Calculates the mean spacing between peaks, as defined by downward crossing of the mean line, followed by an upward crossing to the next downward crossing. If the distance between these downward crossing points is less than 1 percent of the measurement length, then this peak is ignored. Sm is expressed as micro-inches or microns.

Tp (Bearing Ratio)

The percentage of points along the assessment length that project above a line that is parallel to the mean line.

Volume

The integration-by-shells technique is used to find the volume of a solid. This is accomplished by rotating the lamina delineated by the scan trace and a line segment connecting the cursor intercepts through 180 degrees about a vertical axis located half way between the cursors.

RUNNING A SCAN AND LEVELING THE TRACE

This exercise demonstrates how to perform an average roughness measurement at the conclusion of a scan. For this exercise, use an optically flat sample, such as the vertical standard that came with your system. Position the vertical standard so that a 2 mm scan traverses across the glass portion of the standard without encountering a step. For more information, see Sample Loading and Unloading on page 3-13 of Chapter 3.

To run a scan and level the trace:

1. Select **Window** > **Automation Programs** to display the **Automation Programs** window.
2. Select **File** > **New** from the menu to enter the default scan routine into the current automation program.
3. Select **Run** > **Scan Here** with the stage in position to run the current scan routine.

> **NOTE –** Once you run the scan routine and the profile plots, you must level the trace.

4. Select **Plot** > **Level** to replot and level the trace.

> **NOTE –** Software level the trace prior to initiating any analytical function to obtain accurate results.

MAKING AN AVERAGE ROUGHNESS MEASUREMENT

After you run the scan and level the profile trace, you may perform an analytical function from the **Data Plot** window. The procedure for executing the **Average Roughness (Ra)** analytical function on the raw profile data is described below. The analytical function domain is on the data between the R and M cursors. You can relocate the cursors if desired, but for this exercise use the default cursor setting of 100 and 1900 µm for a 2 mm scan.

1. Select **Analysis** > **Analytical Functions** to display the **Analytical Functions** dialog box with selections for setting roughness, waviness, heights, and geometry parameters.
2. Click **Ra** under **Roughness** in the **Analytical Functions** dialog box (see Figure 6-1).
3. Click **Measure** in the **Analytical Functions** dialog box (selecting **Measure and Program** automatically enters the analytical function into the scan routine program).
4. Click **Compute** to clear the dialog box and calculate the average roughness.

> **NOTE –** The result from the **Ra** function and the cursor locations display in the **Analytic Results** area located on the left of the **Data Plot** window. An asterisk appears next to the **Ra** indicating that the analytical function was calculated on raw, unfiltered data.

Figure 6-8: Compute Ra

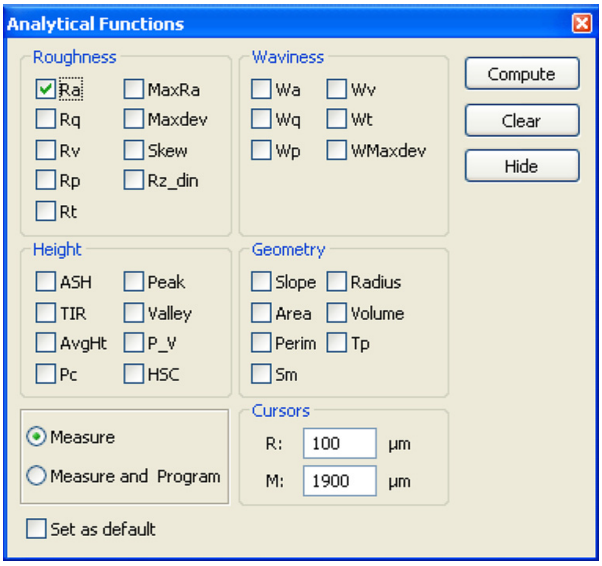
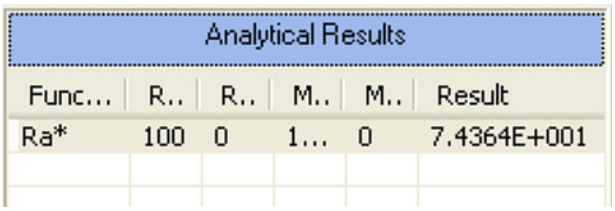


Figure 6-9: Analytical Results Display with Ra from Raw Data



DETERMINING THE CUTOFF WAVELENGTH

The Dektak 150 application is equipped with short pass and long pass digital filters for filtering out high and low frequency signals. The cutoff frequencies define the intended difference between roughness and waviness.

The filters are designed in accordance with the ANSI B46.1 specification on surface texture. The wavelengths are user selectable from 1 to 200,000 µm.

The appropriate cutoff wavelength varies from application to application; however, the cut-off wavelength must be less than the scan length. Also, the cutoff value will not be accepted if fewer than eight data points are available per cutoff wavelength. The **Scan Resolution** parameter displayed in the **Scan Routines** window provides the number of µm per sample for a given scan length and speed. The minimum acceptable cut-off wavelength must be at least eight times longer than the value listed as the scan resolution. This can be otherwise defined as: µm per sample x 8 = minimum acceptable cut-off wavelength. For typical applications, the recommended cutoff filter value is 1/5 the scan length.

For example, the default scan routine used for the purpose of this exercise has a scan length of 2000 µm, a scan duration of 1 second and a scan resolution of 0.513 µm per sample. Multiplying 0.513 by

8 equals 4.10, so the minimum acceptable cut-off wavelength is 5 µm. The scan length must equal the cut-off wavelength, so the maximum cutoff length is 2000. Therefore, you must select a cut-off value between 5 and 2000 µm.

As shown in Figure 6-10, you set the filter cutoff values in the **Roughness and Waviness Filters** dialog box, which provides the following three separate cut-off filters for selecting the wavelength bypass frequency.

Short (High) Pass Filter

This filter calculates *roughness* data, filtering out low frequency waviness signals and allowing high frequency roughness data to pass through.

Long (Low) Pass Filters

This filter calculates *waviness* data, filtering out high frequency roughness signals and allowing low frequency waviness data to pass through.

Band Pass Filter

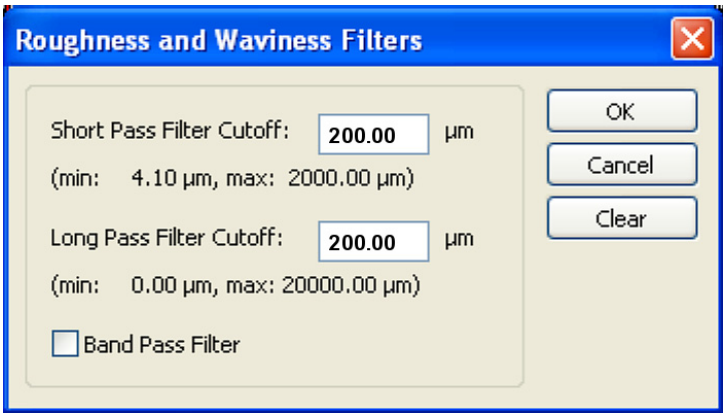
When you select the band pass filter, both the short pass and long pass filters are enabled to calculate the roughness data, creating a band that filters out high frequency signals above the band and low frequency signals below the band.

ACTIVATING THE CUTOFF FILTERS

To obtain accurate roughness measurements, activate the short pass filter.

1 Select **Analysis** > **Cutoff Filters** from the **Data Plot** window menu bar to display a dialog box for setting the roughness and waviness filters.

Figure 6-10: Roughness and Waviness Filters Dialog Box



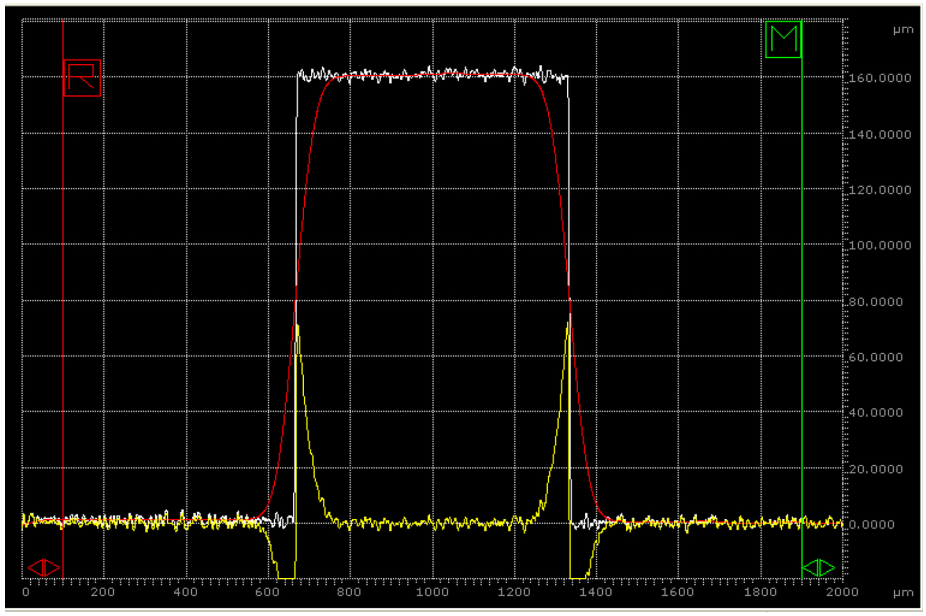
2 Enter a value of **200** in the **Short Pass Filter Cutoff** field.

3 Enter a value of **200** in the **Long Pass Filter Cutoff** field.

4 Click **OK** to replot the profile trace with three separate scan traces, as shown in Figure 6-11.

NOTE – The white trace represents the raw profile data, the yellow trace represents the roughness profile as determined with the short pass filter, and the red trace represents the waviness profile as determined by the long pass filter.

Figure 6-11: Filtered Profile with Three Separate Traces

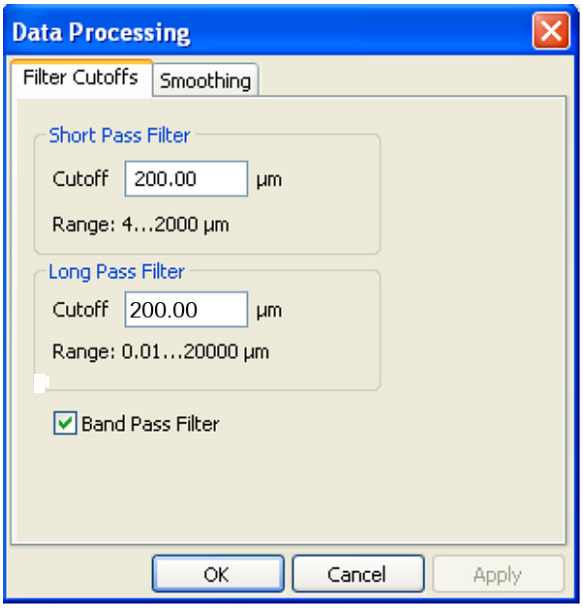


ENTERING FILTER CUTOFFS INTO A SCAN ROUTINE

The procedure below shows you how to enter the short pass and long pass filters into the scan routine to automatically calculate the roughness and waviness analytical functions.

1. Select **Window** > **Scan Routines** to open the **Scan Routines** window.
2. In the **Data Processing** section, click **Filter Cutoffs** to open the **Filter Cutoffs** tab of the **Data Processing** dialog box (see Figure 6-12).
3. Enter a cutoff value of **200** µm in the **Short Pass Filter Cutoff** box for calculating roughness.
4. Enter a cutoff value of **200** µm in the **Long Pass Filter Cutoff** box for calculating waviness.
5. Click **OK** to close the dialog box and enter the cutoff values into the scan routine.

Figure 6-12: Filter Cutoffs Tab of the Data Processing Dialog Box



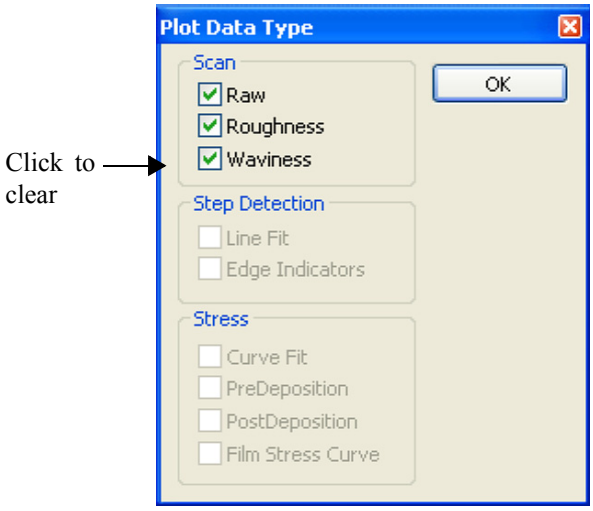
SELECTING THE DATA TYPE

You can select the type of data to display in the **Data Plot** window. You can display the raw, roughness, and waviness profile data either individually or simultaneously.

1 Select **Plot** > **Data Type** to display a dialog box for selecting the raw, roughness, or waviness data type.

NOTE – All three selections should be activated as indicated by their respective check boxes (see Figure 6-13).

Figure 6-13: Data Type Dialog Box



2 Click to clear the **Waviness** check box.

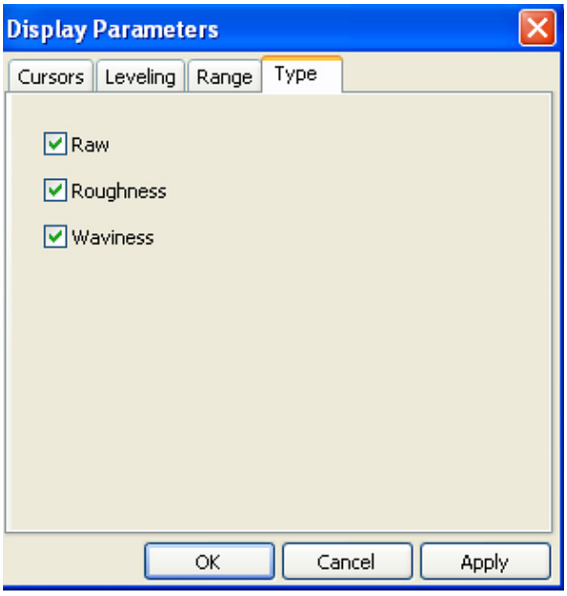
3 Click **OK** to replot the data with the roughness and raw data profiles displayed and the waviness profile deleted.

ENTERING DATA TYPES INTO A SCAN ROUTINE

You can predetermine the type of profile data to display at the conclusion of a scan by entering the selected data types into the scan routine.

1 In the **Display Parameters** section of the **Scan Routines** window, click **Display Data Type** to open the **Type** tab of the **Display Parameters** dialog box. As shown in Figure 6-14, here you can select from three display options: raw, roughness, and waviness.

Figure 6-14: Type Tab of the Display Parameters Dialog Box



NOTE – When you use the default scan routine, the raw profile data is entered as the **Display Data Type** parameter. In this exercise, all three data types are selected.

2 Select the **Waviness** and **Roughness** check boxes to enter all three data types into the scan routine.

NOTE – You cannot select the roughness data type unless you first activate the short pass filter. Likewise, you cannot select the waviness data type unless you first activate the long pass filter.

3 Click **OK**.

After you enter the analytical functions, cutoff filters, and display data types into the current scan routine, they automatically execute whenever the current scan routine runs.

MEASURING AND ENTERING ANALYTICAL FUNCTIONS

After you activate the short pass roughness filter, perform the average roughness analytical function a second time. You can enter one or more analytical functions into the current scan routine from the **Data Plot** window to be automatically calculated whenever the current scan routine runs. In the exercise that follows, you will learn the procedure for measuring the Ra function and entering it into the scan routine.

1 Select **Analysis** > **Analytical Functions** from the **Data Plot** window to open the **Analytical Functions** dialog box (see Figure 6-15 at the left).

NOTE – You can also open the **Analytical Functions** dialog box from the **Scan Routines** window. When you do this, the dialog box appears as shown in Figure 6-16.

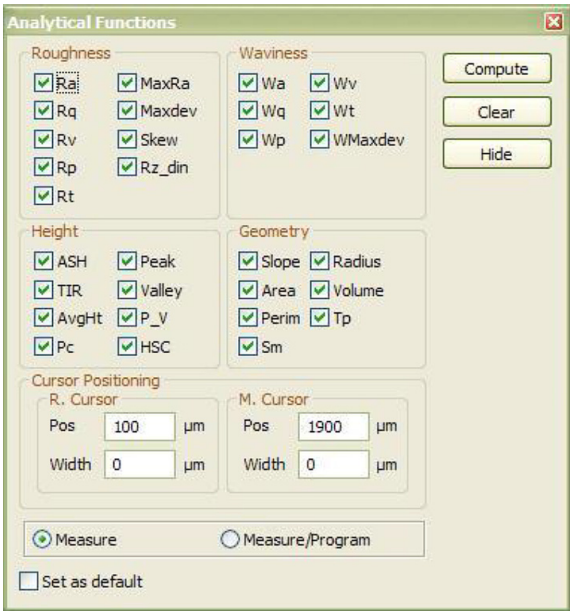
2 Under **Roughness** in the **Analytical Functions** dialog box, click **Ra**.

3 Select **Measure and Program** in the **Analytical Functions** dialog box.

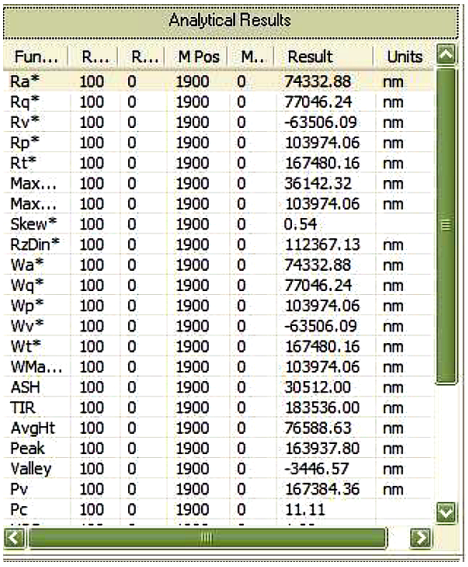
4 Click **Compute** to close the **Analytical Functions** dialog box, perform the measurement, and enter the average roughness into the current scan routine.

NOTE – The result from the Ra function displays in the **Analytic Results** area on the left side of the **Data Plot** window (see Figure 6-15 at the right). The different results from the first Ra are calculated on the unfiltered raw profile data (shown with an asterisk) and the second Ra calculated on the filtered roughness data (shown without an asterisk).

Figure 6-15: Analytical Functions Dialog Box and Results/Data Plot Window



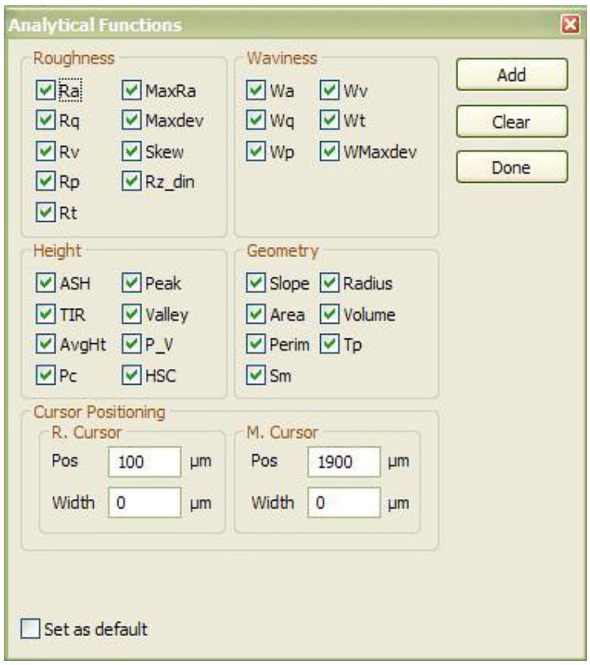
Analytical Functions Dialog Box
from Data Plot Window



Fun...	R...	R...	M Pos	M..	Result	Units
Ra*	100	0	1900	0	74332.88	nm
Rq*	100	0	1900	0	77046.24	nm
Rv*	100	0	1900	0	-63506.09	nm
Rp*	100	0	1900	0	103974.06	nm
Rt*	100	0	1900	0	167480.16	nm
Max...	100	0	1900	0	36142.32	nm
Max...	100	0	1900	0	103974.06	nm
Skew*	100	0	1900	0	0.54	
RzDin*	100	0	1900	0	112367.13	nm
Wa*	100	0	1900	0	74332.88	nm
Wq*	100	0	1900	0	77046.24	nm
Wp*	100	0	1900	0	103974.06	nm
Wv*	100	0	1900	0	-63506.09	nm
Wt*	100	0	1900	0	167480.16	nm
WMa...	100	0	1900	0	103974.06	nm
ASH	100	0	1900	0	30512.00	nm
TIR	100	0	1900	0	183536.00	nm
AvgHt	100	0	1900	0	76588.63	nm
Peak	100	0	1900	0	163937.80	nm
Valley	100	0	1900	0	-3446.57	nm
Pv	100	0	1900	0	167384.36	nm
Pc	100	0	1900	0	11.11	

Analytical Results Section
of Data Plot Window

Figure 6-16: Analytical Functions Dialog Box from Scan Routines Window



ENTERING ANALYTICAL FUNCTIONS INTO A SCAN ROUTINE

You can enter one or more analytical functions into the **Scan Routines** window to be automatically calculated at the conclusion of the scan.

1. Select **Window** > **Scan Routines** to display the **Scan Routines** window.
2. Select **Edit** > **Append Analytical Functions** or click the A**ppend Analytical Functions to Current Scan Routine** icon to display the **Analytical Functions** dialog box.
3. Under **Waviness** in the **Analytical Functions** dialog box, click **Wa**.
4. Set the cursors at different locations for each individual analytical function:
   - Enter **0** in the **R Cursor** box**.**
   - Enter **1900** in the **M Cursor** box.
   - Click **Add**.
5. Click **Done**. As shown in Figure 6-17, Waviness on appears in the **Analytical Functions** area on the right side of the **Scan Routines** window.

Figure 6-17: Analytical Functions Dialog Box with Waviness Selected

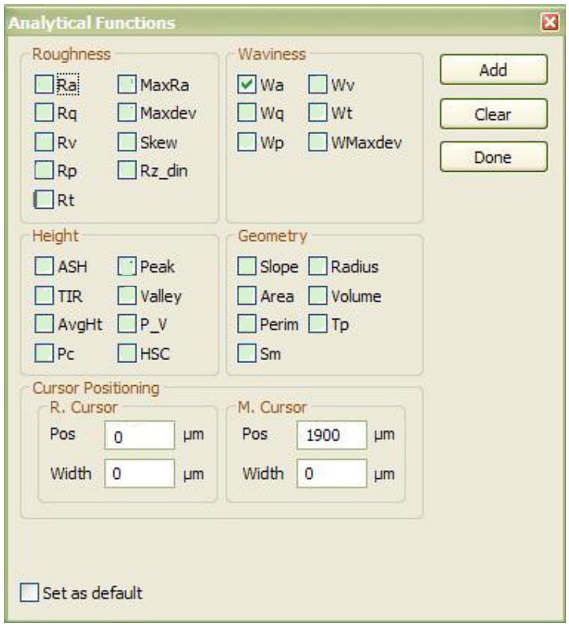
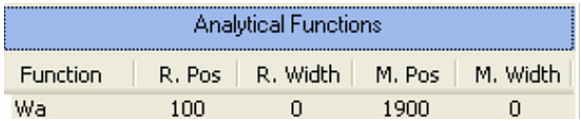


Figure 6-18: Analytical Functions Section of Scan Routines Window



Analytical Functions				
Function	R. Pos	R. Width	M. Pos	M. Width
Wa	100	0	1900	0

DELETING ANALYTICAL FUNCTIONS OR RESULTS

When the **Scan Routines** window appears with an analytical function listed, you can delete that function from the **Analytical Functions** area. Likewise, when the **Data Plot** window appears with an analytical result listed, you can delete that function from the **Analytical Results** area.

The procedure for deleting an analytical function from the **Scan Routines** window is described in the exercise below. (The procedure for deleting an analytical result from the **Data Plot** window is similar.)

1. In the **Analytical Functions** area of the **Scan Routines** window, select one or more analytical functions that you want to delete. Press the CTRL key to select individual functions or press the SHIFT key to select a series of functions.
2. Select **Edit** > **Delete Analytical Functions** or right-click the function that you want to delete and click **Delete.** Alternatively, select the function and press the DELETE key on the keyboard. When you are prompted to confirm the deletion, click **Yes.**

USING THE SMOOTHING FUNCTION

Whenever you activate the smoothing function, the roughness, waviness, or raw profiles are calculated using the smoothed data. The smoothing function reduces high frequency/low amplitude noise on a trace. This can be helpful when scanning samples such as those that have films deposited over rough substrates. The substrate roughness transfers to the film surface, which can make measurements difficult or questionable.

You can apply smoothing in one of two ways. In applications where rough samples will be run on a regular basis, you can enter smoothing into the scan routine. After you do this, the smoothing function performs automatically on each scan profile. Alternatively, you can select the smoothing function after a scan has been completed.

The Dektak 150 application offers the following three degrees of smoothing. The higher the degree, the more smoothing is realized.

- Degree 1: 5-point smoothing
- Degree 2: 11-point smoothing
- Degree 3: 23-point smoothing

Once you select the degree of smoothing, a prompt asks for the value of the vertical distance between the maximum peak to valley roughness. Determine the maximum peak to valley distance of the high frequency low amplitude noise and enter this or a greater value. (You can use the TIR analytical function to determine the noise band.) The smoothing function smooths all data within the specified noise band by examining each data point in turn and comparing it with the previous and following points.

For example, if Degree 1 is selected, five consecutive data points are used in the smoothing calculation. If they lie within the specified noise band, a running calculation is started. A first-order curve is fitted to all consecutive points lying within the noise band. As new points are examined, the

routine calculates the new value of each point by looking at the four closest points that lie within the band.

When the algorithm encounters a point that lies outside the band, the calculation is interrupted. The new point is left as is and becomes a center point of a new noise band. If the next five points are within the new band, the calculation restarts. If subsequent points lie outside the band, they are plotted as is, and each becomes a new reference point.

This technique is preferable to straight filtering, since the slope of the profile is maintained.

Activating the Smoothing Function

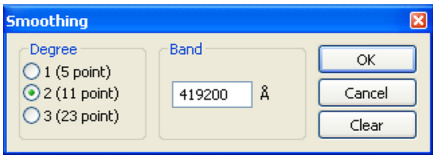
You can perform smoothing on profile data at the conclusion of a scan. The procedure for activating the smoothing function from the **Data Plot** window is described below.

1. Select **Window** > **Data Plot** to display the **Data Plot** window with the replotted profile data.
2. Select **Analysis** > **Analytical Functions** to display the **Analytical Functions** dialog box.
3. Under **Height**, click **TIR**.
4. Select **Measure**.
5. Click **Compute**.

> **NOTE –** The total peak-to-valley distance is calculated.

6. Select **Analysis** > **Smoothing** to display a dialog box for entering smoothing parameters (see Figure 6-19).
7. Select one of three available degrees of smoothing (for the purpose of this exercise, select **2** in the **Degree** section).
8. Enter a value equal to or greater than the value displayed as the **TIR** result in the **Band** field.
9. Click **OK** to smooth and replot the raw profile data.

Figure 6-19: Smoothing Dialog Box

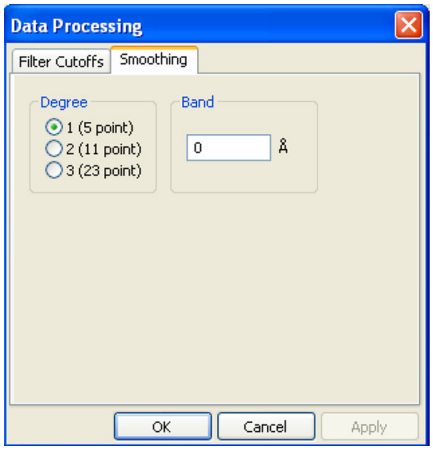


Entering Smoothing into a Scan Routine

The following procedure shows you how to enter smoothing into the current scan routine to make it execute automatically at the conclusion of the scan.

1. Select **Window** > **Scan Routines** to display the **Scan Routines** window.
2. In the **Data Processing** section, click **Smoothing** to display the **Data Processing Parameters** dialog box.

Figure 6-20: Smoothing Tab of the Data Processing Dialog Box



3 Choose the desired smoothing **Degree** (1, 2, or 3) on the **Smoothing** tab (see Figure 6-20).

4 Determine the smoothing band value by performing the **Total Indicated Reading (TIR)** analytical function on the scan to be smoothed. Follow the instructions in Activating the Smoothing Function on page 6-19.

5 In the **Band** field, enter a value that is equal to or greater than the TIR value shown in the **Analytical Results** area of the **Data Plot** window.

6 Click **OK** to automatically smooth the profile data whenever the current scan routine executes.

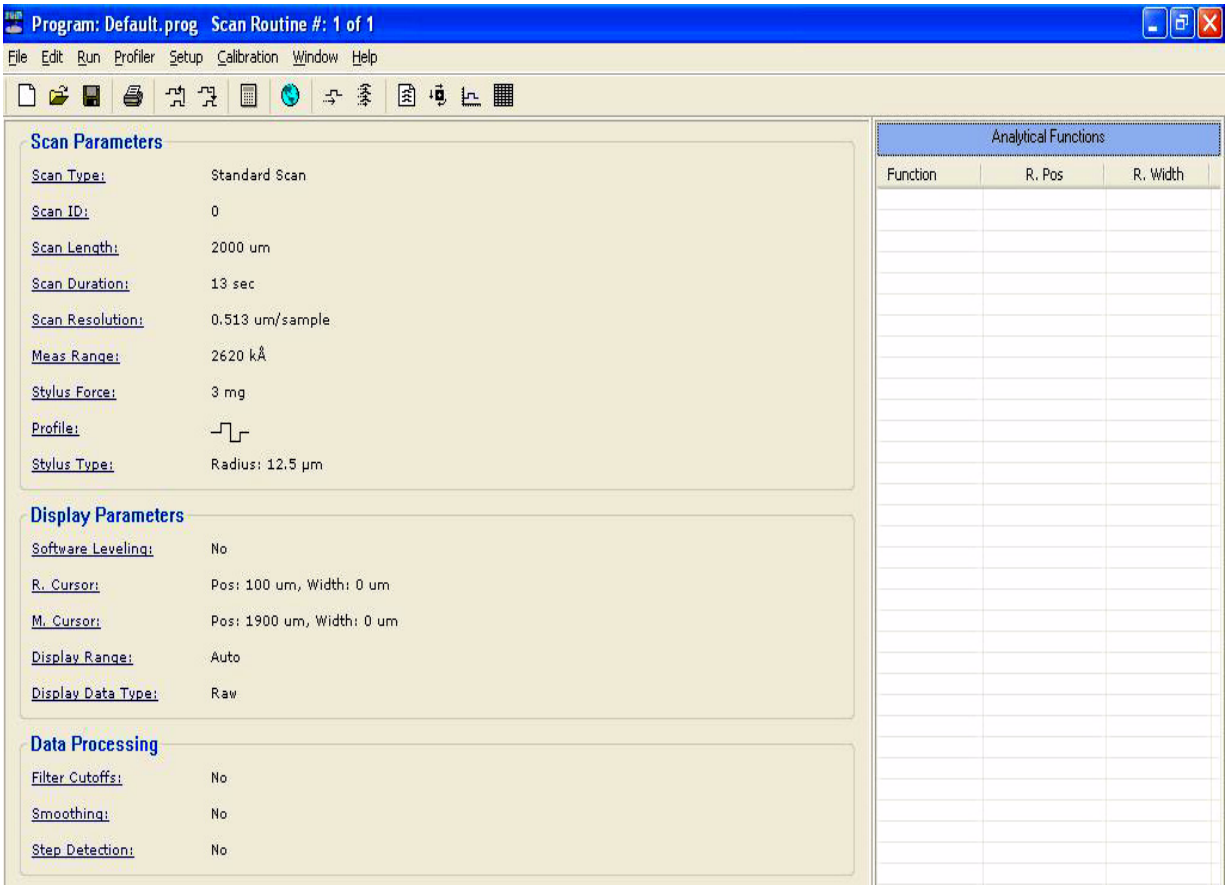
7 To clear smoothing, enter zero (0) in the **Band** field of the **Smoothing** tab of the **Data Processing** dialog box, and then click **OK**.

7

SCAN ROUTINE PARAMETERS

This chapter describes the scan parameters, display parameters, and data processing parameters that are available in the **Scan Routines** window.

Figure 7-1: Scan Routine Window



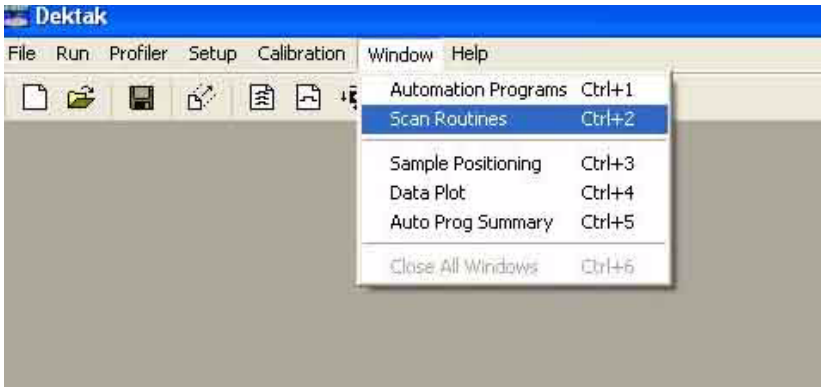
You can enter up to 10,000 different scan routines into a single automation program file. Each scan routine within an automation program contains all the necessary parameters for performing a

specified scan. These individual parameters are user selectable, providing extraordinary flexibility to adapt the Dektak 150 for a wide range of applications.

SCAN PARAMETERS

All of the scan parameters are user selectable and can be accessed from the **Scan Routines** window. To open the **Scan Routines** window, select **Window** > **Scan Routines** from the menu bar (Figure 7-2) or click the **Switch to Scan Routines Window** icon . The procedure for setting the various scan parameters is described below.

Figure 7-2: Windows Menu with Scan Routines Selected



Using the Scan Parameters Dialog Box

Click any parameter in the **Scan Parameters** section of the **Scan Routines** window to open the **Nominal Parameters** tab of the **Scan Parameters** dialog box. Here are some guidelines for using this dialog box:

- After you select a scan parameter, click **OK** to add it into the scan program.
- Alternatively, you can click **Apply** to enter the scan parameter into the scan program but keep the dialog box open to make additional entries.
- If your system includes options that create their own tabs in the **Scan Parameters** dialog box, you must click **Apply** to save your settings before clicking another tab.

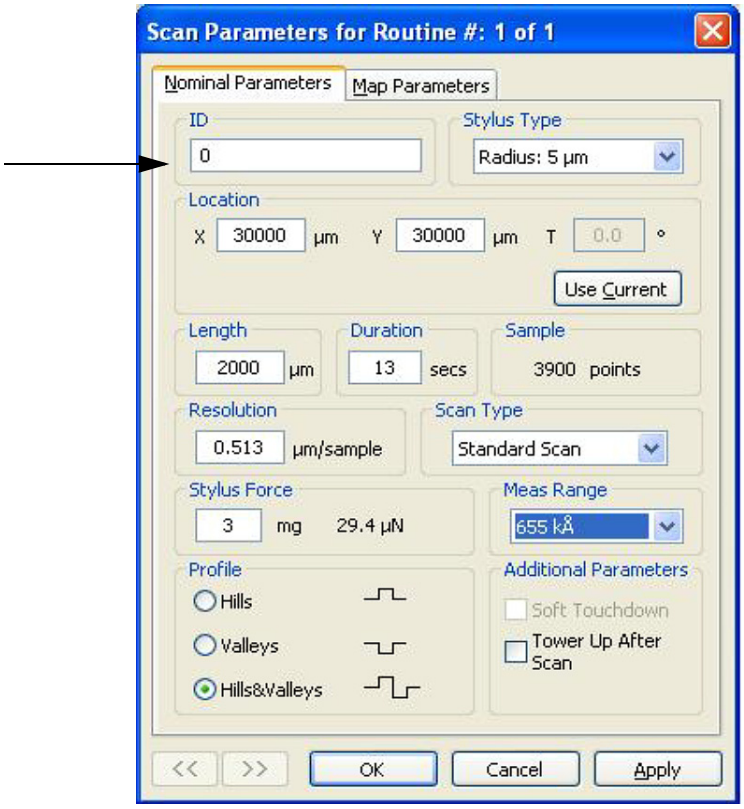
Scan ID

This parameter allows you to assign a fifteen-digit scan identification file name or number.

1. Click any parameter in the **Scan Parameters** section of the **Scan Routines** window (see Figure 7-1) to open the **Nominal Parameters** tab of the **Scan Parameters** dialog box.
2. In the **ID** section, enter the desired file name or number using the keyboard (see Figure 7-3).

NOTE – Most special characters are allowed in the file name, but no spaces.

Figure 7-3: Scan Parameters Dialog Box: ID



3 Click **OK** to close the dialog box and enter the ID into the scan program.

Stylus Type

The **Stylus Type** parameter allows you to specify which stylus type is used in your system.

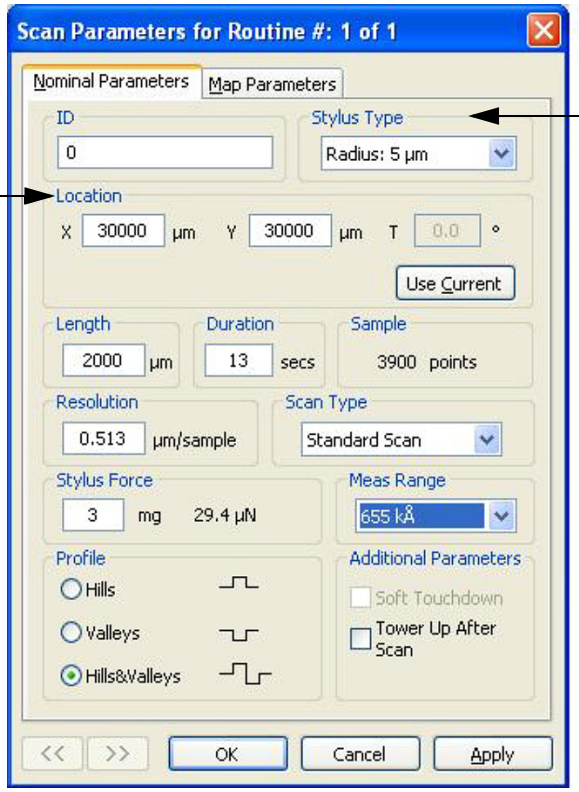
1 Click any parameter in the **Scan Parameters** section of the **Scan Routines** window (see Figure 7-1) to display the **Nominal Parameters** tab of the **Scan Parameters** dialog box.

2 In the **Stylus Type** section (see Figure 7-4), choose the desired stylus type from the drop-down list.

3 Click **OK** to close the dialog box and enter the stylus type into the scan program.

NOTE – The **Stylus Type** parameter does not affect the scan or program.

Figure 7-4: Scan Parameters Dialog Box: Stylus Type



Appears only if your system includes the optional x-y auto stage.

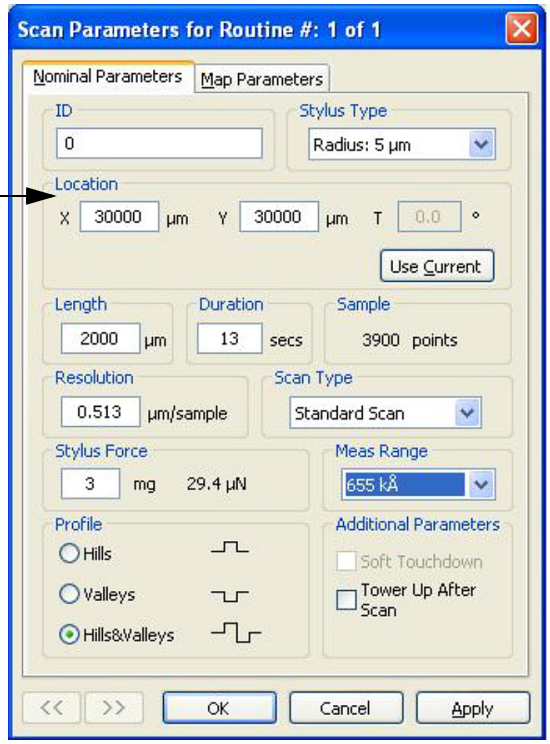
Scan Location

This parameter displays the X and Y location in µm for this particular scan routine.

> **NOTE –** In order for this parameter to be active, your system must include the optional x-y auto stage.

1. Click any parameter in the **Scan Parameters** section of the **Scan Routines** window (see Figure 7-1) to display the **Nominal Parameters** tab of the **Scan Parameters** dialog box.
2. Click in the desired box labeled X or Y and enter the desired coordinates using the keyboard (see Figure 7-5).
3. Click **OK** to close the dialog box and enter the location into the scan program.

Figure 7-5: Scan Parameters Dialog Box: Scan Location



Appears only if your system includes the optional x-y auto stage.

NOTE – Because the numeric values of the X and Y location are often not known, in most cases you must determine the stage location by using the **Sample Positioning** window. From the menu in this window, select **Edit > Define Scan Location/Length**.

Scan Length

Scan lengths from 50 µm to 55,000 µm (50 mm) are possible using the standard Dektak 150 system.

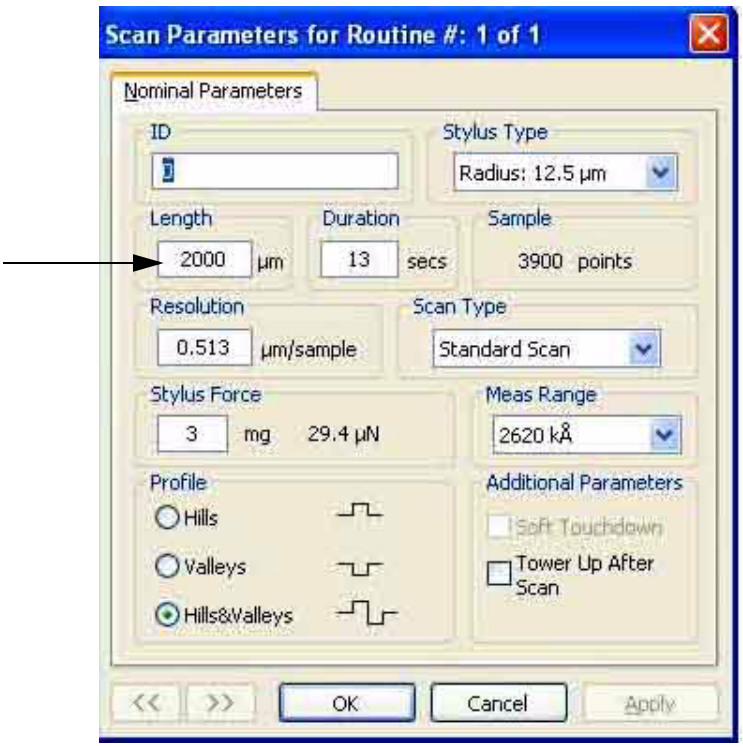
1 Click any parameter in the **Scan Parameters** section of the **Scan Routines** window (see Figure 7-1) to display the **Nominal Parameters** tab of the **Scan Parameters** dialog box.

2 In the **Length** field, enter the desired scan length using the keyboard (see Figure 7-6).

NOTE – The scan length is expressed in microns (µm).

3 Click **OK** to close the dialog box and enter the length into the scan program.

Figure 7-6: Scan Parameters Dialog Box: Length



The scan length can also be set from the **Sample Positioning** window by selecting **Edit** > **Enter Scan Length**. You can enter the scan length manually using Stage Tracking, as discussed in Chapter 4.

Scan Duration/Speed

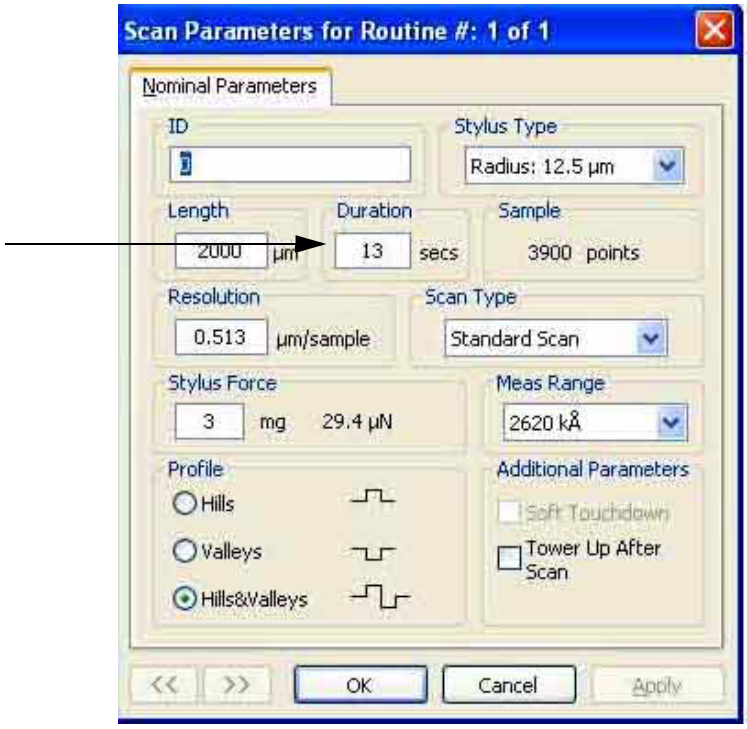
The **Duration** setting displays the amount of time it takes to complete a given scan. Scan duration, in conjunction with scan length, determines the horizontal resolution of a scan. Therefore, scan speed is directly related to the resolution.

For example, a 13-second scan provides 3900 sample data points. You can set the scan duration from 3 to 200 seconds for a maximum of 60,000 data points per scan.

Select a longer scan duration for long scan applications and measurements of very fine surface roughness requiring the highest horizontal resolution. When high throughput is the primary consideration, use a shorter scan duration. For most applications, a 10-20 second scan provides adequate resolution and throughput.

1. Click any parameter in the **Scan Parameters** section of the **Scan Routines** window (see Figure 7-1) to display the **Nominal Parameters** tab of the **Scan Parameters** dialog box.
2. In the **Duration** field, enter the desired scan duration (in seconds) using the keyboard (see Figure 7-7).
3. Click **OK** to close the dialog box and enter the duration into the scan program.

Figure 7-7: Scan Parameters Dialog Box: Duration



Scan Resolution

The **Resolution** parameter (see Figure 7-8) displays the horizontal resolution for the scan length and scan speed (duration) entered into the scan routine. The scan resolution is expressed in µm/sample, indicating the horizontal distance between data points. Data points are the points along the scan path at which data samples are taken. The more data points taken during a given scan length, the shorter the distance between data samples. Therefore, a scan routine with the lowest number of µm per sample provides the best possible horizontal resolution.

The Dektak 150 provides horizontal resolution with a maximum 60,000 data points available per scan. Scan length and scan duration determine the horizontal resolution of the Dektak 150. The profiler maintains a constant sampling rate of 300 data points per second. By slowing scan speed, you can process more samples with a given scan length over a longer period of time. Scan duration may be set anywhere from 3 to 200 seconds. The examples below provide the number of data points per scan at various scan durations for a 2000 µm scan length.

Table 7-3: Data Points Per Scan

Duration	Data Points	Resolution at Maximum Scan Length
200 seconds	60,000	0.033 µm/sample
100 seconds	30,000	0.067 µm/sample
50 seconds	15,000	0.133 µm/sample
13 seconds	3,900	0.513 µm/sample
3 seconds	900	2.222 µm/sample

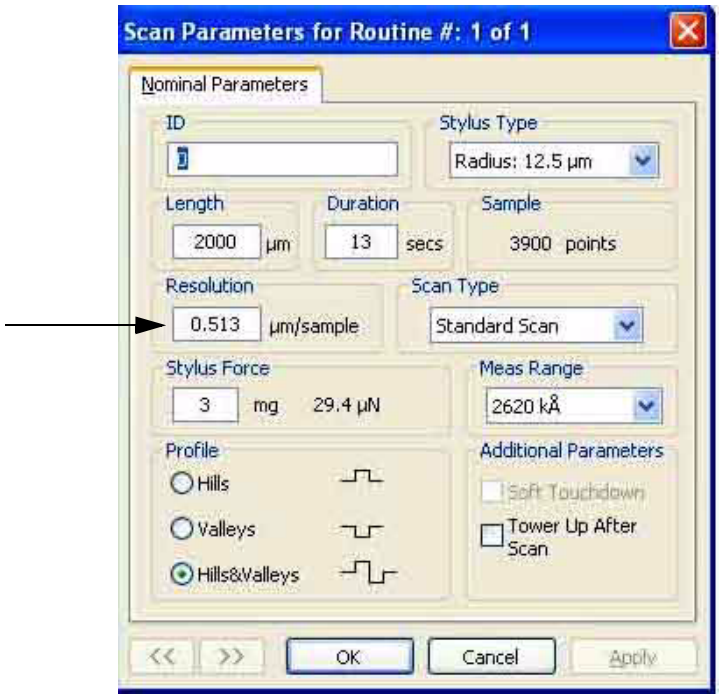
The horizontal resolution of the Dektak 150 directly relates to the scan length and number of data points per scan. The scan length is selectable from 50 µm to 55 mm. Without altering the number of data points per scan, it is possible to adjust the horizontal resolution or the distance between data points by altering the scan length. The scan resolution parameter displays the distance between data points (in µm per sample).

When using a low stylus force, the stylus may bounce off the surface if it encounters a large step at high scan speeds. In applications requiring light stylus force, use low or medium scan speed (in other words, a longer scan duration) at the shortest possible scan length.

To set the scan resolution:

1. Click any parameter in the **Scan Parameters** section of the **Scan Routines** window (see Figure 7-8) to display the **Nominal Parameters** tab of the **Scan Parameters** dialog box.
2. In the **Resolution** field, enter the desired scan duration (in seconds) using the keyboard (see Figure 7-8). The resolution automatically adjusts in accordance with your new duration value.
3. Click **OK** to close the dialog box and enter the resolution into the scan program.

Figure 7-8: Scan Parameters Dialog Box: Resolution

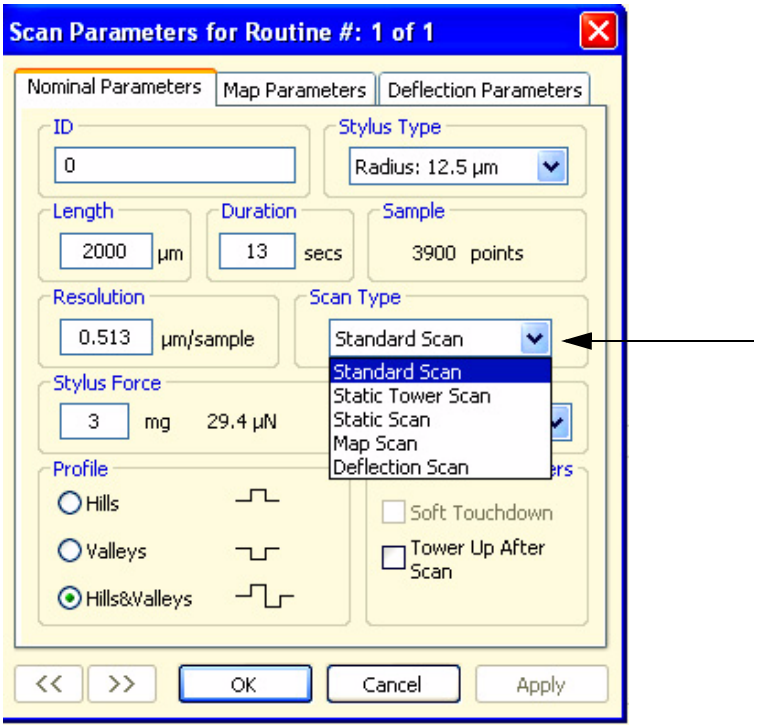


Scan Type

The **Scan Type** parameter allows you to specify which type of scan to be run.

1. Click any parameter in the **Scan Parameters** section of the **Scan Routines** window (see Figure 7-1) to display the **Nominal Parameters** tab of the **Scan Parameters** dialog box.
2. In the **Scan Type** section, choose one of the following scan types from the drop-down list (see Figure 7-9).
   - **Standard Scan**: A normal scan type, in which the scan is performed across the surface of a sample. The tower is nulled before each scan; therefore, each successive scan has its own reference point.
   - **Static Tower Scan**: A special scan type, in which the scan is performed across the surface of a sample, but the tower is nulled before only the first scan. Each successive scan therefore uses the same initial reference point.
   - **Static Scan**: A special scan type, in which the scan is performed at the same point (the stage does not move). The tower is nulled before the scan. This scan type is primarily used for determining the noise and drift of the system.
   - **Map Scan**: The Dektak 3D Mapping Option allows Dektak surface profiler customers to measure, analyze, and view surface contour data in three dimensions (X, Y, and Z). See Appendix E for complete information on 3D mapping.
   - **Deflection Scan (optional)**: See Deflection Scan on page 7-14.
3. Click **OK** to close the dialog box and enter the scan type into the scan program.

Figure 7-9: Scan Parameters Dialog Box: Scan Type



Stylus Force

You can set the stylus force from 1mg to 15 mg force. The **Stylus Force** parameter allows you to adjust the stylus force. If your system includes the N-Lite Option, you can adjust the stylus force down to 0.03 mg. For more information, see Appendix F.

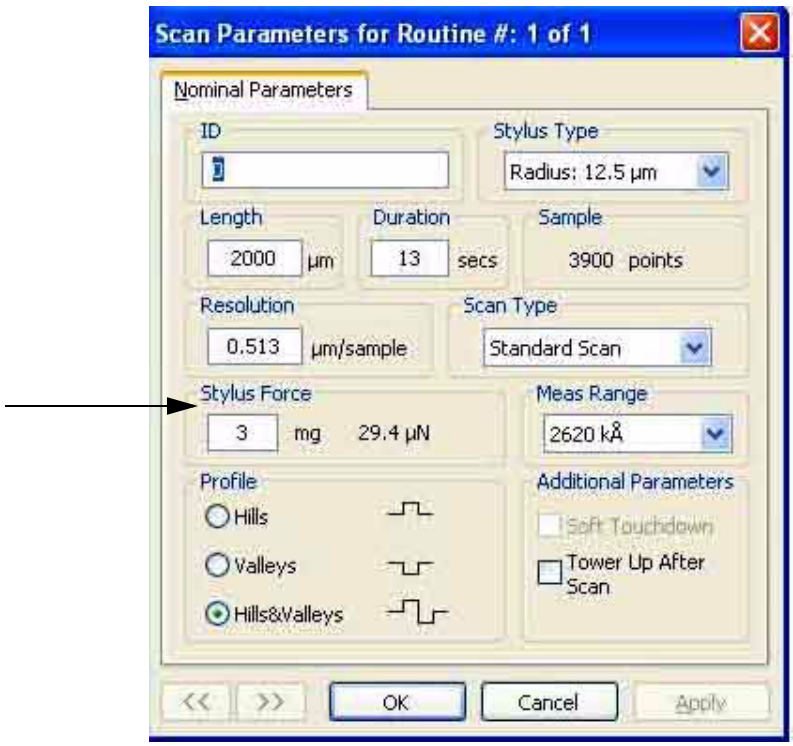
1 Click any parameter in the **Scan Parameters** section of the **Scan Routines** window (see Figure 7-1) to display the **Nominal Parameters** tab of the **Scan Parameters** dialog box.

2 In the **Stylus Force** field, enter the desired stylus force (see Figure 7-10).

3 Click **OK** to close the dialog box and enter the stylus force into the scan program.

> **NOTE –** If you system includes the *N*-Lite option (see Appendix F), that option engages automatically when you enter a Stylus Force value that is < 3 mg.

Figure 7-10: Scan Parameters Dialog Box: Stylus Force



Measurement Range

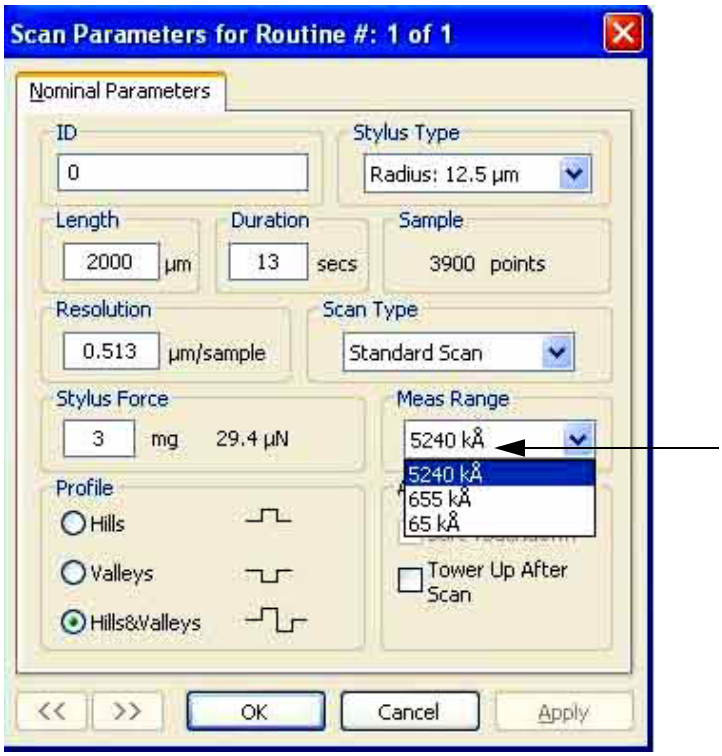
The available vertical resolution depends upon the **Measurement Range** selected. When measuring extremely fine geometries, the 65 kÅ range provides a vertical bit resolution of 1 Å. For general applications, the 10 Å vertical resolution of the 655 kÅ range is usually adequate. When measuring thick films or very rough or curved samples, select the 5240 kÅ range with 80 Å resolution.

1 Click any parameter in the **Scan Parameters** section of the **Scan Routines** window (see Figure 7-1) to display the **Nominal Parameters** tab of the **Scan Parameters** dialog box.

2 In the **Meas Range** field, select one of the measurement ranges from the drop-down list: **65 kÅ**, **655 kÅ** or **5340 kÅ** (or **1 mm**, optional). See Figure 7-11.

3 Click **OK** to close the dialog box and enter the measurement range into the scan program.

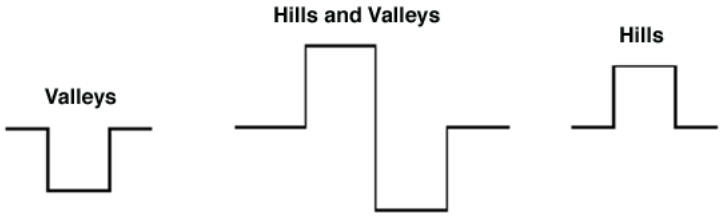
Figure 7-11: Scan Parameters Dialog Box: Measurement Range



Profile

The **Profile** setting scales the measurement range according to the profile selected. Three different profiles are available for a variety of sample surface characteristics (see Figure 7-12).

Figure 7-12: Sample Surface Profiles



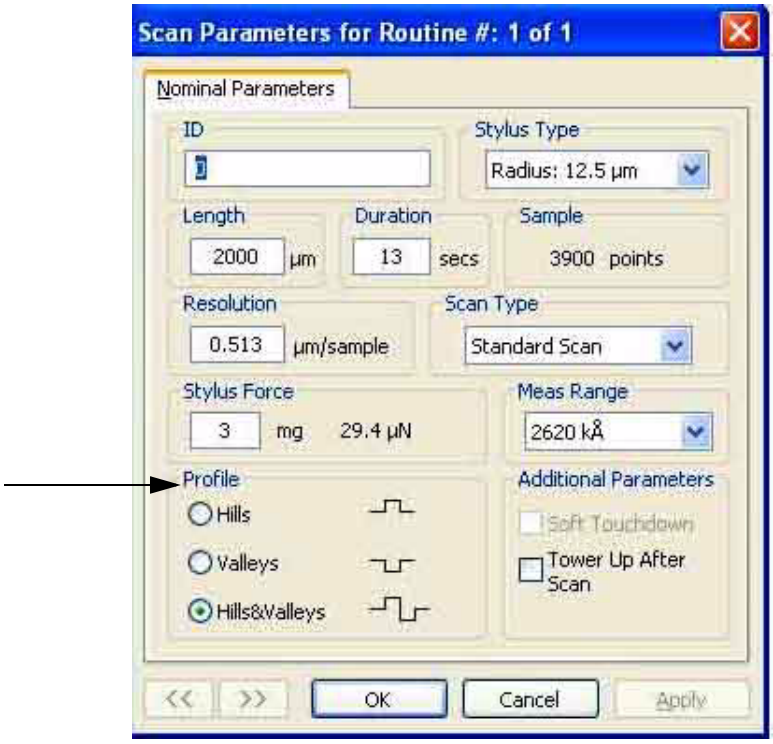
- **Valleys:** Provides 90% of the measurement range below the zero horizontal grid line. Used primarily for measuring etch depths.
- **Hills and Valleys:** Provides 50% of the measurement range above the zero horizontal grid line and 50 percent below. Used in most applications, especially if the surface characteristics of the sample are not well known, or if the sample is out of level.
- **Hills**: Provides 90% of the measurement range above the horizontal grid line. Used primarily for measuring step heights.

1 Click any parameter in the **Scan Parameters** section of the **Scan Routines** window (see Figure 7-1) to display the **Nominal Parameters** tab of the **Scan Parameters** dialog box.

2 Select the desired profile (see Figure 7-13).

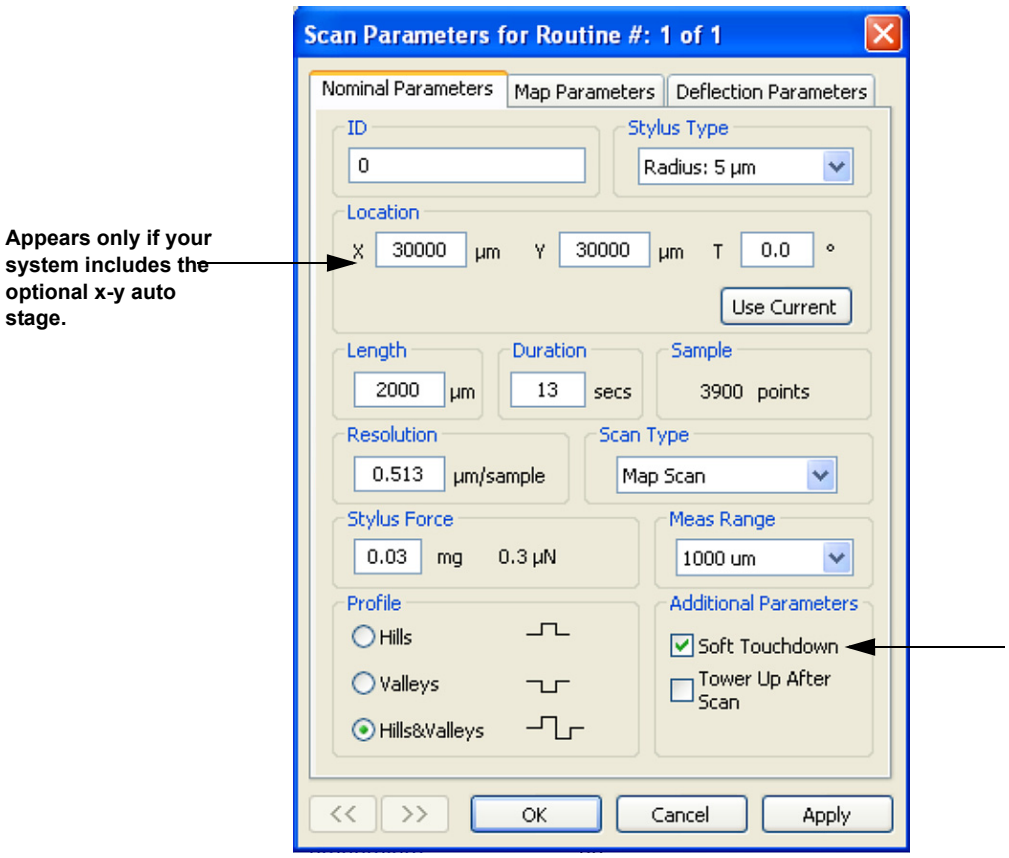
3 Click **OK** to close the dialog box and enter the selected profile into the scan program.

Figure 7-13: Scan Parameters Dialog Box: Profile



When you are running scans to be plotted using the optional 3-D mapping feature described in Appendix E and your system includes the *N*-Lite option described in Appendix F, you can enable soft touchdown. Soft touchdown gradually increments the stylus force up to the specified value, which slowly lowers the stylus. For information on making the soft touchdown settings, see Appendix F.

Figure 7-14: Scan Parameters Dialog Box: Soft Touchdown



Tower Up After Scan

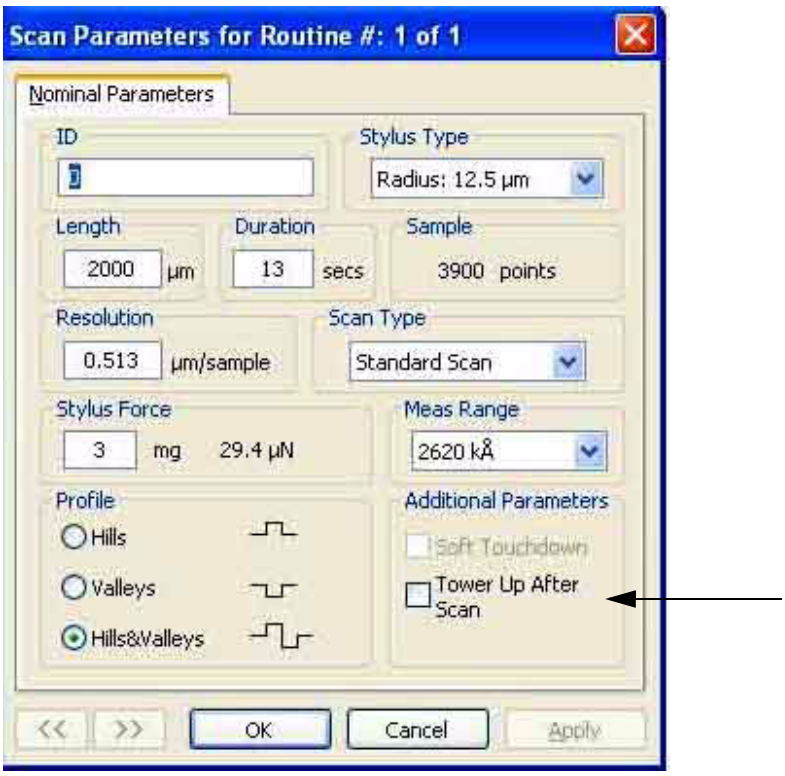
Select this feature to make the stylus automatically tower up after the scan is completed. This is particularly useful for hard disk runout measurements.

The stylus towers up according to the settings in the **Ascent** section of the **Tower** dialog box, which is available from the **Configuration Settings** dialog box. (See Hardware Settings on page 8-12.)

> **NOTE –** The **Tower Up After Scan** option is available only when the **Soft Touchdown** option is NOT selected.

1. Click any parameter in the **Scan Parameters** section of the **Scan Routines** window (see Figure 7-1) to display the **Nominal Parameters** tab of the **Scan Parameters** dialog box.
2. In the **Additional Parameters** section, click **Tower Up After Scan** (see Figure 7-15).

Figure 7-15: Scan Parameters Dialog Box: Tower Up After Scan



3 Click **OK** to close the dialog box and enter the **Tower Up After Scan** function into the scan program.

Deflection Scan

A Deflection Scan is an optional scan type in which the scan is performed at the same point (the stage does not move), but the stylus force is successively incremented beyond the specified value. The tower is nulled before the scan. When the scan is completed, the **Data Plot** window displays the deflections plotted against the applied forces. This scan type is primarily used for determining the deflection and material properties (such as Young's modulus) of movable devices (such as passive MEMS and cantilever devices) subjected to different applied forces.

The **Scan Type** parameter allows you to specify which scan type to use.

1 Click any parameter in the **Scan Parameters** section of the **Scan Routines** window (see Figure 7-1) to display the **Nominal Parameters** tab of the **Scan Parameters** dialog box.

2 In the **Scan Type** section, select **Deflection Scan** from the list.

3 In the **Stylus Force** section, enter the stylus force to be applied at the end of the scan (see Figure 7-16).

4 Click **Apply** to enter the scan type and stylus force into the scan program and keep the dialog box open.

5 Click the **Deflection Parameters** tab, which lists its options under **Additional Parameters** (see Figure 7-16.

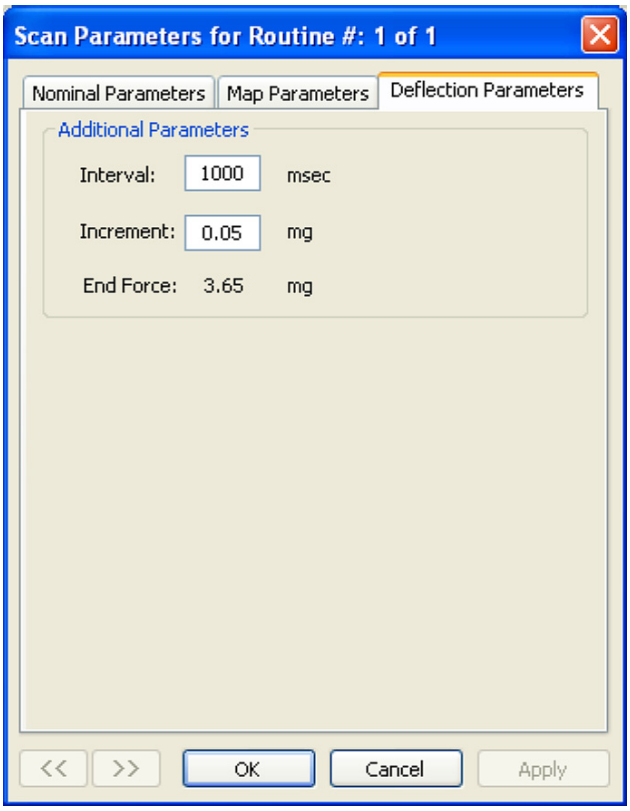
6 Enter the **Interval** in **msec** during which each increment of stylus force should be applied.

7 Enter the **Increment** in **mg** by which the stylus force is incremented after each interval.

8 Click **Apply**.

NOTE – The **End Force** that will be applied by the stylus is calculated and displayed.

Figure 7-16: Scan Parameter Dialog Box: Deflection Parameters (Optional)



Example:

- **Scan Duration** is set at 13 seconds.
- **Stylus Force** is set at 3 mg (on the **Nominal Parameters** tab).
- **Interval** is set at 1000 msec (1 second).
- **Increment** is set at 0.05 mg.
- **End Force** is calculated and displayed as 3.65 mg (13 seconds divided by 1 second, multiplied by 0.05 mg = 0.65 mg to be added in 0.05-mg increments to 3 mg).

DISPLAY PARAMETERS

In its **Display Parameters** section, the **Scan Routines** window contains parameters that allow automatic manipulation of the graphic display of the profile trace. The display parameters are described below.

Software Leveling

You can program the Dektak application to software level the profile trace automatically, in relation to the cursor/trace intercepts, at the conclusion of a scan. In order to obtain accurate step height readings and analytical calculations, you must software-level the trace. You can also enter cursor band widths to perform delta average leveling.

1. In the **Display Parameters** section of the **Scan Routines** window, click **Software Leveling** (see Figure 7-1) to open the **Leveling** tab (see Figure 7-17) .
2. Select the **Automatic Leveling** check box, and then click **Apply**.
3. Click the **Cursors** tab (see Figure 7-18), and make your settings according to these guidelines:
   - When the default band width is **0**, the trace levels using only two points at the R and M Cursor locations.
   - If you know the desired cursor widths, you can enter them into the scan routine. The **Width** field in the **R Cursor** section sets the width of the reference cursor (R), while the **Width** field in the **M Cursor** section sets the width of the measurement cursor (M).
4. Click **OK** to enter automatic leveling and the leveling cursor widths into the scan routine.

Figure 7-17: Display Parameters Dialog Box: Software Leveling

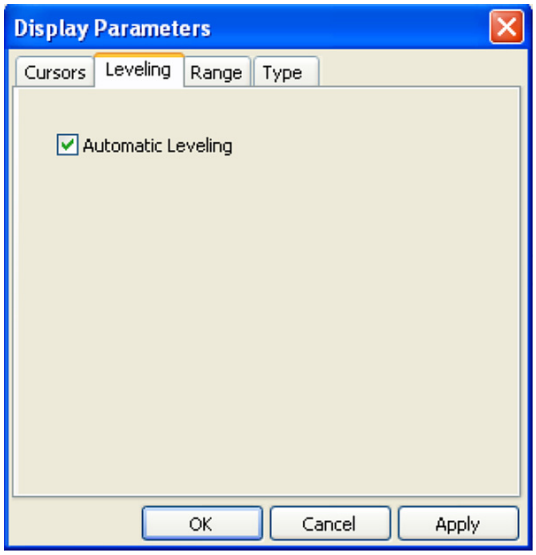
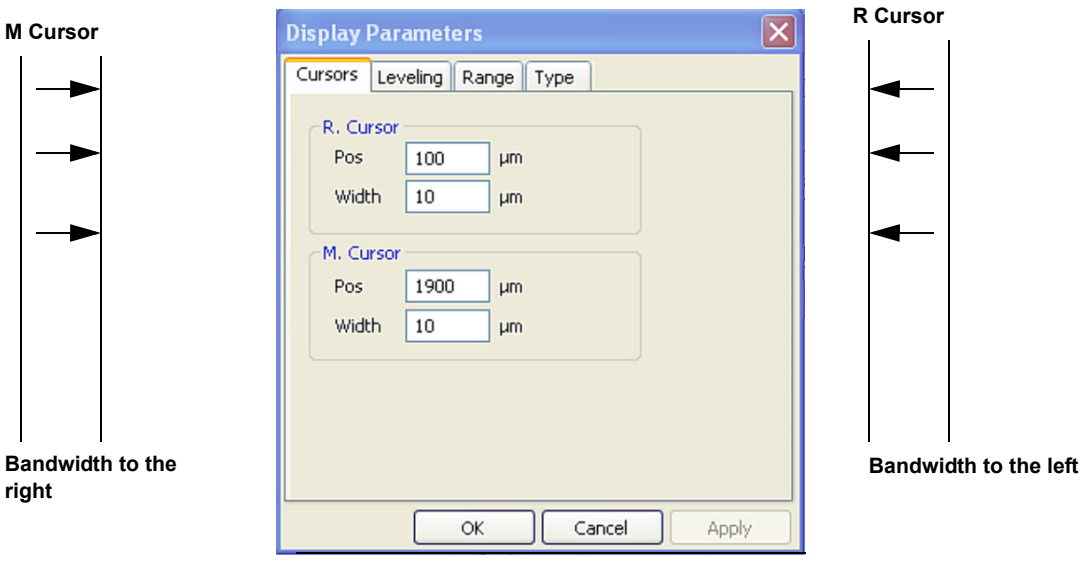


Figure 7-18: Display Parameters: Cursors



NOTE – You can also enter cursor bandwidths from the **Data Plot** window. A delta averaging technique provides a roughness average reading of the section of the profile trace within the bands. The profile trace can then be leveled according to the two average readings. See Setting Cursor Bandwidths on page 4-10.

Reference/Measurement Cursors

The **R Cursor** and **M Cursor** parameters allow you to enter the reference and measurement cursor locations in relation to the horizontal scale of the **Data Plot** window into a scan routine. Whenever the scan routine executes, the cursors automatically position at the programmed locations.

If you know the desired cursor settings, you can numerically enter the settings directly into the scan routine in the **Scan Routines** window.

1. In the **Display Parameters** section of the **Scan Routines** window **(**see Figure 7-1), click **R. Cursor** or **M. Cursor** to open the **Cursors** tab (see (Figure 7-18) .
2. Enter the desired cursor location for the **R** and/or **M Cursor,** and then enter the **Bandwidth** values.
3. Click **OK** to enter the cursor positions into the scan routine.

Entering Cursor Positions from the Data Plot Window

If you do not know the desired cursor settings, you can enter cursor locations into the current scan routine from the **Data Plot** window.

1. Run a sample scan of the feature to measure to set the cursor locations for leveling.
2. When the scan is complete, position the reference cursor at a location along the reference plane (such as the base of a step or the lip of an etched depth). For more information on cursor positioning, see Reference/Measurement Cursors on page 4-9.

3 To level the trace accurately, position the measurement cursor some distance away from the reference cursor but along the same horizontal plane (such as the base of the step or the lip of the etched depth).

4 After the cursors are properly positioned, select **Edit** > **Enter Software Leveling** from the menu bar to enter the new cursor locations into the scan routine.

NOTE – The software leveling function now occurs at the specified cursor locations whenever the current scan routine executes and software leveling has been selected.

Display Range

The **Automatic Ranging** feature automatically scales and ranges the profile trace to fill 80% of the data plot display. However, in some applications where repetitive or like scans are compared, you can preset the graphic scale by numeric entry.

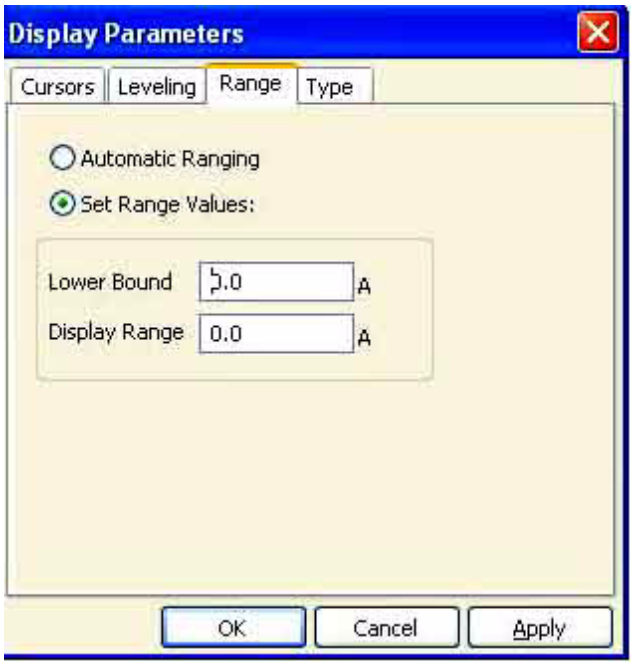
1 In the **Display Parameters** section of the **Scan Routines** window **(**see Figure 7-1), click **Display Range** to open the **Range** tab (see (Figure 7-19).

2 Do one of the following:

- To allow the system to automatically set the range , click **Automatic Ranging**.
- To set the display range at a specified value, click **Set Range Values** to activate fields for entering the upper and lower boundaries of the graphic scale. Enter the desired setting for the lower boundary in the **Lower Bound** box and the upper boundary in the **Display Range** box.

3 Click **OK**.

Figure 7-19: Display Parameters Dialog Box: Range

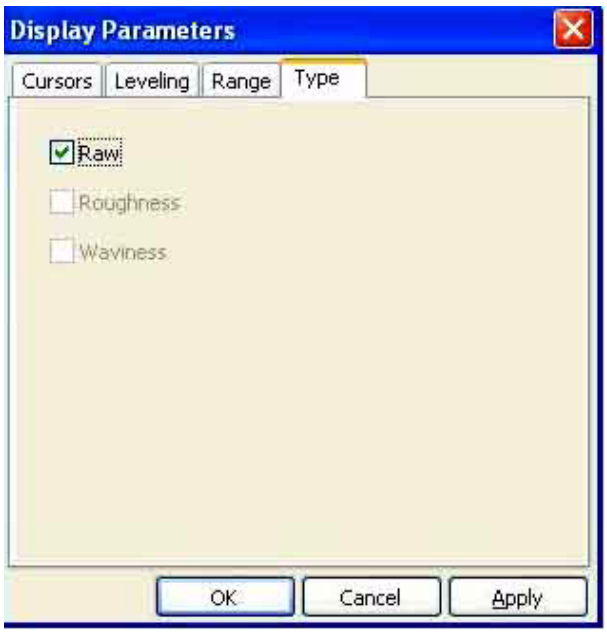


Display Data Type

Click the **Type** tab to set this parameter, which allows you to display the raw profile data, roughness, and waviness profile (see Figure 7-20). You can display the raw profile and roughness or waviness

profiles individually or simultaneously, to easily correlate the profiles. See Entering Data Types into a Scan Routine on page 6-14 for a detailed description of the function and use of the **Display Data Type** parameter.

Figure 7-20: Display Parameters Dialog Box: Type



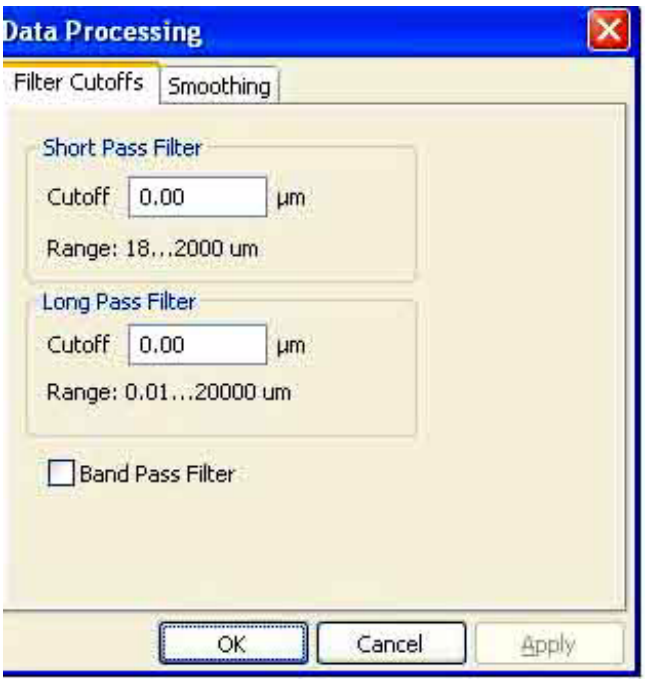
DATA PROCESSING PARAMETERS

These parameters allow you to filter and smooth your data, as well as set the options for Step Detection analysis.

Filter Cutoffs

The **Data Processing** section of the **Scan Routines** window includes the **Filter Cutoffs** tab, which contains options that allow you to activate filter cutoffs (Figure 7-21). For a full description of the Filter Cutoffs, see Data Processing Settings on page 5-15.

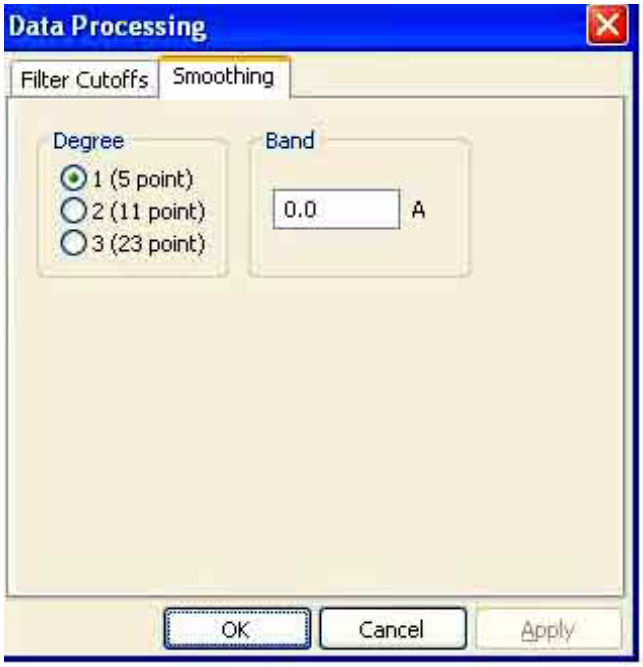
Figure 7-21: Data Processing, Filter Cutoffs Tab



Smoothing

The **Data Processing** section of the Scan Routines window includes the **Smoothing** tab, which contains options that allow you to activate smoothing filters (Figure 7-22). For a full description of the smoothing filters, see Data Processing Settings on page 5-15.

Figure 7-22: Data Processing, Filter Smoothing Tab



Step Detection

The **Data Processing** section of the **Scan Routines** window includes Step Detection settings, which appear on the **General Settings** tab (Figure 7-23) and the **Every Step** tab (Figure 7-24). For instructions on making setting for Step Detection analysis, see Appendix D.

Figure 7-23: Step Detection, General Settings Tab

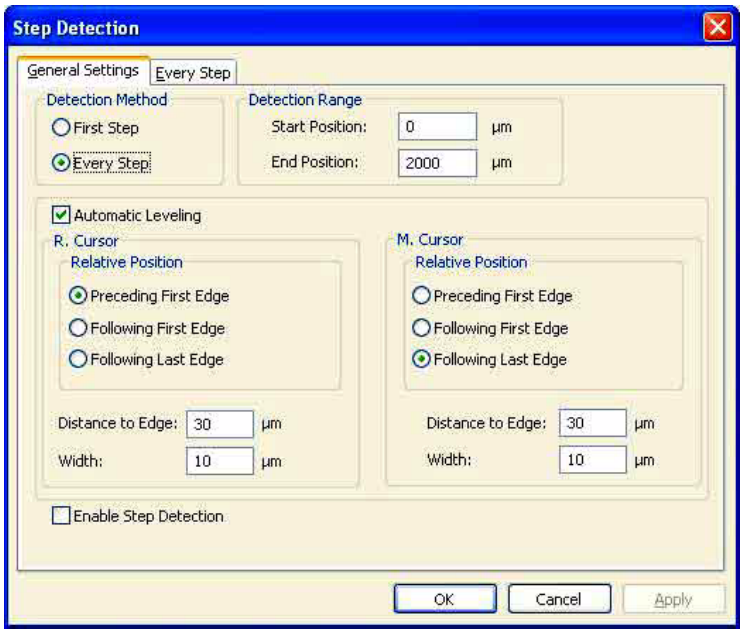
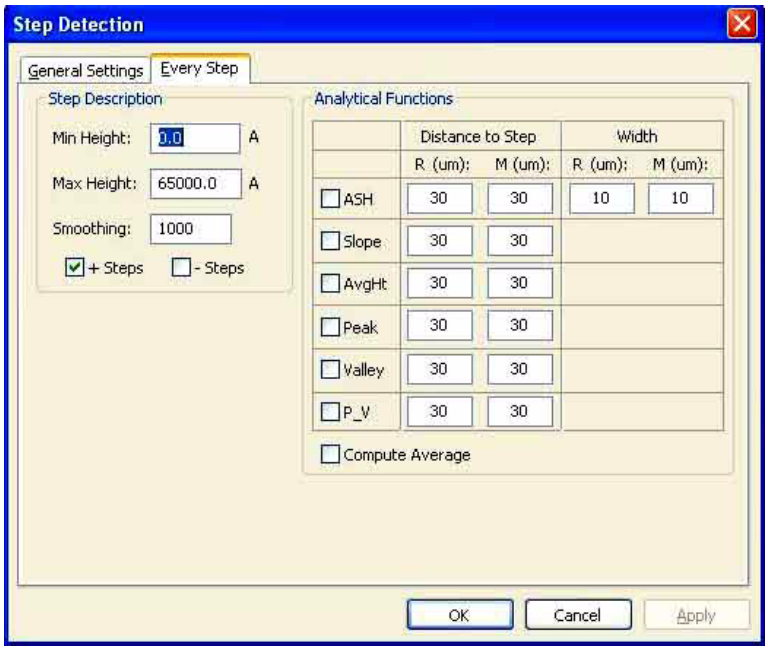


Figure 7-24: Step Detection, Every Step Tab.



8

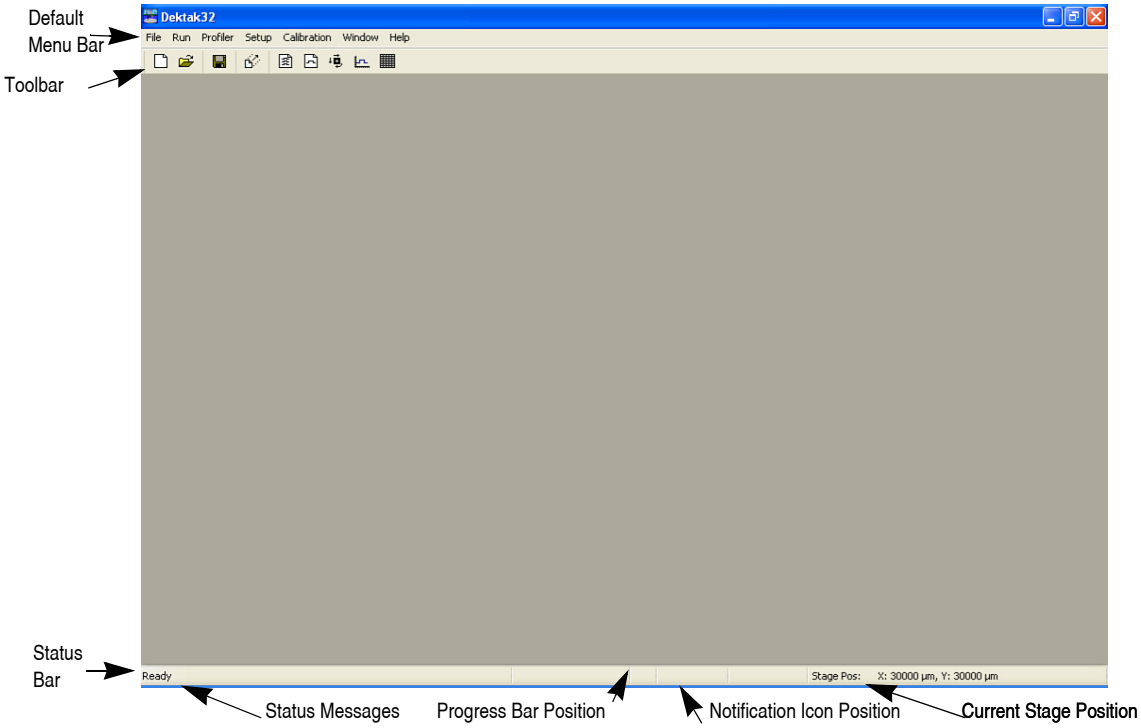
MENU AND TOOLBAR DESCRIPTIONS

The Dektak 150 application uses Microsoft Windows XP as the operating system. Whenever you first access the Dektak 150 application, or close all windows, the Dektak 150 **Startup** window appears (see Figure 8-1). The menu bar and the toolbar below it continually appear at the top of all Dektak 150 windows, and the status bar appears at the bottom. Each Dektak 150 window has its own specific menus and tool bars. These menu items and toolbar icons are described in the following sections.

STARTUP WINDOW

When no other window is active in the Dektak 150 application, the **Startup** window appears. As shown in Figure 8-1, it contains a default menu bar, toolbar, and status bar.

Figure 8-1: Dektak 150 Startup Window



Default Menu Bar

The default menu bar (see Figure 8-1) provides access to the different types of operations available. The various menus contained within the default menu bar in the **Startup** window appear under the headings **File**, **Run**, **Profiler**, **Setup**, **Calibration**, **Window,** and **Help**.

A description of the contents of each menu, the keyboard shortcuts (if any) associated with the menu items, and instructions for accessing them are provided in the remainder of this chapter.

NOTE – Menu items appear "grayed out" when the function is not currently available. For example, the menu item **File > Print** is not available when there is nothing to be printed.

NOTE – Combination keystrokes are indicated by "+". For example, "**Ctrl+N**" means hold down the **Ctrl** key, press and release the **N** key, and then release the **Ctrl** key.

Additional Menus

Most of the other windows contain at least one menu in addition to those that appear on the default menu bar. These menus are described in the sections that follow.

Toolbar

Each window contains a unique toolbar, consisting of a set of icons to perform various functions. You can open some menu items with icons located on specific toolbars. See Toolbars and Icons on page 8-27 for a complete description of each toolbar.

Status Bar

A status bar is located at the bottom of the screen. It contains window-specific status messages, a progress bar (when appropriate), a notification icon when Global Editing Mode is active, and the current position of the stage (see Figure 8-1).

FILE MENU

The **File** menu allows you to open and save files, and print scan data and parameters. To access the **File** menu, select **File** on the menu bar.

Figure 8-2: File Menu

New **Ctrl+N**

The **New** command creates a new automation program with a single scan containing the default scan parameters.

Open **Ctrl+O**

The **Open** command opens an automation program or other previously saved files. Select **File** > **Open** to display a list of available files.

Save **Ctrl+S**

The **Save** command by default saves any recent changes to the current automation program. If the **Data Plot** window is active, scan data is saved. If the **Dektak Database** window is active, the APS Report is saved.

Save As

The **Save As** command by default saves an automation program under a different file name. Select **File** > **Save As** to display a list of file names currently in use, and enter a new file name to use. If the **Data Plot** window is active, scan data is saved under a different file name. If the **Dektak Database** window is active, the APS Report is saved under a different file name.

Export **Ctrl+E**

The **Export** command by default exports an automation program as an ASCII file. Select **File** > **Export** to display a list of .txt file names currently in use, and type a new file name to use. If the **Data Plot** window is active, scan data is exported under a different file name. If the **Dektak Database** window is active, the APS Report data is exported under a different file name.

Print **Ctrl+P**

Select **File** > **Print** to print a form appropriate for the active window. (If there is no predefined form for the window, the print function acts as a print-screen command, printing the entire current active screen.)

Explore Dektak Directory **Ctrl+Alt+E**

Opens Windows Explorer at the active directory (\Veeco\Dektak32 by default).

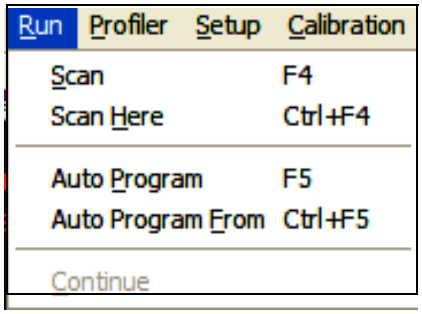
Exit **Alt+F4**

Closes the Dektak 150 application (after confirmation).

RUN MENU

This menu runs a scan routine or an automation program. To access the **Run** menu, select **Run** from the menu bar.

Figure 8-3: Run Menu



Scan **F4**

Select **Run** > **Scan** to run the current scan at the stage position specified in the scan.

Scan Here **Ctrl+F4**

Select **Run** > **Scan Here** to run the current scan starting at the current stage position.

Auto Program **F5**

Select **Run** > **Auto Program** to run all of the scan routines in the current automation program, beginning with scan routine 1.

Auto Program From **Ctrl+F5**

Select **Run** > **Auto Program From** to run the current automation program, beginning at the selected scan routine.

Continue

The **Continue** function has two purposes:

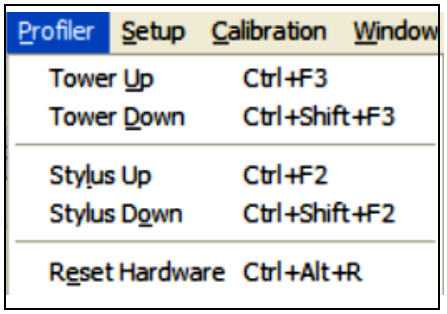
- Select **Run** > **Continue** to run the next scan in sequence of a multiple-scan automation program, when the autoprogram function (**Adjust Position Before Each Scan**) has been activated.
- Select **Run** > **Continue** to continue at the next scan in sequence of a multiple-scan automation program, when the automation program was aborted during a scan.

> **NOTE –** If you abort the operation while moving the stage, the stage position is lost, and you cannot continue. You must reset the hardware.

PROFILER MENU

This menu is used for controlling profiler functions. To access the **Profiler** menu, select **Profiler** from the menu bar.

Figure 8-4: Profiler Menu



Tower Up **Ctrl+F3**

Select **Tower Up** to lift the stylus and raise the tower and optics up to the home position.

Tower Down **Ctrl+Shift+F3**

Select **Tower Dow**n to lower the tower and optics down to the stylus null position, and then raise the stylus from the sample.

Stylus Up **Ctrl+F2**

Select **Stylus Up** to lift the stylus off the sample surface without raising the tower. This allows the user to view the video image of the sample surface while positioning the stage, without contact between the stylus and sample.

Stylus Down **Ctrl+Shift+F2**

Select **Stylus Down** to lower the stylus onto the sample surface unless the tower is already in the home position. The tower and stylus automatically raise a small amount off the sample surface whenever the sample stage repositions.

Reset Hardware **Ctrl+Alt+R**

Select **Profiler > Reset Hardware** for a complete hardware reset (same as the software initialization sequence).

Manual Leveling

The stage can be manually tilted until level.

SETUP MENU

Use this menu to set up the Dektak 150 system.

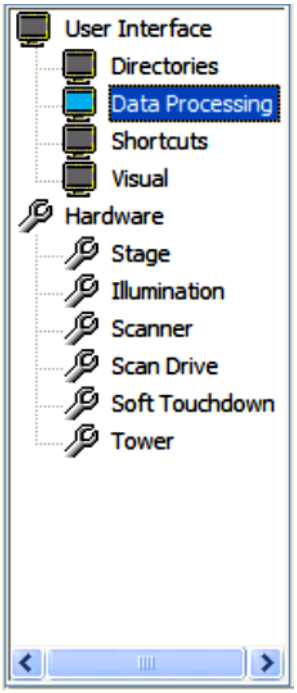
Figure 8-5: Setup Menu

Configuration Settings

Select **Setup > Configuration Settings** and press the **CTRL** key or enter the password in the dialog box to open the **Configuration Settings** dialog box. As shown in Figure 8-5, this dialog box includes two sections—**User Interface** and **Hardware**.

> **NOTE –** Click **OK** after making your selections to close the dialog box. Click **Apply** instead of **OK** if you want to keep the dialog box open to click other icons.

Figure 8-6: Configuration Settings Dialog Box



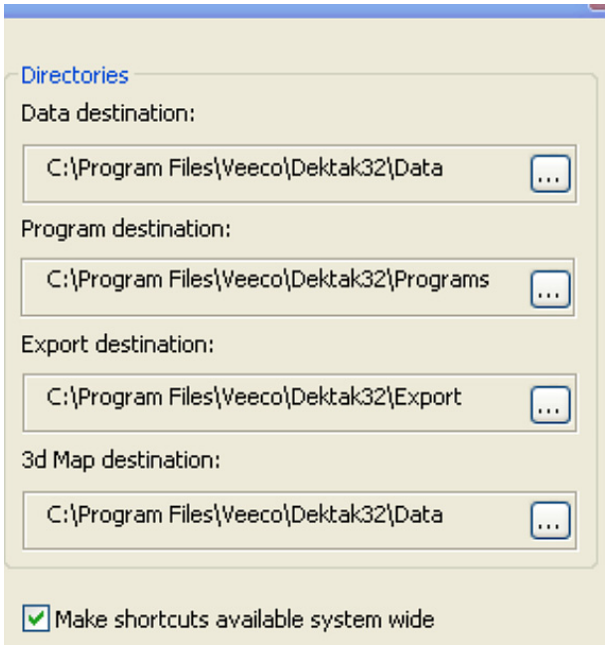
USER INTERFACE SETTINGS

Click the following icons to access settings that affect the appearance of your Dektak 150 software.

Directories

These settings allow you to specify the default working directories for data, program, export and 3D map files. Select the **Make shortcuts available system wide** check box if you want icons for the directories to appear in file dialog boxes such as **Open**, **Save** and **Save As**.

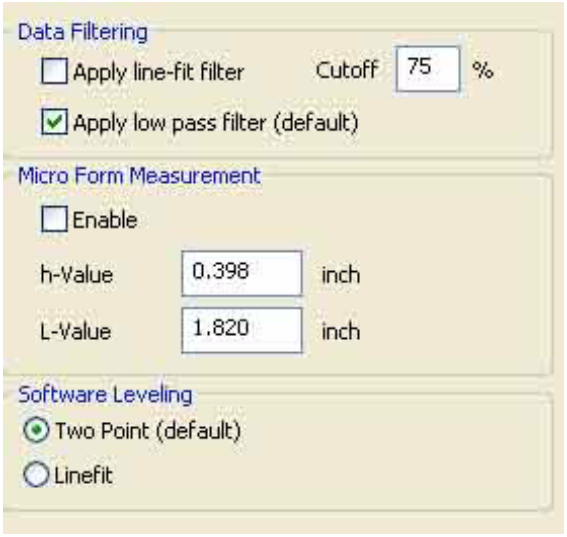
Figure 8-7: Directories Dialog Box



Data Processing

These settings allow you filter the data with a line-fit or low pass filter. They also allow you to enable MicroForm Measurement (see Enabling MicroForm Measurement on page 5-35) and perform software leveling (see Software Leveling on page 4-14).

Figure 8-8: Data Processing Dialog Box



Shortcuts

This dialog box allows you to ace the drop-down list (see Figure 8-10) to assign an analytical function to the F11 and F12 keys . For more information, see Assigning Analytical Functions to Keystrokes on page 3-6.

Figure 8-9: Shortcuts Dialog Box

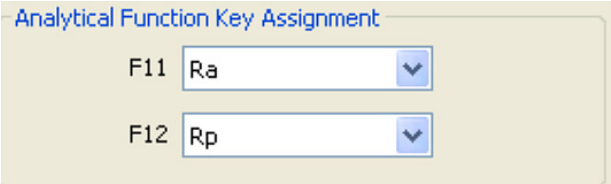
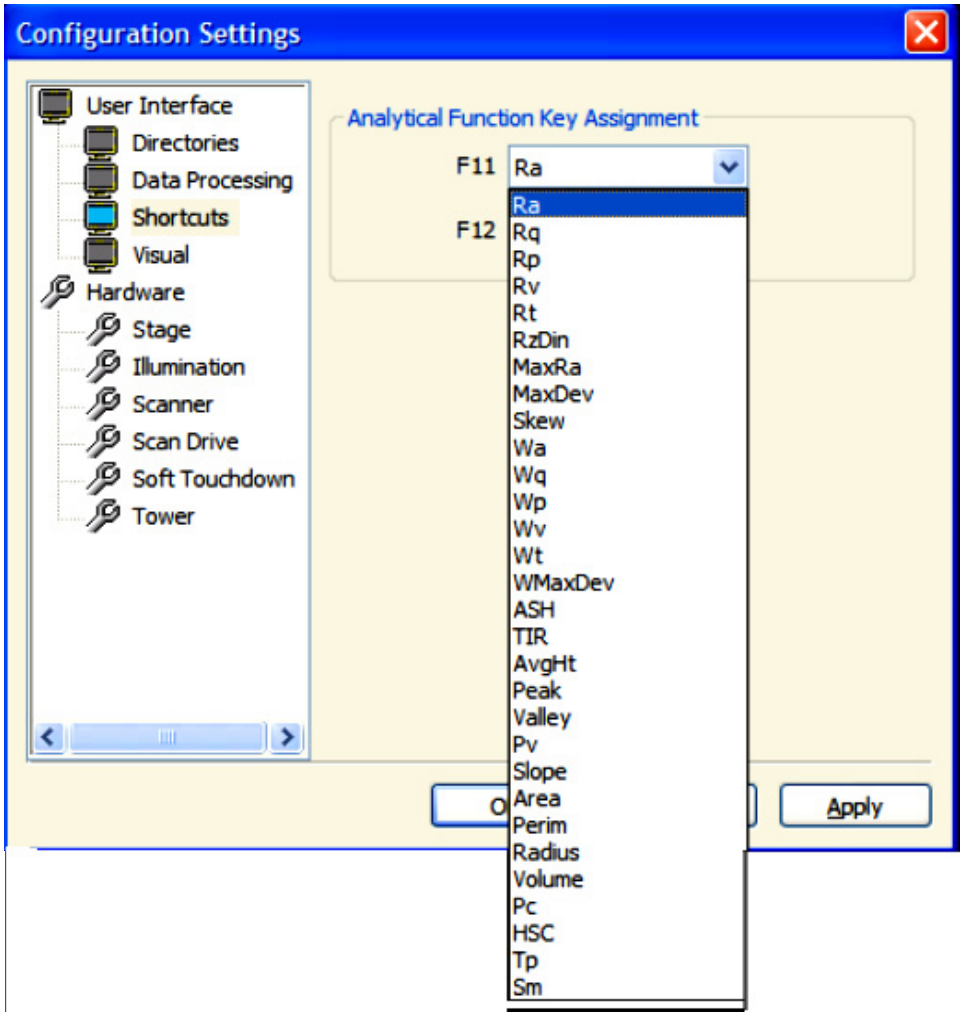


Figure 8-10: Drop-Down List of Analytical Functions



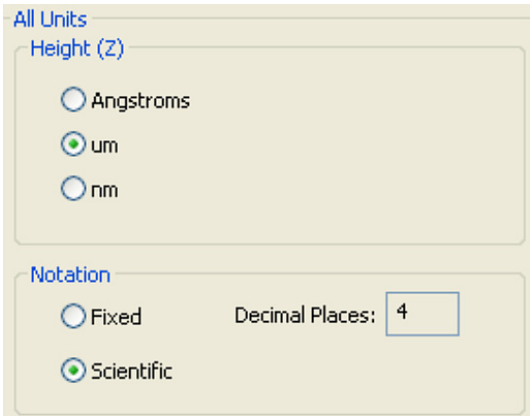
Units

In the **All Units** section, select **Angstroms**, **um**, or **nm**.

In the **Notation** section, select **Fixed** or **Scientific**. The system then makes the appropriate **Decimal Places** setting. This field cannot be modified by the user.

> **NOTE –** You can change the units in which information is displayed before or after a scan. For more information, see Changing Units Before or After a Scan on page 4-8.

Figure 8-11: Units Dialog Box



Visual

In the **General** section, click **Show Sidebar Buttons** to display them on the screen. Different buttons are available for each screen. For more information, see Side Bar Buttons on page 3-7.

Figure 8-12: Sidebar Buttons in Data Plot Window

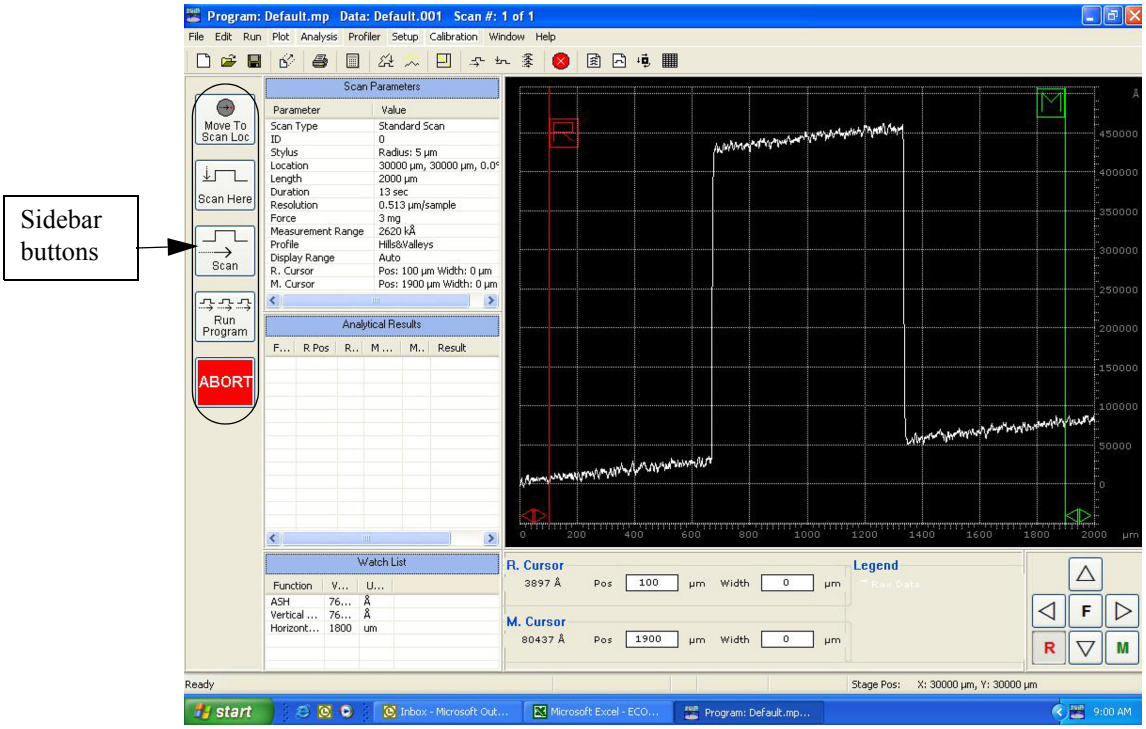
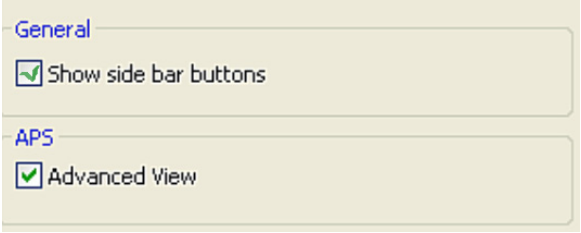


Figure 8-13: Visual Dialog Box



HARDWARE SETTINGS

For an illustration of the hardware settings in the **Configuration Settings** dialog box, see Figure 8-6.

CAUTION: The Dektak 150 hardware settings are set at the factory and should not be modified by the user. Changing hardware settings affects both scan results and the performance of the Dektak 150 system. Furthermore, it may void the warranty. The only exceptions are the **Illumination** and **Soft Touchdown** settings, which are discussed in this section.

NOTE – After you change Dektak 150 hardware settings, a few seconds of delay occurs while the system downloads the parameters into the E-box.

Illumination

This dialog box allows you to set the increment to be used when changing the sample illumination (see Stylus Reticle Alignment on page 3-19). Enter a value between 1 and 255 for the **Illumination Increment** for the USB camera.

Figure 8-14: Illumination Dialog Box

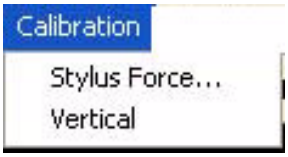
Soft Touchdown

The **Soft Touchdown** setting applies only if your system includes the soft touchdown option for the 3D Mapping function. Instructions for making this setting appear in Appendix E.

CALIBRATION MENU

This menu is used for calibrating various operations of the system.

Figure 8-15: Calibration Men

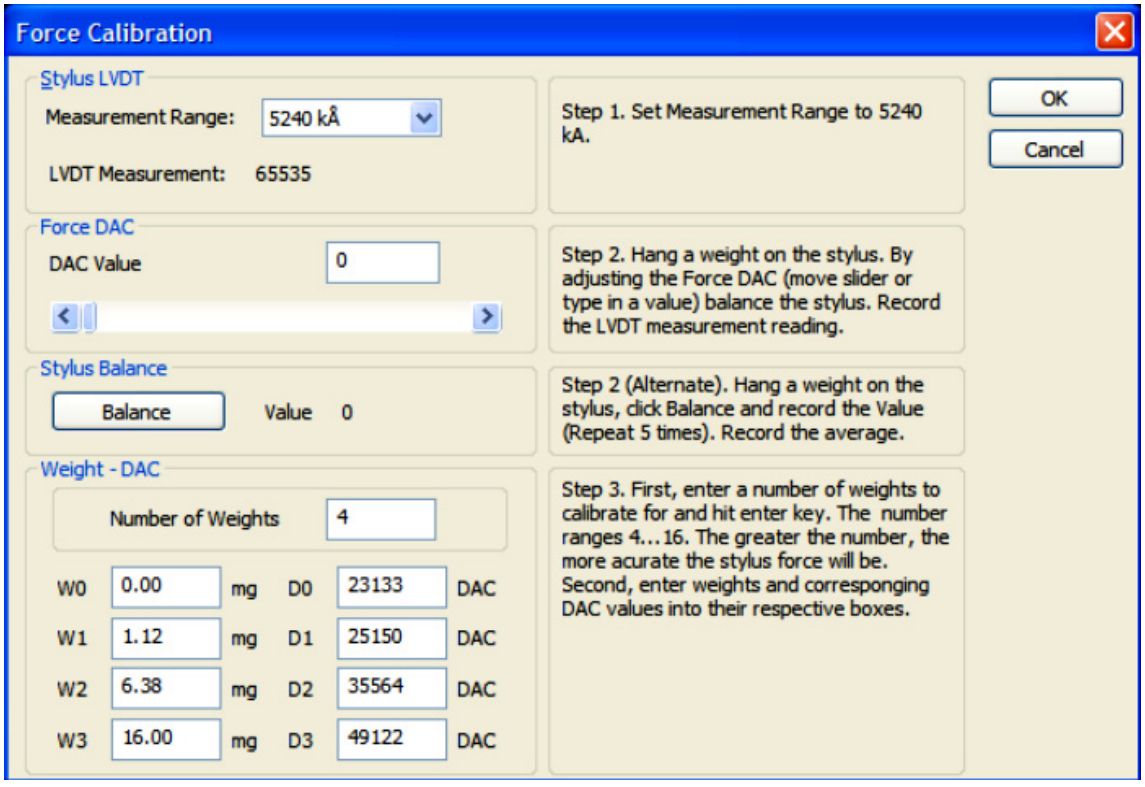


Stylus Force

This selection opens the **Force Calibration** dialog box.

CAUTION
The force calibration settings should be changed only by trained personnel.

Figure 8-16: Force Calibration Dialog Box



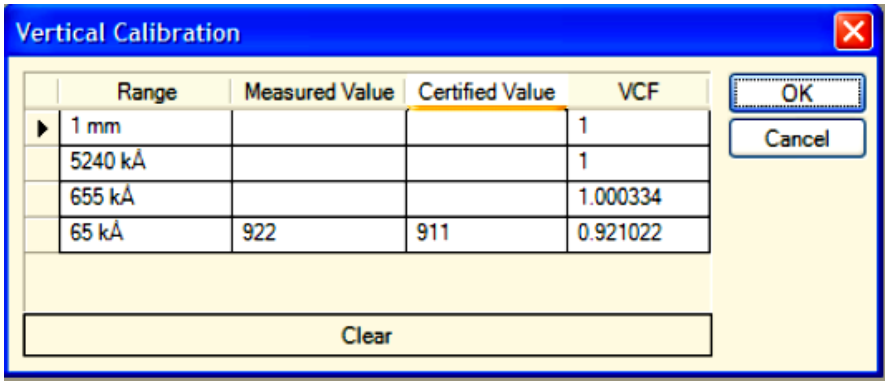
In this dialog box you can choose the measurement range in the **Stylus LVDT** section and then manually select the amount of force to be placed on the stylus to change the position of the stylus using the slider in the **Force DAC** section.

To calibrate the stylus force, follow the instructions given in the three steps listed at the right side of the dialog box.

Vertical

Select **Calibration > Vertical** to open the **Vertical Calibration** dialog box, which allows you to set and clear the vertical calibration of the Dektak 150 profiler.

Figure 8-17: Vertical Calibration Dialog Box

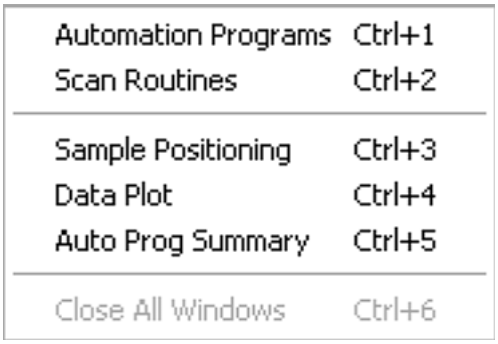


NOTE – Always clear the existing vertical calibration for the selected range before re-performing the vertical calibration.

WINDOW MENU

This menu provides access to the various Dektak windows (see Figure 8-18). The options listed on this menu depend on the screen from which it is opened.

Figure 8-18: Window Menu on Startup Screen



Automation Programs Ctrl+1

Select **Window** > **Automation Programs** to make alterations to the automation programs.

Scan Routines Ctrl+2

Select **Window** > **Scan Routines** to edit the scan parameters in the **Scan Routines** window.

Sample Positioning Ctrl+3

This selection opens the **Sample Positioning** window, which is a real-time video display that allows you to position the stylus accurately to the points of interest on a sample.

Data Plot Ctrl+4

This selection opens the **Data Plot** window. Note that this selection is available whether or not a scan has been run or saved data has been loaded. The **Data Plot** window displays the scaled profile trace, along with the Scan Parameters, Analytical Results, and a real-time Watch List.

Auto Prog Summary Ctrl+5

This selection opens the **Dektak Database** window, where you can load and display a saved APS Report. For more information, see Activating the APS Report Function on page 5-27 and Contents of the APS Report on page 5-30.

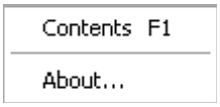
Close All Windows **Ctrl+6**

Select **Window** > **Close All Windows** to return to the Dektak **Startup** window.

HELP MENU

NOTE – The **Help** menu is available only if the Help files were installed along with the Dektak 150 software.

Figure 8-19: Help Menu



Contents **F1**

Select click **Help** > **Contents** > **Dektak 150 Manual.pdf** or press the F1 key to view this manual in PDF format.

About

Select **Help** > **About** to view the number of the currently installed version of the Dektak software. The **Help** dialog box also provides a number of convenient links and functions on the two tabs described below.

General Tab

On the **General** tab you can:

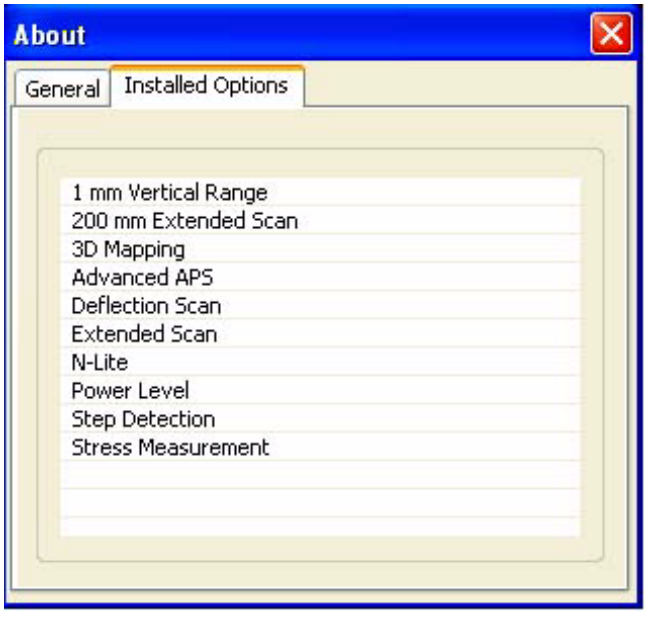
- Click a link to open the Release Notes for this version of the Dektak 150 software.
- Click a link to contact Veeco Technical Support (USA only).
- Click a link to open the home page of the Veeco web site.
- Click a button to back up your Dektak 150 system settings.
- Click a button to restore your Dektak 150 system settings.
- Click a button to view your system information.

Figure 8-20: General Tab of the About Help Dialog Box

Installed Options Tab

On the **Installed Options** tab, you can view a list of the add-on software options that are installed in your system.

Figure 8-21: Installed Options Tab of the About Help Dialog Box

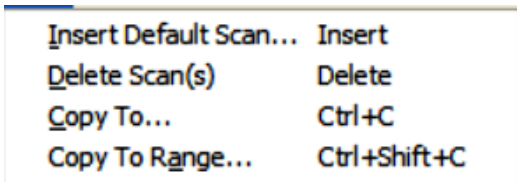


AUTOMATION PROGRAMS WINDOW MENU SELECTIONS

The **Automation Programs** window provides the **Run** menu, **Profiler** menu, **Setup** menu, **Calibration** menu, **Window** menu, and **Help** menu. All of these menus are described earlier in this chapter.

In addition, the **Automation Programs** window includes an **Edit** menu (see Figure 8-22). This menu is briefly described in this section. A more detailed description of its functions is provided in Copying an Automation Program on page 5-3.

Figure 8-22: Automation Programs Edit Menu



Edit Menu

Insert Default Scan… Insert

Inserts a default scan routine at the highlighted scan in the list, or at the specified scan index number.

Delete Scan Delete

Removes the selected scan from the list.

Copy To… Ctrl+T

Copies the selected scan to a specified location in the list.

Copy To Range… Ctrl+A

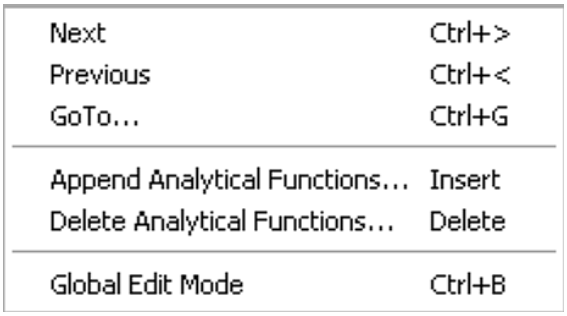
Copies the selected scan to each of a specified range of scan locations in the list.

SCAN ROUTINES WINDOW MENU SELECTIONS

The **Scan Routines** window provides the **Run** menu, **Profiler** menu, **Setup** menu, **Calibration** menu, **Window** menu, and **Help** menu. All of these menus are described earlier in this chapter.

In addition, the **Scan Routines** window includes an **Edit** menu (see Figure 8-23), which is described below.

Figure 8-23: Scan Routines Window Edit Menu



Edit Menu

Next **Ctrl+>**

Designates the next scan routine in the Automation Programs list as the current scan routine.

Previous **Ctrl+<**

Designates the previous scan routine in the Automation Programs list as the current scan routine.

Go To **Ctrl+G**

Designates the specified scan routine in the Automation Programs list as the current scan routine. Type the scan routine number in the pop-up **Go To** dialog box and press the ENTER key.

Append Analytical Functions… **Insert**

Opens the **Analytical Functions** dialog box, where functions may be selected to be attached to the scan routines.

Delete Analytical Functions… **Delete**

Opens the **Delete Analytical Functions** dialog box, where one or more analytical functions may be deleted from the scan routines.

Global Edit Mode **Ctrl+B**

Toggles Global Edit Mode on or off. When on, changes made to the current scan routine are also made in all the other scan routines within a multiscan Automation Program. For more information, see Global Editing of Scan Routine Parameters on page 5-18.

SAMPLE POSITIONING WINDOW POP-UP MENU SELECTIONS

When the **Sample Positioning** window is open, you can open a pop-up menu by right-clicking the mouse in the camera view pane. The options on this menu (see Figure 8-24) are briefly described below. For more detailed descriptions of the use and functions of the menu items, see Defining Scan Location and Length on page 5-4.

Figure 8-24: Sample Positioning Window Pop-up Menu

Tower Up **Ctrl+F3**

Select **Tower Up** to lift the stylus and raise the tower and optics up to the home position.

Tower Down **Ctrl+Shift+F3**

Select **Tower Down** to lower the tower and optics down to the stylus null position, and then raise the stylus from the sample.

Stylus Up Ctrl+F2

Select **Stylus Up** to lift the stylus off the sample surface without raising the tower. This allows the user to view the video image of the sample surface while positioning the stage, without contact between the stylus and sample.

Stylus Down Ctrl+Shift+F2

Select **Stylus Down** to lower the stylus onto the sample surface. The tower and stylus automatically raise a small amount off the sample surface whenever the sample stage repositions.

Stage Leveling

Select **Auto Level** or **Power Leveling**.

Reset Hardware Ctrl+Alt+R

Select **Reset Hardware** for a complete hardware reset (same as the software initialization sequence).

Save as Image

Select **Save As Image** to open the **Save Image** dialog box, which allows you to save the image of the sample surface in graphic format that can be exported into other programs or documents for later viewing. You can choose to save the video image as a jpeg file (.jpg extension), a bitmap file (.bmp extension), a tiff file (.tif extension) or a tga file (.tga extension). The procedure for saving the video image is described below.

1. In the **Sample Positioning** window, adjust the focus and sample position until the desired video image of the sample surface is displayed on the screen.
2. Right-click the mouse anywhere in the video/graphics display area.
3. Click **Save as Image** in the pop-up menu.
4. The **Save Image** dialog box appears, enabling the current video image to be saved in the format you select. Enter the desired file name and directory location and click **OK**.

Video

Select **Video** to open the **Video** submenu, which offers the following three choices.

Video Only

Select **Video > Video Only** to project the video image of the sample surface from the Dektak 150 camera on the monitor.

Graphics Only

Select **Video > Graphics Only** to display the graphic screen on the monitor without the video image.

Video and Graphics

Select **Video > Video and Graphics** to superimpose the graphic screen over the video image of the sample surface.

Stylus Reticule

Select **Stylus Reticule** to open the stylus reticule submenu, which offers the following two choices

Align

Select **Stylus Reticule > Align** to open the **Stylus Alignment** window, where you can align the targeting cursor to the stylus tip. Then double-click the left mouse button to open a **Confirmation** dialog box, where you can choose whether or not to update the stylus reticule location, or cancel and close the window. (See Stylus Reticle Alignment on page 3-19 for more information.)

Reset

Select **Stylus Reticule > Reset** to open a **Confirmation** dialog box, where you can choose whether or not to reset the stylus reticule location to its default (centered) location.

Update Alignment Reticle

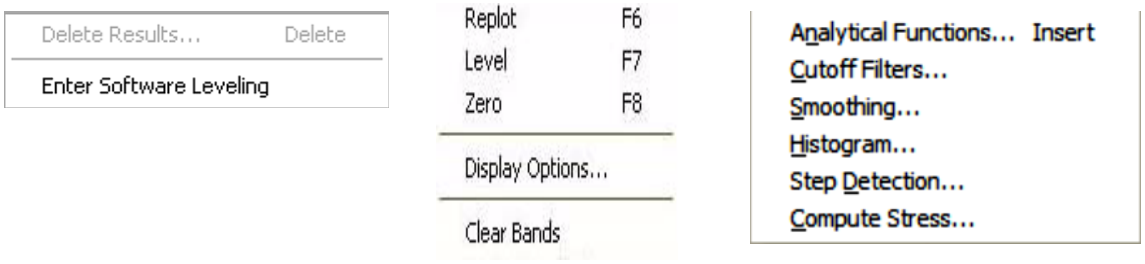
Select **Update Alignment Reticule** to align the feature reticule with surface features away from the stylus to more accurately position the stylus prior to scanning. (See Feature Reticle Alignment on page 3-22 for more information.)

DATA PLOT WINDOW MENU SELECTIONS

The **Data Plot** window provides the **Run** menu, **Profiler** menu, **Setup** menu, **Calibration** menu, **Window** menu, and **Help** menu. All of these menus are described earlier in this chapter.

In addition, the **Data Plot** window includes an **Edit** menu, **Plot** menu, and **Analysis** menu (see Figure 8-25). Furthermore, when you right-click in the **Data Plot** window, the **Save as** pop-up menu appears. These four menus are briefly described in this section. More detailed descriptions of the use of these menu items appear in Chapter 4 and Chapter 6.

Figure 8-25: Data Plot Window: Edit, Plot and Analysis Menus



Edit Menu

Delete Results Delete

Deletes selected analytical results (if any). Select the analytical result in the list at the left side of the **Data Plot** window, and then select **Edit > Delete Results.** In the **Delete Analytical Results** dialog box, choose one of the following:

- Select **Delete 1 Item(s)** to remove the highlighted analytical result from the list.
- Type a number in the field to remove that number of analytical results from the list, starting with the selected one.
- Select **Delete All** to remove all analytical results from the list.

Enter Software Leveling

Select **Edit > Enter Software Leveling** to capture the current positions of the R and M cursors.

Plot Menu

Replot F6

Re-plots the trace according to the boundaries settings. Also redisplays the original boundaries if no boundary box is being drawn on the plot.

Level **F7**

Levels the trace at the current R and M cursor intercepts.

Zero **F8**

Changes the zero position of the graph vertically to align with the intercept of the R cursor and the plot.

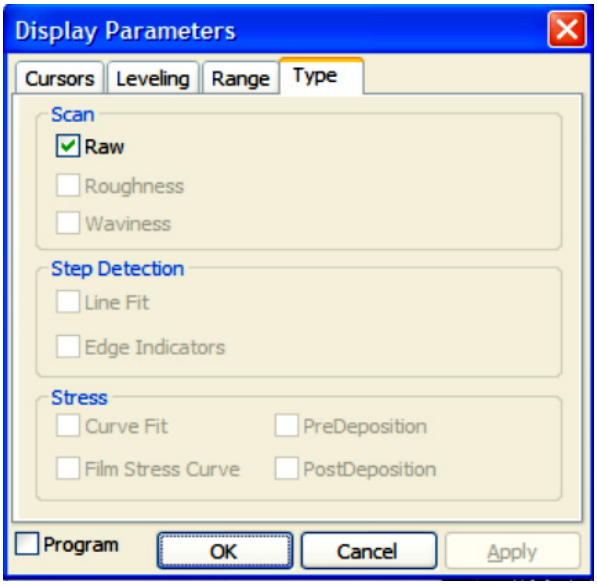
Display Options

Opens the **Display Parameters** dialog box (see Figure 8-26), where:

- The **Type** tab lets you choose the type of data you want to display. See Selecting the Data Type on page 6-13 for details.
- The **Range** tab lets you set Automatic Ranging or set range values.
- The **Leveling** tab lets you select automatic leveling.
- The **Cursors** tab lets you set the position and width of the R and M cursors.

> **NOTE –** The **Step Detection** and **Stress** sections of the **Type** tab are for use with the Step Detection feature and Stress Measurement Option. The Stress Measurement Option is described in Appendix C, and the Step Detection feature is described in Appendix D.

Figure 8-26: Display Parameters Dialog Box



Clear Bands

Resets the bands to zero width at the R and M cursors.

Default Bands

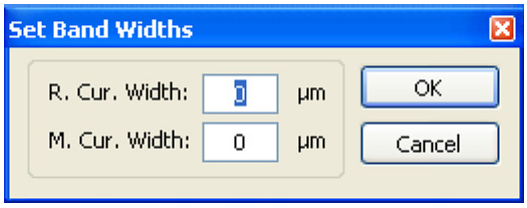
Sets the width of the bands at the R and M cursors to the number of samples acquired in one second, according to the formula:

300 * (scan length) / (number of data points)

Band Widths

Opens the **Set Band Widths** dialog box, where you can type in the widths of the bands at the R and at the M cursors.

Figure 8-27: Set Band Widths Dialog Box



Analysis Menu

Analytical Functions Insert

Opens the **Analytical Functions** dialog box, where functions can be selected in real time to be attached to the current scan and computed.

> **NOTE –** Analytical functions are not appended to the scan routine. In order to do that, you must use the **Append Analytical Functions** option on the **Scan Routines** window **Edit** menu (see Scan Routines Window Menu Selections on page 8-19).

Cutoff Filters

Select **Analysis > Cutoff Filters** to open the **Roughness and Waviness Filters** dialog box, where you can specify values for **Long Pass** and **Short Pass Filter Cutoffs**. Select the check box if you want to apply a **Band Pass Filter**. For more information, see Activating the Cutoff Filters on page 6-11.

Smoothing

Select **Analysis > Smoothing** to open the **Smoothing** dialog box, where you can specify the **Smoothing degree** and **Smoothing band**. For more information, see Using the Smoothing Function on page 6-18.

Histogram

Select **Analysis > Histogram** to open the **Histogram** dialog box, where you can view the height distribution of data points. You can also set the triangular cursors (at the top right corner of the histogram) at any points to show the Y and Z axis value.

Step Detection

Select **Analysis > Step Detection** to open the **Step Detection** dialog box, where you can specify various parameters for performing the step detection function. See Appendix D for more information.

Compute Stress

Select **Analysis > Compute Stress** to open the **Stress Parameters** dialog box, where you can specify various parameters for characteristics of the substrate being measured for stress. See Appendix C for more information.

Stress Results

Select **Analysis > Stress Results** to open the **Stress Results** dialog box, where you can view the maximum and average compressive and tensile stresses as calculated from the stress curve. See Stress Results on page C-5 for more information.

NOTE – The Stress Measurement Option must be installed and stress must be computed, for this menu item to appear.

DEKTAK DATABASE WINDOW SELECTIONS

The **Dektak Database** window provides a **File** menu, a **Window** menu and a **Help** menu.

File Menu

This menu provides **Open**, **Save**, **Page Setup**, **Print**, and **Print Preview** options.

Window Menu

Close All Windows

Select **Window > Close All Windows** to close all open windows.

Help Menu

About

Select **Help > About** to view the version of Vision that is installed.

TOOLBARS AND ICONS

Close All Windows

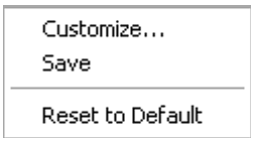
Each window includes a toolbar containing icons that allow you to perform a variety of different functions with a click of a button. These icons and their respective functions are described in the sections below for each window.

NOTE – Some similar icons have slightly different functions depending on the particular toolbar in which they appear.

Customizing the Toolbars

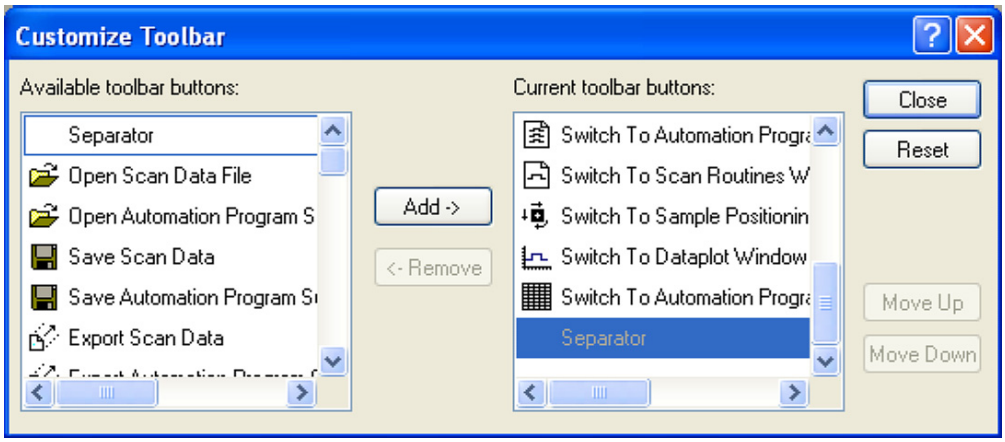
You can customize the toolbar in each window to include only those icons you want. To customize a toolbar, right-click anywhere in the toolbar ribbon to open the **Toolbar** menu.

Figure 8-28: Toolbar Menu



Select **Customize** to open the **Customize Toolbar** dialog box.

Figure 8-29: Customize Toolbar Dialog Box



The dialog box shown in the figure above is associated with the **Startup** window, but it is typical of the dialog box you would obtain in any window. (The specific contents of the list boxes reflect the toolbar of the particular Dektak 150 window that is displayed.)

The **Current toolbar buttons** list box at the right shows the buttons (icons) currently on the toolbar for the window that is displayed.

The **Available toolbar buttons** list box at the left contains buttons that are not on the toolbar, but are available for use.

Here are some ways in which you can customize a toolbar:

- To add a button (or a separator) to the toolbar, select the item in the **Available toolbar buttons** list box and double-click it, or click the **Add ->** button. Your selection is moved to the **Current toolbar buttons** list box and placed beneath the currently highlighted item in the list. (The separator line always remains available for use.)
- To remove a button (or a separator line) from the toolbar, select the item in the **Current toolbar buttons** list box and double-click it, or click the **<- Remove** button. Your selection is removed from the list and placed in the **Available toolbar buttons** list box. (If you selected a separator line, it will simply be removed.)
- To change the location of an item in the toolbar, select the item in the **Current toolbar buttons** list box and click the **Move Up** or **Move Down** button, as appropriate.

- Click **Close** to accept your changes, or **Reset** to return to the default toolbar configuration.
- If you want to save your modified toolbar for use the next time you launch the Dektak program, be sure to right-click anywhere in the toolbar ribbon to pop up the **Toolbar** menu and click **Save** (see Figure 8-28).
- To return to the default toolbar configuration at any time, right-click anywhere in the toolbar ribbon to pop up the **Toolbar** menu and click **Reset to Default**. To keep the default configuration, click **Save**.

Startup Window Toolbar and Icons

Figure 8-30: Startup Window Toolbar

Table 8-4: Startup Window Toolbar Icon Descriptions

Description	Icon
New: Create new Automation Program.	
Open: Open Automation Program file.	
Save: Save currently active Automation Program.	
Export: Export currently active Automation Program.	
Automation Programs Window: Switch to the **Automation Programs** window.	
Scan Routines Window: Switch to the **Scan Routines** window.	
Sample Positioning Window: Switch to the **Sample Positioning** window.	
Data Plot Window: Switch to the **Data Plot** window.	
Automation Program Summary: Switch to the Automation Program Summary Database.	

Automation Programs Window Toolbar and Icons

Figure 8-31: Automation Programs Window Toolbar

Table 8-5: Automation Programs Window Toolbar Icon Descriptions

Description	Icon
New: Create new Automation Program.	
Open: Open Automation Program file.	
Save: Save currently active Automation Program.	
Print: Print Automation Program parameters.	
Export: Export currently active Automation Program.	
Copy: Copy currently selected scan routine.	
Copy to Range: Copy currently selected scan routine to a range of scan routines.	
Delete: Delete currently selected scan routine.	
Delete Range: Delete range of scan routines.	
Run Scan Routine: Run currently active scan routine.	
Run Scan Routine Here: Run currently active scan routine starting at the current stage location.	
Run Automation Program: Run Automation Program.	

Scan Routines Window: Switch to the **Scan Routines** window.	
Sample Positioning Window: Switch to the **Sample Positioning** window.	
Data Plot Window: Switch to the **Data Plot** window.	
Dektak Database: Switch to the Dektak Database.	

Scan Routines Window Toolbar and Icons

Figure 8-32: Scan Routines Window Toolbar

Table 8-6: Scan Routines Window Toolbar Icon Descriptions

New: Create new Automation Program.	
Open: Open Automation Program file.	
Save: Save currently active Automation Program.	
Print: Print Automation Program parameters.	
Previous Scan: Select and display previous scan routine of a multiscan Automation Program.	
Next Scan: Select and display next scan routine of a multiscan Automation Program.	
Append Functions: Append analytical functions to current scan routine.	
Global Edit: Enables and disables global edit mode for scan routines.	

Run Scan Routine: Run the currently active scan routine.	
Run Scan Routine Here: Run currently active scan routine starting at the current stage location.	
Run Automation Program: Run Automation Program.	
Automation Program Window: Switch to the Automation Program Window.	
Sample Positioning Window: Switch to the **Sample Positioning** window.	
Data Plot Window: Switch to the **Data Plot** window.	
Dektak Database: Switch to the Dektak Database.	

Sample Positioning Window Toolbar and Icons

Figure 8-33: Sample Positioning Window Toolbar

Table 8-7: Sample Positioning Window Toolbar Icon Descriptions

Description	Icon
Increase Illumination: Increase sample illumination.	
Decrease Illumination: Decrease sample illumination.	
Tower Up: Lift the stylus, raise the tower and optics to the home position.	
Tower Down: Lower the tower and optics to the stylus null position. The stylus is then raised from the sample.	

Stylus Up: Lift the stylus off the sample surface, while the tower and camera remain in the null position.	
Stylus Down: Move the tower down to the null position. Lower the stylus.	
Run Scan Routine: Run currently active scan routine.	
Run Scan Routine Here: Run currently active scan routine at current stage location.	
Run Automation Program: Run Automation Program.	
Abort: Abort current operation. Note that you must reset the hardware if you have aborted operation while the stage is moving or the stage is rotating. .	
Stage Control Window: Display/Hide **Stage Control** window.	
Automation Programs Window: Switch to the **Automation Programs** window.	
Scan Routines Window: Switch to the **Scan Routines** window.	
Data Plot Window: Switch to the **Data Plot** window.	
Dektak Database: Switch to the Dektak Database.	

Data Plot Window Toolbar and Icons

Figure 8-34: Data Plot Window Toolbar

Table 8-8: Data Plot Window Toolbar Icon Descriptions

New: Create new Automation Program.	
Open: Open scan data file.	
Save: Save scan data.	
Export: Export scan data.	
Print: Print scan data and parameters.	
Display Analytical Functions: Display **Analytical Functions** dialog box.	
Level: Level the trace at the current R and M cursor intercepts.	
Replot: Perform the replot function on the scan trace.	
Toggle Data Plot Size: Toggle data plot size.	
Histogram: Display a histogram of the data.	
Run Scan Routine: Run currently active scan routine.	
Run Scan Routine Here: Run currently active scan routine at current stage location.	
Run Automation Program: Run Automation Program.	

Abort: Abort current operation. ***Note**: If you abort an operation while moving the stage, the stage position is lost, and you cannot continue. You must reset the hardware as described in* X-Y Auto and Y Auto Stage Control Panel on page 3-8.	
Automation Programs Window: Switch to the **Automation Programs** window.	
Scan Routines Window: Switch to the **Scan Routines** window.	
Sample Positioning Window: Switch to the **Sample Positioning** window.	
Dektak Database: Switch to the Dektak Database.	

Dektak Database Toolbar and Icons

When you select the **Dektak Database** icon, the Dektak Database appears. This database contains all generated APS Reports. For more information, see Working with APS Reports on page 5-27.

Figure 8-35: Automation Program Summary Database Toolbar

Table 8-9: Dektak Database Toolbar Icon Descriptions

Open: Open an APS Report.	
Save: Save an APS Report.	
Print: Print an APS Report.	
Print Preview: Preview an APS Report prior to printing.	
Toolbar Options: Add or remove toolbar options.	
Update: Refreshes the data to display the latest changes to an APS Report.	

9

CALIBRATION AND MAINTENANCE

This chapter tells you how to keep your Dektak 150 surface profiler in top working condition.

OVERVIEW OF VERTICAL CALIBRATION

Setting the vertical calibration requires taking a height or depth measurement and comparing the results with the standard's certified value. A measured value that is within ± 0.5% of the certified value ensures that your Dektak 150 system is taking accurate measurements.

$$\frac{\text{Certified Value}}{\text{Measured Value}} = \text{VCF (Vertical Calibration Factor)}$$

Here are the general steps for vertical calibration:

1 Determine the measurement range that you want to calibrate first. Ideally, perform the calibrations in this order:

- 65 kÅ range
- 655 kÅ range
- 5240 kÅ range
- Optional 1 mm range

> **NOTE –** The measurement range is selected in the **Meas Range** list on the **Nominal Parameters** tab of the **Scan Parameters** dialog box. For more information, see Measurement Range on page 7-10.

2 Place a certified standard on a leveled stage. Follow these selection guidelines:

- A single 5 µm (50 kÅ) calibration standard can be used for the 65 kÅ and 655 kÅ ranges.
- A 10 µm (100 kÅ) calibration standard is preferred for the 655 kÅ and 5240 kÅ ranges.
- The the 1 mm range requires the special vertical standard that comes with the Extended Vertical Range option.

NOTE – All Veeco-provided calibration standards are certified by Physikalisch - Technische Bundesanstat in Braunschweig., Germany, according to the European norm EN 5436-1 (Type A-1). A certificate is included with each standard.

3. Make some preliminary measurements and to ensure that the standard is correctly positioned and that the profile trace is in range.
4. Run an automation program provided by Veeco to perform five measurements, calculate an analytical function, and average the results.
5. Compare the measured value with the certified value. The measured value should be within ± 0.5% of the certified value.
6. Enter the results of the averaged measurement in the **Vertical Calibration** dialog box.
7. Repeat the above steps to set the calibration for each additional measurement range.

CALIBRATING THE 65 KÅ RANGE

This section tells you how to set the calibration for the 65 kÅ measurement range. The steps are similar for the other measurement ranges.

Making the Preliminary Measurements

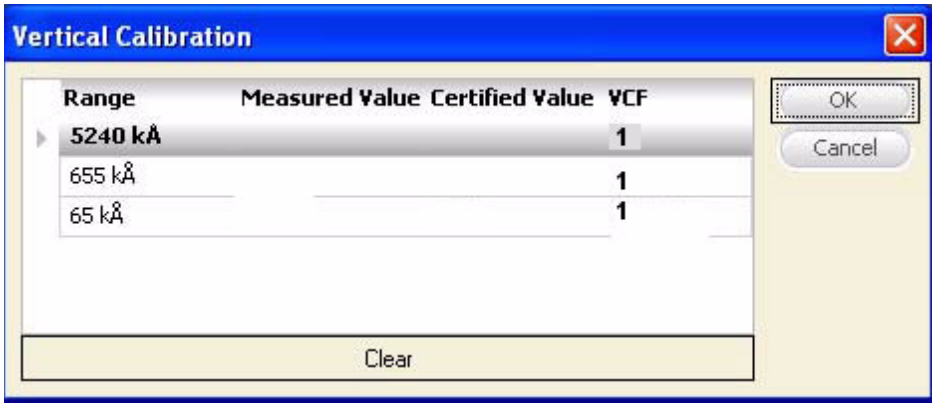
To make the preliminary measurements for the 65 kÅ range:

1. Place a 5 µm (50 kÅ) calibration standard on the center of the leveled stage.
2. Use the **Stage Control Panel** or move the sample itself to position the sample under the stylus.
3. Select **Profiler** > **Tower Down**. The optical assembly towers down, the stylus nulls, and the stylus lifts off the sample.
4. Adjust the illumination with either the **Illumination Up** and **Illumination Down** icons  or use the Up and Down Arrow keys on the keyboard.
5. Use the **Stage Control Panel** or move the sample itself until the crosshairs are at the desired measurement location.

NOTE – Check the documentation that came with your standard to confirm the certified measurement location (scan in the zone between the 2 scribe marks).

6. In the **Vertical Calibration** dialog box, clear the Vertical Calibration Factor (VCF) *BEFORE* the measurement. To do this, select the desired range and click **Clear**. The VCF goes to 1.

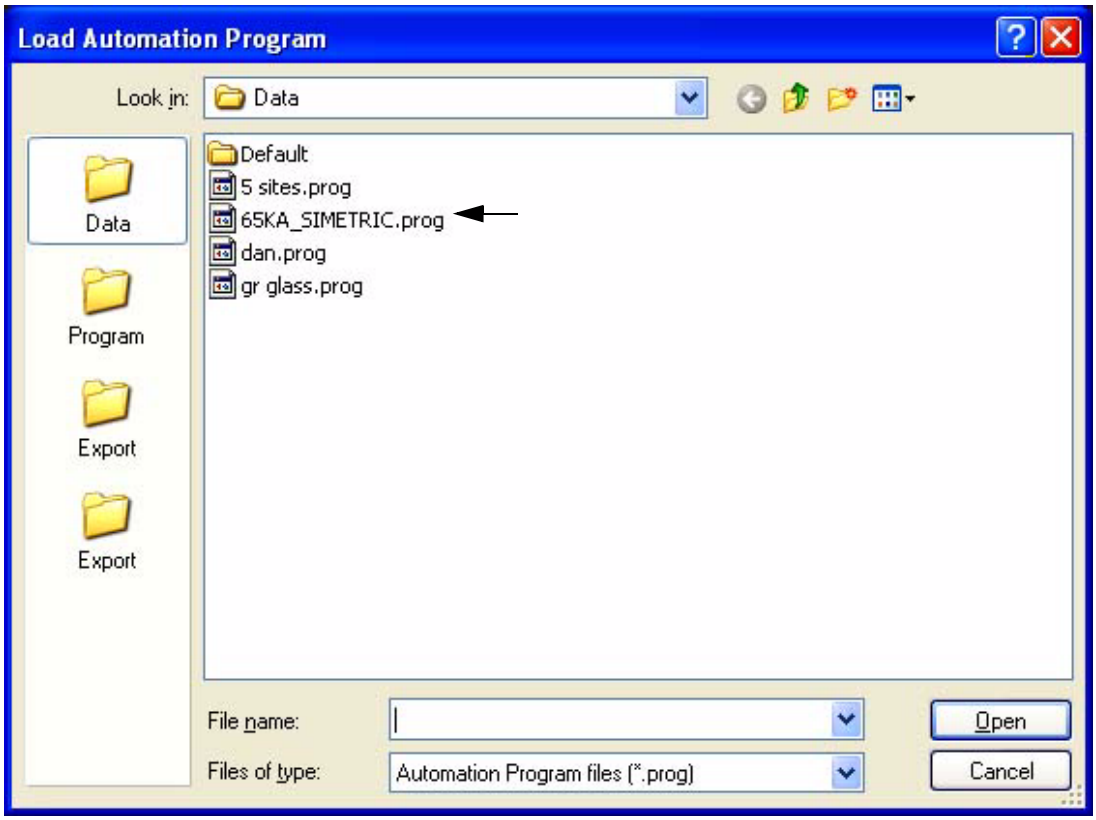
Figure 9-1: Vertical Calibration Dialog Box with Cleared VCFs



7 Select **File > Open** from the menu bar. The **Local Automation Program** dialog box appears.

8 Select the 65KA_SIMETRIC.prog file from Data folder in the C:\\DEKTAK\Program folder (see Figure 9-2).

Figure 9-2: Simetric Program File



9 If your system includes the X-Y auto stage:

a. Select **Window > Scan Routines**.

b. Select **Edit > Global Edit Mode**.

c. Click any underlined scan parameter to open the **Scan Parameters** dialog box.

d. Select **Use Current Location**.

e. In the Profile Section, select **Hills&Valleys**.

10 Perform the preliminary scans:

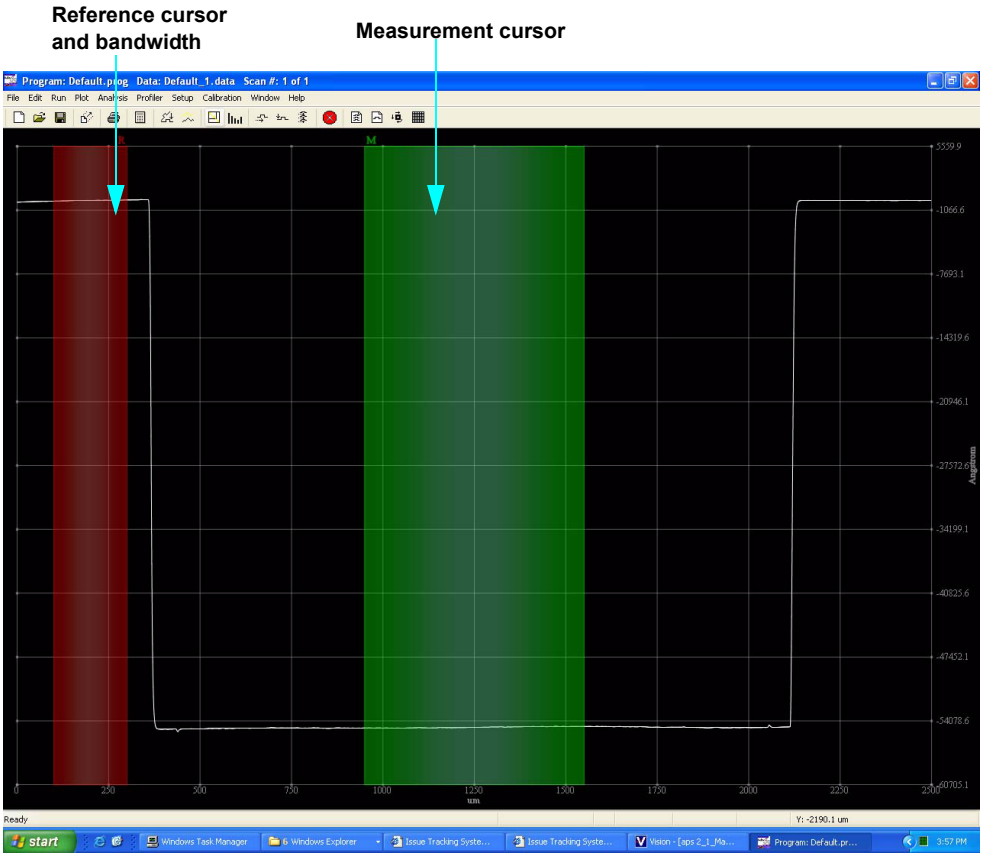
a. Select **Run > Scan Here**. The scan should be at least 2500 µm in length.

b. As you observe the profile trace in the **Data Plot** window, do the following, as necessary:

- If the profile trace goes out of range, re-level the stage.
- If the first falling edge is not at 375 µm on a vertical standard or the first rising edge is not at 375 µm on a step-height standard , adjust the scan start position until it is within 50 µm.

The plot should resemble the one shown in Figure 9-3.

Figure 9-3: Plot from Calibration in the 65 kÅ Range



Calculating the Average Step Height

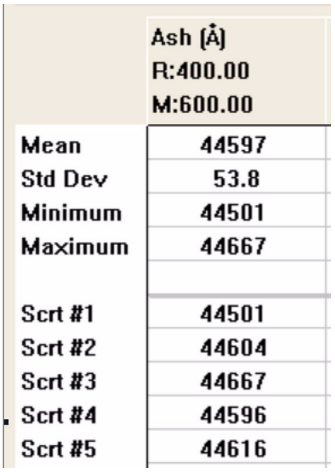
1 Select **Calibration > Vertical** from the menu bar.

2 If the VCF was not cleared for the 65 kÅ range prior to the preliminary measurements, select the 65 kÅ range and click **Clea**r (see Figure 9-1).

3 Select **Run > Auto Program** from the menu bar (or press the F5 key on the keyboard) to run the five scans using the 65K_SIMETRICS.prog automation program.

4 Follow the instructions in the Calibration Wizard that appears. During the automation program, the database logs the Average Step Height (ASH) from all five scans.

Figure 9-4: Summary Results for ASH Measurement with Values Shown in Angstroms

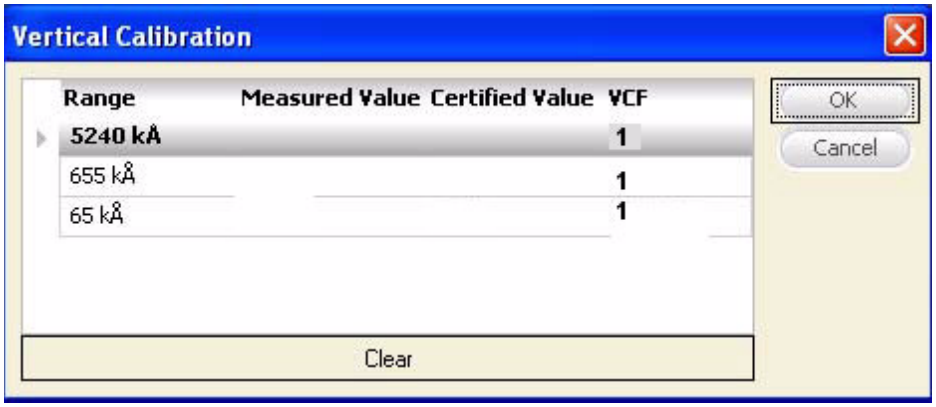


	Ash (Å) R:400.00 M:600.00
Mean	44597
Std Dev	53.8
Minimum	44501
Maximum	44667
Scrt #1	44501
Scrt #2	44604
Scrt #3	44667
Scrt #4	44596
Scrt #5	44616

Setting the Vertical Calibration

1 Select **Calibration > Vertical > Set** from the menu bar to open the **Vertical Calibration** dialog box.

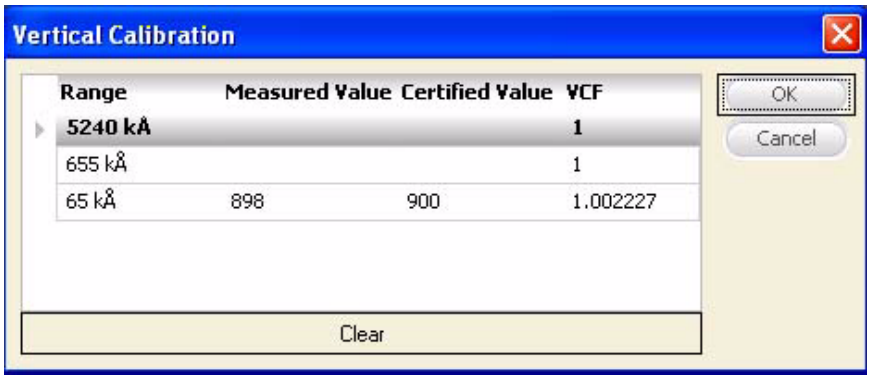
Figure 9-5: Vertical Calibration Dialog Box with Cleared VCFs



NOTE – If the range to be calibrated should was not cleared prior to making the preliminary measurements or calculating the ASH, select the range to be calibrated, click **Clear**, and run the automation program again.

2 Enter the averaged measurement value and the certified VCF value in the appropriate fields (see Vertical Calibration Dialog Box with Measurement Values on page 9-6).The averaged measurement should be within ± 0.5% of the certified value of the measured standard.

Figure 9-6: Vertical Calibration Dialog Box with Measurement Values



3 Do one of the following:

- If the results are acceptable,. click **OK**.
- If the results are not acceptable, repeat the measurement.
- If the results are still off, calibrate the Null and repeat the measurement again.

CALIBRATING THE OTHER RANGES

Repeat the steps outlined in Calibrating the 65 kÅ Range on page 9-2 for the 655 kÅ range and the 5240 kÅ range, ideally using the 10 µm (100 kÅ) calibration standard.

Calibrating the Optional 1 mm Range

To set the vertical calibration for the 1mm Extended Vertical Range Option, use the vertical standard (approximately 780 - 795 µm) provided with that option. This extended range standard is actually a gage block that is 0.029 of an inch (0.7366 mm) thick.

Scanning on the extended range standard differs from the normal vertical standard. The measured step height is the height of the standard itself, not a step on the standard. Scan across the top of the standard and onto the chuck surface, calibrating to the step *down*.

NOTE – To scan the vertical standard, you must use the **Valleys** or **Hills and Valleys** setting under **Profile** in the **Scan Parameters** dialog box.

GENERAL CARE AND HANDLING

Like any precision instrument, the Dektak 150 system requires care in handling and operation. Please adhere to the following recommendations:

- Allow the Dektak 150 system to warm up for approximately 15 minutes prior to use to stabilize the electronics.

- Do not use leadscrew lubricants. The leadscrews are Teflon-coated and require no additional lubricant.
- Always position the sample so that the stylus is the only part of the stylus arm that touches the sample.
- Always keep the environmental enclosure door closed both when the Dektak 150 is in use and when it is not.
- Never connect or disconnect any cables when power is on.
- Do not lower the stylus tower without the stage assembly in place.
- Do not move a sample during a scan.
- Avoid vibration and shock during measurements. For example, ensure that an operator or observer does not bump a surface close to the profiler or the profiler itself during a scan.
- Always raise the stylus tower and optical assembly into maximum vertical position when the system is not in use, even when power is left on.

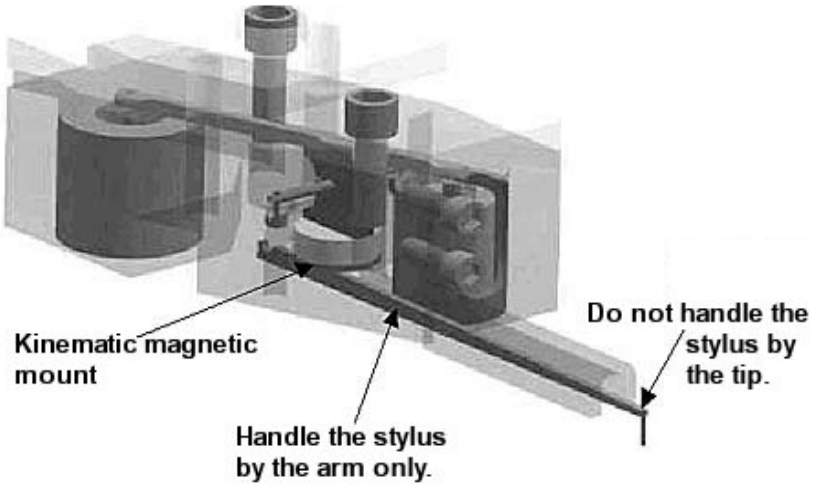
CLEANING THE PROFILER

Clean the exposed surfaces of the Dektak 150 profiler using a soft cloth that is moisturized (if necessary) with deionized water. Clean the profiler at least every six months. In addition, clean the area around the profiler whenever visible contamination is present.

STYLUS REPLACEMENT AND TIP CLEANING

All Dektak 150 styli have the same shank size but differ in the radius of the diamond tip. This section describes the procedure for removing and replacing a stylus.

Figure 9-7: Stylus Assembly



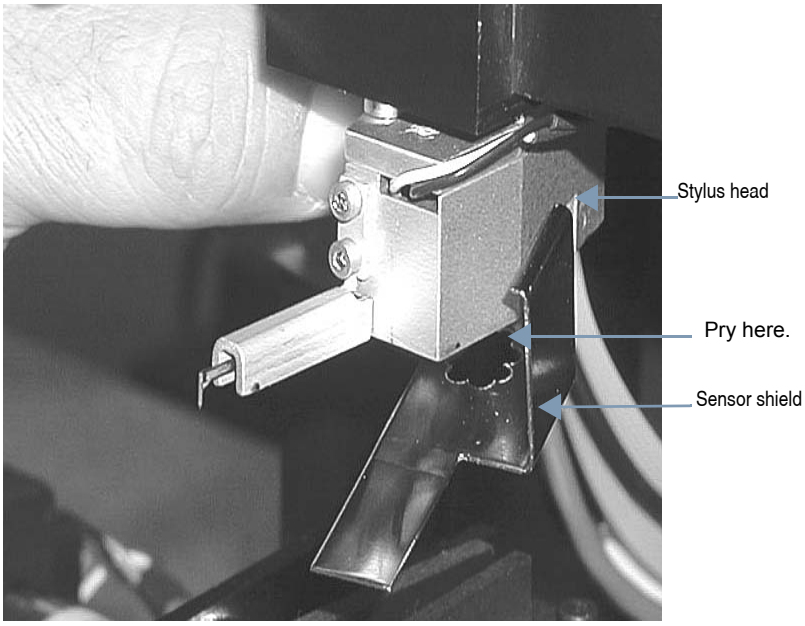
CAUTION
The stylus suspension system is very delicate. Use the stylus replacement fixture when removing or installing a stylus.

Removing the Stylus

1. Select **Profiler** > **Tower Up** to raise the stylus and optical assembly to the maximum vertical position.
2. Remove the stylus sensor shield using a small slot screwdriver to gently pry the sensor air shield down and away from the stylus head. Set it aside. Do NOT touch the stylus.

CAUTION
Do not remove the grounding cable. Do NOT touch the stylus.

Figure 9-8: Removing the Sensor Shield



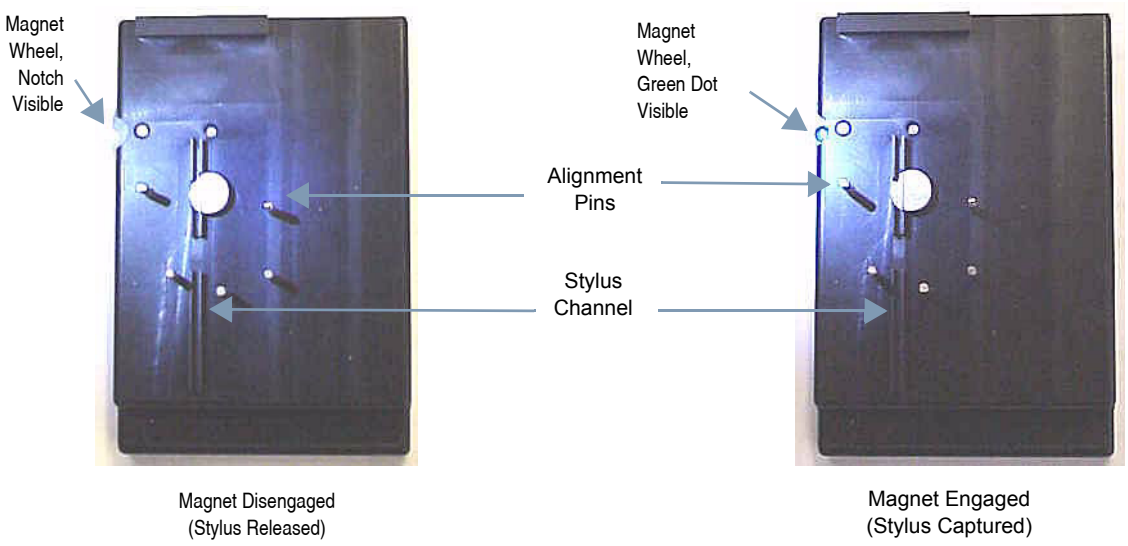
3 Remove the stylus using the stylus exchange tool.

Figure 9-9: Stylus Exchange Tool

NOTE – The quick-release stylus mechanism enables fast and easy stylus replacement.

a. Verify that the stylus exchange tool is in the disengaged position (that is, make sure that the magnet wheel is rotated so that the end notch is visible, as shown on the left side of Figure 9-10).

Figure 9-10: Stylus Exchange Tool Details



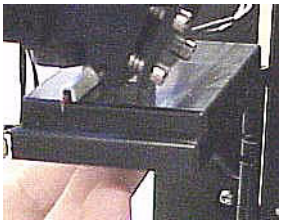
b. Place the stylus exchange tool underneath the scan head.

c. Align the pins of the stylus exchange tool with the stylus sensor housing.

Figure 9-11: Aligning the Stylus Replacement Fixture

d. Push the stylus exchange tool up until the bottom of the scan head is against the top of it. Be sure the stylus is seated in the channel on the tool. If necessary, gently tap the end of the stylus shaft (NOT the tip) with your finger to align the shaft with the channel.

Figure 9-12: Scan Head Flush with Fixture

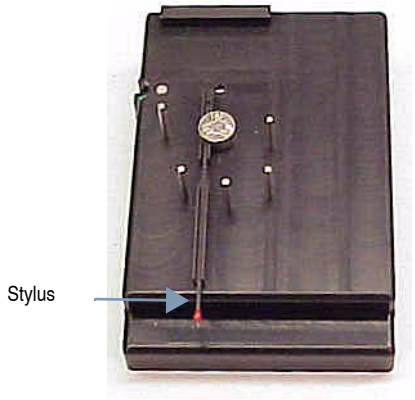


NOTE – If the stylus is not properly seated in the channel, it will tend to rotate when you remove it.

e. Rotate the magnet wheel to engage the magnet (so that the green dot is visible) in the stylus exchange tool (see the right side of Figure 9-14).

f. Carefully lower the stylus exchange tool. The stylus is held in place magnetically.

Figure 9-13: Fixture with Captured Stylus



4 To remove the stylus from the stylus exchange tool:

a. Disengage the magnet by rotating the wheel in either direction so a notch is visible.

b. Gently lift the stylus out of the tool, and then place it in its protective case.

Installing a New Stylus

After you have removed an old stylus, follow these steps to install a new one:

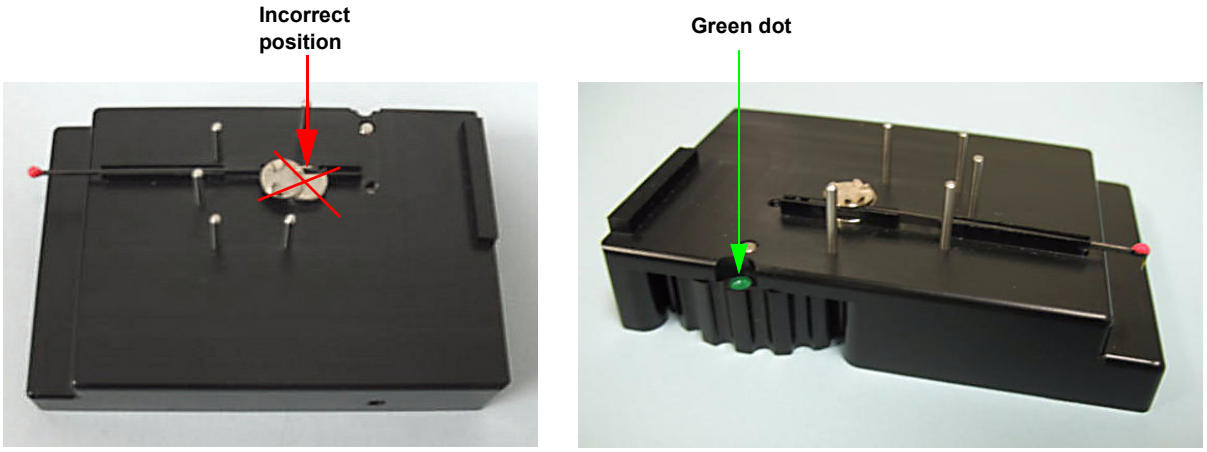
1 Locate the new stylus and stylus exchange tool. Each stylus comes in its own protective plastic case.

2 The stylus exchange tool is designed to magnetically hold the stylus until it is seated in the sensor head. Turn the thumb wheel on the exchange tool so that the green dot (see Figure 9-14) is NOT visible (that is, the magnet is disengaged).

3 Open the stylus case, and gently remove the stylus. Lift the stylus by its central disk, not by the beam.

4 Place the stylus into the exchange tool. Align the round disk with the silver magnet on the tool. The stylus arm must be centered within the long trench (see Figure 9-14). The stylus tip should point down.

Figure 9-14: Alignment of Stylus and Stylus Exchange Tool



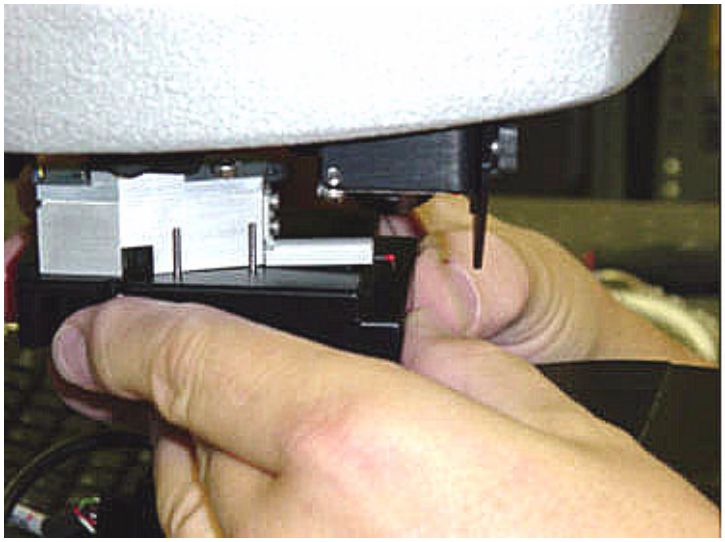
Stylus misaligned with exchange tool

Stylus correctly aligned with exchange tool

5 Turn the knob on the stylus exchange tool so that the green dot is visible (right side of Figure 9-14) and the magnet is engaged.

6 Holding the stylus exchange tool from the edges, align its pins with the outside of the sensor. (Because this is a precision alignment, you may want to practice several times without the stylus in the way.) Push up until the tool is flush with the bottom of the sensor (see Figure 9-15).

Figure 9-15: Aligning the Exchange Tool with the Sensor

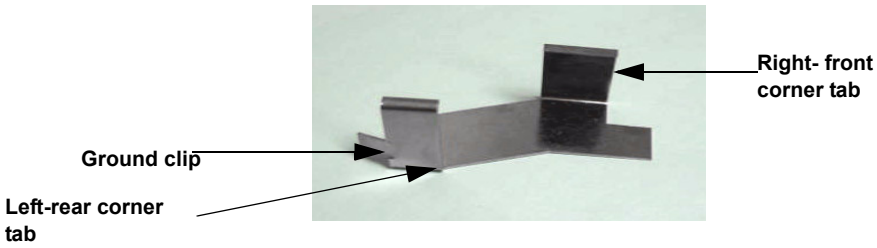


7 Turn the thumb wheel to disengage the exchange tool's magnet.

8 Carefully lower the exchange tool to remove it.

9 Locate the stylus shield (see Figure 9-16).

Figure 9-16: Stylus Shield



10 Place the shield around the sensor head, such that the right-front corner tab is engaged (see Figure 9-17).

11 Press in on the left -rear corner tab until the shield clicks into place (see Figure 9-18).

Figure 9-17: Attaching the Right-Front Corner Tab

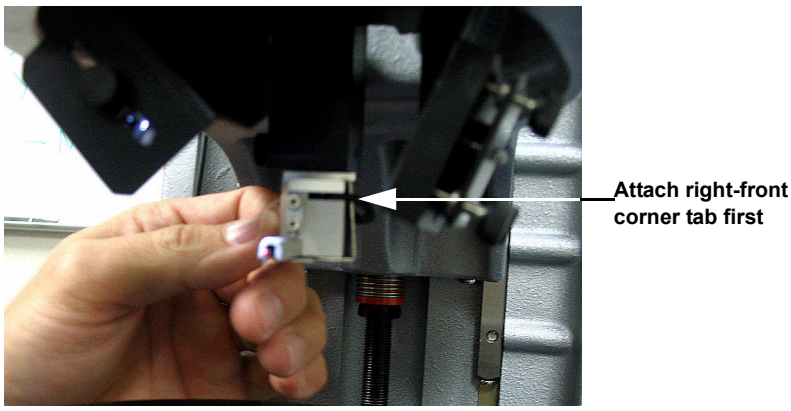
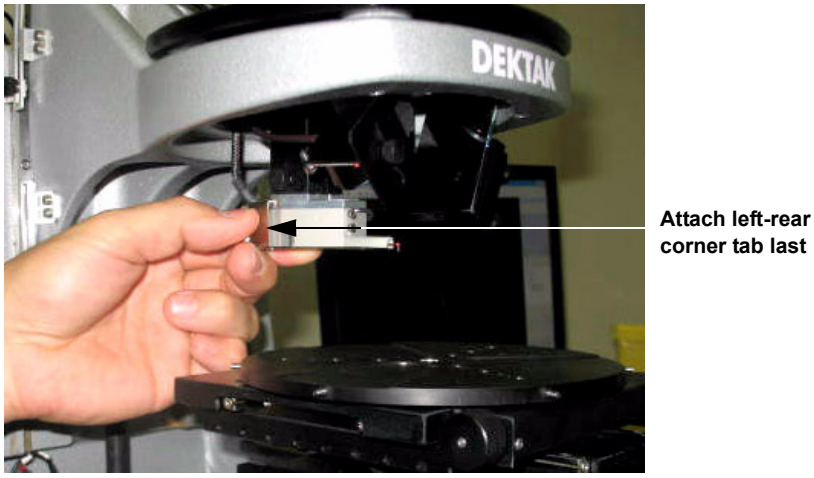


Figure 9-18: Attaching Left-Rear Corner Tab



NOTE – See Adjusting the Optics on page 9-17 for instructions for adjusting the video image of the stylus tip.

Cleaning the Stylus

A stylus may need to be cleaned periodically to remove any dust particles from the tip.

To clean the stylus tip:

1. Select **Stylus** > **Tower Up** to raise the tower to the maximum vertical position.
2. Remove any samples from the stage.
3. Clean the tip using a lint-free swab moistened with deionized water or laboratory grade alcohol. Lightly touch the tip with the lint-free swab to remove dust. You may also use a small soft-bristle paintbrush. Do NOT use an air gun.

CAUTION: Dispose of wipes in an appropriately labelled solvent-contaminated waste container.

ATTENTION: Jeter les compressesde nettoyage daus une poubelle correctement étiquettée pour les solvents.

VORSICHT: Entsorgen Sie Alkohol-getränkte Tücher in einem dafür vorgesehenen Behälter für Lösungsmittel abfälle.

CLEANING THE X-Y STAGE AND BLOCK

Contamination of the stage decreases scan performance. Therefore, whenever you see dust or dirt on the chuck/stage assembly or on the polished aluminum block on which it rests, you must clean the contaminated area with lint-free and abrasive-free tissues moistened with deionized water or laboratory- grade isopropyl alcohol.

Even if you do not see visible dust or dirt, you must regularly clean the chuck/stage assembly and block as part of preventative maintenance. Use the following guidelines for the frequency of cleaning:

- Whenever visible contamination is present, clean the chuck/stage assembly and polished aluminum block before scanning.
- If the system is in heavy use, clean the chuck/stage assembly and polished aluminum block weekly or more frequently if environmental contamination is present.
- If the system is in minimum use, clean the chuck/stage assembly and polished aluminum block quarterly.

Detailed cleaning instructions appear after the Caution box.

CAUTION: Do not use other solvents, such as spectrograde acetone, which may attack the adhesives used to mount the Teflon tapes. To avoid damage to the Teflon tapes, do not allow them to touch any surface other than the reference block.

ATTENTION: Ne pas utiliser d'autres solvants, tels que de l'acétone pour spectrographie, qui pourraient attaquer les adhésifs utilisés pour monter les protections en Téflon. Pour éviter d'abimer les protections en Téflon, ne pas les mettre en contact avec d'autres surfaces que les surfaces des blocs.

VORSICHT: Lösungsmittel wie Azeton können den Kleber, mit dem die Teflonunterlagen an der Unterseite des Probentisches befestigt sind, angreifen und sollten daher nicht verwendet werden. Verwenden Sie nur Isopropylalkohol und demineralisiertes Wasser. Um die Teflonunterlagen vor Beschädigung zu schützen, sollten sie ausschließlich auf der Referenzunterlage verwendet werden. Vermeiden Sie es, den Probentisch auf andere Oberflächen zu setzen.

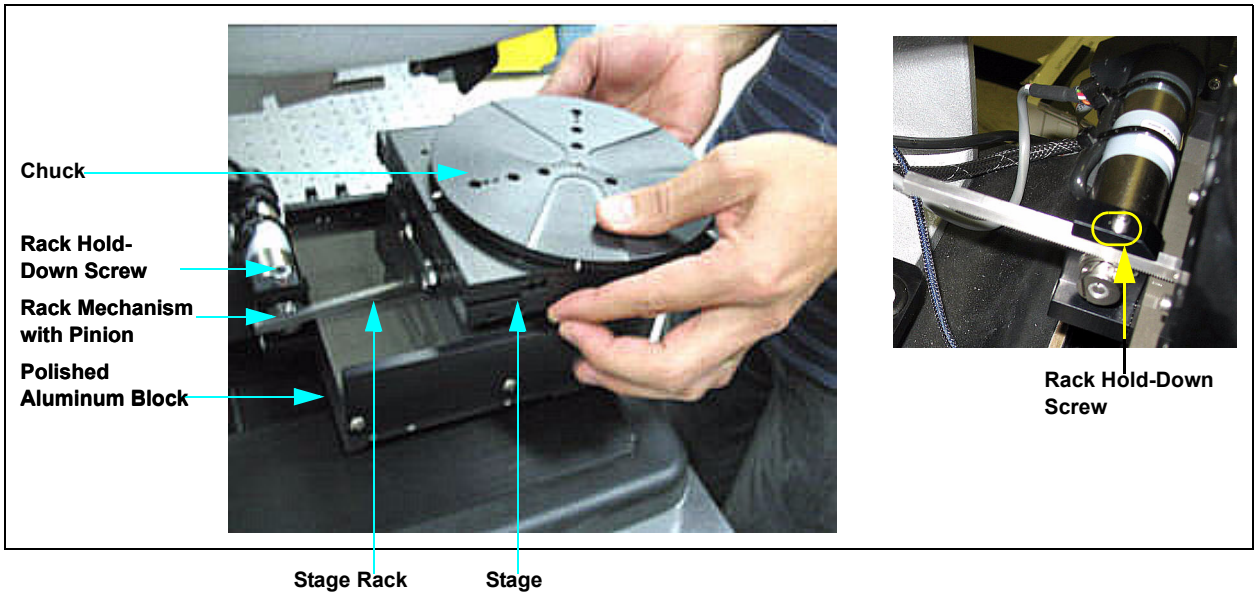
To clean the chuck/stage assembly and polished aluminum block:

1 Remove the chuck/stage assembly from the polished aluminum block located at its base:

a. Loosen the rack hold-down screw.

b. Gently lift the chuck/stage assembly away from the polished aluminum block. All of these parts appear in Figure 9-19.

Figure 9-19: Lifting the Stage from the Polished Aluminum Block



2 Place the chuck/stage assembly on a clean, safe surface.

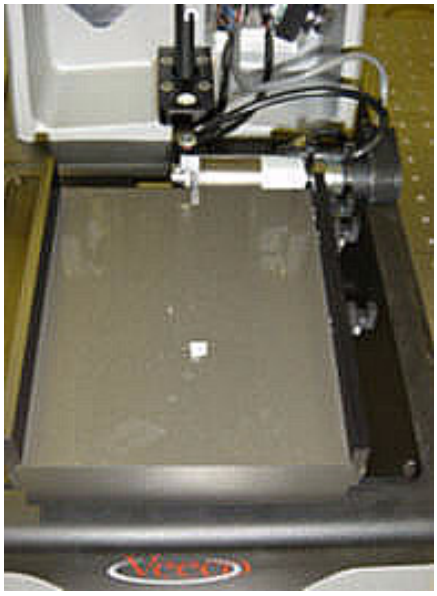
3 Moisten lint-free, abrasive-free tissues with deionized water or laboratory-grade isopropyl alcohol.

4 Use the moistened tissues to clean the top surface of the chuck, all parts of the stage below it (see Figure 9-19), and the polished aluminum block (see Figure 9-20). Always wipe new spots with a clean portion of the tissue to avoid transferring contamination to another area.

5 Check the polished aluminum block to ensure that there are no scratches or blemishes in the traverse area.

6 Use a rotary motion to buff the cleaned block with a clean, lint-free cloth. If the surface has been properly cleans, the cloth should move evenly against it.

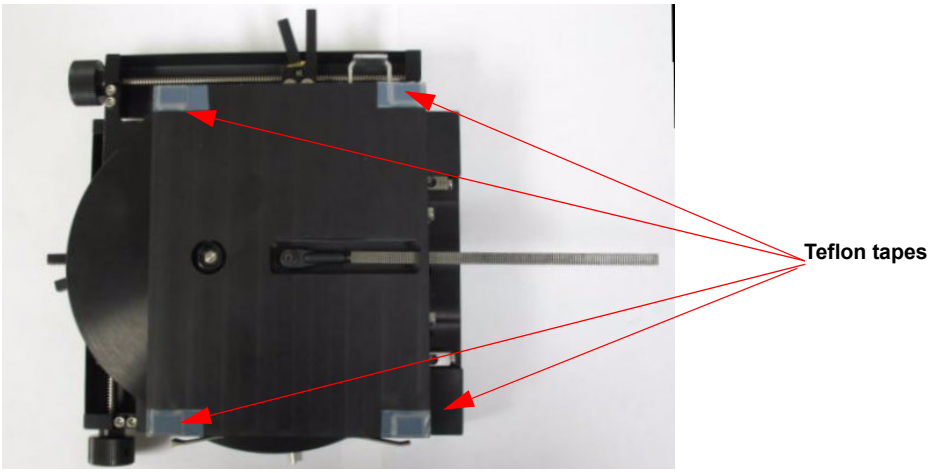
Figure 9-20: Polished Aluminum Block



7 Turn the chuck/stage assembly over and clean both the surfaces of the Teflon tapes on the bottom of the stage and the areas around the tapes. Ensure that no debris is embedded in tapes. Check to see that there is no excess adhesive from the tapes adhering to any running surface.

NOTE – Replace the Teflon tapes every three years or as needed. Contact Veeco for service.

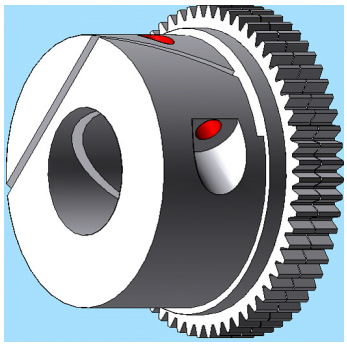
Figure 9-21: Teflon Tapes on the Bottom of the Stage



IMPORTANT! DO NOT touch the Teflon tapes or the polished aluminum block after cleaning. If this happens, you must repeat the cleaning procedure.

8 Clean the stage rack (see Figure 9-19) and drive pinion (see Figure 9-19 and Figure 9-22) with instrument grade “canned air.” Hold the can upright and use short bursts to avoid releasing propellant.

Figure 9-22: Drive Pinion



9 Replace the chuck/stage assembly on the polished aluminum block and adjust the rack and pinion gears according to the instructions in Installing the Stage on page 2-16.

	**CAUTION:**	Dispose of wipes in an appropriately labelled solvent-contaminated waste container.
	ATTENTION:	Jeter les compresses de nettoyage daus une poubelle correctement étiquettée pour les solvents.
	VORSICHT:	Entsorgen Sie Alkohol-getränkte Tücher in einem dafür vorgesehenen Behälter für Lösungsmittel abfälle.

ADJUSTING THE OPTICS

After replacing the stylus or performing other maintenance, you may need to adjust the optics to align the video image so that the stylus tip appears in the center of the screen.

NOTE – If the optical setup is substantially out of range, multiple iterations of the procedures outlined below may be required to optimize all adjustments.

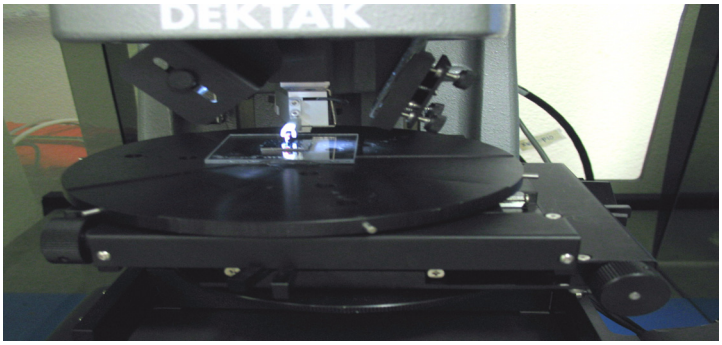
Adjusting the Standard Fixed Optics

To adjust the standard fixed optics:

1. Place the vertical standard that came with your system on the stage beneath the stylus, with the printing facing the front of the system (Figure 9-23). The system scans from front to back, so be sure there are at least a few millimeters of the standard located to the back of the stylus tip.

2. Press the **Stylus Down** button  to lower the stylus onto the standard (Figure 9-23).

Figure 9-23: Stylus Lowered onto the Standard



NOTE – The above activity cannot damage the stylus/sensor. However, clipped data may appear on the monitor.

3. Adjust the focus lock screw near the base of the optical assembly (see Figure 9-24):
   a. Loosen the focus lock screw if necessary.
   b. Watching the computer monitor, turn the focus ring until the stylus tip on screen is as sharp as possible (see Figure 9-24 and Figure 9-25).
   c. Finger-tighten the focus lock screw.

Figure 9-24: Adjustlng Focus

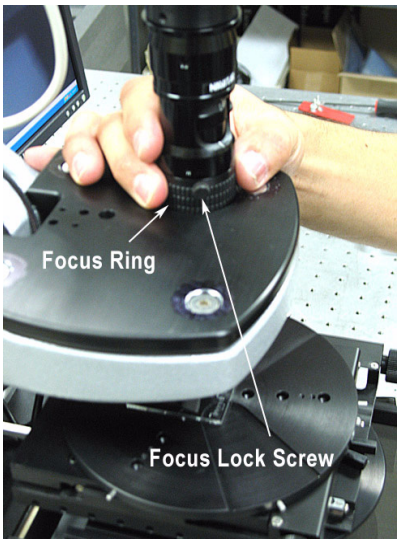
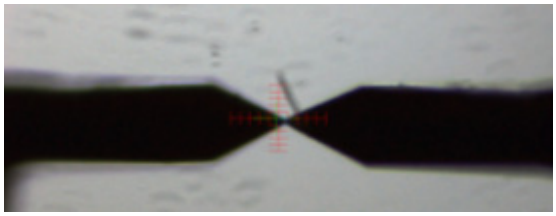
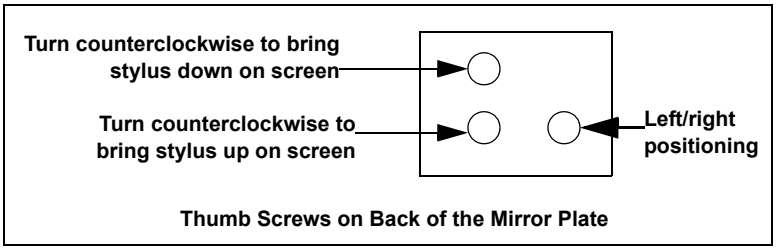


Figure 9-25: Stylus Tip in Focus

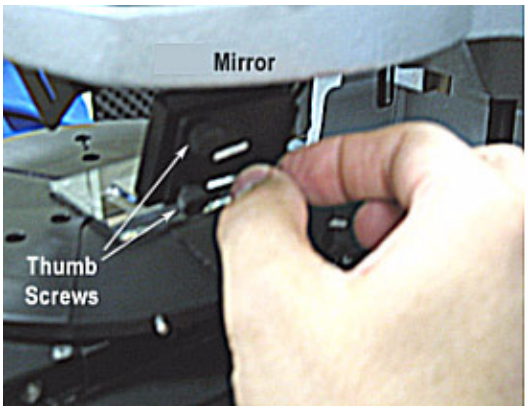


4 If the system is out of alignment, use the thumb screws on the back of the mirror plate to adjust the mirror in or out (see Figure 9-26). The two thumb screws on the left adjust the image from top to bottom, while the single thumb screw on the right adjusts the image from left to right (for the normal optical assembly position).

Figure 9-26: Adjusting the Mirror



Thumb Screws on Back of the Mirror Plate



Adjusting the mirror with the thumb screws

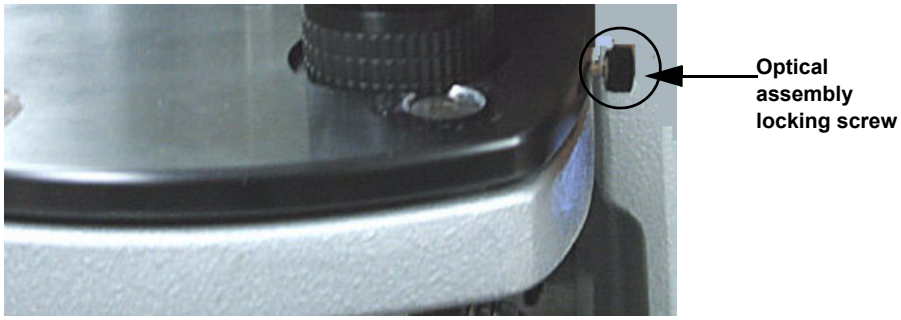
5 If the system is still out of alignment, slightly adjust the entire optical assembly:

a. Loosen the locking screw on the right side that holds the optical assembly in place (see Figure 9-27).

b. Make slight positional adjustments until the image of the stylus on the screen comes into focus (see Figure 9-25).

c. Tighten the optical assembly locking screw (see Figure 9-27).

Figure 9-27: Optical Assembly Locking Screw



Adjusting the Optional Zoom Optics

1. Place the vertical standard that came with your system on the stage beneath the stylus, with the printing facing the front of the system (Figure 9-23). The system scans from front to back, so be sure there are at least a few millimeters of the standard located to the back of the stylus tip.

2. Press the **Stylus Down** button  to lower the stylus onto the standard (Figure 9-23).

3. Adjust the zoom optics:

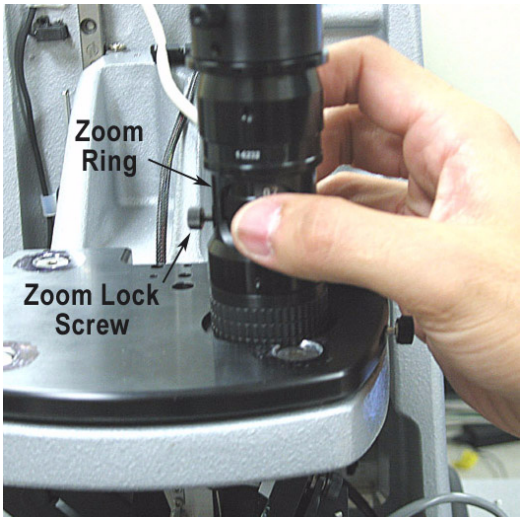
   a. Loosen the zoom lock screw (see Figure 9-28).

   b. Rotate the zoom ring until you arrive at the desired position (see Figure 9-28).

   c. Tighten the zoom lock screw (see Figure 9-28).

   d. If necessary, refocus.

Figure 9-28: Adjusting the Optional Zoom Optics



4. Watching the computer monitor, turn the thumb screws on the back of the mirror plate (if necessary) to align the stylus tip with the center of the crosshairs (Figure 9-25). This is a delicate adjustment, so turn the thumb screws in increments of only half a turn.

5. If the image of the stylus (see Figure 9-25) is far off the center of the screen, or not even on the screen, you must performed the procedures outlined in Adjusting the Coarse Alignment on page 9-22.

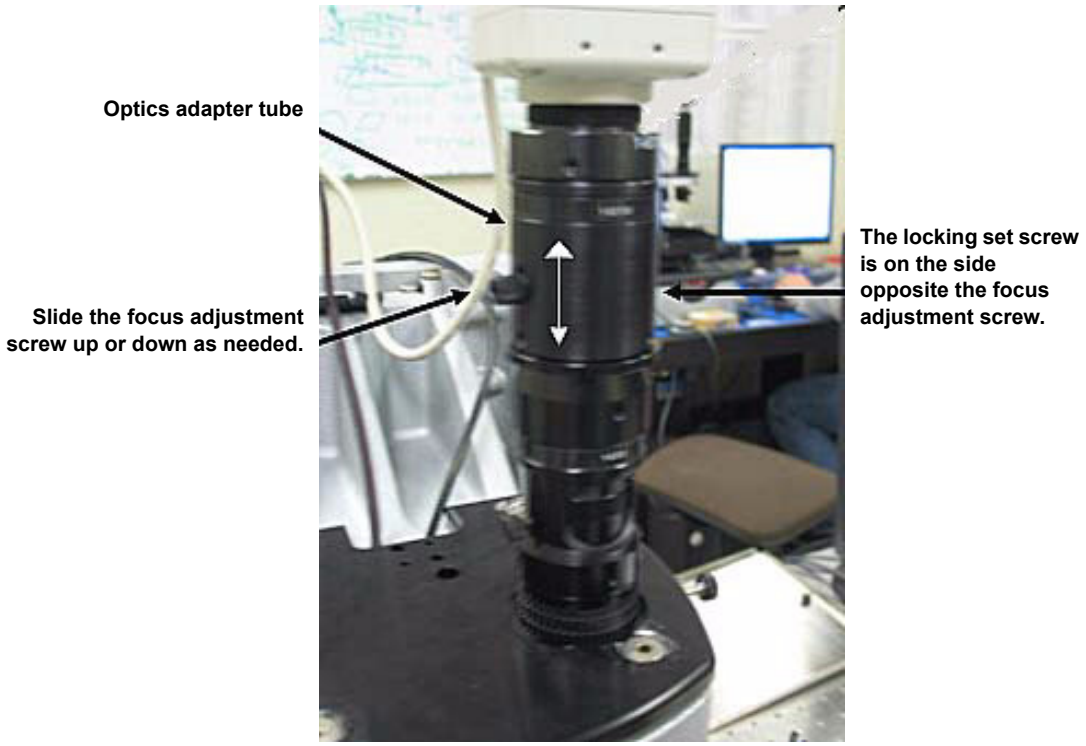
Adjusting Zoom Optics Parcentering

1. Zoom all the way out.
2. Note the location of the stylus tip.
3. Zoom all the way in.
4. Adjust the thumb screws on the back of the mirror plate (see Figure 9-26) to put the stylus tip where it was in step 2. You may have to do this several times to achieve the correct position.

Adjusting Zoom Optics Parfocality

1. Use the focus ring to get a good image of the stylus at high magnification (zoom in). (see Figure 9-24, Figure 9-25, and Figure 9-29).
2. Loosen the locking set screw on the side opposite the focus adjustment screw (see Figure 9-29).
3. Zoom out to low magnification and adjust the vertical position of the focus adjustment screw by raising or lowering it in the slot, until you get good focus. Lock it with the locking set screw. located on the side opposite the focus adjustment screw (see Figure 9-29).
4. Zoom back in to high magnification and adjust the focus again, first with the focus ring, and then with the focus adjustment screw.
5. Repeat until you are in focus at high magnification (zoomed all the way in) and at low magnification (zoomed all the way out).
6. If the image of the stylus (see Figure 9-25) is far off the center of the screen, or not even on the screen, you must adjust the coarse alignment as explained in the section that follows.

Figure 9-29: Screws Used to Adjust Zoom Optics Parfocality



ADJUSTING THE COARSE ALIGNMENT

If the image of the stylus (see Figure 9-25) is far off the center of the screen, or not even on the screen, you must adjust the three set screws (see Figure 9-30) around the perimeter of the optics adapter ring (the ring just below the camera). Never take these set screws out—just loosen them enough to enable positional adjustment. You may have to repeat this process several times to achieve optimal coarse alignment.

Figure 9-30: Location of Set Screws around the Perimeter of the Optics Adapter Ring

Use the three set screws around the perimeter of this ring to adjust the coarse alignment. Never take them out -- just loosen them enough to enable adjustment.

SERVICE CONTRACTS

To maximize equipment operation and avoid major repairs, Veeco offers customized service contracts to meet customer needs and to extend the one-year factory warranty. Service contracts include routine maintenance to keep the equipment up to factory specification.

For more information on service contracts, contact your local Veeco Service Center.

MAJOR REPAIRS

The Dektak 150 cannot be readily repaired after major component failures without the assistance of specialized test equipment and software routines. In the event of equipment failure, please call the Veeco Service Center nearest you for assistance.

WARNING: Never open the profiler, E-box, computer console or video monitor when connected to the primary power source. Major service should only be performed by qualified, factory-trained, Veeco service personnel.

AVERTISSEMENT: Ne jamais ouvrir l'ordinateur ou l'écran video lorsqu'ils sont branchés sur une source de courant. Toute intervention majeure devrait seulement être réalisée par du personnel qualifié et formé par Veeco.

WARNUNG: Computerkonsole und Videomonitor dürfen unter keinen Umständen geöffnet werden, während sie an die Spannungsversorgung angeschlossen sind. Größere Wartungsarbeiten sollten nur von qualifiziertem, und durch Veeco ausgebildetes Personal durchgeführt werden.

Before calling the Veeco Service Center, do the following:

1. Have the serial number of your profiler and the version of your Dektak 150 software at hand.
2. Restart the Dektak 150 by closing the Windows application, turning off the system, and then turning the power back on.
3. Verify all cables are properly connected and free of obvious damage.
4. Verify all power cords are connected properly.
5. Verify the sample illumination is properly adjusted.
6. Verify the stylus tower moves up and down when you activate the **Tower Up** and **Tower Down** functions.

NOTE – All parts of the Dektak 150 must be serviced by the manufacturer or designated representative.

A

FACILITIES SPECIFICATIONS

As a a high-precision measuring instrument capable of measuring minute physical surface variations, the Dektak 150 is extremely sensitive to the environment in which it operates. You must set up one of the following operating environments:

- **Normal Operating Conditions**: The area that houses the Dektak 150 must be free from excessive dust. Vibration levels must be minimal. The scan head must be protected to eliminate drafts. The door to the environmental enclosure should be closed both when and when not making measurements.
- **Reference Operating Conditions**: For very critical measurements, you can purchase an optional vibration isolation table or platform that is designed for use with the Dektak 150. The scanning mechanism is sensitive to transient convective flow. After turning on the system, allow it to stabilize for at least 15 minutes.

Table A-1 lists the facilities requirements of the Dektak 150 system. Table A-1 lists its dimensions and weight.

Table A-1: Facilities Requirements

Facility	Requirement
Temperature	Operating Range, 20°-25°C (68°-77°F).
Clean Room	Not required. (Class 1000 or better recommended.)
Relative Humidity	50%, +/-20% relative humidity (non-condensing)
Input Voltage	100 - 240 V ～, 50 - 60 Hz, 3.0 A
Power Demand	720 VA maximum
Power Connection	Four 6-ft, 3-conductor, 16AWG power cords supplied with system. Cords terminate with male NEMA L5-15 connectors. Connectors rated for 13 amps, 1,625 watts @ 125 VAC.
Warm-up Time	15 min. for maximum stability
Vibration	Not to exceed 70 µg from 1 to 100 Hz on floor with flat noise spectrum.

Facility	Requirement
Compressed Air	80 psi (if optional vibration isolation platform or table is used)
Vacuum	20 mm Hg (If optional ceramic vacuum chuck is used)
Acoustics	Not to exceed 60 dB(A) across the frequency spectrum.

Table A-2: Dektak 150 Dimensions and Weight

DIMENSIONS AND WEIGHT	
Profiler Dimensions	292 mm W x 508 mm D x 527 mm H (11.5 in. W x 20 in. D x 20.75 in. H)
Enclosure Dimensions	28.0 in. L x 19.8 in. W x 26.0 H (71.1 cm L x 49.8 cm W x 66.0 cm H)
Profiler Weight	34 kg (75 lbs.), 115 lbs shipping weight
Enclosure Weight	21.7 kg (48 lbs.)
Shipping Box Dimensions	Box 1 (computer): 22” x 22” x 14” Box 2 (system): 24” x 18” x 22” Box 3 (system accessories): 22” x 22” x 12” Box 4 (enclosure): 36” x 36” x 24” Box 5 (optional monitor): 18” x 15” x 7” Box 6 (optional vibration isolation table or platform): 42” x 36” x 50” (table) or 29” x 30” x 6” (platform)

Vibration Interference

Do not operate the system near sources of vibration (such as fans or motors) or in excessive air flow (such as from a cleanroom air duct). For optimum performance, place the tool in an area with minimal foot traffic and low acoustical noise.

Floor

The floor must be level, rigid and capable of supporting the Dektak 150 surface profiler on a bench or the preferred vibration isolation table.

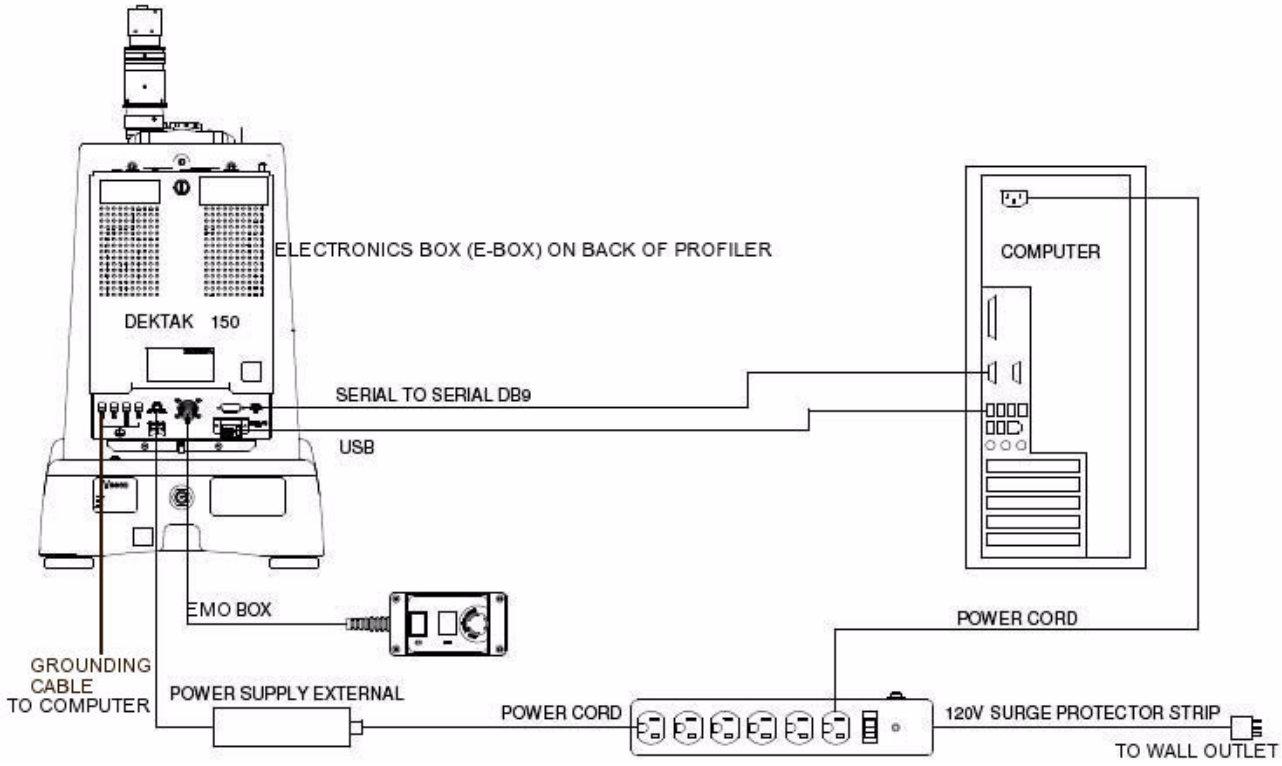
System Location and Service Access

Position the system with the work area in front to allow adequate working space for the operator. The rear of the system must have a minimum service access clearance of 24" (610 mm).

Cable Connections

The following drawing shows the cable connections required by the Dektak 150 system.

Figure A-1: Dektak 150 Cable Connections



Dektak 150 Dimensions with Enclosure

The following drawings show the dimensions of the Dektak 150 system dimensions of the system with the environmental enclosure.

Figure A-2: Dektak 150 Dimensions with Enclosure - Front View

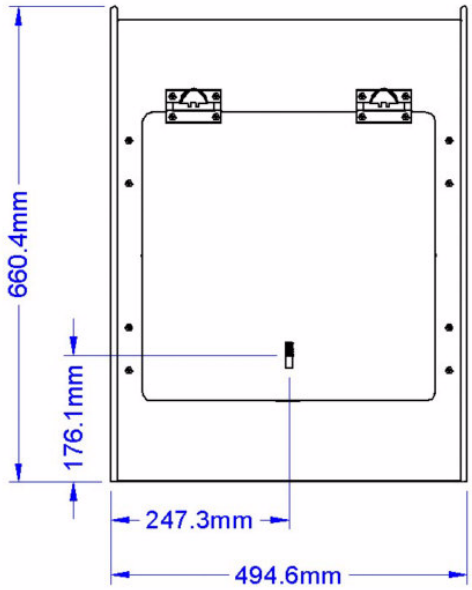


Figure A-3: Dektak 150 Dimensions with Enclosure - Side View

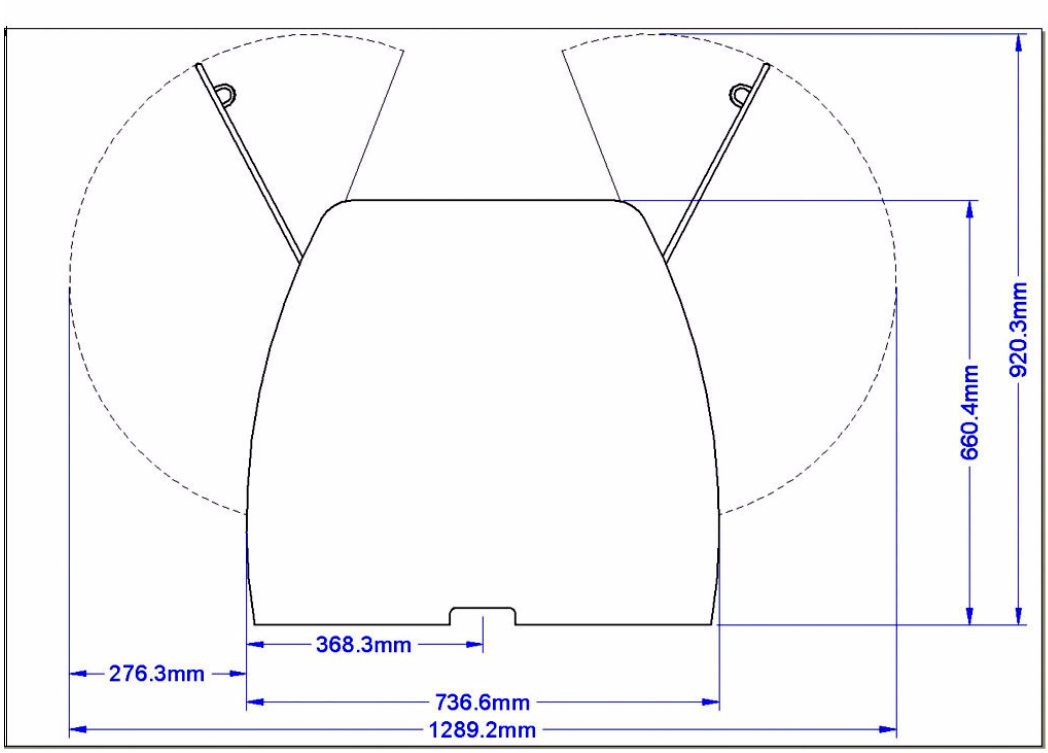
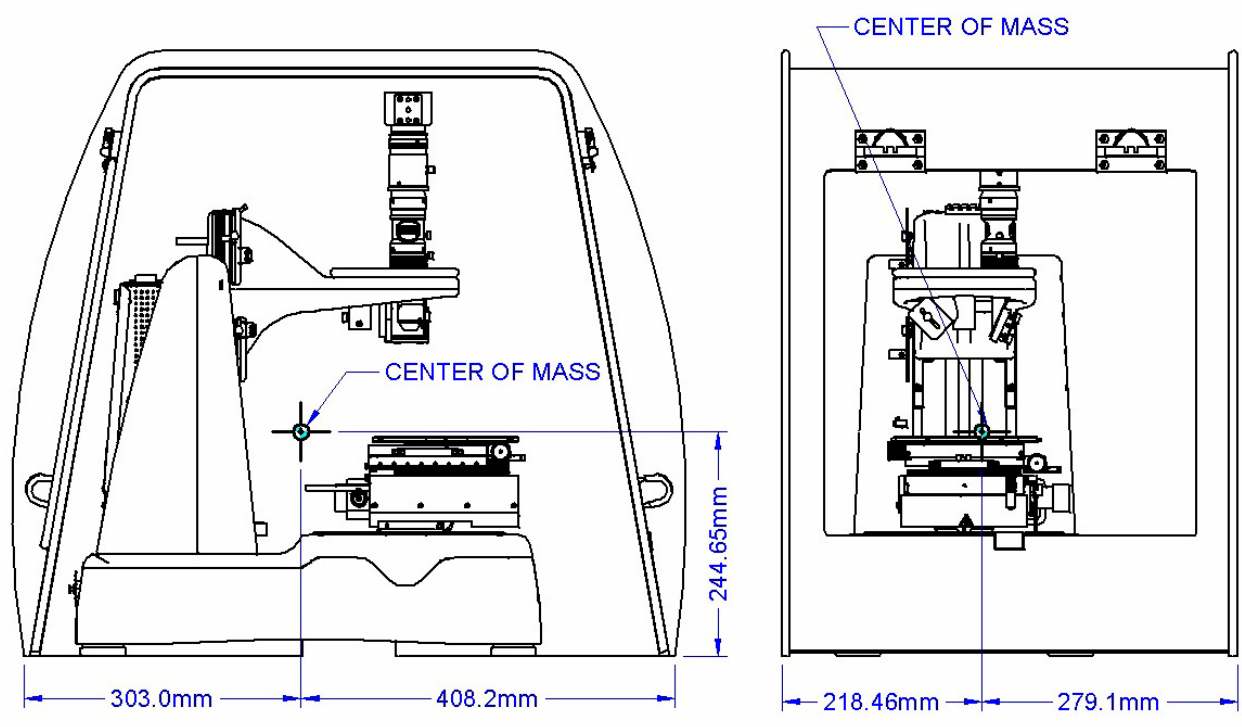


Figure A-4: Dektak 150 Dimensions with Enclosure - Center of Mass



Dektak 150 Dimensions without Enclosure

The following drawings show the dimensions of the Dektak 150 surface profiler without the environmental enclosure.

Figure A-5: Dektak 150 without Enclosure - Front View

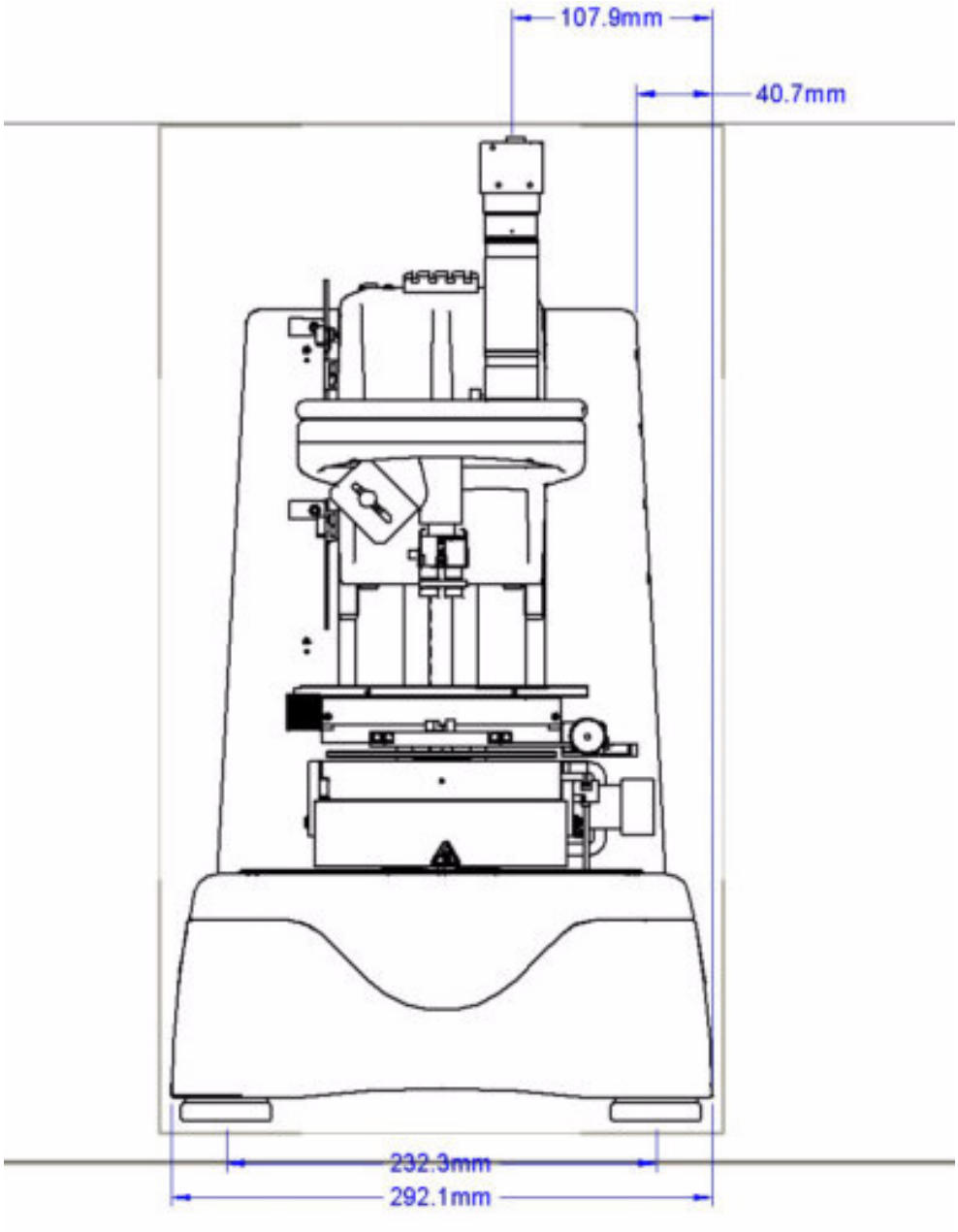


Figure A-6:Dektak 150 without Enclosure - Side View

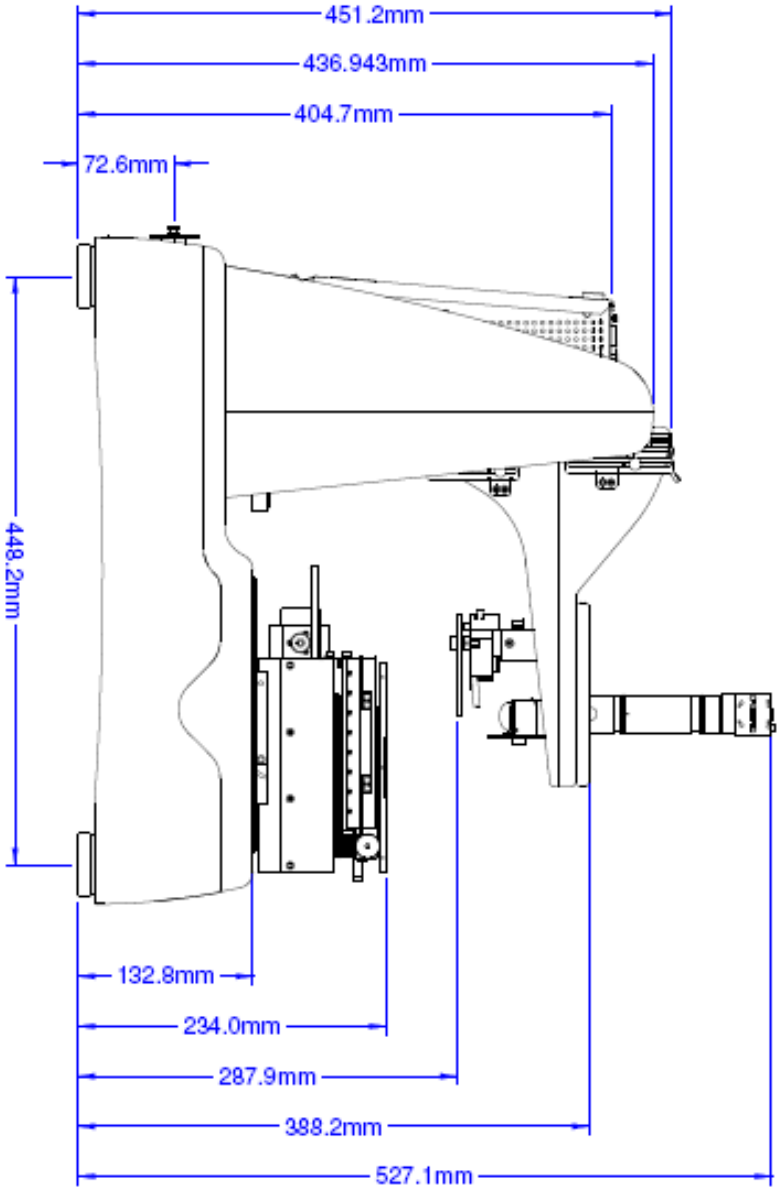


Figure A-7: Dektak 150 Dimensions without Enclosure - Top View

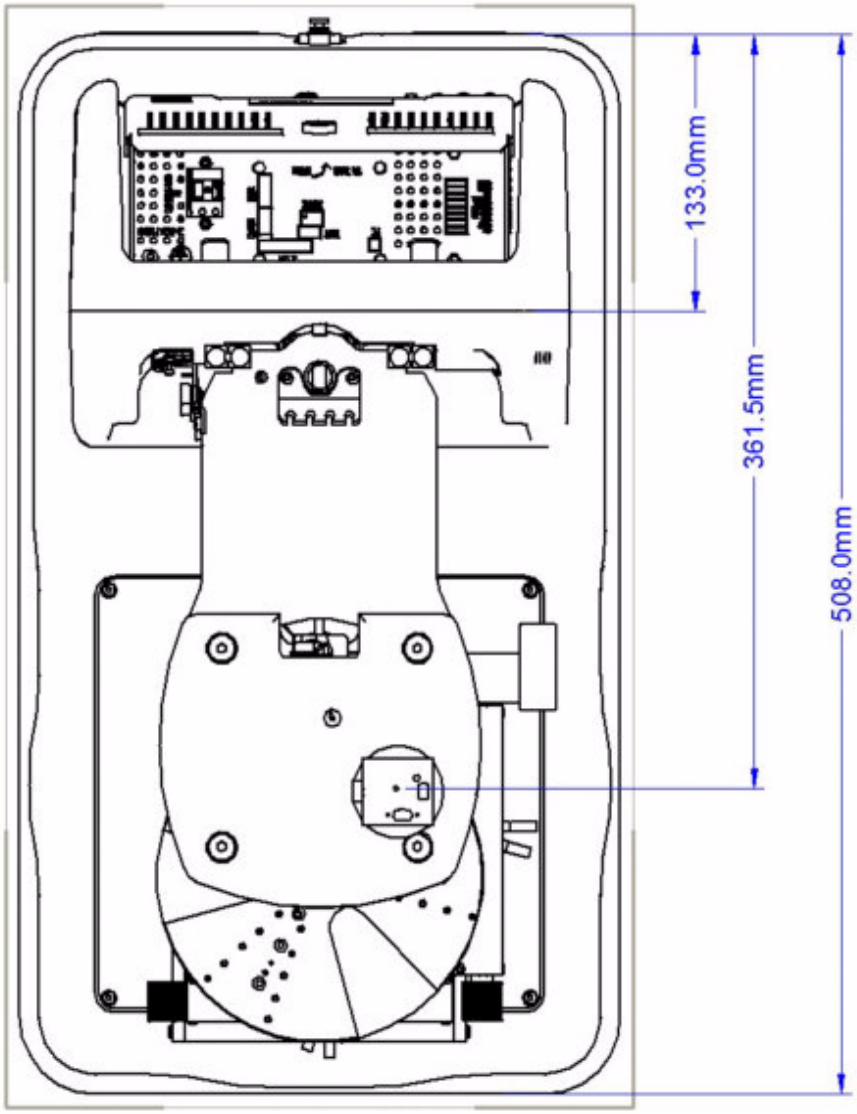
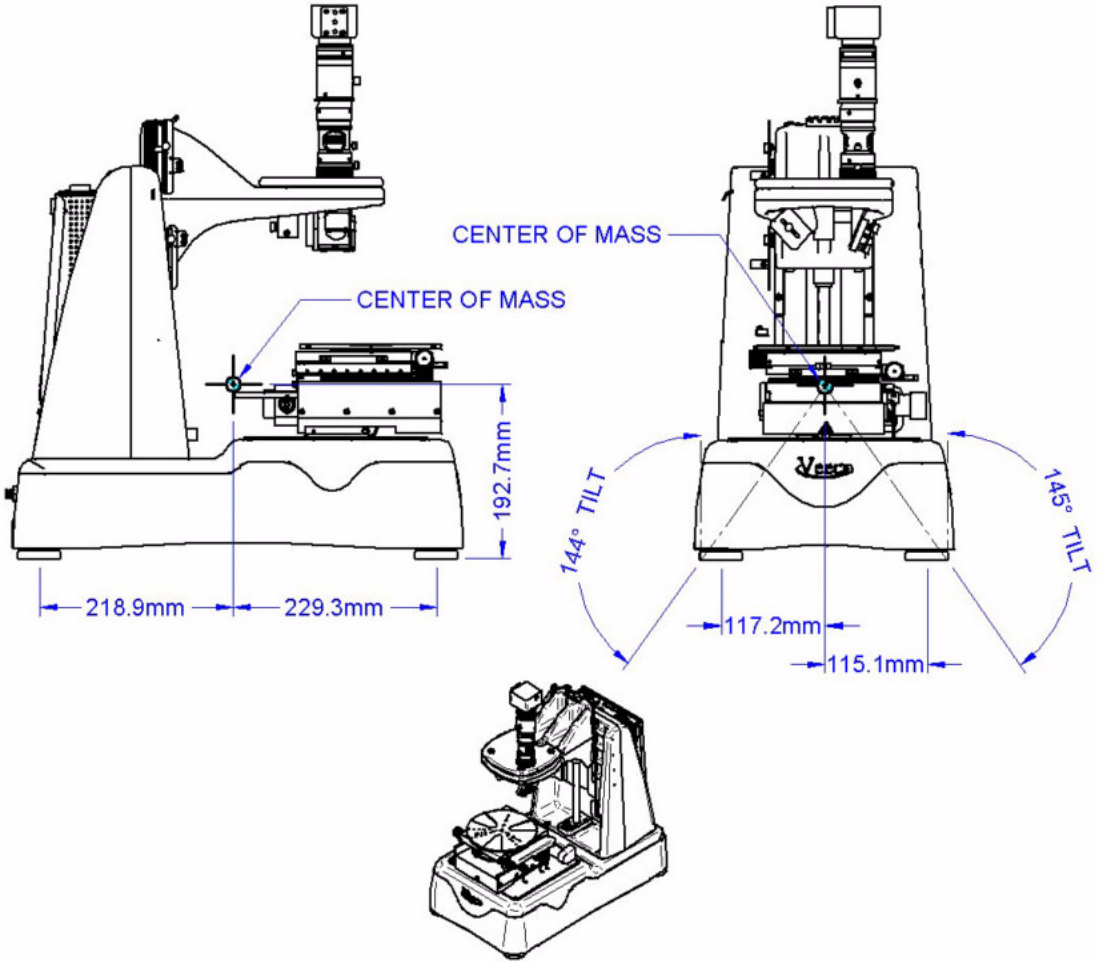


Figure A-8: Dektak 150 without Enclosure - Center of Mass



B

TECHNICAL SPECIFICATIONS AND PURCHASED OPTIONS

DEKTAK 150 TECHNICAL SPECIFICATIONS

Table B-1: Dektak 150 Technical Specifications

SYSTEM	
Measurement Technique	Stylus profilometry (contact)
Measurement Capability	Two-dimensional surface profile measurement (standard)
Sample Viewing (Camera and Optical Assembly)	• 640 x 480-pixel (1/3 in.-format) color camera, USB • Fixed magnification optics, 2.6 mm FOV (166X with 17 in. monitor) • Optional manual zoom optics, variable 0.67 to 4.29 mm FOV (644X to 100X with 17 in. monitor)
Sample Illumination	Variable intensity white-light LED
Stylus Sensor	Low-Inertia Sensor (LIS 3)
Stylus Force	1 to 15 mg with LIS 3 sensor; 0.03 to 15 mg with *N*-Lite sensor option
Stylus Options	25 µm, 12.5 µm, 5 µm, 2.5 µm, 0.7 µm, 0.2 µm, 50 nm super sharp tip, High Aspect Ratio (HAR) 2 x 10 µm, HAR 20 x 200 µm
Sample-Positioning Stage	• Standard manual X-Y/theta, 100 x 100 mm X-Y translation, 360-degree rotation • Manual leveling • Two-point programmable or cursor software leveling
Automation Stage (Optional)	•Y auto stage, 100 mm (4 in.) travel, 5 µm repeatability, 0.5 µm resolution • X-Y auto stage, 150 mm (6 in.) travel, 5 µm repeatability, 0.5 nm resolution

Sample Positioning Translation	• Standard manual X/Y/theta stage: X Axis, ±50 mm , Y Axis, ±50 mm
Computer System	• PC with a Celeron® or Semprom™ processor • Optional Pentium® 4 or Athlon™ processor • Optional 17 in. flat-panel display
Software	• Dektak 150 software running under Windows XP • Step Detection software • Optional Stress Measurement software • Optional 3-D Mapping software (standard with Y auto stage) • Other optional software listed in Table B-2
Vibration Isolation	• Optional vibration isolation table • Optional table-top vibration isolation platform
Environmental Enclosure	Conductive, tinted, all-acrylic enclosure
PERFORMANCE	
Scan Length Range	50 µm to 55 mm (2 mils to 2.16 in.)
Scan Speed Ranges	3 seconds to 200 seconds
Data Points per Scan	60,000 maximum
Maximum Sample Thickness	101 mm (4 in.), depending on Dektak 150 system configuration
Maximum Wafer Size	150 mm (6 in.)
Maximum Sample Weight	3 kg (6.6 lbs)
Vertical Range	524 µm (0.02 in.) standard; 1 mm (0.039 in.) optional
Vertical Resolution (at various ranges)	1 Å (@65 kÅ), 10 Å (@655 kÅ), 80 Å (@5240 kÅ); 160 Å (@1 mm)
Stylus Tracking Force	Programmable, 1-15 mg; down to 0.03 with N-*Lite* option
Micro-Form Measurement	Increases accuracy of measurements of difficult shapes and steep slopes to within 0.25 degrees
Step Height Repeatability	6.0 Å, 1 sigma on 0.1 mm step height
ENVIRONMENT (For detailed facilities specifications and drawings, see Appendix A.)	
Power Requirements Current Phase	100-120~ or 220-240~, 50/60 Hz, 5A@100-120~ or 3A @ 220-240~ (+/-10%) Single Phase
Power Requirements Input Voltage	100 to 120VAC/200 to 264VAC, 50 to 60Hz
Warm-up Time	15 min. for maximum stability
Temperature Range	20 to 25º C (68 to 77º F)
Humidity Range	5‘0%, +/-20% non-condensing
DIMENSIONS AND WEIGHT	
Profiler Dimensions	292 mm W x 508 mm D x 527 mm H (11.5 in. W x 20 in. D x 20.75 in. H)
Enclosure Dimensions	L= 28.0 in.(71.1 cm), W = 19.6 in. (49.8 cm), H= 26.0 in. (66.0 cm)

Profiler Weight	34 kg (75 lbs.) lbs., 115 lbs. shipping weight
Enclosure Weight	21.7 kg (48 lbs)
Shipping Box Dimensions	Box 1 (computer): 22” x 22” x 14” Box 2 (system): 24” x 18” x 22” Box 3 (system accessories): 22” x 22” x 12” Box 4 (enclosure): Box 5 (optional monitor): 18” x 15” x 7” Box 6 (optional vibration isolation table or platform): 42” x 36” x 50” (table) or 29” x 30” x 6” (platform)

DEKTAK 150 PURCHASED OPTIONS

Table B-2: Dektak 150 Options and Accessories

Item	Description/Function	Part Number
Y Auto Stage	Motorized, 100 mm, single-axis stage enables the mapping of 3D images in Wyko Vision (included).	838-112
X-Y Auto Stage	Motorized, 150 mm, X-Y stage provides automation and programmability of up to 200 sites on samples of up to six inches in diameter.	838-111
Ceramic Vacuum Chuck	Removable chuck provides sample restraint for small samples and pieces of samples. Vacuum source required.	838-071
Additional Styli	A number of standard and custom Low Inertia Sensor 3 Styli are available for scanning various types of surfaces.	See Table B-3
Calibration Standards	A broad line of calibration standards calibrate the system for many types of applications.	See Table B-3
Extended Vertical Range	Increases maximum vertical measurement range from 524 µm to 1 mm for measuring large steps or curved surfaces.	838-124
Monitor	17" high-resolution flat panel display color monitor.	701-298
Intel® Pentium® 4 Microprocessor	At least 1 GB RAM and 40 GB or greater IDE HD with a CD-RW drive.	838-116
Vibration Isolation Table	Isolates the scan head from floor vibration, which can affect instrument resolution and repeatability.	838-039
Vibration Isolation Platform	Bench-top isolation system. Requires 80 psi air supply.	See factory.
220/240 Volt System Assembly, UK	Configuration changes for 220/240 volt power for European operation	838-002
220/240 Volt System Assembly, UK	Configuration changes for 220/240 volt power for UK operation	838-003
Manual Zoom Optical Assembly	Provides 0.67 - 4.29 mm horizontal field of view; 3mm fine focus.	701-298
Scan-Stitching Software	Enables shape measurements on samples greater than 55 mm.	See factory.
Stress Measurement Software	Calculates tensile or compressive stress on processed wafers.	838-122

N-Lite Low Force Package	Allows stylus-to-surface engage routines for ultra-low force profiling.	775-315
Dektak 150 Software	Additional license of Dektak 150 software to allow installation on remote workstation	775-312
3D Wyko Vision Analysis Package with Y auto stage	Wyko Vision analyzes 3-D maps of the scan data taken using the Y auto stage.	838-125
2D Wyko Vision Analysis Package	Wyko Vision provides a wide range of options for displaying and analyzing the 2D scan.	838-123

For a list of styli and calibration standards, see Table B-3 on the page that follows.

Table B-3: Styli and Calibration Standards

Item	Description		Part No.
Standard Low Inertia Sensor 3 Styli	**Color Code**	**Size**	
Orange	Assy, Stylus, 5 µm	838-030-1	Orange
White	Assy, Stylus, 2w x 2d Hi Aspect Ratio	838-030-2	White
Green	Assy, Stylus, 0.7 µm R x 45°	838-030-3	Green
Gray	Assy, Stylus, 2.5 Micron R	838-030-4	Gray
Yellow	Assy, Stylus, 0.2 µm	838-030-5	Yellow
Red	Assy, Stylus, 12.5 µm	838-030-6	Red
Black	Assy, Stylus, 25 µm	838-030-7	Black
Gold	Assy, Stylus,50 nm Sharp Tip (30°)--for *N*-Lite only	838-030-8	Gold
Blue	Assy, Stylus, Chisel Type	838-030-9	Blue
Pink	Assy, Stylus, Hi Aspect Ratio, 20 µm Radius x 200 µm tall	838-030-10	Pink
Silver	Assy, Stylus, 5 µm x 15^{o}	838-030-11	Silver
Custom Low Inertia Sensor 3 Styli	**Color Code**	**Size**	**Part No.**
	White	Assy, Stylus, 2w x 2d Hi Aspect Ratio	838-030-2
	Green	Assy, Stylus, 0.7 µm R x 45°	838-030-3
	Yellow	Assy, Stylus, 0.2 µm	838-030-5
	Gold	Assy, Stylus,50 nm Sharp Tip (30°)--for *N*-Lite only	838-030-8
	Pink	Assy, Stylus, Hi Aspect Ratio, 20 x 200 (20w x 200d)	838-030-10

Item	Description	Part No.
Individual Calibration Standards	**Description**	**Part No.**
	Vertical Standard, 50NM (.5 KÅ), VSO, Silicon	300-998
	Vertical Standard, 100NM (1 KÅ), VSO, Silicon	300-999
	Vertical Standard, 230NM (2.3 KÅ), VSO, Silicon	301-005
	Vertical Standard, 450NM (4.5 KÅ), VSO, Silicon	301-006
	Vertical Standard, 1UM (10 KÅ), VSE, Silicon	301-007
	Vertical Standard, 5UM (50 KÅ), VSE, Silicon	301-008
	Vertical Standard, 10UM (100 KÅ), VSE, Silicon	301-009
	Vertical Standard, 900UM (9000 KÅ), VSE, Silicon	301-010
	Step Height, One Step Only	301-017
Step Height Set	50nm, 100 nm, 500 nm, 100 µm , 5 µm, silicon	301-011

C

STRESS MEASUREMENT

NOTE – Stress Measurement is an optional feature that must be installed in the Dektak software prior to use.

The Dektak 150 stress measurement function calculates tensile or compressive stress on processed wafers. Its algorithm creates a curve comprising stress values for every data point on the scan trace. If a pre-stress (pre-deposition) scan data file is saved, the calculation proceeds (on all the scan data points) as follows:

1. A running average with a window size of 1/10 the scan length loads and smooths the pre-stress scan data.
2. The smoothed data is further smoothed using a segmented third order polynomial interpolation technique.
3. The first and second derivatives of the smoothed data trace derives the curvature trace.
4. Steps 1 - 3 are also applied to the post-stress scan data, producing a curvature trace for the post-stress scan data.
5. The stress curve computes from the comparison of the two curvature traces.
6. The maximum and average compressive and tensile stresses are calculated from the stress curve, and displayed in the **Analytical Results** window (see Figure C-2).

The Dektak stress formula appears in Figure C-1.

Figure C-1: Dektak Stress Measurement Formula

Assuming an initially flat substrate, the stress in the film can be calculated as:

$$\sigma = \frac{1}{6}\left(\frac{1}{R_{post}} - \frac{1}{R_{pre}}\right)\frac{E}{(1-\upsilon)}\frac{t_s^2}{t_f}$$

where

σ = stress in the film, after deposition

R_{pre} = substrate radius of curvature, before deposition

R_{post} = substrate radius of curvature, after deposition

E = Young's modulus

υ = Poisson's ratio

t_s = substrate thickness

t_f = film thickness.

Figure C-2: Analytical Results Window

Analytical Results

Function	R	R	M	M	Result
Compressive Maximum	0...	0...	0...	0...	0 MPa
Compressive Average	0...	0...	5...	0...	0 MPa
Tensile Maximum	4...	0...	4...	0...	36661 MPa
Tensile Average	0...	0...	5...	0...	31209 MPa

NOTE – Only those values of the stress curve between the cursors are considered.

THREE-POINT SUBSTRATE SUSPENSION

To compensate for substrate deflection created by gravity or by a vacuum hold stage, the stress measurement provides three-point substrate suspension. Three 0.25" diameter steel ball bearings suspend the substrate above the stage surface. These ball bearings fit into the holes on top of the stage. A magnet is provided for removing the ball bearings from the stage.

Using the stage alignment pins improves the stress results by controlling wafer position repeatability for pre- and post-disposition scan results.

CREATING A STRESS REFERENCE

Prior to calculating stress, you must establish a reference. You can calculate stress using a straight line as the reference, or by producing a preliminary reference scan on the sample prior to processing. In order to accurately measure stress, the reference scan and the scan produced after thin film deposition must have identical scan parameters, including cursor locations (stress computes the data between the reference and measurement cursors). For this reason, save the scan parameters used to produce the original reference scan in an automation program file to use after deposition.

Once you produce the reference scan, save the scan in a data file. The data file is then used as the reference for comparison and stress calculation.

IDENTIFYING SUBSTRATE CHARACTERISTICS

To collect substrate statistics:

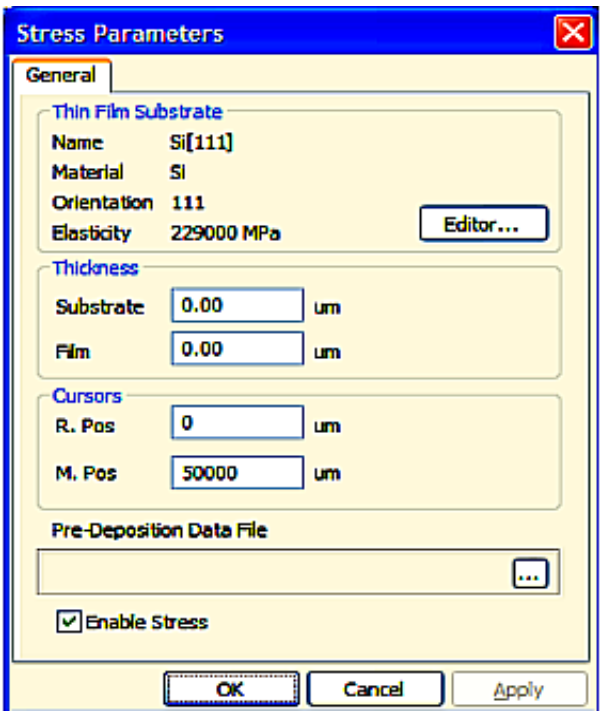
1. Position the R and M cursors to surround the portion of the scan trace over which to collect stress statistics.
2. If a reference scan is used to compute stress, use the exact scan parameters for the reference scan to produce the scan on the substrate after deposition. Whether you use the default straight line reference or a reference scan to calculate stress, scan the substrate after thin film deposition.

   NOTE – The scan automatically plots.

3. Once you complete the scan on the substrate after deposition, enter the characteristics of the substrate being measured for stress into the stress calculation. To do this, select **Analysis** > **Compute Stress** to display the **Stress Parameters** dialog box (see Figure C-3).

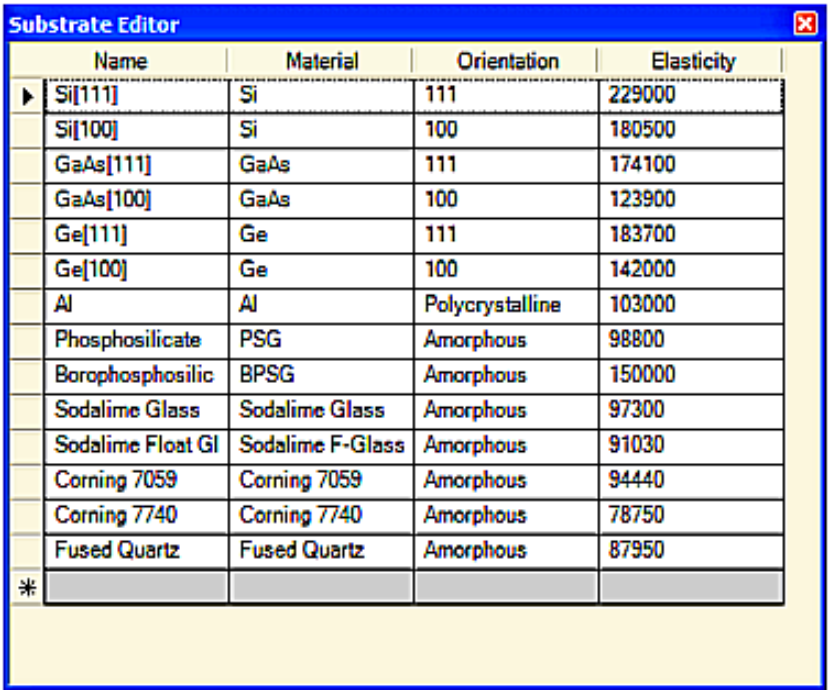
   NOTE – The **Thin Film Substrate** box of the **Stress Parameters** dialog box displays the material, orientation, and elasticity of the thin film substrate. Several options are stored in memory to compute stress in a variety of applications.

Figure C-3: Stress Parameters Dialog Box



4 Click **Editor** in the **Thin Film Substrate** section to view the pre-programmed thin film substrate elasticity constants (see Figure C-4).

Figure C-4: Substrate Editor



Name	Material	Orientation	Elasticity
Si[111]	Si	111	229000
Si[100]	Si	100	180500
GaAs[111]	GaAs	111	174100
GaAs[100]	GaAs	100	123900
Ge[111]	Ge	111	183700
Ge[100]	Ge	100	142000
Al	Al	Polycrystalline	103000
Phosphosilicate	PSG	Amorphous	98800
Borophosphosilic	BPSG	Amorphous	150000
Sodalime Glass	Sodalime Glass	Amorphous	97300
Sodalime Float Gl	Sodalime F-Glass	Amorphous	91030
Corning 7059	Corning 7059	Amorphous	94440
Corning 7740	Corning 7740	Amorphous	78750
Fused Quartz	Fused Quartz	Amorphous	87950

5 Select the thin film substrate to be measured for stress and double-click to set/select.

ENTERING STRESS PARAMETERS

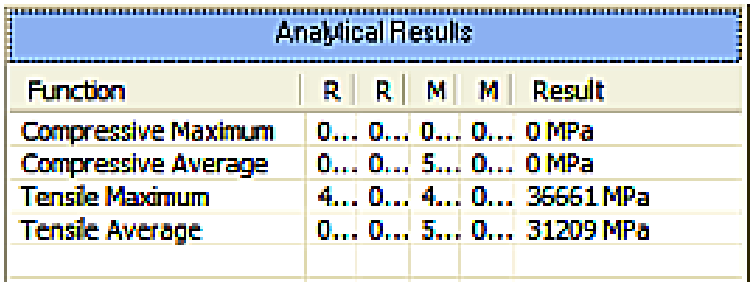
Once you identify the substrate material and orientation, you can enter other stress parameters in the **Stress Parameters** dialog box (see Figure C-3).

1. Verify the correct value displays in the **Elasticity** field. If the elasticity of the substrate is different than the value displayed, click **Editor** and enter the correct value.
2. Click the **Substrate thickness** field and enter that value in µm.
3. Click the **Film thickness** field and enter that value in µm.
4. Verify that the cursor positions are in the desired location.
5. Click **OK** if the stress is to be measured against the default straight line reference to display the stress result.
6. Click the **...** button in the **PreDeposition Data File** section if the stress is to be measured against a reference scan produced earlier and saved in a data file. The **Specify File** dialog box opens.
7. Browse the data folder and choose the appropriate file. Click **Select** to close the **Specify File** dialog box.
8. Select the **Enable Stress** check box in the **Stress Parameters** dialog box.
9. Click **OK** to close the **Stress Parameters** dialog box.

STRESS RESULTS

The statistical stress results appear in the **Analytical Results** window (see Figure C-5).

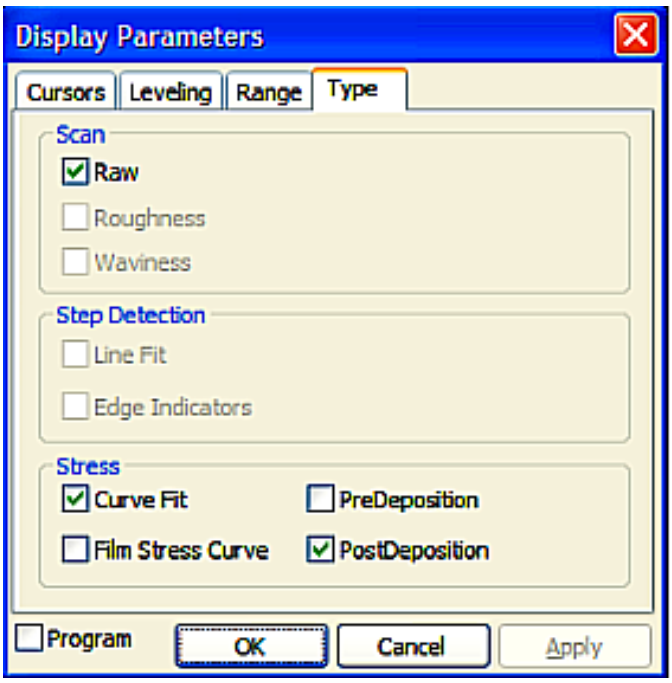
Figure C-5: Analytical Results Window



You can obtain a printout of stress results by either selecting **File > Print** or clicking the **Print** button on the toolbar.

Upon completion of the stress computation, you can display the stress data traces in the **Data Plot** window. Select **Plot > Display Options** from the menu bar or right-click on the plot and select **Display Options** to open the **Display Parameters** dialog box (see Figure C-6).

Figure C-6: Display Parameters Dialog Box: Type Tab



You can select the following types of stress plots from the dialog box:

Curve Fit

Curve fit plots in cyan.

PreDeposition

Predeposition data curve plots in blue.

> **NOTE –** This choice is available only if a pre-deposition data file was loaded.

PostDeposition

Post-deposition data curve plots in green.

Film Stress Curve

Film stress curve plots in orange.

> **NOTE –** This choice is relevant only if a pre-deposition data file was loaded.

Constraints and Limitations

When using the stress measurement options you must:

- Manually level the stage and verify that the stage is in the same leveled position before running both the pre- and post-stress scans.

- Ensure that both pre- and post-stress scans must have the same number of data points. Do not abort either scan before completion.
- Measure flat wafers to obtain optimal performance of the algorithm. Surface features can throw off the curve-fitting algorithm and produce invalid maximum stress values.

D

STEP DETECTION FUNCTION

The Dektak 150 Step Detection function enables the automatic computation of analytic functions on scanned features using a two step process. First, the Step Detection algorithm locates the leading and trailing edge of each scanned feature. Dektak 150 reference and measurement cursors then automatically position at a relative distance from each detected edge, where chosen analytic functions such as Average Step Height and Slope compute. The **Step Finder** is a filter that accentuates the edges of a scanned feature where a high variation (high frequency) between data points exist.

STEP DETECTION METHOD

A least-squares fit algorithm determines the location of feature edges. The following variables are used by the least-squares fit algorithm to determine the fitting criteria of a line to scanned data points.

- **First Step:** Automatically positions the R and M cursors for selected analytical functions relative to the beginning of the first step that matches the Step Description parameters. If a matching step is found, the ASH of the left edge and the right edge are the first two entries in the **Analytic Results** section. If relative values are requested, they are displayed.
- **Every Step:** Positions the R and M cursors for selected analytical functions relative to every step that matches the Step Description parameters.

Feature edges are determined by the relative change in slope of each line segment and the proximity (minimum width) from other line segments. The operational procedure for step detection is described in the following pages.

STEP DETECTION PARAMETERS

The **Step Detection** dialog box displays all the necessary parameters for performing the step detection function (see Figure D-1).

You can open the **Step Detection** dialog box from two of the Dektak 150 application windows. One of the choices displayed in the dialog box depends on the window from which the box was opened:

- To open the **Step Detection** dialog box from the **Scan Routines** window, click **Step Detection** in the **Data Processing** section (lower left corner of the window).
- To open the **Step Detection** dialog box from the **Data Plot** window containing a plot, select **Analysis > Step Detection** from the menu bar.

> **IMPORTANT!** Veeco recommends that you scan a representative sample and set up step detection in the **Data Plot** window, where you can immediately see the effects of your changes.

General Settings Tab

When the dialog box first appears, it defaults to the **Every Step** detection method on the **General Settings** tab (see Figure D-1). You can set various parameters on this tab to suit your requirements.

Detection Method Section

Select the **First Step** or **Every Step** check box. The **Every Step** check box is selected by default. When you select **First Step**, the **Every Step** tab becomes the **First Step** tab.

Figure D-1: General Settings Tab with Every Step Selected

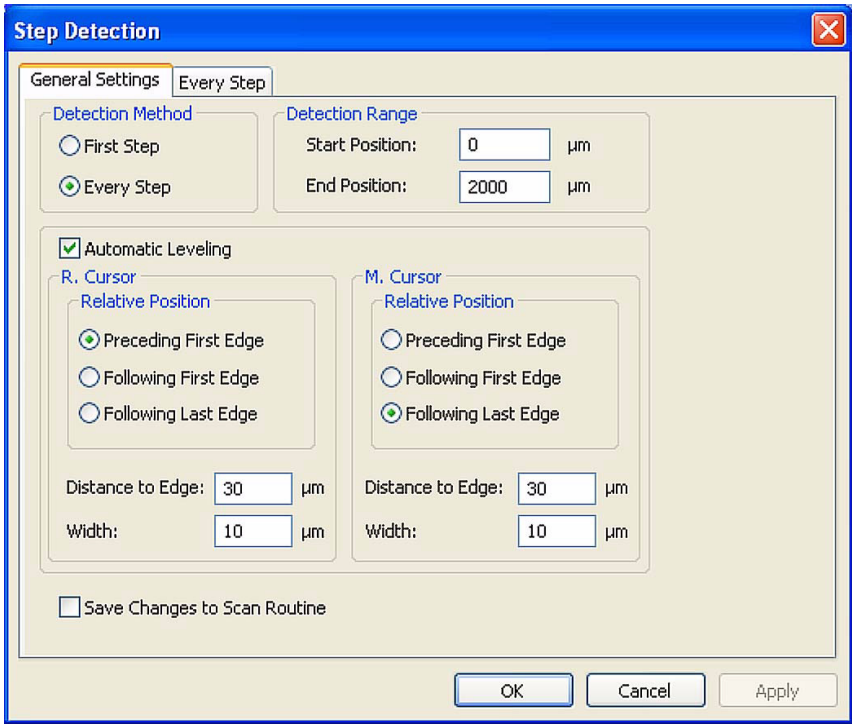
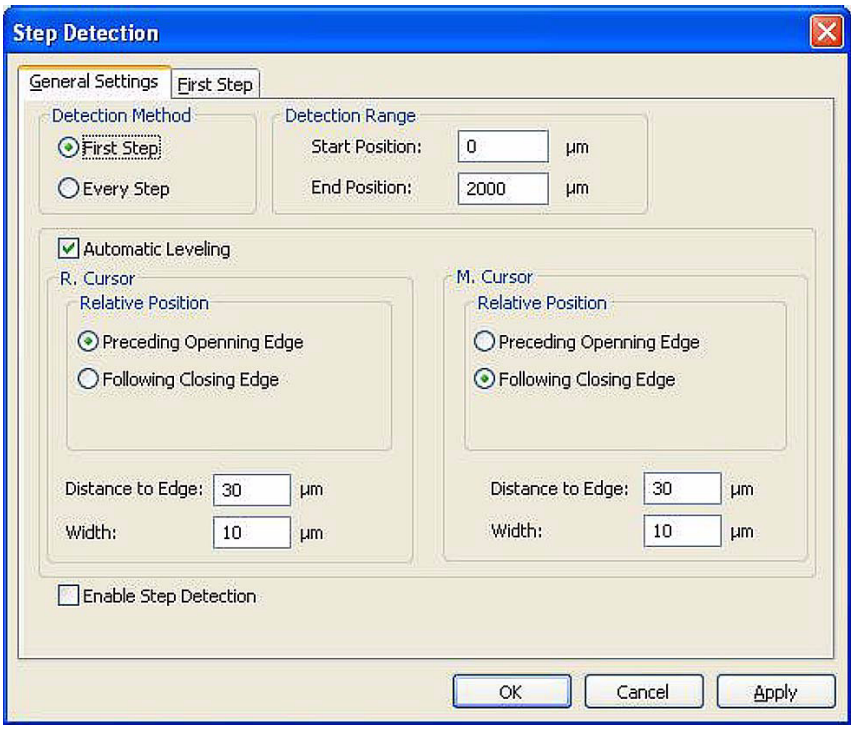


Figure D-2: General Settings Tab With First Step Selected



Detection Range Section

- **Start Position**: The position, in µm, to start searching for a step.
- **End Position**: The position, in µm, to end searching for a step. The default end position is 2000 µm regardless of the actual scan length.

Automatic Leveling

When this check box is selected, the system automatically levels the trace with the R and M cursors each placed near an edge at a **Relative Position** that you specify, at a distance from the edge that you specify. You can also specify the **Width** for each cursor.

Save Changes To Scan Routine

When this check box is selected, all entered Step Detection parameters are saved to the current scan routine.

> **NOTE –** This check box is available only when step detection has been initiated from the menu bar in the **Data Plot** window.

Enable Step Detection

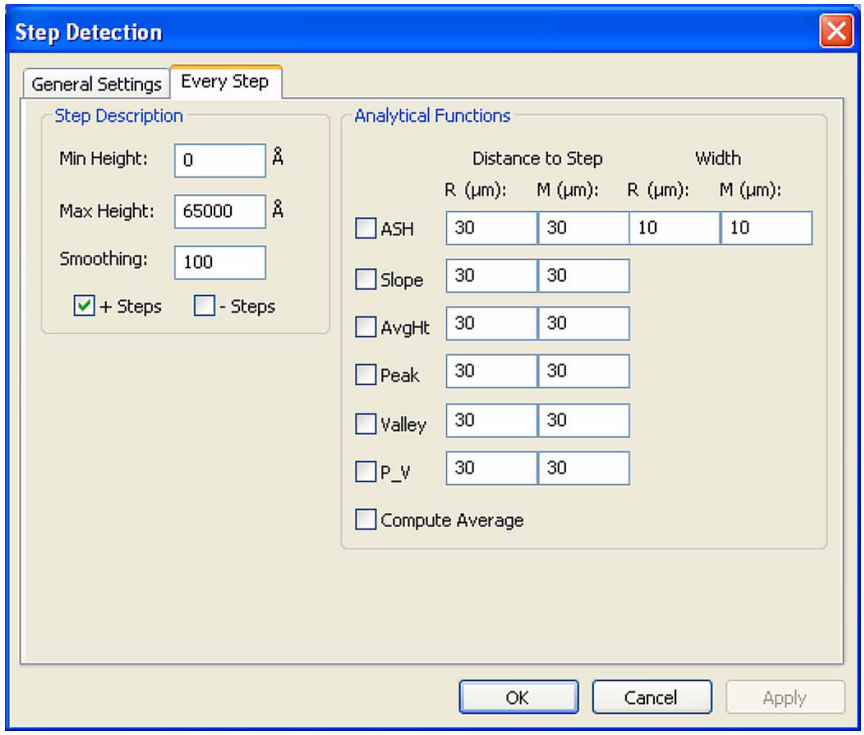
When this check box is selected, the system performs Step Detection as specified on the current scan.

NOTE – This check box is available only when the dialog box is opened from the **Data Processing** section of the **Scan Routines** window.

Every Step Tab

You may need to change the parameter values on the **Every Step** tab, depending on the steps to measure (see Figure D-3). Click the **Every Step** tab to display its contents. A description of the parameters contained in the **Every Step** tab is provided below.

Figure D-3: Step Detection Dialog Box: Every Step Tab



Step Description Section

- **Min Height**: Indicates the minimum height of the features to measure.
- **Max Height**: Indicates the maximum height of the features to measure.
- **Smoothing**: Indicates the minimum edge height used to search for potential steps, in angstroms.
- **+ Steps**: When selected, Step Detection searches for the first positive step matching Step Description parameters.
- **- Steps**: When selected, Step Detection searches for the first negative step matching Step Description parameters.

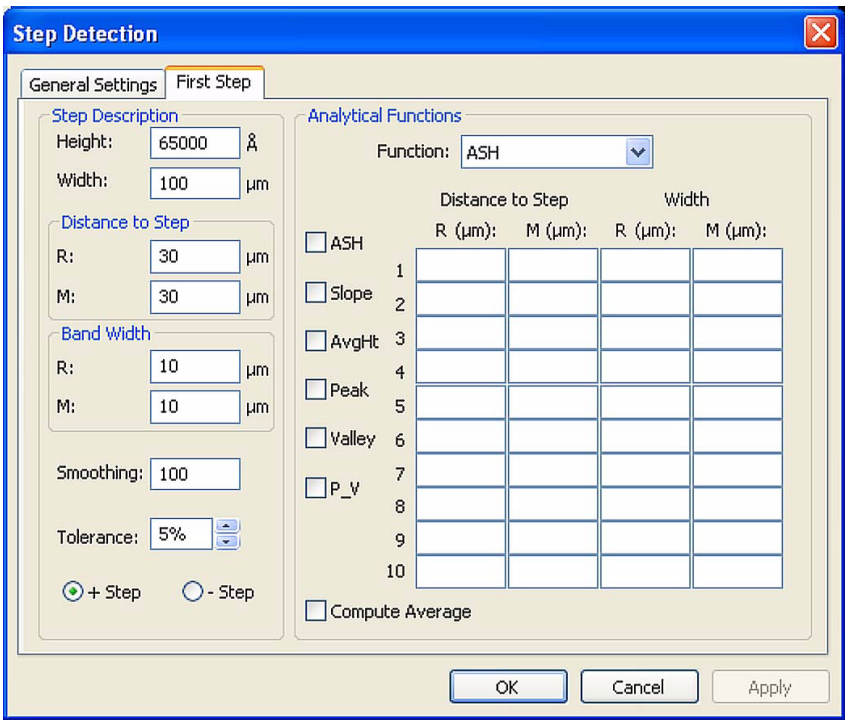
Analytical Functions Section

- **ASH**: Compute Average Step Height function.
- **Slope**: Compute Slope function.
- **AvgHt**: Compute Average Height function.
- **Peak**: Compute Maximum Peak function.
- **Valley**: Compute Maximum Valley function.
- **P_V**: Compute Maximum Peak to Valley function.
- **Compute Average**: Compute the average of all results of each analytical function.

First Step Tab

If you select First Step as the detection method, you can click the **First Step** tab (see Figure D-4). A description of the parameters contained on this tab appears after the figure.

Figure D-4: Step Detection Dialog Box: First Step Tab



Step Description Section

- **Height**: The desired height of the step to detect.
- **Width**: The desired width of the step to detect in µm.

Distance To Step Section

- **R**: The relative position of the R cursor to the left of the potential step being detected.
- **M**: The relative position of the M cursor to the right of the potential step being detected.

Band Width Section

- **R**: Width of R cursor band positioned to the left of the potential step being detected.
- **M**: Width of M cursor band positioned to the right of the potential step being detected.

Additional Parameters

- **Smoothing**: Factor used for smoothing. Larger values result in more smoothing.
- **Tolerance:** Error factor used for calculating the height and width of the matching step.
- **+ Step**: When selected, Step Detection will search for the first positive step matching Step Description parameters.
- **- Step**: When selected, Step Detection will search for the first negative step matching Step Description parameters.

Analytical Functions Section

Select the check boxes for the analytical functions desired:

- **ASH**: Computes Average Step Height function.
- **Slope**: Computes Slope function.
- **AvgHt**: Compute Average Height function.
- **Peak**: Compute Maximum Peak function.
- **Valley**: Compute Maximum Valley function.
- **P_V**: Compute Maximum Peak to Valley function.
- **Compute Average**: Compute the average of all results of each selected analytical function.

Then select each of the desired functions in turn from the **Function** drop-down list to enter the appropriate cursor information in the grid for each function.

Distance to Step Columns

R (μm)

The relative distance from the beginning of the detected step at which to place the R cursor prior to performing the corresponding analytical function. Negative values fall to the left of the beginning of the step, positive values to the right. You may enter up to 10 distances for each analytical function.

M (μm)

The relative distance from the beginning of the detected step at which to place the M cursor prior to performing the corresponding analytical function. Negative values fall to the left of the beginning of the step, positive values to the right. You may enter up to 10 distances for each analytical function.

Width Columns

R (µm)

R-cursor band width used when performing corresponding analytical function. You may enter up to 10 widths for each analytical function.

M (µm)

M-cursor band width used when performing corresponding analytical function. You may enter up to 10 widths for each analytical function.

STEP DETECTION SETUP

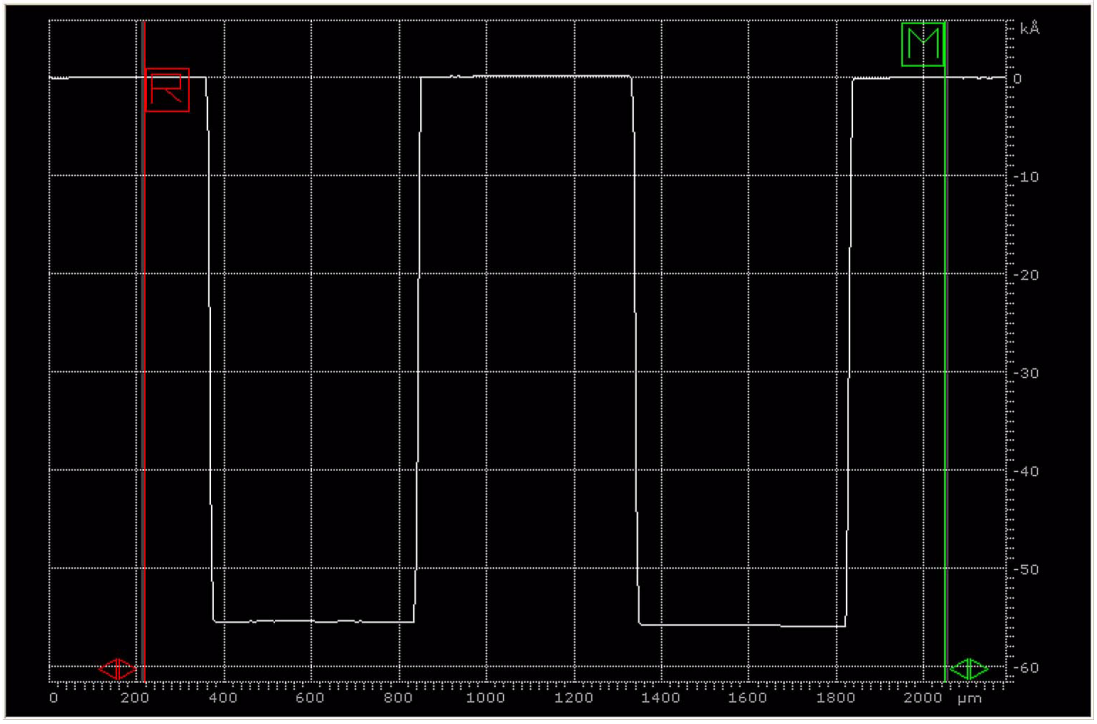
Step Detection is typically used for finding and measuring steps when performing multi-scan automated operations. It scans similar features at multiple locations on multiple samples with the step heights measured automatically.

Prior to using Step Detection in a multi-scan operation, create a sample scan of the feature to aid in setting up the Step Detection parameters. Using the scan shown in Figure D-5 as an example of a sample scan, the following pages demonstrate how to set up and perform Step Detection on a scan data file.

Figure D-5 shows a scan across a feature with steps (trenches) located at approximately 350 µm and 1350 µm. The procedure to invoke Step Detection on an existing scan data file is provided below.

Select **Analysis** > **Step Detection** from the menu bar with a scanned profile of multiple steps displayed in the **Data Plot** window (see Figure D-5).

Figure D-5: Typical Scan of Multiple Steps



Performing Step Detection on a Single Scan

1. With the **Step Parameters** dialog box displayed, select the **Step Detection** method (**First Step** or **Every Step**).
2. Select the desired parameters for the scan to measure the scanned step or steps.
3. Click **OK**.

The resulting scan after you enable Step Detection redisplays the plotted profile and detects and measures the steps applicable to selected Step Detection parameters.

Selected analytical functions (such as ASH measurement) perform on the detected steps. The steps are detected, causing the ASH measurement to compute with R and M cursors positioned on either side of the step and displayed to the left of the plotted profile.

You can now automatically locate the cursors to their corresponding position by highlighting the desired analytic result.

Programming Step Detection in a Scan Routine

The same criteria for locating feature edges on a single data file can be used for performing step detection on similar features during subsequent scans.

1. Select **Window** > **Scan Routines** to display the **Scan Routines** window to enable Step Detection during a scan.
2. Under **Data Processing**, click **Step Detection** to display the default values in the **Step Detection** dialog box.
3. Select the **Step Detection Enabled** check box to enable step detection while scanning.

Programming Step Detection on Multiple Scans

You can use the Automation Program Summary (APS) Report with step detection to automatically compute standard deviation and mean values of chosen analytic functions at each detected step for a series of scans.

1. Select **Window** > **Automation Programs** to program a series of scans with Step Detection.
2. Under **Automation Program Options**, click **APS File** to open the **Automation Program Options** dialog box**.**
3. On the **General** tab, in the **Auto Program Summary (APS)** section, click the **Compute & Display** check box.
4. Accept the default file, or specify the desired file for the APS summary, and click **OK**.
5. Select **Edit** > **Copy To...** to create a copy of the previously developed scan routine.
6. In the dialog box that pops up, enter a numerical value for the new **Scan Routine #** into the field and click **OK**.
7. Double-click the left mouse button on the newly created scan routine to allow modification of the new scan routine location.
8. Modify any parameters of the scan routine you want to alter.

9 Select **Window** > **Automation Programs** to run the automation programs.

10 Select **Run** > **Auto Program From...** after highlighting the first automation program to execute.

The result is an Automation Program Summary Report with Mean, Standard Deviation, Minimum, Maximum and Range values for ASH measurements at each detected step.

E

3D MAPPING FUNCTION

NOTE – For non-automated configurations of the Dektak 150 system, the 3D Mapping function is an optional feature that must be installed in the Dektak software prior to use.

The Dektak Three Dimensional (3D) Mapping function allows Dektak 15- surface profiler users to easily measure, analyze, and view surface contour data in three dimensions (X, Y, and Z), instead of the two dimensions (X and Z) that standard products provide. Dektak 150 surface profilers collect 3D data through the use of mapped scans. The mapped scan data is then converted into data files that the Vision software can analyze and display.

OVERVIEW

NOTE – The 3D Mapping function runs within the Dektak 150 software. However, the Vision component can run as a stand-alone analysis tool on any computer that meets the system configuration specifications.

The following minimum configuration is required to run the 3D Mapping function:

Hardware

- Pentium-based IBM compatible PC
- Dektak 150 profiler equipped with the y auto stage or x-y auto stage

Software

- Microsoft Windows XP. The package is network-compatible based on the network compatibility of the underlying operating system. This typically includes remote file system storage and retrieval, along with remote printing.

- The 3D Mapping Option software, which includes:
  - Vision Image Analysis Software CD
  - Advanced Analysis Plug-in Software CD

SETTING UP A 3D MAPPING PROGRAM

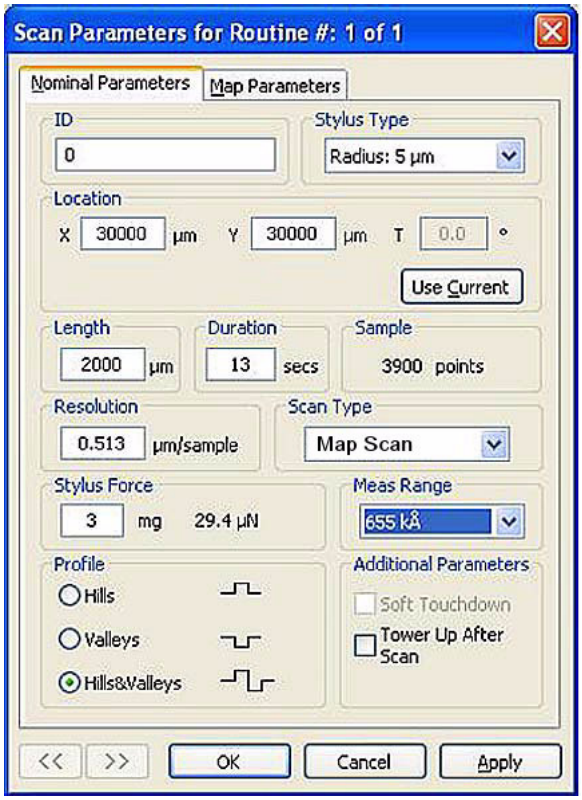
NOTE – The Dektak 150 software allows you to include both standard scans and map scans in a single automation program.

Steps for the Y Auto Stage

If your Dektak 150 profiler includes the the Y auto stage, follow these steps to set up a 3D map:

1. Open the **Scan Routines** window.
2. Click any of the entries in the **Scan Parameters** section to open the **Scan Parameters** dialog box with the **Nominal Parameters** tab displayed (see Figure E-1),
3. In the **Scan Type** section of the **Nominal Parameters** tab, select **Map Scan** from the drop-down list.

Figure E-1: Scan Parameters Dialog Box--Map Scan Type



4 Make or modify any additional settings in the **Scan Parameters** dialog box. For example, if you know the desired scan length and map width, enter your scan length on the **Nominal Parameters** tab and enter your map width on the **Map Parameters** tab.

5 Click **OK** to close the dialog box.

Steps for the X-Y Auto Stage

If your Dektak 150 profiler includes the X-Y auto stage, follow these steps to set up a 3D map:

1 Open the **Scan Routines** window.

2 Click any of the entries in the **Scan Parameters** section to open the **Scan Parameters** dialog box with the **Nominal Parameters** tab displayed (see Figure E-1).

3 In the **Scan Type** section of the **Nominal Parameters** tab, select **Map Scan** from the list. .

4 Select **Window > Sample Positioning**. The **Sample Positioning** window appears.

5 Select **Edit** > **Define Map Area** (or press **CTRL+D** on the keyboard). In the **Sample Positioning** window, locate the feature to be mapped, using either the high or low magnification camera to view the area.

6 Null the stylus at any corner of the intended mapping area. To do this:

   a. Position the stylus horizontally over the sample.

   b. Select **Tower Down** to bring the sample into focus before setting the map area.

7 Follow the directions displayed:

   a. Roll the mouse to define the X extent.

   b. Click the left mouse button.

   c. Roll the mouse to define the Y extent.

   d. Click the left mouse button.

   The software always calculates the coordinates at the lower left corner of the map area. It also enters those coordinates into both the **Automation Program** window (**Scan Routines** section) and the **Location** for the scan routine in the **Scan Routines** window (**Scan Parameters** section). The map proceeds from bottom to top, moving in the positive Y direction with each new scan line.

8 Open the **Scan Routines** window.

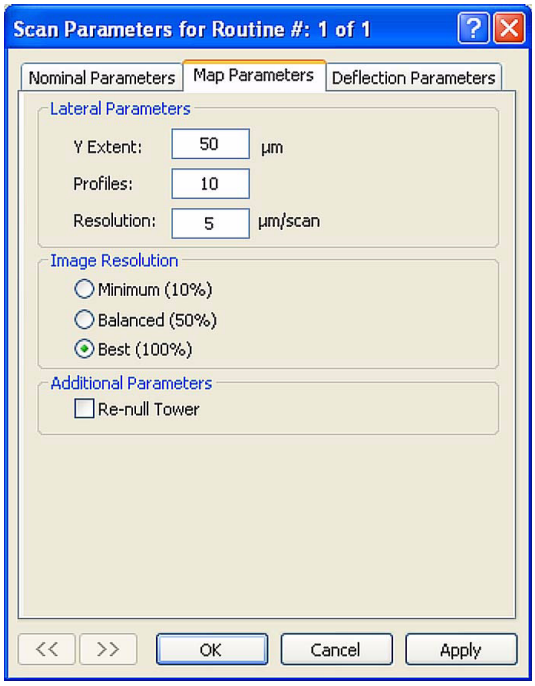
9 Click any of the entries in the **Scan Parameters** section at the left side of the window, to open the **Scan Parameters** dialog box.

10 Click the **Map Parameters** tab.

11 Enter or change any of the parameters on the **Map Parameters** tab of the **Scan Parameters** dialog box. For example, enter the number of **Profiles** (scan lines) up to 10,000 (100 scan lines is recommended), or the vertical scan **Resolution** (down to 1.0 µm/scan).

> **NOTE –** Entering a new value for **Resolution** automatically resets the number of **Profiles** required for the specified **Y Extent**. Conversely, entering a new value for the number of **Profiles** automatically resets the value for **Resolution** as required for the specified **Y Extent**. (The product of **Profiles** times **Resolution** equals **Y Extent**.)

Figure E-2: Scan Parameters Dialog Box: Map Parameters Tab



12 Click **OK** in the **Scan Parameters** dialog box to accept the scan parameters. The mapping parameters are now stored in the automation program.

SELECTING FILES FOR SAVING MAPPING DATA

In the **Automation Programs** window, click **Data File** in the **Automation Program Options** section to display the **General** tab in the **Automation Program Options** dialog box.

In the **Scan Data** section, you have the following choices for saving your data:

- Accept the default file name to save the mapping data.
- Click the button to open the **Select a Data File** dialog box where you can specify a new data file name.

> **NOTE –** Unless otherwise specified, mapping data is automatically saved to the Default.*nnn.* data file in the Dektak32\Data\Default folder on the C: drive. This data file name is the same as that used for a standard scan. All scans taken are stored in a single file.

RUNNING A 3D MAPPING PROGRAM

To execute a 3D mapping program, run the automation program containing the desired mapping parameters. To do this, select **Run** > **Auto Program**.

> **NOTE –** The **Data Plot** window displays and plots each scan in real time. Once all the scans in the automation mapping program are complete, the map file (*.data) is created. You can then access the data file from the Vision software program. You can also open the data file in Dektak to view the last scan in the map.

ABOUT SOFT TOUCHDOWN

Soft touchdown is an alternate stylus touchdown routine to *N*-lite. Although it can be used with all stylus forces, it is most often used with repeated scans for 3D Mapping.

Soft touchdown is very beneficial for materials that build up an electrostatic charge from repeated scans. This added functionality allows sensitive materials to be mapped without the use of a Polonium or Ion source to achieve quality surface mapping without damaging the sample. Soft touchdown is also helpful for systems that are using special tips, such as delicate high-aspect ratio and super-sharp tips such as sub-micron that can easy damage surfaces.

MODIFYING THE SOFT TOUCHDOWN SETTINGS

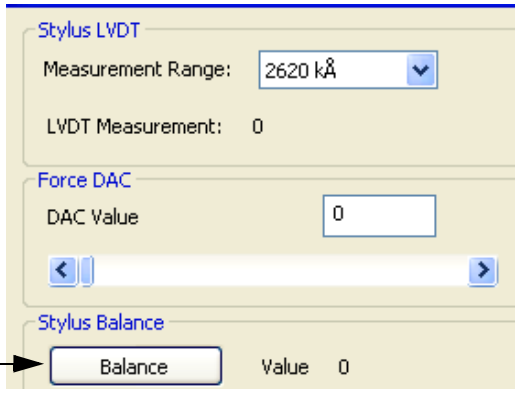
Unlike *N*-lite, soft touchdown is not self-calibrating. When it is enabled, you must to perform a quick calibration whenever the stylus is replaced.

To calibrate the soft touchdown routine:

1 Find the stylus balance point:

- **a.** Select **Calibration > Stylus Force**.
- **b.** Click the **Balance** button (see Figure E-3). This operation can take up to 30 seconds.
- **c.** Record the balance point value.
- **d.** Close the **Force Calibration** window. Do not save any changes.

Figure E-3: Balance Button in Force Calibration Dialog Box



2 Enter the modified balance point value into the soft touchdown settings:

   a. Select **Setup > Configuration Settings**. Enter the password `dektak32` and click **Enter**.

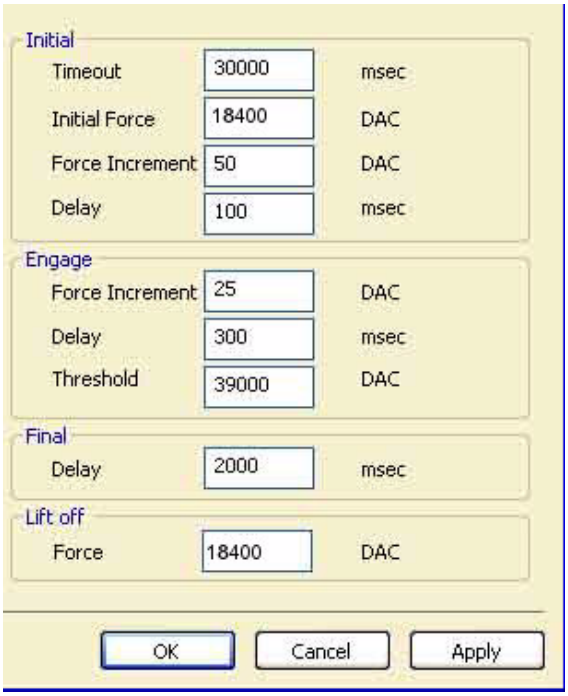
   b. In the **Hardware** section, click **Soft Touchdown**. The **Soft Touchdown** dialog box appears (see Figure E-4).

   c. Subtract 600 from the balance point that you recorded in step 1, and then enter the result in the **Initial Force** field. For example, if your balance point is 19000, subtract 600 from it, and then enter 18400 in the **Initial Force** field.

   d. Enter the number that you calculated in the previous step (the balance point minus 600) in the **Lift Off Force** field.

3 Click **Apply** and then click **OK**.

Figure E-4: Soft Touchdown Dialog Box



4 When you are asked if you want to reset the hardware, click **Yes**. There is a brief pause while the system changes the hardware configuration settings.

Figure E-5: Reset Hardware Dialog Box

Checking Stylus Operation after Calibration

With soft touchdown enabled, watch the stylus as it finishes a scan and the stage moves to next scan location. The stylus should be slightly below its balance point, and you should see it gently bobbing, but not touching the surface.

When the stylus engages, it should come down smoothly, and then slow as it nears the surface and gently come into contact.

WARNING

Movements that are too forceful can result in damage to the stylus and/or the sample.

Troubleshooting Soft Touchdown Problems

The following strategies can help solve soft touchdown problems:

- If the stylus does not pick up at the end of the scan, repeat steps 1 - 3 in the previous section. If it still does not pick up, decrease the Initial and Lift Off Force values in increments of 100 DAC counts until stylus operation becomes smooth.
- If the stylus comes down forcefully after a long pause, repeat steps 1 -3 in the previous section. If it still comes down too forcefully, increase the Initial and Lift Off Force values in increments of 100 DAC counts until stylus operation becomes smooth.
- If the stylus comes down smoothly at first, but then contacts too quickly at the end, either decrease the Engage force increment or increase the delay.
- If the stylus bobs dramatically as it engages, decrease the Initial Force value and increase the delay.

As you troubleshoot, bear in mind the following:

- Soft Touchdown is automatically enabled with *N*-lite forces.
- Soft Touchdown cannot be used with **Tower Up after Scan** operation.
- Although Soft Touchdown cannot be used in **Hill** mode, it can be used in both **Valleys** and **Hills and Valleys** modes.

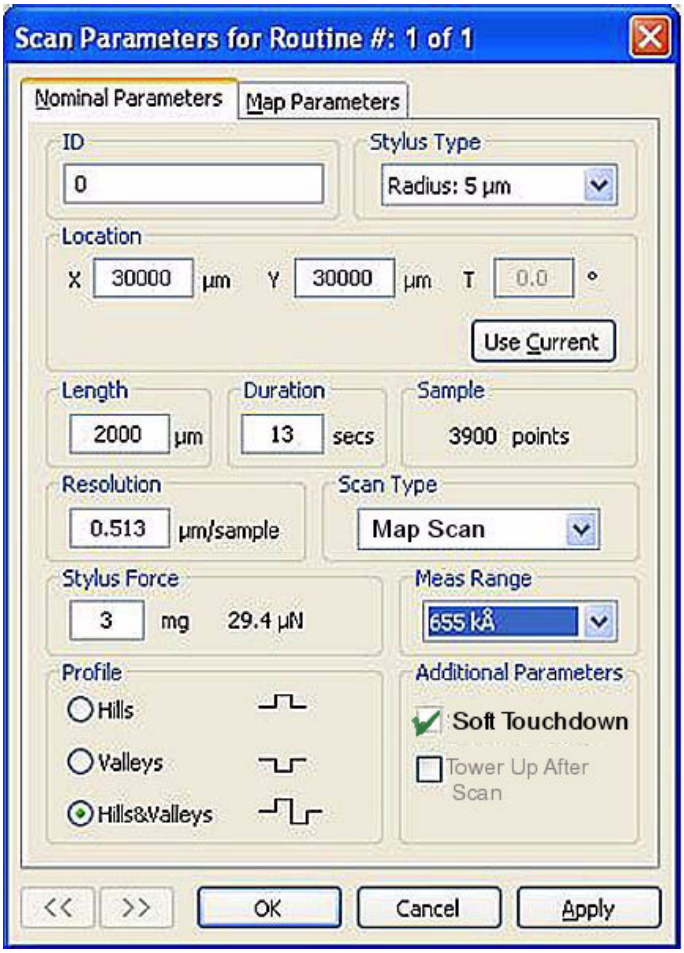
ENTERING SOFT TOUCHDOWN INTO A SCAN ROUTINE

NOTE – The **Soft Touchdown** option is available only when the **Map Scan** scan type is selected and the **Tower Up After Scan** option is NOT selected.

To enter soft touchdown into a scan routine:

1 Click any parameter in the **Scan Parameters** section of the **Scan Routines** window to open the **Nominal Parameters** tab of the **Scan Parameters** dialog box.

Figure E-6: Nominal Parameters Tab of Scan Parameters Dialog Box



2 In the **Additional Parameters** section, select the **Soft Touchdown** check box (see Figure E-6) , and then click **OK**.

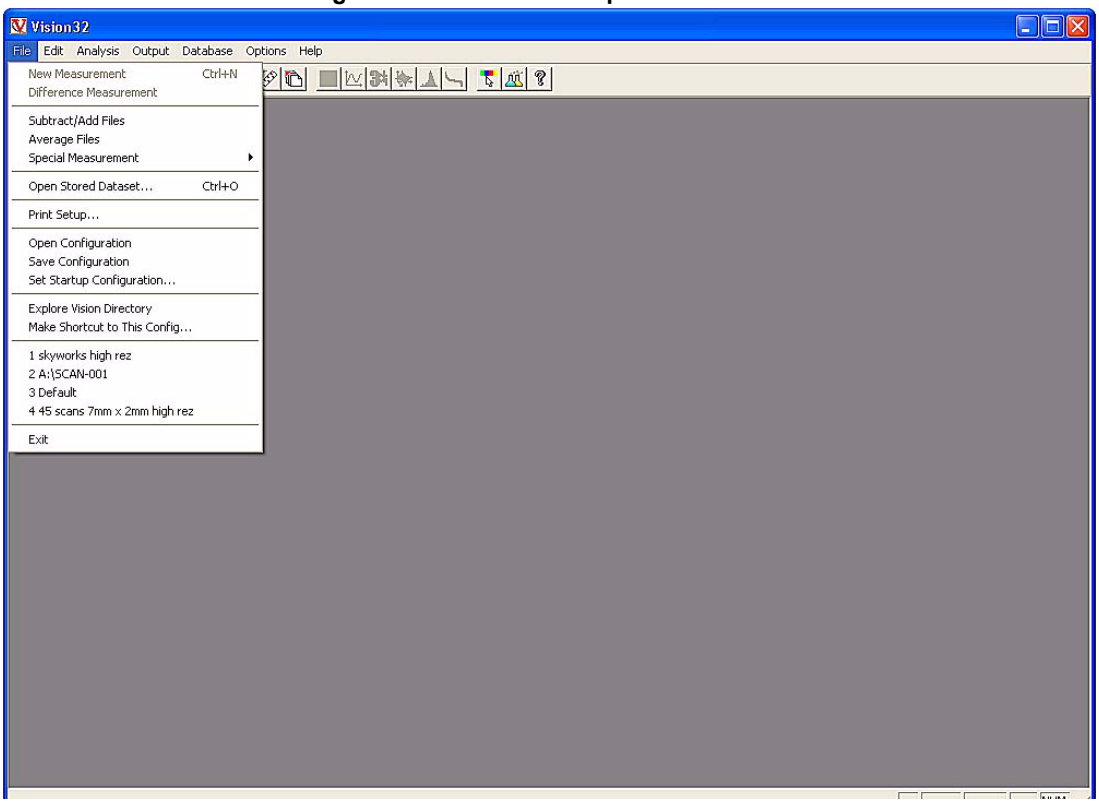
USING VISION'S BASIC FUNCTIONS

The Dektak 3D Mapping Option produces 3D images of a sample that are converted into data that the Vision 3D rendering software can analyze and store in a .data file (see Selecting Files for Saving Mapping Data on page E-4).

Start-Up Window

Once started, Vision displays a **Start-Up** window that incorporates both a menu bar and a toolbar for command selection (see Figure E-7). Use the **Start-Up** window as a home base for performing data analysis, transformations and image presentation.

Figure E-7: Vision Start-Up Window



Open

Select **File** > **Open Stored Dataset** or click the icon to open a scanned image file and transfer the data into a working data buffer (current data set) for use by the package. The **Open Stored Dataset** dialog box appears (see Figure E-9). All data analysis, transformations, and image presentations perform from the current data set.

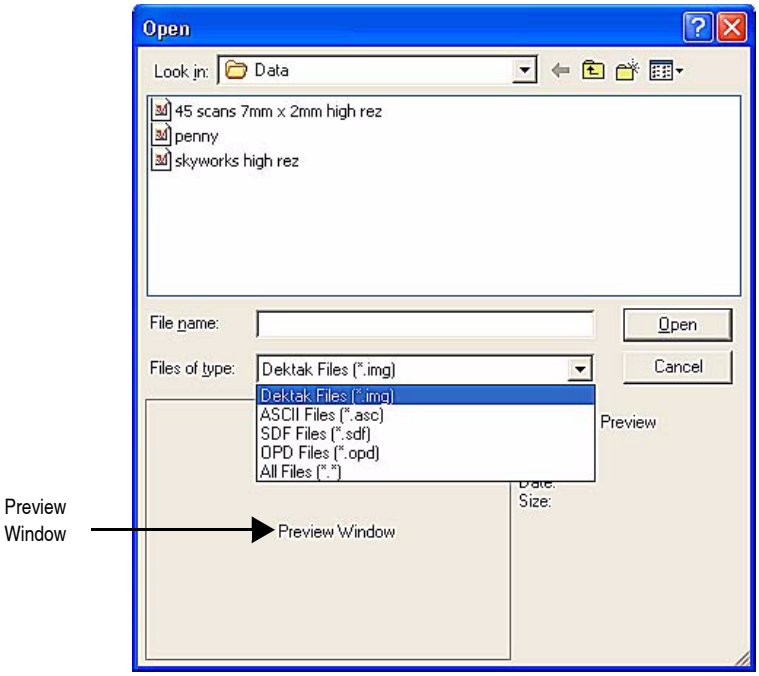
Figure E-8: Open a Dataset Icon

1 Choose the type of file you want to open by selecting the drop-down list box next to the **Open** box. Vision opens four different file types: Dektak (*.data), ASCII Files (*.asc), SDF (*.sdf), and OPD (*.opd).

> **NOTE –** The default file type for Vision is .data.

2 Click **Open** browse for a file. A preview of the file you select appears for quick recognition of the file.

Figure E-9: Open Dialog Box



Save

Select **File** > **Save As** to save an image. This command is typically used when you have transformed the dataset and wish to save the results of the transformation independent of the raw data set. The data is saved in Vision file format (*.opd format, not in data file format (*.data).

Printing

You can print the current window from anywhere within the package on an attached printer. There are three print options available: the entire display contents, the current window, or the client area of the current window. The entire display command sends every pixel shown on the monitor to the printer. The current window is defined as the current active Microsoft Windows window, including the window border, sizing handles, title bar, menu bar, and window client area (contents). The client area is the portion of a window excluding the title bar, menu bar, and window border, if any. To print the current window press **CTRL+P**; to print the entire screen press **CTRL+S**; and to print the current client area press **CTRL+SHIFT+P**. The specific portion of the screen is then sent to the current default printer as defined by Microsoft Windows and the user. The page orientation of the output automatically changes so the largest possible image prints on a page.

Vision Toolbar

The Vision toobar provides access to the most frequently used options of the Vision software.

Figure E-10: Vision Toolbar

The following table describes the icons on the Vision tool bar.

Table E-1Vision Menu Bar

Description	Button/Icon
Open: Opens a dataset for viewing and analysis.	
Save: Saves the current database.	
Print: Prints the active dataset.	
Processed Options: Opens the **Processed Options** dialog box, where you can set various data processing parameters.	
Edit Masks for this Dataset: Opens the **Mask Editor** window.	
Units Options: Opens the **Units** dialog box, which allows you to change the display units between English and metric.	
Contour Plot: Applies a contour plot display file to the current dataset. (This is the default analysis.)	
2D Analysis: Applies the 2D display file to the current dataset.	
3D Interactive Plot: Applies the 3D display file to the current dataset and allows you to interact with the data.	
Filtered Histogram Analysis: Applies the Filtered Histogram analysis to the current dataset.	
Help: Opens the Vision Help files.	

ANALYZING DATA

After you have taken a measurement, you can use a number of options and analyses to produce a vast array of information about your sample data. Analyses calculate a wide range of statistics from measured data. Analyses can be applied automatically following each new measurement. The name of the analysis, in this case, is stored with the configuration file. Analyses can also be applied to stored datasets.

Vision includes several standard analyses, such as producing 2D and 3D plots. The **Analysis** menu displays the analysis options included in your system. Frequently accessed analyses appear directly on the menu bar. A comprehensive list of installed analyses appears under **Analysis** > **Custom Options**.

Datasets

A dataset contains raw data and parameters for a single measured part. Dataset files have an .data extension, designating a binary format specific to Dektak datasets. Dataset contents are shown on-screen in a display file, which typically shows a plot of the raw data and a list of the parameters.

When you open a dataset, you can change the way the file is displayed. To save these changes in the.opd file, choose **File** > **Save Dataset**. The next time you open the dataset, these viewing options will be used. To open a dataset, select **File** > **Open Existing Dataset**, then select the file to open.

Processed Options

Processed Options allow you to remove terms, apply filtering, and perform data operations to enhance the measurement data. Processed options can be applied to the current dataset only or can be set as the measurement default and saved in the configuration file.

To access these options, select **Analysis** > **Processed Options**, or click the **Processed Options** button on the toolbar. Either action opens the **Processed Options** dialog box (see Figure E-11).

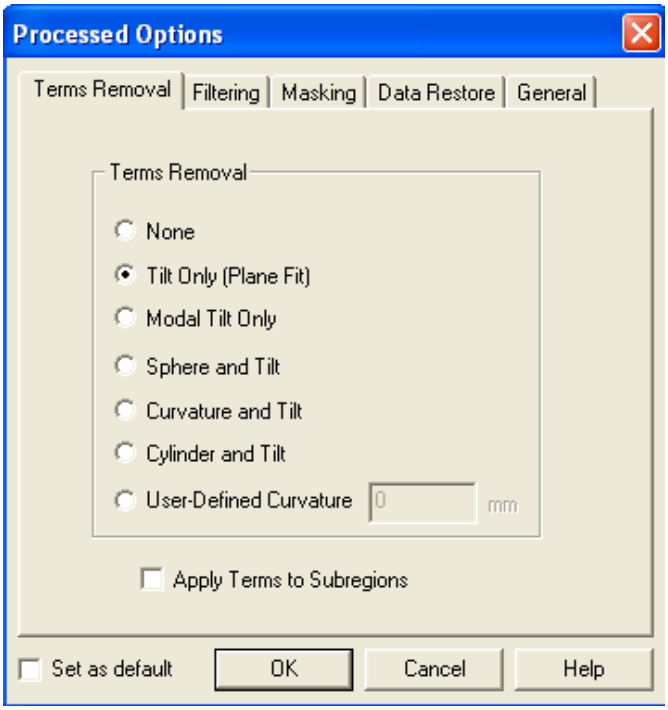
> **NOTE –** When you change options in this dialog box and click **OK**, the changes will be immediately effected in any currently open display windows. By saving your configuration, you can assure that your settings will be used each time you open your configuration file.

Within the **Processed Options** dialog box you can set the options described below.

Terms Removal Options

Terms removal options remove tilt, curvature, or cylindrical characteristics inherent to your sample or measurement method (see Figure E-11).

Figure E-11: Processed Options Dialog Box - Terms Removal Tab



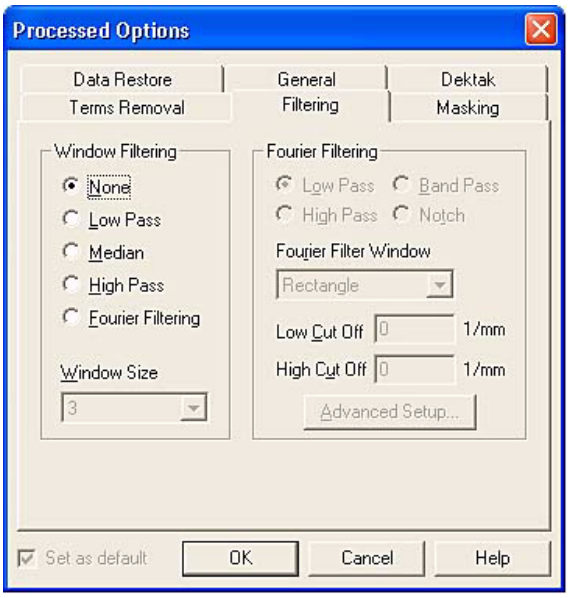
- **None** Click this option to perform an analysis with no terms removal.
- **Tilt Only** (Plane Fit) Click this option to remove linear tilt from surface measurements. Since the system and the sample always have some inherent tilt, most users remove this term when new data is taken.
- **Modal Tilt Only** Click this option to remove tilt based on the most prevalent tilt in the dataset. Removing modal tilt is appropriate for stepped surfaces where the surfaces are planar to each other.
- **Sphere and Tilt** Click this option to remove true sphere from the dataset (as opposed to a parabolic fit when using the Curvature and Tilt option).
- **Curvature and Tilt** Click this option to remove both curvature and tilt. Removing curvature causes spherical samples, such as ball bearings, to appear flat, so that you can observe the surface features instead of the dominant shape.
- **Cylinder and Tilt** Click this option to remove both cylinder and tilt. Removing cylinder causes cylindrical samples to appear flat, so you can observe the surface features instead of the dominant shape.
- **User-Defined Curvature** Click this option to remove a curvature based on the value that you enter for the radius of curvature in the field to the right.
- **Apply Terms to Subregions** Select this check box to transfer the settings of Terms Removal to the dataset if a subregion is defined. When this check box is cleared, terms removal is set to None.
- **Zero Mean** If you have defined a subregion on an output plot, the **Zero Mean** check box

appears in the upper right corner of the **Terms Removal** dialog box. Select this box to set the zero height to the mean of the current data. Otherwise, it is set to the height of parent.

Filtering Options

The filtering options create a modified data array to produce one of the effects described after the figure.

Figure E-12: Processed Options Dialog Box - Filtering Tab



Low Pass Smoothing (Box Car Filter)

This filter removes the effects of high spatial frequency roughness, smoothing over features that are smaller than the specified window size. The system eliminates small-scale roughness, making the most significant features of the dataset become easier to distinguish.

Median Smoothing (Median Filter)

The median of the valid points in each window is used as the data element in the new, smoother array. (In other words, it filters out noisy and "spiked" data.) The median is the value of the middle point when the points are sorted from smallest to largest.

High Pass Smoothing (Edge Enhancing Filter)

High spatial frequencies are emphasized. This filter removes major undulations and large-scale waviness, making small-scale roughness easier to distinguish.

Digital Filters (Fourier Filtering)

Digital filters selectively suppress roughness or waviness in a dataset. These filters work in the spatial frequency spectrum of the dataset rather than on the pixels themselves. By selecting different digital filter types, some of frequency content of the dataset can be selectively removed from the image, accentuating or attenuating features of selected size range. Select from the following digital filter options.

Table E-2Digital Filter Options

Digital Filter	Description
Fourier Low Pass	Removes spatial frequency components above the specified **Low Digital Cutoff Frequency**. It makes the larger features of the dataset easier to distinguish.
Fourier High Pass	Removes spatial frequency components below the specified **High Digital Cutoff Frequency**. It accentuates surface roughness by minimizing the effect of large-scale waviness.
Band Pass	Passes spatial frequencies below the **High Cutoff** and above the **Low Cutoff**.
Notch Filter	Passes spatial frequencies above the **High Cutoff** and below the **Low Cutoff**.
Fourier Filter Type	Select the shape of the digital filter to apply: **Rectangle**, **Butterworth** (default is 3rd Order), or **Exponential** (the default is s = standard deviation = 0.2). You can also click **Adv. Setup** to access more options for digital filtering.
Low Cut Off	Specify the low cut off to be used for **Fourier Filtering** options.
High Cut Off	Specify the high cut off to be used for **Fourier Filtering** options.

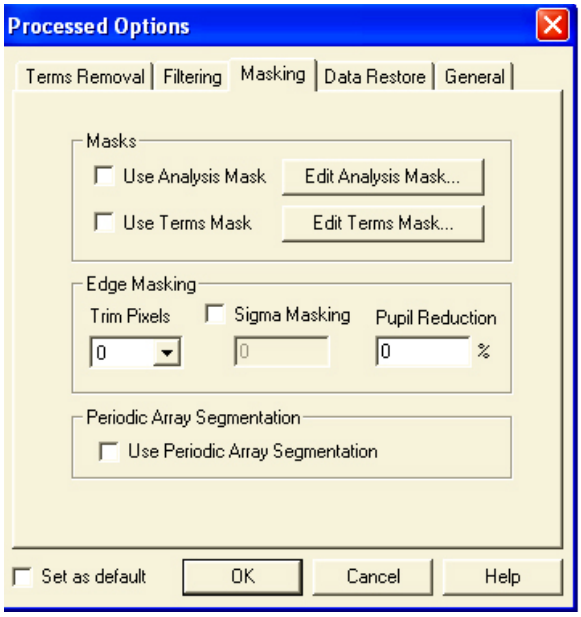
Masking Options

Masks are used to isolate flat areas in a dataset that can be “flattened.” Isolating an area with a terms mask and then flattening is useful for flattening scan-to-scan irregularities seen when mapping features that are 1 µm and smaller.

When you apply a mask, you temporarily eliminate areas of information from a dataset so that you can focus on the pertinent data (see Figure E-13). Using masks, you can also analyze or modify specific portions of the data. Once you've defined a mask, you can save it to disk, to a dataset, or as part of a configuration file.

For instructions on applying a Terms mask for flattening, see the next section. For more instructions on masking, see Masking on page E-31.

Figure E-13: Processed Options Dialog Box - Masking Tab



- **Use Analysis Mask:** Activates the mask associated with the current analysis.
- **Use Terms Mask:** Activates the current terms mask. For the mask option to be valid, you must set a mask for the selected dataset. If terms are selected for removal, but a terms mask is not applied, terms will be removed across the entire dataset.

You define both types of masks in the Mask Editor (see Figure E-15).

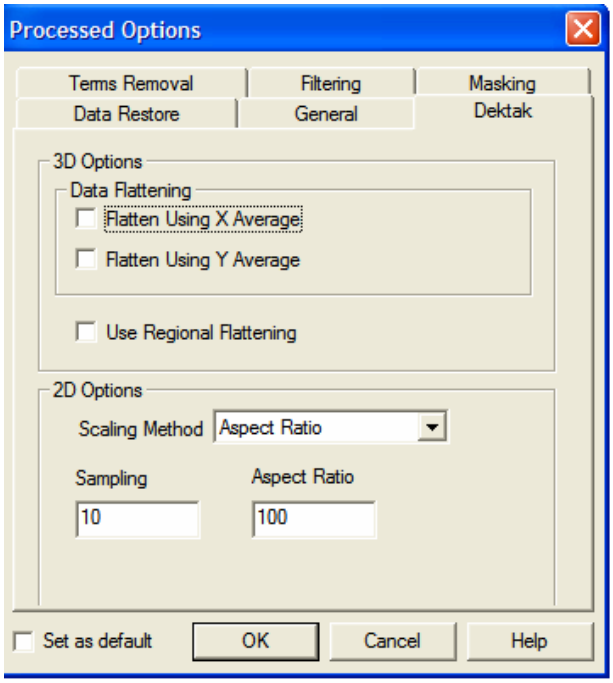
Dektak Options

The **Dektak** tab of the **Processed Options** dialog box (see Figure E-14) contains two sections **-- 3D Options** and **2D Options.**

In the **3D Options** section, the **Data Flattening** options flatten data using averages from the X or Y axes. Alternatively, you can apply regional flattening, which uses an overall average of the X and Y axes. Instructions for applying data flattening appear after Figure E-14.

In the **2D Options** section, you can specify a scaling method, which is explained after Figure E-15.

Figure E-14: Processed Options Dialog Box - Dektak Tab

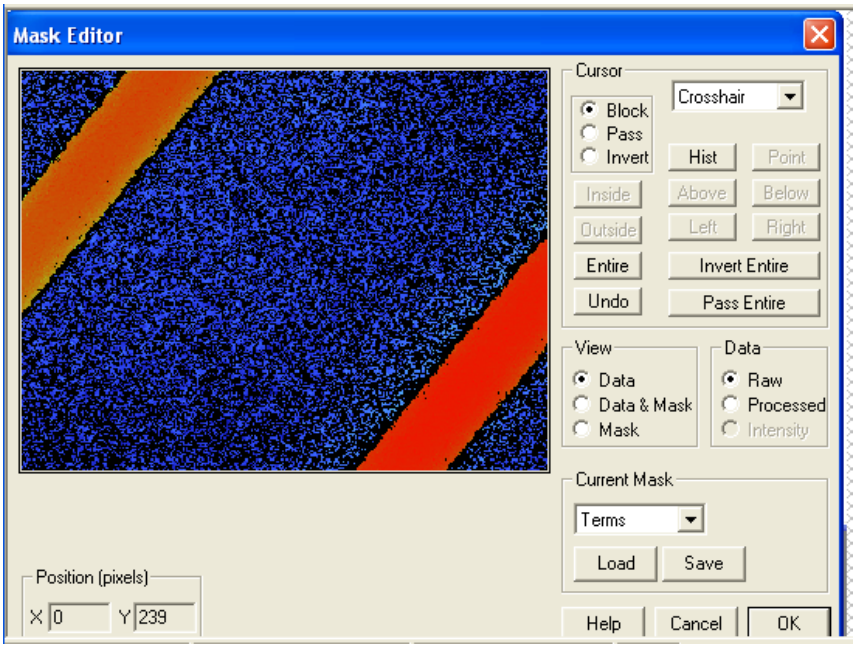


3D Options

To apply data flattening:

1. Click **Flatten Using X Average** (the recommended flattening method).
2. Click the **Masking** tab. Select a flat region on your sample and apply a terms mask through the entire Y axis. (If you have not already defined a terms mask, do so in the Mask Editor (see Figure E-15). For instructions, see Creating and Editing Masks on page E-33.
3. Click **OK** in the Mask Editor, then click **OK** on the **Dektak** tab of the **Processed Options** dialog box.
4. Perform a 3D analysis. The program flattens the data according to the specifications of your mask.

Figure E-15: Terms Mask Editor

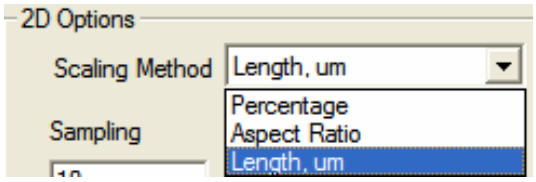


2D Options

To select a scaling method:

1 Select one of the following options from the **Scaling Method** list — **Length**, **Percentage**, or **Aspect Ratio**. The label of the field on the left below the list changes accordingly.

Figure E-16: 2D Scaling Method Options



2 Enter a value in the **Length**, **Percentage**, or **Aspect Ratio** field.

3 If desired, change the value in the **Sampling** field. However, it is recommended that you retain the default value of 10.

4 Click **OK**.

5 Perform a 2D analysis. The program scales the data according to your specified scaling method.

DISPLAYING DATA

Vision provides a large number of graphical plots, allowing you to produce meaningful data from test results.

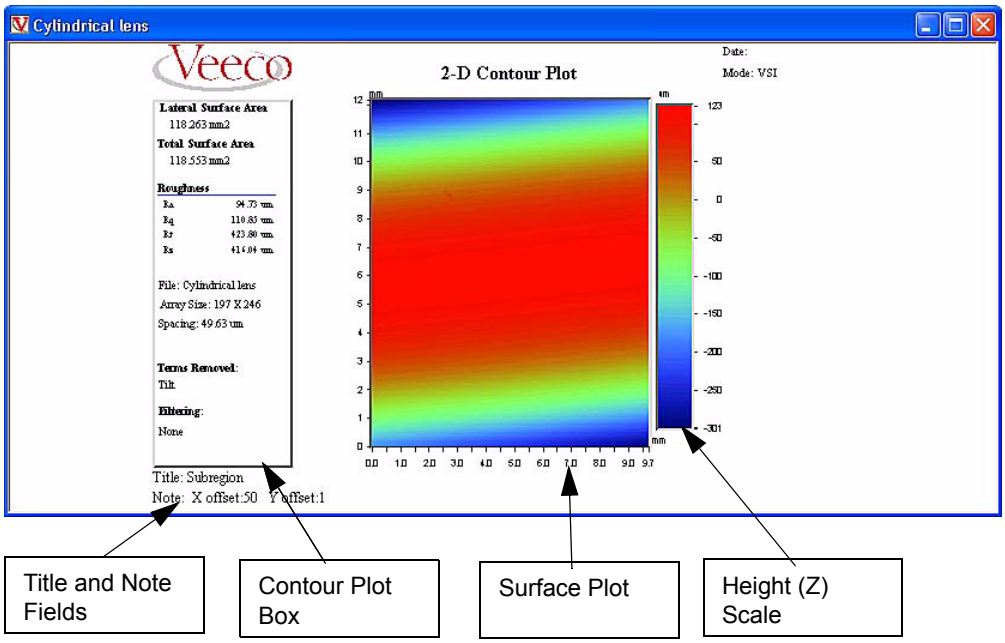
Setting the Units

You may want to display your data in specific units or in a common unit system. By clicking the **Units** icon or by selecting **Options** > **Units**, you can display the **Units** dialog box. This dialog box allows you to choose which units (English or metric) you prefer to use, and which magnitude you prefer. This option can be set before the measurement and saved in the configuration file, or it can be changed at any time after the measurement. In addition, you can set the units you choose as the default for future measurements by selecting the **Set as Default** check box.

Standard Display File

The standard .wdf display file includes the basic statistics from the measurement along with a contour plot of the results.

Figure E-17: Contour Plot



Display Files for Each Analysis

Vision includes many analysis routines to manipulate measurement results. Typically, each analysis includes its own display output that shows the relevant statistics and plots for that analysis. The file type of this output is either .wdf or .cdf (custom display file).

To use the display output from a different analysis:

1 Select **Analysis** > **Custom Options**.

2 Select your analysis from the scrolling list.

3 Click **Calculate** to perform the analysis and display the output.

Display Custom Files (.cdf)

Your Veeco customer representative may provide you with one or more custom display (.cdf) files designed for your particular application. You can choose to use one of these output files, or you can create your own .cdf file.

To create a custom display file:

1 Select **Edit** > **Create Custom Display**. This opens a blank display file for editing.

> **NOTE –** You may also select **Edit** > **Open Custom Display** to view and edit an existing custom display file. It is often easier to alter an existing file than to create one from scratch.

2 To add a rectangle to the display, select **Edit** > **New Rectangle**. Click the **Filled Rectangle** box to add a filled rectangle, then select the fill color. Click **OK** to add the rectangle to the display file, then position it and size it on the page.

3 To add headings or other text, select **Edit** > **New Static Text**. Enter the text string, its size and typeface, then click **OK**. Position the text on the page.

4 To add an analysis result field, select **Edit** > **New Analysis Result**. Select the result from the list, define its text characteristics on the left, then click **OK.** Position the field on the page.

5 To add a plot, select **Edit** > **New Plot Item**. Select the desired plot from the list, choose the required calculation, then click **OK**. Position the plot on the page.

6 To add an analysis results table, select **Edit** > **New Plot Item**. Select **Results Table** from the **Type of Plot** pull-down menu, then click **OK**. Position the table on the page.

7 When you have completed the custom display, click the **Save** button on the toolbar, or select **File** > **Save Custom File As**. Save the custom display file for future use.

Selecting a Default Output File

The Default Output File is the display file that appears each time you click the **New Measurement** button to take a measurement.

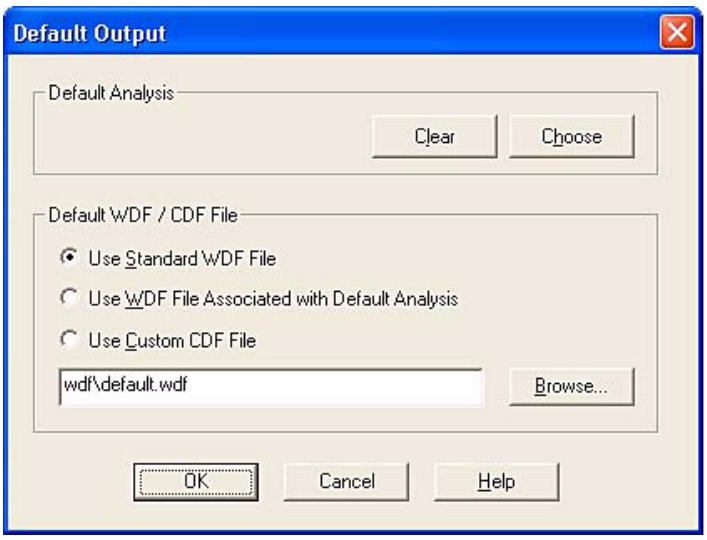
To select the default output:

1 Select **Output** > **Default Output**. This action opens the **Set Default Output** dialog box (Figure E-18).

2 Select the default output display format to use. If you choose to use a custom .cdf file, click **Browse** to select the path to the file.

3 Click **OK** to accept the new default display.

Figure E-18: Set Default Output Dialog Box



Setting Titles and User Notes

Vision offers two fields that you can customize on most display files: **Title** and **Note**. The **Title** and **Note** are displayed on any of the standard display files. You may also add them to any custom display files. In addition, Vision allows you to set various "**User Notes**" that are saved with the file but do not appear on the display file. They may be viewed when the file is open. These parameters are optional; they will remain blank if you do not set them.

To set the Title and Notes:

1. Select **Options** > **Set Title/Notes**.
2. Enter the title/note text in the appropriate boxes.
3. Click **OK**. The active dataset is automatically updated.

To set the User Notes:

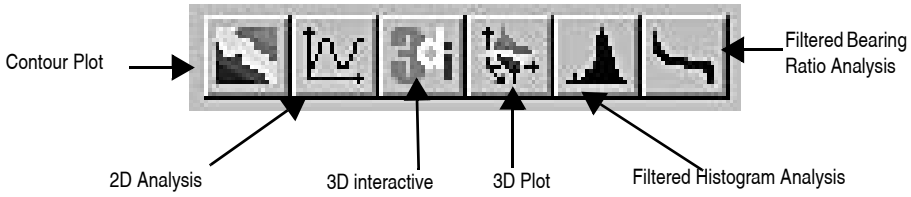
1. Select **Options** > **Set User Notes**.
2. Enter the text in the appropriate boxes.
3. Click **OK**. The notes are appended to the active dataset. They are *not* visible on the display file.

Vision does not automatically save the titles or notes you add to the dataset. To save the changes to your dataset, select **File** > **Save**.

Standard Plots

Analyses are the specific calculations performed upon measurement data to return particular results about the test part. Vision can perform many analyses on data. You can open several windows simultaneously, showing various analyses of the same measurement data. The icons for these plots are grouped in the Lab Mode menu bar (see Figure E-19)

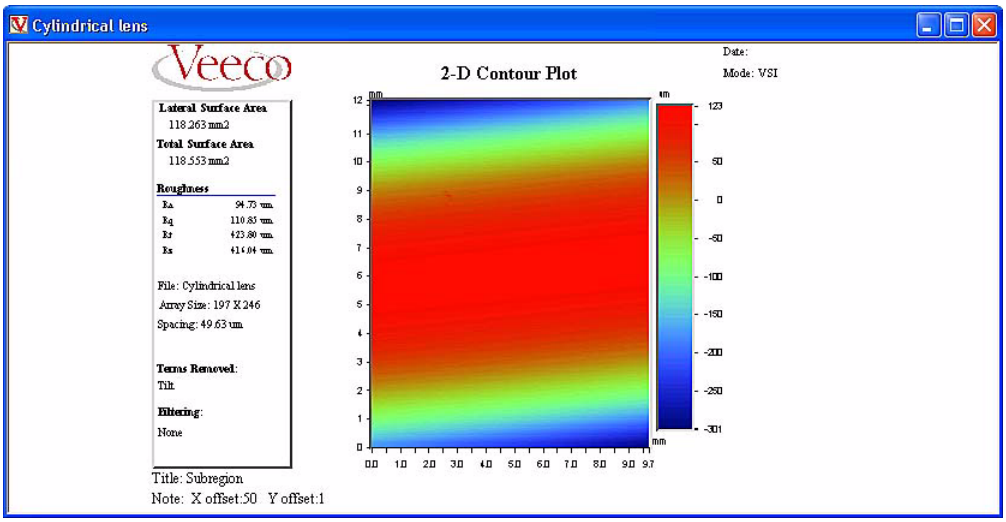
Figure E-19: Icons for Main Analysis Plots.



Contour Plot

A contour plot provides a visual, pixel-for-pixel representation of your dataset and applicable dataset statistics. Data heights are color-coded for easy interpretation. To display a contour plot of the current dataset, select **Analysis** > **Contour**, **Analysis** > **Custom Options** > **Contour Plot** > **OK**, or click the **Contour Plot** button (see Figure E-19). This option is available when a dataset is open.

Figure E-20: Contour Plot



Contour Plot Box

The Contour Plot Box to the left of the surface plot contains statistics and information about the plot. The terms regarding the plot in the contour plot are defined below:

- **Lateral Surface Area:** Lateral surface area of the plot.
- **Total Surface Area:** Total surface area of the plot.
- **Surface Statistics:** Surface statistics for the region measured. The statistics are based on the entire area.
  - **Ra:** Average Roughness
  - **Rq:** Root Mean Square (RMS) Roughness
  - **Rz:** Average Maximum Height
  - **Rt:** Maximum Height of Profile, Rp + Rv
- **Terms Removed:** Lists the terms removed from the plot.
- **Filtering:** Lists the filtering options in use.

Surface Plot

A plot of the surface as viewed from directly above (see Figure E-20). Surface heights are depicted by the colors on the vertical height scale to the right of the plot.

Height (Z) Scale

A vertical height scale, centered about the mean height (see Figure E-20). The scale relates colors (or gray-scale levels) to the surface heights they represent. You can change the vertical scale with the **Output** > **User Limits** command.

- **Lateral Surface Area:** Lateral surface area of the plot.
- **Total Surface Area:** Total surface area of the plot.
- **Terms Removed:** Lists the terms removed from the plot.
- **Filtering:** Lists the filtering options in use.

Plot Options Menu

Right-click on a contour plot to access these options (see Figure E-21):

- **Plot Options:** Opens the **Plot Options** dialog box.
- **Analysis Options:** Opens the **Processed Options** dialog box.
- **Color:** Choose the colors used to designate data heights.
- **Background Color:** Choose a background to enhance readability. If your plot contains data in the entire field of view, you will not see the effect of changing the background color.
- **Max Contrast:** Provides maximum color contrast for data set displays.
- **Define Subregion:** Zoom in on a rectangular area of your plot. Click **Define Subregion**, then click and drag to draw a rectangular region. A new window appears showing your subregion and its statistics. After you have clicked **Define Subregion**, but before selecting the subregion, you may choose **Abort Subregion** to cancel.

  After you define a subregion, a **Zero Mean** check box appears in the **Processed Options** dialog box. Right-click on the contour plot to open the **Contour Plot** menu, select **Analysis Options,** then select the **Zero Mean** check box to set the “zero” height to the mean height of the subregion.
- **Duplicate:** Make a copy of the plot. You can then make changes to plot options and compare the plot to the original. Choose **Full Resolution** to copy every pixel, **Half Resolution** to copy every other pixel, or **Quarter Resolution** to copy every fourth pixel.
- **Save as TIFF:** Saves only the contour plot to a tagged image format (.tif) file.
- **Save to disk:** Opens the **Save As** dialog box, which allows one to save the dataset.
- **Cursor Type:** Choose the type of cursor to display.
- **Cursor Width:** Choose the width of the Crosshair, 2-point or Radial cursors.

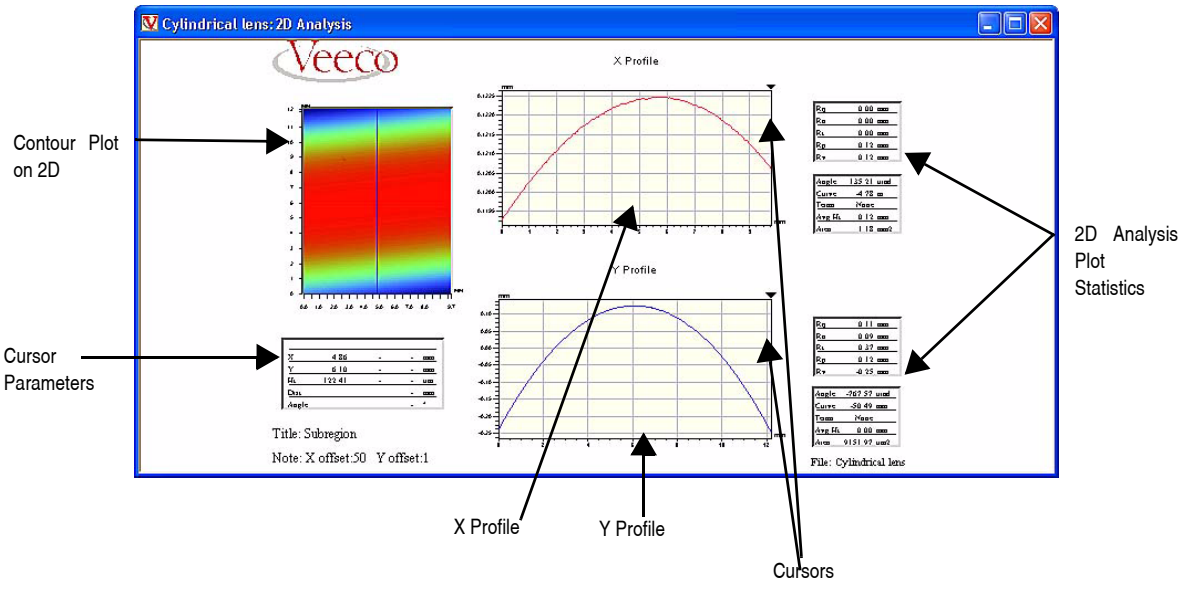
Figure E-21: Contour Plot Menu

2D Analysis

The 2D Analysis displays a contour plot and X and Y profile plots (see Figure E-22. You can access the 2D Plot by selecting **Analysis** > **2D Profile**, **Analysis** > **Custom Options** > **2D Plot** > **OK**, or by clicking the **2D Analysis** button (see Figure E-21). This option is available when a dataset is open.

NOTE – When you open the results of a Dektak 150 scan in Vision, the program performs 2D-trace analysis on the data and displays it as a 2D plot similar to the one shown in Figure E-22.

Figure E-22: 2D Analysis Plot



- The 2D profiles correspond to the cursor positions on the contour plot. You can view different profiles in the X and Y directions by moving the cursors on the contour plot. Point to the region of interest and click the left mouse button or click and drag the cursors.

2D Analysis Plot Cursors

On the 2D Analysis plots, set these cursors at the points of interest by clicking and dragging them to position (see Figure E-22). The statistics to the right of the X and Y profile plots refer to the area between the cursors. The X and Y distance between the two points are shown above and to the right of the plot.

You can expand the width of each cursor by clicking and dragging the arrows at its base. When expanded, the height of the cursor is the average height over the cursor region.

When you have selected the Multiple Crosshairs cursor type, you may have several traces on the profile plots, each of which can have associated cursors. Only the cursors for the currently active trace are shown. To show statistics for the different traces, you can click on the trace, or right-click on the profile plot and select **Next Trace** or **Previous Trace**.

Cursor Parameters

These parameters are related to the cursor positions on the contour plot (see Figure E-22). If no cursors are present, parameters are based on the farthest left and the farthest right data points. The Cursor Parameter box appears to the right of the 2D Analysis Plot (see Figure E-22). Table E-3 describes each cursor parameter.

Table E-3: Cursor Parameters

	Crosshair	Multiple Crosshair	2-Point	Radial
X	X position of cursor relative to lower left corner.	X position of last two cursors touched, and the difference (delta) between them.	X positions of the two endpoints and the difference (delta) between them.	X position of center of circle and the end of the radius line, and the difference (delta) between them.
Y	Y position of cursor relative to lower left corner.	Y position of last two cursors touched, and the difference (delta) between them.	Y positions of the two endpoints and the difference (delta) between them.	Y position of center of circle and the end of the radius line, and the difference (delta) between them.
Ht.	Data height at crosshair	Data height at crosshair of the last two cursors touched, and the height difference between them.	Data height at each endpoint and the difference (delta) between them.	Data height at center of circle and end of the radius line, and the difference (delta) between them.
Dist	N/A	Distance between crosshairs of the last two cursors touched.	Distance between the two endpoints.	Radius of the circle.
Angle	N/A	Angle created by a line between crosshairs of the last two cursors touched. Zero is horizontal.	The angle of the line. Zero is horizontal.	The angle of the radius line. Zero is horizontal.

X Profile

Data profile corresponding to the X cursor or Radial cursor on the contour plot (see Figure E-22).

Y Profile

Data profile corresponding to the Y cursor or Circumference cursor on the contour plot (see Figure E-22).

2D Analysis Plot Statistics

Surface statistics for the region between the cursors on the X profile or Y profile (see Figure E-22):

- **Rq:** Root mean square (RMS) roughness.
- **Ra:** Average roughness.
- **Rt:** Maximum height of profile, Rp + Rv.
- **Rp:** Maximum peak height.
- **Rv:** Maximum valley depth.
- **Angle:** Angle between the two intersection points.
- **Curve:** Radius of curvature of region between the cursors.
- **Terms:** Terms removed under Plot Properties.
- **Avg Ht.:** Average height of region between cursors.
- **Area:** Area under curve between the cursors.

When one or both cursors are against the edge of the profile plot, the statistics are shown for the entire profile.

When using Multiple Crosshairs, your profile plots include a trace for each set of crosshairs. Click on a trace to show statistics for it. You can also right-click on the profile plot and select **Next Trace** or **Previous Trace**.

The crosshairs corresponding to the active trace are marked on the contour plot. Therefore, you can look to the contour plot to see for which trace the statistics are shown. Also, the title of the profile plot appears in the color of the currently active trace.

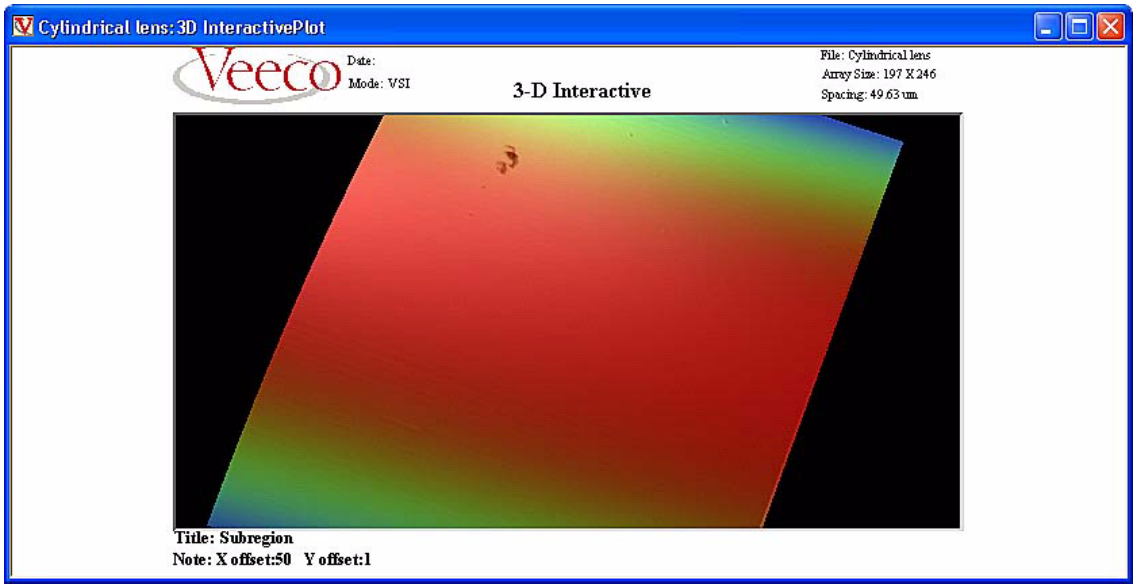
3D Interactive Plot

The 3D interactive plot lets you view a dataset in three dimensions, from any angle, and with various color and lighting effects.

1. Open a dataset, select **Analysis** > **3D Interactive Plot**, **Analysis** > **Custom Options** > **3D Interactive Plot** > **OK**, or click the **3D Interactive Plot** button to view the dataset (see Figure E-23).
2. Click and drag in the plot to rotate the dataset in all three dimensions.

> **NOTE –** While the data is rotating, Vision switches to a low-resolution mode to re-draw the plot in real time.

Figure E-23: 3D Interactive Plot



3D Interactive Plot Menu

Right-click on the plot to view the following options in the **3D Interactive** menu:

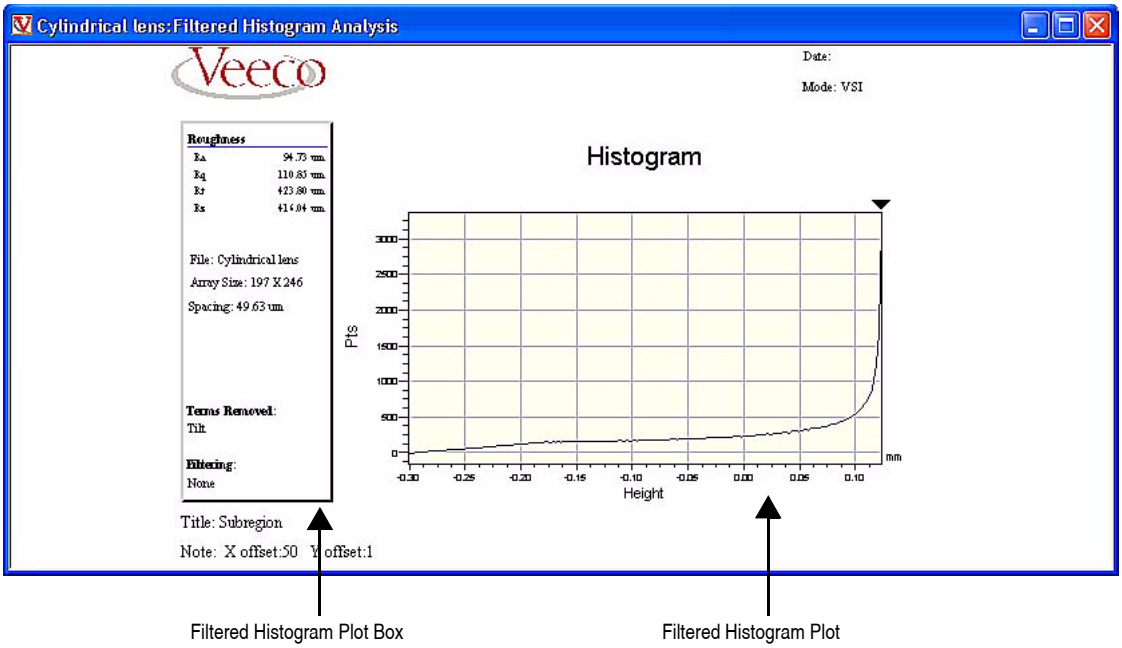
- **Analysis Options:** Opens the **Processed Options** dialog box.
- **Plot Options:** Opens the **3D Settings** dialog box where you can adjust lighting, scaling and other plot options.
- **Color:** Select the color palette.
- **Background Color:** Choose the background color for the plot.

Filtered Histogram

The histogram is a line graph representing the number of data points at each surface height. The vertical axis represents the number of data points contained within equally spaced intervals (bins), while the horizontal axis represents the surface height.

To generate a histogram choose **Analysis** > **Filtered Histogram** > **Calculate**, or click the **Filtered Histogram Analysis** button (see Figure E-24).

Figure E-24: Filtered Histogram Plot



Filtered Histogram Plot

In addition to showing the height distribution, the histogram also shows the amount of noise in the measurement. For a random surface, noise spikes are suggested by infrequently occurring peaks.

Filtered Histogram Options Dialog Box

To access the **Filtered Histogram Options** dialog box, right-click on the histogram plot then choose **Histogram Options.** The following options are available in the **Filtered Histogram** dialog box:

- **Number of bins:** Sets the number of bins (10 to 5000) used in the histogram calculation.
- **Mirror X Axis:** Plots the histogram data on an X axis that is centered about zero. This allows you to see how the data points are distributed about a zero mean level.
- **Show All Open Datasets:** The histogram for the dataset in the active window is drawn in black. Histograms for all other open datasets are drawn in different colors on the same plot. This allows you to compare the actual distributions of multiple datasets.
- **Show Gaussian:** Displays a Gaussian curve on the histogram, based upon the RMS, the number of data points, and the current bin size. The curve lets you compare a normal, random distribution to the actual distribution of your dataset.
- **Show Q Value Stats:** Q value statistics are calculated using a certain percentage of data points from the histogram. At each percentage point, the difference between the highest bin value and the lowest bin value is calculated. These statistics are useful for examining how the peak-to-valley changes as the number of data points changes. Q value statistics are calculated using 80%, 85%, 90%, and 95% of the data points.

- To obtain a more detailed listing of the histogram data and Q value statistics, click the right mouse button on the histogram. Select **Print Table** to print two histogram data tables: one based on the point distribution, and one based on the Q value distribution. The Q value distribution can be listed in terms of percent (if the Q Value Table by Percent option is selected) or in terms of peak-to-valley.
- **Print Q Value Table by Percent:** If this option is selected, the Q value distribution printed with the **Print Table** option described above is listed by percentage (in increments of 5%) for 5% to 100% of the data points. If this option is not selected, the Q value distribution is listed by peak-to-valley increments.
- **Log Scale:** If selected, this option displays logarithmic units along the Y-axis of the plot.
- **Set as Default:** Check this box to define the current options settings as the default settings. Any subsequent filtered histogram measurement will be analyzed using these settings.

Filtered Histogram Plot Box

The Contour Plot Box to the left of the surface plot contains the following statistics and parameters about the plot:

- **Roughness:** Roughness statistics for the region measured. The statistics are based on the entire area.
  - **Ra:** Average Roughness
  - **Rq:** Root Mean Square (RMS) Roughness
  - **Rz:** Average Maximum Height
  - **Rt:** Maximum Height of Profile, Rp + Rv
- **Terms Removed:** Lists the terms removed from the plot.
- **Filtering:** Lists the filtering options in use.

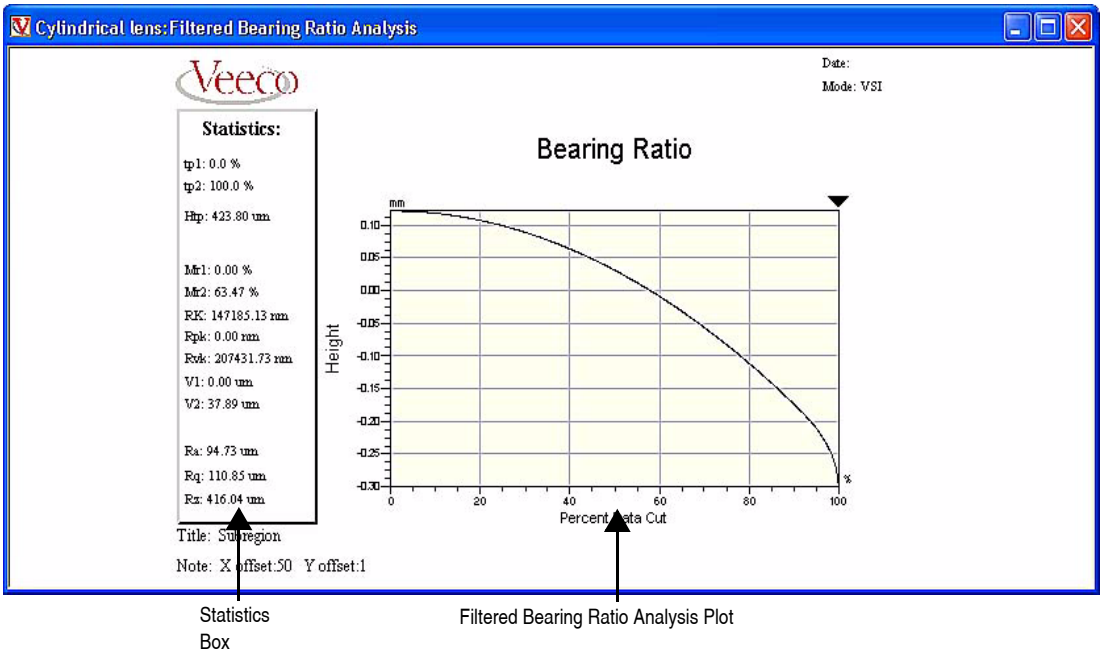
Filtered Bearing Ratio Analysis Plot

The bearing ratio curve (also called material ratio curve) is a graphical representation of the tp (bearing ratio) parameter in relation to the profile level (see Figure E-25). This curve contains all of the amplitude information of a profile.

The display file for the bearing ratio analysis shows the bearing ratio curve, along with various bearing ratio statistics. You can use the profile plot to mask portions of the data as well.

To generate a filtered bearing ratio histogram, click the **Filtered Bearing Ratio Analysis** button.

Figure E-25: Filtered Bearing Ratio Analysis Plot



Statistics Box

To determine these parameters, the analysis calculates the area of minimum slope of the bearing ratio curve within a 40% window. This is accomplished by computing the height difference of the curve's profile depth axis for points separated by 40% on the tp axis. The bearing ratio curve is first intersected at 0% and 40%, and the Htp is found. The 40% window is then moved to the right and the Htp monitored for each point until the minimum Htp value is found.

- **tp1:** User-defined peak threshold (peak offset)
- **tp2:** User-defined valley threshold (valley offset)
- **Htp:** H1 - H2
  - **H1:** Height corresponding to tp1
  - **H2:** Height corresponding to tp2
- **Mr1:** Peak material component
- **Mr2:** Valley material component
- **RK:** Core roughness depth
- **Rpk:** Reduced peak height
- **Rvk:** Reduced valley depth
- **V1:** Related to Rpk and MR1
- **V2:** Related to Rpk and MR1
- **Ra:** Average Roughness

- **Rq:** Root Mean Square (RMS) Roughness
- **Rz:** Average Maximum Height

Filtered Bearing Ratio Analysis Options

Right click the Filtered Ratio Analysis plot and click **Bearing Options** to display the **Bearing Ratio Options** dialog box. The following options are available:

- **Number of Bins:** The bearing ratio calculation uses a histogram of heights. The number of bins specifies the number of equally spaced height intervals into which the data points fall.
- **Peak Offset:** A percentage of the highest pixels in the dataset to be excluded from the analysis.
- **Valley Offset:** A percentage of the lowest pixels in the dataset to be excluded from the analysis.
- **Upper (tp1):** The peak threshold bearing ratio value, corresponding to the height H1 Used to calculate the Htp height between bearing ratios (see Figure E-25).
- **Lower (tp2):** The valley threshold bearing ratio value, corresponding to the height H2. Used to calculate Htp (see Figure E-25).
- **Set as Default:** Select this check box to define the current options settings as the default settings. Any subsequent bearing ratio measurement will be analyzed using these settings.
- **Show All Open Datasets:** The histogram for the dataset in the active window is drawn in black. Histograms for all other open datasets are drawn in different colors on the same plot. This allows you to compare the actual distributions of multiple datasets.

MASKING

A mask, by temporarily eliminating regions of data from the display, enables you to focus on specific regions of interest for your analyses and to perform modifications on specific portions of your data. You can also create a detector mask to mask detector pixels during a measurement. Once you have defined a mask, you can store it to disk for future use.

Masks have a number of uses, including:

- Eliminating a bad spot from the sample surface (seen after data is taken).
- Isolating a single area of the sample surface for repeated analyses.
- Showing only those data points within a certain height range.
- Fitting tilt, curvature, or cylinder terms to a region that you specify.
- Eliminating detector pixel elements (while data is taken).

Vision provides four types of masks—analysis, terms, height threshold, and detector.

Analysis Mask

An analysis mask enables you to block areas of data that could adversely affect your measurements. You can use an analysis mask to view or analyze specified portions of a dataset. With the analysis mask applied, the system eliminates the blocked data from the analysis, and the surface statistics change to depict the masked dataset. Retrieve data that was blocked by turning off the mask and re-analyzing the data.

Terms Mask

A terms mask acts like a filter, enabling you to define an area over which you can specify an area that more accurately defines a surface for terms analysis. Terms masks are typically used for surfaces with steps or other discontinuous features. For example, you can use a terms mask to perform a tilt, curvature, or cylinder terms fit. The fit performed on the masked area is then applied to the entire dataset.

A terms mask is particularly useful when you want to fit terms to a surface that has an abrupt change. If you were to select tilt for terms removal, the resulting dataset would resemble a sawtooth. This is because the plane that best represents the data must take into account both planes forming the step. This "best fit" plane is approximately the average of the two plane surfaces; subtracting it produces the sawtooth. If you define a terms mask that covers only one side of the step, the terms fit will be based on the best fit plane over the flat part of the sample.

Height Threshold (Histogram) Mask

A height threshold mask blocks data points of a specified height or range of heights. This can be useful for looking at surfaces with features of distinctive heights. You can also use a height threshold mask to mask spikes that are not in the normal distribution of heights. When you create a height threshold mask, you examine a histogram of height data to determine which heights to mask.

Detector Mask

A detector mask blocks detector pixel elements during a measurement. This is useful for eliminating regions of the surface from the analysis, such as irrelevant background features. You can also use a detector mask to eliminate detector pixels that are defective and adversely affect your measurements. Note that unlike an analysis mask, a detector mask permanently eliminates data points from the raw data. The only way to “retrieve” these lost data points is to disable the detector mask and make another measurement of the same surface.

> **NOTE –** If you use the **Data Restore** function to restore data points that were included in the raw data but considered invalid for analysis purposes, the system also attempts to restore the data points that were permanently blocked with the detector mask.

Loading and Saving Masks

To load and use an existing mask:

1. Select **Edit** > **Set New Measurement Masks**.
2. Locate the mask by clicking the **Browse** button next to the appropriate type of mask.

3 Check the **Apply Mask to Stored Data** box to apply the mask.

To save a mask to the current Configuration file, click **Save** in the **Mask Editor** window.

Creating and Editing Masks

> **NOTE –** Analysis and terms masks are automatically saved with the dataset. Datasets are stored as raw data and processed data. If a mask is applied during analysis, the mask will be stored with the processed data. When you reopen the dataset, the mask can be reapplied to the dataset by turning on the mask. Remember that with a detector mask, masked regions of data are permanently blocked in the raw data.

To create or edit Analysis, Terms or Height Threshold masks:

1 Open a dataset.

2 Select **Edit** > **Edit Masks** to access the **Mask Editor** window (see Figure E-15).

To create or edit a Detector Mask:

1 Select **Measurement Options** > **PSI Options**.

2 Click the **Edit Detector Mask** button to open the **Detector Mask Editor** window.

You can use several cursor tools to create and change the mask. To use cursor tools, first select a cursor type from the **Cursor** menu. Move your cursor to the Mask Editor plot to begin creating a mask.

For Local (Area) masks, use the **Crosshair** tool to set an insertion point wherever you click on your plot. You can also drag to move the cursor point. Once you have an insertion point you can choose to perform functions to the selected **Point** of data, to data **Above** or **Below** the cursor, or to data to the **Left** or **Right** of the cursor.

Use the four **Area** tools to create shapes within the mask area:

- **Rectangle:** Press the left mouse button and drag to create a rectangular area.
- **Circle:** Press the left mouse button and drag to create a circular area.
- **Ellipse:** Press the left mouse button and drag to create an elliptical area.
- **Polygon:** Place the mouse pointer over the location of one point on the polygon. Click to set your starting point, position the cursor and click once for each side you want to create, then double-click to set the shape in place. A polygon can have up to 50 sides.

After you have created an area, you can move it by holding down the Shift key while clicking and dragging it with the left mouse button.

> **NOTE –** By right-clicking in the Mask viewing region, you can select the size and the location of the mask to be displayed in pixels or in mm.

You can also perform the following functions on an area:

- **Block:** Block out sections of data. For example, if you are working with a circular cursor tool and you select **Block**, when you click on the **Inside** button the program will define a mask that

blocks all the data inside the circle.

- **Pass:** Allows data to pass through area(s) that may have been previously blocked. For example, if you create a blocked inner circle, select **Pass**, and then click on the **Inside** button, the program will define a mask that passes the data within the circle.
- **Invert:** Used to invert the mask; exposed portions of your plot will be masked, and previously masked portions will be exposed.
- **Inside:** Applies the selected function (**Block, Pass,** or **Invert**) to the inside of the area.
- **Outside:** Applies the selected function to the outside of the area.
- **Entire:** Applies the selected function (**Block, Pass,** or **Invert**) to the entire mask. May be used at any time as long as a cursor tool is not in the process of being created. To erase the current mask, you can select **Pass** and then click on **Entire**.
- **Undo:** Used to undo the most recent change made to the mask currently defined in the **Mask Editor** window.

With a mask visible in the **Mask Editor** window, select **Mask Outline** to create an outline of the mask on the dataset. You can then modify the identical, outlined mask. This is useful when you are making measurements of samples in which identical features from sample to sample vary slightly in size or position.

Height Threshold (Histogram) Masks

The **Height Threshold Editor** window shows you a histogram of the height distribution for your sample. You have the option to create a high pass, low pass, or range pass mask.

1. Select the number of cursors you want to use—one cursor for a high or low pass mask, and two cursors for a selected range.
2. If using one cursor, place your cursor at the cutoff point, then select **Left** (to mask all data left of the cursor, lower than the cutoff) or **Right** (to mask all data right of the cursor, higher than the cutoff).
3. If using two cursors, place the two cursors at the cutoff points and select **Outside** (to mask all data outside the cursor range) or **Inside** (to mask all data inside the cursor range).
4. Press **Mask**. The editor will mask the selected region(s) and adjust the histogram accordingly. You can repeat this process as many times as desired on the same histogram.

Selecting Mask Views

In the **Mask Editor** window, you can select from three **View** options:

- Select **Data** to see data wherever the mask is set to **Pass**.
- Select **Mask** to view the mask itself.
- Select **Data & Mask** to view the data and mask in four color sets. Data appears as either good or bad, as follows:
  - **White** indicates that data is good and unmasked.
  - **Green** indicates that data is good and masked.

- **Black** indicates that data is bad and unmasked if a detector mask is not applied. If a detector mask is applied, black can indicate both bad and masked data.
- **Red** indicates that data is bad and masked.

Selecting Data Displays

In the **Mask Editor** window you can choose to display data before or after processing.

Select **Raw** to see the data in its unprocessed state, without any terms applied. When making changes to a mask that has already been applied, raw data is sometimes better to use because the analysis mask has not been applied to it.

You can also view **Processed** data that has had masks, terms, or other options applied to it.

Saving Masks

Terms, analysis, and detector masks can all be saved independently of a dataset. By saving a mask separately from the data, you can apply the same mask to different datasets.

To save a mask, open the **Mask Editor** and select **To/From Disk** from the **Current Mask** menu. Click **Save** and enter a file name for the mask. The mask is saved into the specified directory with a .msk extension.

Applying a Detector Mask

1. Select **Edit** > **Set New Measurement Mask.**
2. Enter the path and file name of your saved detector mask in the appropriate slot (or choose **Browse** to determine the location of your mask).
3. Close the **Mask Editor**.
4. Select **Hardware** > **Measurement Options** > **PSI Options**.
5. Select the **Use Detector Mask** check box.

Applying an Analysis or Terms Mask to a New Measurement

1. Select **Edit** > **Set New Measurement Mask**.
2. Enter the path and the file name of your saved mask in the appropriate slot (either Terms Mask or Analysis Mask). You may use the **Browse** button to determine the location of your mask.
3. Close the **Mask Editor**.
4. Select **Analysis** > **Processed Options** to access the **Processed Data Options** dialog box.
5. Check either the **Use Analysis Mask** or **Use Terms Mask** box.
6. Select any terms to be removed, if applicable. Filtering, data invert, and data restore options can also be selected.
7. Click **OK** to close the dialog box.

With this configuration, all new measurements taken will have the selected mask applied.

Applying a Saved Mask to an Existing Dataset

To apply a saved analysis or terms mask to an existing (unmasked) dataset:

1. Select **Edit** > **Edit Mask**.
2. From the **Current Mask** menu, select **To/From Disk**.
3. Click **Load**.
4. Select your mask and click **OK**.

   The selected mask is applied to the current dataset only.

Saving a Mask to a Configuration File

1. Create the mask.
2. Select **On** and click **Save**. This saves the current mask, but does not permanently save the mask to the configuration file or to the disk.
3. Select **File** > **Save Configuration** to save the mask to the current configuration file.

DATASETS AND DATABASES

When you make a measurement, the system determines the height of every point on the sample. This data is the height profile, also known as the raw data. Vision analyzes this raw data to determine the pertinent parameters.

You can store data and parameters in two forms through Vision: datasets and databases. Datasets allow you to view snapshots of your process. Databases allow you to store data over time and to view trends in your process.

A database stores analysis parameters from one measurement or from many measurements. Vision database files are comma-separated-variable files with .csv extensions. Raw data is not recorded in a database.

The analysis options available for the data in the form of a dataset may also be recorded in a database, allowing you to compile long-term data or to apply various statistical analysis to your data.

About Vision Databases

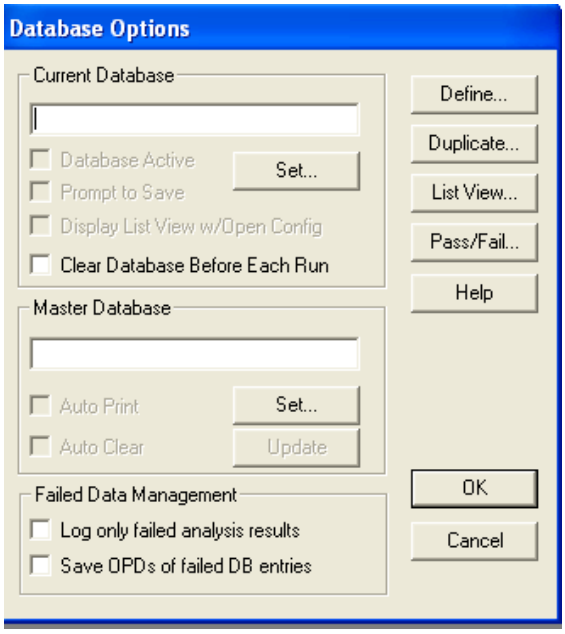
Once you have performed a measurement, you can store the results to a Vision database. The basic steps for working with a database are:

1. Define a database and the fields within it.
2. Select and activate the database.
3. Select whether to log data automatically or manually.
4. Decide whether to add the contents of the current database to a master database.
5. View or print the results of the database file.

Click the **Database Options** button (see Figure E-26) on the toolbar to open the **Database Options** dialog box (see Figure E-27). From here you can reach most of the database functions.

Figure E-26: Database Options Button

Figure E-27: Database Options Dialog Box



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N-LITE OPTION

NOTE – *N*-Lite is a purchased option that must be installed in your system before you can open and analyze a Dektak 150 2D scan as described in this appendix.

ABOUT THE *N*-LITE OPTION

The *N*-Lite Low Inertia Sensor (LIS) 3 Option allows stylus-to-surface engagement for ultra-low-force profiling. The sensor enables the stylus force to be adjusted down to 0.03 mg for measuring very soft films or when using an extremely sharp, sub-micron stylus to measure sub-micron lines and trenches. Servo control suspends the stylus in a free-floating state, maintaining constant force, even over long steps.

The above functions mean that you can make scratch-free measurements of resists, polymers, and soft metals such as gold. High-aspect-ratio, super-sharp, 50 µm styli reach into 10µm deep by 2µm wide trenches. Such styli enable the accurate measurement of Shallow Trench Isolation (STI) etch depth and the characterization of deep structures for MEMS.

The *N*-Lite LIS 3 Option includes the following features:

- Low force servoed sample engage
- Automatic invocation of *N*-Lite for scans at less than 3mg stylus force
- Reduced-force pre-scan stylus touchdown
- Minimal stylus tip drag—"gore zone"
- No impact on Dektak 150 user interface
- Accurate measurement force (± 20 µg)
- Vertical positioning accuracy: ± 0.20µm
- Automatic "minimal force" calibration

NOTE – Some calibration is required after installation of the *N*-Lite option.

MAIN FUNCTIONS

The Servoed Engaged, Fine Positioning, and Stylus Retouch functions allow the *N*-Lite Option to produce very low, accurate forces for any sensor position:

Servoed Engage

The servoed engage function prevents the stylus from traveling across the sample surface during tower engagement. This significantly reduces the traverse distance and forces exerted on the surface. It is especially useful in preventing damage to soft samples with extremely sharp styli. By default, *N*-Lite is designed to limit post-contact stylus travel to no more than 5µm vertically during the servoed engage.

Fine Positioning

Fine positioning precisely locates the sensor relative to the sample surface. During this operation, the servo is disabled, and the force is set to the minimum value necessary to remain on surface. There is a small amount of stylus traverse during this phase of the engage.

Stylus Retouch

The retouch accurately establishes the true minimum force necessary for the stylus to engage the sample surface. During this phase, there is no profiler tower motion. The stylus lifts from the sample surface and then lowers to retouch the sample surface with the minimum possible force. This minimum, zero force dynamically shifts the force calibration curve as the final scanning force is applied, thus providing automatic force calibration. Because the retouch compensates for thermal and electrical drift in the sensor force mechanism, extremely precise forces (within ±20 µg) are possible.

SOLVING *N*-LITE MEASUREMENT PROBLEMS

Due to the very low forces achievable with *N*-Lite, it is possible for the sensor to have limited downward travel from the final engage (null) position. This is because the sensor mechanism is a balanced pivot arm, with the balance point set so that the zero-force-coil position of the stylus rests at its upper stop. The force coil is energized to bring the stylus down into visibility and apply scan forces. Even though the jewel bearings used for the sensor pivot are effectively friction free, it still takes a small fraction of a milligram of force to swing the pivot-arm across the measurable range.

When engaging *N*-Lite, it is possible for the sample surface to “disappear” below the reach of the stylus during scanning. As discussed above, at very low forces the stylus has limited downward travel

from the final engage (null) position. Due to these sensor physics, you must take these steps to ensure proper use of the tool:

- Using extreme care, manually level the sample to prevent “walk away” from the stylus.
- Run tests and precisely level for map scans to prevent data distortion or loss. This problem will be evident when the sample “walks away” from the stylus on individual, intermittent scans in the map, producing “air scans.”
- Specify and test scan forces adequate to deflect the stylus to the bottom of all depressed sample features. This prevents the detail of these features from becoming lost in temporary, unintended disengages.
- Know and understand the expected sample/scan shape, ensuring that measured data are correctly understood and evaluated.
- Solve problems caused by static electricity according to the instructions in Solving Stiction Problems.

> **NOTE –** If you are unsure of how to make a particular measurement or experience difficulties, contact Veeco Applications Support for assistance in designing specific tests to measure, quantify, and qualify your procedures.

SOLVING STICTION PROBLEMS

Static electricity is usually responsible for stiction problems during the retouch phase. Take the following steps to check the system and sample grounding.

1. Use a digital volt meter (DVM) to verify that the system grounding is functioning properly.
2. Verify that the following grounding equipment is available and in use:
   - Static discharge mats
   - Wrist straps
   - Any other equipment appropriate to your site

> **NOTE –** Even a non-conducting sample can build up static charge after multiple scans. This can degrade the performance of the *N*-Lite software. Use alpha-particle grounding and/or proper grounding of the sample to prevent this from occurring.

> **NOTE –** Static brushes are shipped with all systems.

3. Use proper sample handling.
4. Mount an alpha-particle source on the system, locating it as close to the stylus tip as possible Ensure that the source does not interfere with the sample or profiler mechanics. .

NOTE – Adjusting the timeout and lift increment parameters in the Dektak 150 configuration file also can help alleviate stiction problems. For assistance with editing the configuration file, call Veeco Technical Support.

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