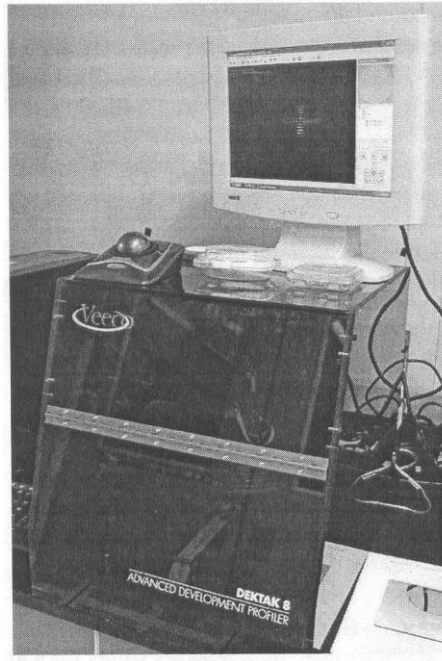


Approved by Principal Investigator _____ Date: _____

Approved by Super User: _____ Date: _____

**Standard Operating Procedure
BNC
Veeco Dektak 8M Stylus Profilometer
Version 2016 Dec 16**



I. Purpose

This Standard Operating Procedure (SOP) outlines requirements to be considered by an authorized user of the Dektak 8M Stylus Profilometer as well as describes the normal operation of the profilometer and any hazards that may be encountered during normal operation. Finally, the SOP explains how to minimize any hazards and how to respond in an emergency situation. This document is to be reviewed one year from the date of approval or as conditions warrant, whichever is the shorter time period.

The Dektak 8M Surface Profiler is an advanced surface profile measuring system, which accurately measures vertical features ranging in height from 50 Angstroms to 2,620,000 Angstroms or 262 microns on a wide variety of substrate surfaces.

II. Personnel

- A. Authorized Personnel: The Dektak 8M may be operated only by authorized personnel who are fully cognizant of all safety issues involved in the operation of such a device. These personnel are to ensure that the profilometer is only operated in the manner laid out in this document. To become an authorized user, one must:
1. Complete Environment, Health & Safety (EH&S) training class.
 2. Take the baseline BNC Safety Orientation class

3. Read and fully understand the SOP
 4. Receive training on the profilometer by an authorized Super User and User.
 5. Sign the authorized user sheet to affirm that the above steps have been completed.
- B. Unauthorized personnel: No unauthorized personnel may enter the BNC clean room facility unless accompanied by an authorized user. All visitors must be briefed on proper safety protocol and must wear appropriate protective eyewear located on the premises.

III. Hazards

- A. Electrical Hazards: Use normal precautions with external house (110VAC) connections behind the chassis.
- B. Chemical: N/A.
- C. Pressure Hazards: N/A
- D. Other: N/A

IV. Hazard Controls

- A. Electrical
1. Only qualified personnel may perform all internal maintenance to the profilometer and more than one user must be present when performing said maintenance.
 2. Every portion of the electrical system, including the printed circuit cards, should be assumed to be at dangerous voltage level.
- C. Chemical and Pressure
- I. N/A
- D. Other
1. Proper eye protection must be worn at all times in the clean room.

V. Technical Specifications

Stylus: 12.5 μm radius (Diamond)

Scan Range: x: 50 μm – 50 mm

z: 50 Å – 262 μm

z Resolution: 1 Å/65 KÅ

10 Å/655 KÅ

40 Å/2620 KÅ

Force: 1 – 15 mg

Zoom: 35x – 200x

Scan Speed Ranges: 3 seconds to 200 seconds

Leveling: Manual, two-point programmable or cursor leveling

Stylus Tracking Force: Programmable, 1-15 mg

Maximum Sample Thickness: 25.4 mm (1.00 inches)

Maximum Sample Weight: 2.5 Kg (5 lb)

Sample Stage Diameter: 200 mm (8 inches)

Sample Stage Translation: X Axis, ± 105 mm (± 4 inches) (from center)

Y Axis, -105mm (4.0 inches)

Sample Stage Rotation: Theta, 360°

Power Requirements: 100/115/220Vac $\pm 10\%$, 50-60Hz, 200VA

Warm-up Time: 15 minutes recommended for maximum stability

Operating Temperature: 21° C $\pm 3^\circ$ C (70° F $\pm 5^\circ$ F)

Specification Summary

	Scientific*	Metric*
VERTICAL DISPLAY RANGE	50 Å to 2620 KÅ	10 nm to 131 μm
VERTICAL RESOLUTION	1Å/65 KÅ	0.1 nm/6.5 μm
In a Selected Range	10 Å/655 KÅ	1 nm/65.5 μm
	40 Å/2620 KÅ	4 nm/262 μm
DATA POINTS PER MICRON	0.04 to 40	0.04 to 40
SCAN LENGTH RANGE	50 μm to 50 mm	50 μm to 50 mm

Å = Angstroms μm = micrometer (micron)

* Switch selectable on top panel of Main Electronics Unit.

VI. Glossary of Function Keys

Description	Icon
Video Camera High Magnification: Switches to the high magnification video microscope.	
Video Camera Low Magnification: Switches to the low magnification video microscope.	
Increase Illumination: Increases sample illumination incrementally with each click.	
Decrease Illumination: Decreases sample illumination decrementally with each click.	
Video Display: Displays the video image only.	
Graphics Display: Displays graphics only.	
Video and Graphics Overlay Display: Displays both video and graphics.	
Tower Up: Raises the stylus and optics to the home position.	

Tower Down: Lowers the stylus and optics to the sample.	
Stylus Up: Raises the stylus arm off the sample surface.	
Stylus Down: Lowers and nulls the stylus onto the sample surface.	
Load: Centers the stylus over the stage.	
Unload: Translates the stage to the profiler door for loading.	
Stage Rotation Adjustment: Click and hold the icon to rotate the stage counter-clockwise. Use the left trackball button to rotate the stage at low speed, and the left trackball button in conjunction with the Ctrl key to rotate the stage at high speed. (Only available with Autotheta).	
Stage Rotation Adjustment: Click and hold the icon to rotate the stage clockwise. Use the left trackball button to rotate the stage at low speed, and the left trackball button in conjunction with the Ctrl key to rotate the stage at high speed. (Only available with Autotheta).	
X-Y Stage Position Adjustment: Jogs the sample position right or left, as viewed in camera view pane. Use the left trackball button to jog the stage at low speed, and the left trackball button in conjunction with the Ctrl key to jog the stage at high speed.	
X-Y Stage Position Adjustment: Jogs the sample position forward or backwards as viewed in the camera view pane. Use the left trackball button to jog the stage at low speed, and the left trackball button in conjunction with the Ctrl key to jog the stage at high speed.	
Displays the Automation Program Window .	

Displays the Scan Routine Window .	
Displays the Data Plot Window .	
Displays the Automation Program Summary Window .	
Displays the Help menu.	
Large Key Icons: Click on the corresponding icon to: Move to the location of the current scan routine. Execute only the current scan routine. Execute the current scan routine at the current location. Run the entire program. Abort.	

VII. Operations

- A. REMINDER: THE STYLUS ON THE DEKTAK COSTS \$1,000 EACH.
- B. General Note: It is always good practice to check the profilometer with a calibration standard before measuring your actual device.
- C. NEVER TOUCH THE STYLUS NOR THE SERVO MECHANISMS.
- D. DO NOT ATTEMPT TO MEASURE WET MATERIALS WHICH CAN GUM UP THE STYLUS! THIS IS NOT A WET CHEMISTRY MEASUREMENT SYSTEM.

1. If the system is not already on, turn **ON** the Dektak 8 by flipping the power switch located on the rear of the E-Box connected to the profile cover.

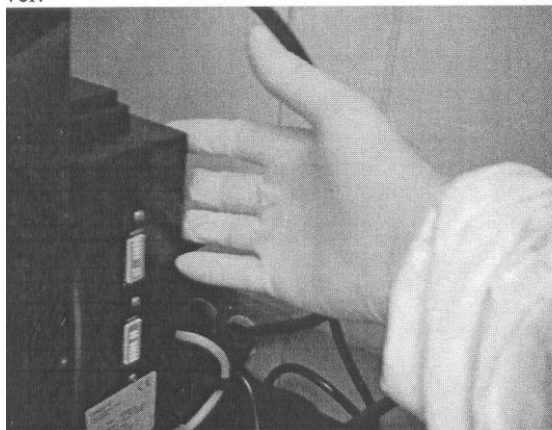



Fig 1. Power switch located on the rear panel of the E-Box

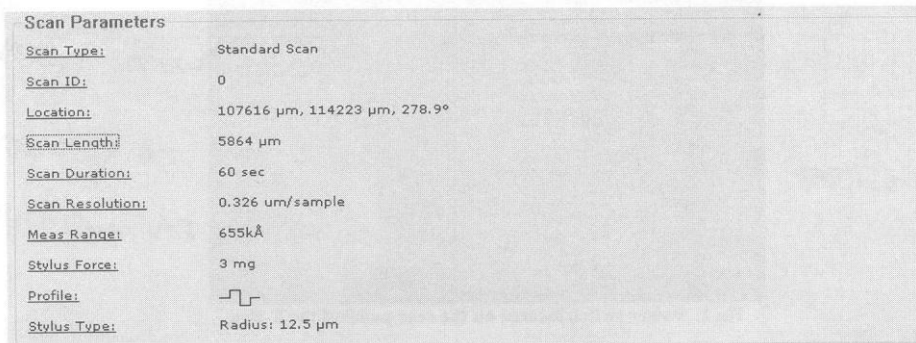
2. Turn the monitor **ON** by depressing the power button located on the front of the monitor in the lower-middle.
3. Turn the computer **ON** by depressing the power switch located on the front of the computer.
4. The Login Username is: Corldept and the Password is: machusnot!7 (note all lower case)
5. Double click on the Dektak32 icon on the desktop or *Select Start>All Programs>Dektak32>Dektak32* from the Windows toolbar.



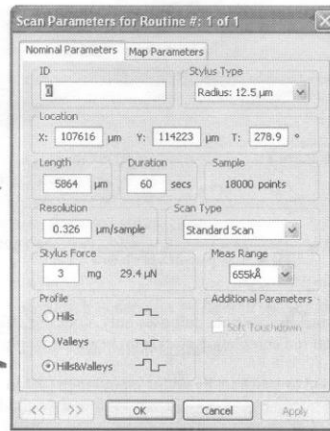
6. The Dektak 8 sample stage will initialize and the Start Screen will display. Wait until the initialization movement of both stage and stylus arm have completed and fully stopped.

A “**READY**” message is usually displayed on the left side of the screen to indicate the initialization protocol has completed. This should take at most a few minutes. The stylus arm moves to the center position and the stage also stops at the center position. The optics tower will rise to the upper position in order to protect the stylus.


7. **Go to File/New menu** to start a new scan. New scans will receive default scan parameters.
8. If you receive a “Critical Error, Failed to Initialize Flashpoint” Click OK. Note that this is due to the problems with the Dektak video card interface incompatibility.
9. **Set up the scan parameters** by selecting . The following screen will allow adjustment of the scan parameters by clicking the link on the screen.

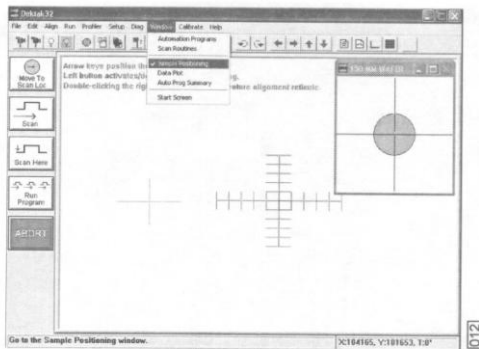


10. Definition of the Scan Parameters are as follows:
 - i. **ID** can be the desired file name.
 - ii. **Stylus Type**: 12.5 micron radius tip (for note purposes only, does not affect scan).
 - iii. **Scan Duration**: Time required for completing the scan from beginning to end.
Note that the longer the scan routine, the more data points recorded and more time required for the scan.
 - iv. **Scan Type**: Standard Scan.
 - v. **Stylus Force**: Force applied to the substrate by stylus. Input ranges from (0.7 to 15 mg).
 1. For soft materials (photoresist, polymers, soft metals, gold), use low force such as 1 to 2 mg.
 2. For hard materials (Chrome, Nickel, Silicon, glass), use higher force such as 10 to 15 mg.
 - vi. **Measurement Thickness Range**: Four step ranges, 1mm, 2620 kÅ (262.0 microns), 655kÅ (65.5 microns), and 65kÅ (6.5 microns).
 - vii. **Profile**: Hills, Valleys, or Hills & Valleys, depending upon feature geometry.
11. The Scan Parameter dialog box will summarize the selected parameters. Click OK if parameters are correct.



12. **Position sample** by going to the top of the window menu, select “Sample Positioning”

and Click. Selecting the icon  will also open the Sample Positioning Window.



13. The “Sample Positioning” screen will produce a screen with three icons looking like

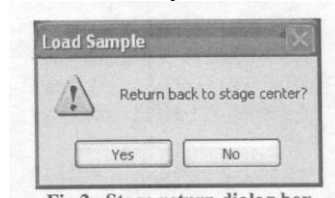


14. The arrow shown above points outward to the lower right which positions the sample stage to the **sample loading position**. The other two icons with arrows pointing inward will either load the sample to a corner or a predetermined scan position.

15. Select the icon pointing outward to move the sample stage to the loading position. Open the profilometer box panel door with the scanner instrumentation. Do not touch the stylus or any of the servo mechanisms.

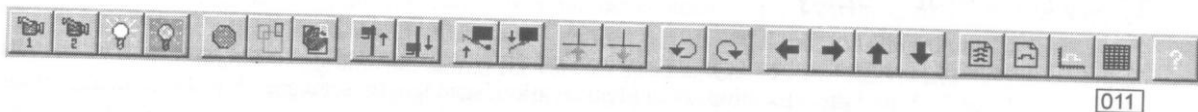
16. The **stage vacuum “toggle” switch** is located inside the profilometer box. It is on the left side of the inner box chassis. Switch the vacuum OFF. Note that the vacuum region is located at the center of the chuck. Once the wafer or sample has been placed on the center of the chuck, switch the vacuum ON. The sample should now be secured. Note: if the sample is not large enough (minimum 1 cm²), other means such as securing the sample to a large 4 inch wafer may be necessary. **DO NOT USE ANY TAPE DIRECTLY ON THE WAFER CHUCK!**

17. When the sample is secured to the chuck. Select either loading position icons (arrows pointing inward). The sample chuck will move to the designated position in the vicinity of the stylus automatically. When you receive the message

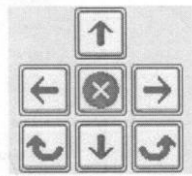


, reply YES and sample stage will proceed.

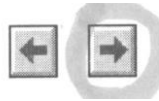
18. Wait for the sample chuck positioning to stop before continuing. **DO NOT ATTEMPT TO USE FINGERS OR TWEEZERS TO PHYSICALLY POSITION THE SAMPLE WHEN THE WAFER CHUCK IS AWAY FROM THE LOADING POSITION AREA.** Final positioning will be done with the sample stage movement or stylus controls.
19. You will need to be familiar with **V. GLOSSARY** icons for controlling the profilometer scanning and positioning.



20. Observe that the stylus has been positioned directly over the wafer chuck. Use the





or



(towards back, towards front) or



(towards left, towards right) controls to position the desired sample to be measured beneath the stylus. This will be the approximate position. The final position will require the use of the video camera.

21. Before using the camera, **turn on the stage lights** with . By toggling either  or



. You may increase




or decrease



the illumination of the sample.

Typically, only the 50% intensity position on the light sidebar is necessary for proper lighting. Careful not to over saturate the video camera by having the intensity too bright.



22. **Turn ON or OFF camera #2** by toggling . **IMPORTANT NOTE:** If the video camera amplifier has been disabled, positioning by visual observation without the assistance of the video camera may be necessary. This will be done **patiently** by positioning and measuring sequentially until the desired location is found.


23. In order to get an accurate position of the stylus relative to the sample location of interest,




lower the stylus tower by selecting

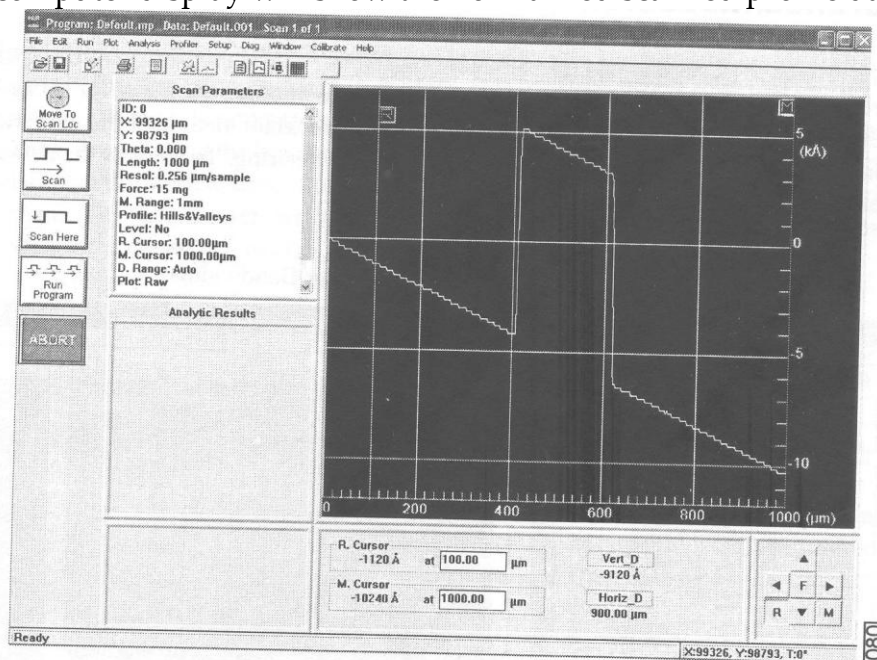
.

The stylus will lower until it touches the surface and then rise to a stylus neutral noncontact position as to protect the stylus. The


stylus can also be placed on the surface by selecting stylus down . The stylus will also touch the surface momentarily and rise to a stylus neutral or null position as to protect the stylus. **Note that the stylus replacement costs \$1,000!!!** Positioning by selecting either stylus tower or stylus down will place the camera optics within focus but with the stylus in the non contact position.

24. When the stylus has been properly positioned, **scanning** can be enabled from the select

position by selecting . The stylus will quickly rise and lower to the surface of the sample and the video screen will show the stylus moving across the surface as the computer display will show the raw scan data. When the scan has been completed, the computer display will show the normalized scanned profile data plot.



25. **Analysis of the data** can be accomplished on the displayed data plot screen. Selecting from the menu and clicking on **Plot** will permit Software Data **Leveling**, Setting Reference **Zero** Point, and Profile **Measurements** to be taken from the displayed data plot. In addition, selecting and clicking on **Analysis** will provide additional automated measurement tools such as Average Step Height measurement (**ASH**). **Replot** provides plot magnification, and **Restore** allows restoring truncated boundaries to original conditions.

26. **Sample Unloading** can be done by selecting the Unload command  in the stage control panel on the right side of the screen. Open the profilometer front door, turn OFF the vacuum via toggle switch on the left, and remove sample from the chuck.

27. Once the sample has been removed, click YES in the Load Sample dialog box to return the stage to home position. When the stage has finalized its homing protocol, the output text in the lower left hand corner display will show “Ready”.

VII. Shut Down Procedures

1. With the stage returned to home position, Close the program. The stage light will turn off when the program is closing.
2. When the program has properly closed, shutdown the computer if necessary.
3. Turn off the power toggle switch to the Instrument at the back of the instrument
4. Close the profilometer front panel door.

VIII. Emergency Procedures

- A. DEKTEK profilometer accidents: Notify lab management and PI immediately.
- B. Power outage: If there is a power outage, turn off the profilometer per the shut down procedure (VII) to avoid a hazardous situation when power is restored. If there is an emergency, leave laboratory immediately and either return after emergency to shut down profilometer or contact lab management.

Authorized Users:

I have read and understood the Standard Operating Procedures for DEKTAK 8M Stylus Profilometer

Name (print)	Signature	Date	PI or Super User Initial

Appendix A – In case of medical emergencies, consult lab safety protocol or lab safety plan.

In the event of a profilometer accident, follow the procedure below:

1. Ensure that the profilometer is shut off per Section VII in **Shut Down Procedures**.
2. Provide for the safety of the personnel (first aid, evacuation, etc.) as needed.
3. Obtain medical assistance for anyone who may be injured.

UC Optometry Clinic (Normal Hours)	642-2020
UC Optometry Clinic (24 Hour Emergencies)	642-0992
University Health Services (Emergency)	642-3188
Ambulance (urgent medical care)	9-911

4. If there is a fire, pull the alarm, and contact the fire department by calling 9-911. Do not fight the fire unless it is very small and you have been trained in fire fighting techniques.
5. Inform the Office of Environment Health, & Safety (EH&S) as soon as possible.
6. During normal working hours, call the following:

EH&S Office	642-3073
BNC Safety Officer (Paul Lum)	666-3356
EH&S Health & Safety Manager	642-3073

After normal working hours, call 642-6760 to contact the UC Police Department who can contact the above using their emergency call list.

7. Inform **(PI NAME)** and the BNC safety officer (BNC Management) as soon as possible. If there is an injury, **(PI NAME)** will need to submit a report of injury to the Worker's Compensation Office.
8. After the incident, do not resume use of the profilometer system until the BNC lab manager and EH&S has reviewed the incident and approved the resumption of research.