



Certificate of Compliance

Name: Michigan Metrology, LLC Date: 4/28/11

Model: NT8000

System S/N: NT8000-01-019

This is to certify that the above system has been inspected, serviced and calibrated to ensure optimal operating performance.

The system calibration was conducted in accordance to the procedure outlined in the Bruker manual and was performed utilizing a certified standard, which is traceable to NIST.

It is recommended that a factory-authorized representative perform this certification every three years.



Bruker Field Service Engineer
Brian Henry

Statement of Uncertainty

The WYKO NT8000 is a self-calibrating device based on an internal HeNe laser interferometer. During calibration verification, the WYKO NT8000 measures a step height specimen multiple times to demonstrate the repeatability of a depth (height) measurement. The step height specimen (SHV1554) used for this work has been certified as being $10.034 \mu\text{m} \pm 0.031 \mu\text{m}$ (2 sigma) measured by NIST internal control #M8609. As per *ISO Guide to Uncertainty in Measurement*, section 3.4.5, the resulting uncertainty demonstrated by multiple measurements of the standard may be viewed as determining the uncertainty in determining the height of a given image feature for the WYKO NT 8000.

Calibration verification of the WYKO NT8000 is performed at various times throughout the year. Typically the step standard is measured within 8 weeks of the project presented here and is included in the report for reference.

The following table contains measurements of the NIST traceable standard during calibration verification of the machine indicating the mean value and 2 sigma standard deviation. As per guidelines provided by *ISO/IEC 17025 – 2005*, and *ISO Guide to the Expression of Uncertainty in Measurement, ISBN; 92-67-10188-9*, Michigan Metrology states the uncertainty of the measured step height specimen using a coverage factor of $k=2$.

**Step Height Standard Measurement Statement of
Uncertainty Table**

Standard Information	
Step Height Standard Serial Number	SHV1554
Step Height Standard Nominal Value (μm)	10.034
Step Height Standard 2 sigma uncertainty (μm)	0.031
Measurement Conditions	
NT8000 Serial Number	NT8000-01-018
Objective Lens Magnification	2.5X / 0.5X (total 1.4X)
Objective Lens Serial Number	IX28121
Filters	None
Date	5/31/2010
Time	9:27 AM
Operator	DKC
Measurement Results	
	Measured Step Height (um)
Measurement 01	10.040
Measurement 02	10.041
Measurement 03	10.042
Measurement 04	10.043
Measurement 05	10.041
Measurement 06	10.043
Measurement 07	10.039
Measurement 08	10.038
Measurement 09	10.043
Measurement 10	10.043
Average	10.041
1 Sigma (standard deviation)	0.002
Percent Error from Calibrated Step Height	0.1%
Step Height Stated Uncertainty (Coverage Factor of 2) (um)	0.004
Signature	
Title	
Date	

The WYKO NT8000 is a self calibrating device based on an internal HeNe laser interferometer. For reference, a nominal 10.0 um step height specimen is measured to assure proper function. The certification for the step height specimen follows this page

Date: 05/31/2010

Time: 09:27:22

Mag: 1.4 X

X/YSize: 640 X 480

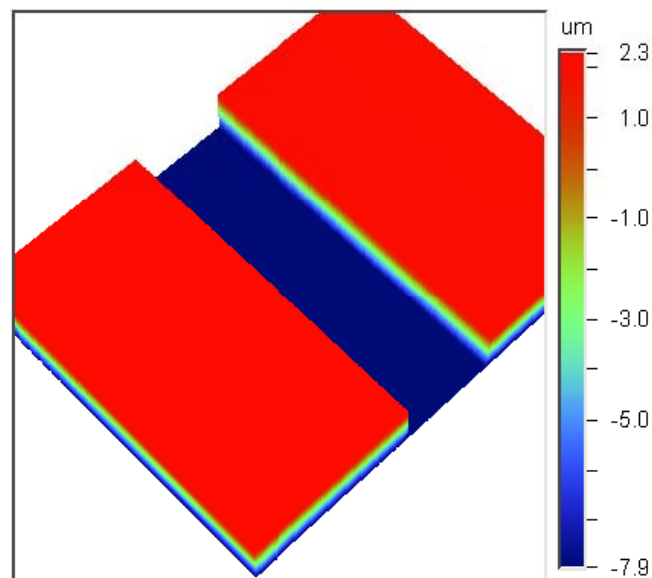
Pixel size: 7.27 um

Step Results:

StepAvg: 10.040 um

Stdev: 5.14 nm

Count: 480



U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
100 BUREAU DRIVE, MAIL STOP 8212
GAITHERSBURG, MD 20899-8212

REPORT OF CALIBRATION

For: One Step Height Standard Serial No. SHV 1554

Submitted by: Michigan Metrology, LLC
ATTN: Donald Cohen
17199 N. Laurel Park Drive
Suite 51
Livonia, MI 48152

NIST Test Number: 821/273534-06 Customer P.O. No. 1014

Internal Control #: M8609

Materials Received: 04/18/2006 Reporting Date: 06/23/2006

Technical Contacts: T. Brian Renegar 301-975-4274
C. Dewey Foreman 301-975-5836
Metrology Building (220), Room A117

The results for NIST step height measurements are as follows:

Specimen ID	Step Height Average (μm)	Combined Expanded Calibration Uncertainty ($k=2$) (μm)
SHV 1554	10.034	± 0.031

The above quoted result represents an average of nine values measured over evenly distributed positions on the specimen surface. For information concerning our customary measurement procedures and uncertainties, see Appendix A and its references. A record of the measured values is included as Appendix B. Note: The ISO algorithm was used for calculating the step height values. For more information, please see Appendix A.

The specimen is expected to maintain its calibration value for at least 7 years provided that measurements are taken on clear, undamaged areas.

Measurements made by: D. Foreman
D. Foreman

For the Director,
National Institute of Standards and Technology

Theodore Vorburger
Dr. Theodore Vorburger, Group Leader
Surface and Microform Metrology Group
Precision Engineering Division
Manufacturing Engineering Laboratory

The height resolution of the WYKO NT8000 used in the VSI mode is verified by measuring a super polished substrate known to have a surface roughness, R_a of less than 0.2 nm. The resulting R_q (i.e. RMS) as measured by the NT8000 in the VSI mode, is an indication of the height resolution. The figure below indicates a height resolution in the VSI mode of less than 6 nm.

3D Statistics

Date: 05/31/2010

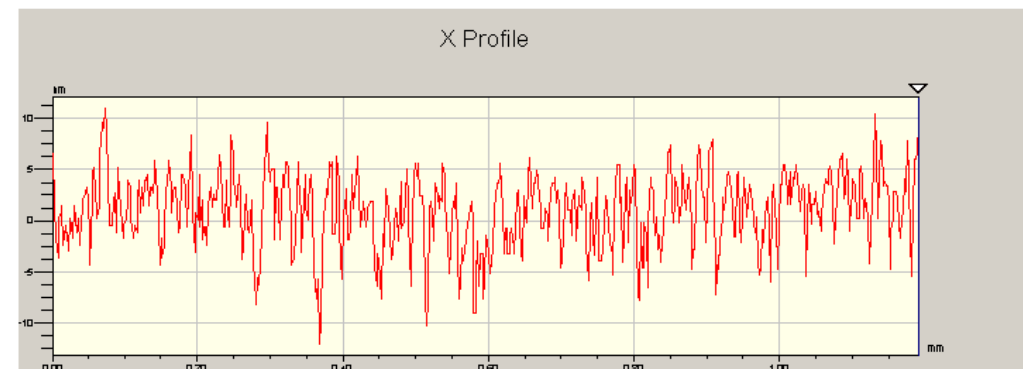
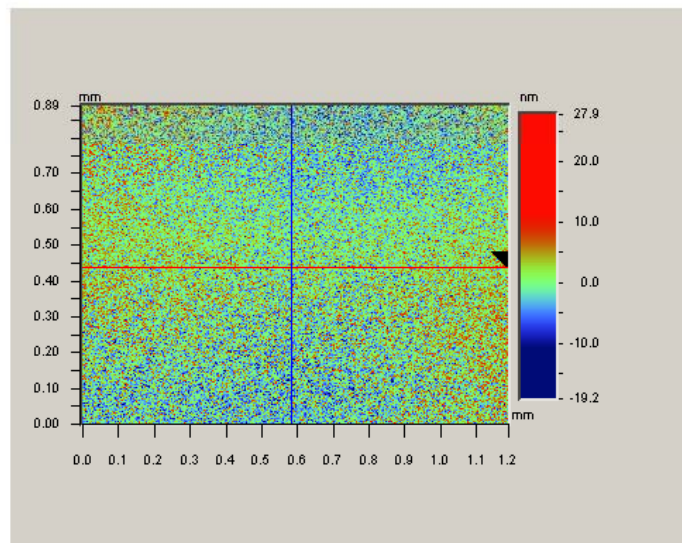
Time: 09:33:01

Pixel size: 1.86 μm

X/YSize: 640 X 480

R_a : 3.21 nm

R_q : 4.036 nm



The height resolution of the WYKO NT-8000 used in the PSI mode, is verified by measuring a super polished substrate known to have a surface roughness, R_a of less than 0.2 nm. The height resolution in the PSI mode is determined by measuring the RMS (i.e. R_q) of the "surface" generated by taking the difference between two successive measurements. The figure below indicates a height resolution in the PSI mode of less than 0.3 nm.

3D Statistics

Date: 05/31/2010
Time: 09:34:37
Pixel size: 1.86 μm
X/YSize: 640 X 480

R_a : 0.18 nm
 R_q : 0.220 nm

