

Procedure Title: Step Height Calibrations (15030C) using Talystep

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1 Scope

This procedure determines the step height of calibration specimens by mechanical comparison to NIST calibrated standards. Step height specimens in the range of 4 μm and smaller are measured using the Talystep profilometer and are covered under this procedure.

2 References

J.F. Song and T.V. Vorburger, Standard Reference Specimens in Quality Control of Engineering Surfaces, *J. Res. NIST* **96**, 271 (1991).

Stylus-laser surface calibration system, T.V. Vorburger, J.F. Song, C.H.W. Giauque, T.B. Renegar, E.P. Whinton, and M.C. Croarkin, *Precision Engineering* **19**, 157 (1996).

3 General

Operating instructions and manuals are located near all instruments, giving easy access to reference guides.

This procedure is not significantly sensitive to temperature and can be performed whenever the temperature is stable between 18 °C and 22 °C.

4 Procedure

1. Power Up

1. Turn all equipment on. The instrument needs at least an hour of warm up time before measurements are performed.

2. Logging On

1. Log onto Windows using your NIST General Realm username and password.
2. Run Menu.vi LabView program.

3. Instrument Calibration

1. Choose an appropriate NIST Step Height Master to calibrate the instrument with. This will be the step height that has the closest (but larger than) value to that of the customer step height standard. For instance, if the customer step height has a nominal value of 1 μm , then the appropriate NIST Step Height Master to calibrate the instrument with would be the 1.0157 μm standard.
2. Set the stylus force in accordance with procedures described in the “operating instructions” section of the “Talystep Calibrations And Operating Instructions” book.

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3. Place the NIST step height master on the stage. Align with the step height patch.
4. Perform test measurements to level the standard to the instrument reference path. Also correct for any apparent curvature or form deviation.
5. In the Menu.vi program, select the “KCAL” program.
6. Enter file name using the following example format: 01jan08a.dat
7. Enter all appropriate sample and instrument information into the “Header” fields. (e.g.: Step Height Master used, instrument magnification, traverse speed, trace length, etc.)
8. Start measurements of the step height.
9. Analyze the resulting profiles using the NIST step height algorithm. Compare resulting calibration KCAL values to those in the “KCAL No. 2” book. If the values are acceptable, continue scanning until 3 successful measurements have been completed.
10. The average value will be reported. Record this value and relevant information (date, step height master, magnification) into the “KCAL No. 2” book. Complete the program by accepting the data.
11. Run the “Calibration Statistics” program. Select the data file of the measurements just performed, and print the report. This instrument calibration information will be saved in the File Copy of the Calibration Report.

4. Measure Customer Step Height Specimen

1. Determine the location of measurement positions. Nine uniformly positioned locations are measured over the central half of the step region. Two traces are measured at each position for statistical averaging, resulting in a total of 18 measurements on the specimen.
2. Place the customer step height standard on the stage. Align with the step height patch.
3. Perform test measurements to level the standard to the instrument reference path. Also correct for any apparent curvature or form deviation.
4. In the Menu.vi program, select the “STEP” program.
5. Enter file name using the following example format: 01jan08b.dat. The letter will increment from one set of measurements to another so there are no duplicate file names.
6. Enter all appropriate sample and instrument information into the “Header” fields. (e.g.: Step Height Master used, instrument magnification, traverse speed, trace length, KCAL information, etc.)
7. Start measurements of the step height.
8. After each measured profile, analyze using the appropriate step height algorithm. For most step standards, the NIST algorithm is used. However, “triple steps” and those with large curvature or form deviations in the plateau or groove regions of the step are to be measured with the ISO algorithm. Additional step height algorithms are available for special measurements. If other than the NIST algorithm is used, it will be noted in the Calibration Report.
9. Continue measurements until all 18 profiles have been successfully measured. Complete the program by accepting the data.

10. Run the “Calibration Statistics” program. Select the data file of the measurements just performed, and print the “Appendix B” report. This information will be included in the Calibration Report.

5. Re-Check Measurement using NIST Step Height Master

1. To re-check, or verify, the instrument calibration after measurements of the customer specimen have been completed, use the next smallest NIST Step Height Master to that which was used for the instrument calibration. For example, if the 1.0157 μm step master was used for calibration, then the 0.3024 μm step should be used for re-check.
2. Place the NIST step height master on the stage. Align with the step height patch.
3. Perform test measurements to level the standard to the instrument reference path. Also correct for any apparent curvature or form deviation.
4. In the Menu.vi program, select the “STEP” program.
5. Enter file name using the following example format: 01jan08c.dat. The letter will increment from one set of measurements to another so there are no duplicate file names.
6. Enter all appropriate sample and instrument information into the “Header” fields. (e.g.: Step Height Master used, instrument magnification, traverse speed, trace length, KCAL information, etc.)
7. Start measurements of the step height.
8. Analyze the resulting profiles using the NIST step height algorithm. Compare the resulting step height value to that of the certified value of the step height master. If the value is acceptable, continue scanning until two successful measurements have been completed.
9. The average value will be reported. Complete the program by accepting the data.
10. Run the “Calibration Statistics” program. Select the data file of the measurements just performed, and print the report. This re-check information will be saved in the File Copy of the Calibration Report.

6. Post measurement data collecting

1. Retrieve the re-check Appendix B data. The resulting measured value will be entered into the appropriate control chart, which is located on the mxnet file server:
\\mel.nist.gov\mel\mxproj\surfmet\Surface Calibrations\Control Chart
2. Copy all measured data (KCAL, customer measurements, re-check) to the appropriate folder on the mxnet file server under the folder for Talystep measurements:
\\mel.nist.gov\mel\mxproj\surfmet\Surface Calibrations\Control Chart\Talystep

7. Finish

1. The measurement/analysis process is now complete, and the final report can be started.
2. If no more measurements are to be taken, close any programs that are running and log off of the computer. If the Talystep is not to be used in the next few days, turn off the power to the control box.