

Procedure Title: **Roughness Calibrations (15010C) using Form Talysurf**
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1 Scope

This procedure determines the surface roughness of calibration specimens by mechanical comparison to NIST calibrated standards. Surface roughness specimens of up to 10 μm are measured using the Form Talysurf 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. Whitenton, 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. Insure all equipment is powered up. Make sure laser is turned on. The instrument needs at least an hour of warm up time before measurements are performed.
2. Logging On
 1. Log onto Windows using the proper user name and password.
 2. Start the Form Talysurf *Ultra* software. User name is **Admin**, and there is no password.
3. Instrument Ball Calibration
 1. Place calibration ball on stage. Make sure red dot is pointing in the 3 O'clock position.
 2. If necessary, to ensure the reference bar is dirt free, move the traversing unit in its whole range, from about (0 – 5) mm to about (115 – 120) mm, at least two cycles.
 3. Align ball with stylus in the X and Y axis by eye as close as possible.
 4. Contact surface.

5. Perform Autocrest X. Precision should be 0.02mm and data length should be 0.5mm.
6. Perform Autocrest Y. Precision should be 0.04mm, data length 0.5mm, and spacing 0.1mm. “Initial Crest Position” should equal the current Y stage position.
7. “Calibrate -> New” using “NIST Standard Ball”. The name of the calibration file should include the date performed. e.g.: 01-01-2008. “Auto-adjust Z height” should be checked. “Autocrest X” in measurement window should be selected, but not “Autocrest Y”. Gauge range should be set to 80%.
8. Once the calibration is complete, check to make sure that the P_t value is smaller than 0.15 μm . If it is larger, the calibration must be repeated. Perhaps just measuring again will solve the problem. If not, the surface of the ball may need to be cleaned, if any upward spikes are present (dirt, contamination, etc.). Or perhaps another X or Y autocrest may need to be performed if any downward deep valleys are present.
9. Once a successful calibration has been completed, print the calibration. This will be retained in the File Copy of the Calibration Report folder.

4. **Check Roughness measurement using NIST Roughness Standard**
 1. An SRM standard will be used for checking the roughness calibration of the instrument.
 2. Place the appropriate SRM on the stage.
 3. Align stylus tip with top left corner of roughness patch.
 4. Ensure that the Y stage is in a good location to reach the measured area of the specimen. If not, you may need to shift the specimen on the stage in the Y direction.
 5. Contact surface and verify again that the tip is at the top most corner.
 6. In the *Ultra* software, click **View -> Folders**. Browse to the Surface Calibrations directory, then to “Checks”, and then to the type of specimen being used (e.g.: SRM 2073_1104). Create a new folder in this directory and name it to today’s date.
 7. Select this folder as the active folder. **It is important to make sure the data that is taken will be stored in this folder.**
 8. Open Windows Explorer and browse to the “Surface Calibrations” directory. The full path is: C:\Work\Data\Surface Calibrations. Browse to “Checks”, and then to the type of specimen being used (e.g.: SRM 2073_1104). Create a new folder in this directory and name it to today’s date. This is where the exported data will eventually be stored.
 9. Still within Windows Explorer, browse back to “Surface Calibrations”, and then to “Export Temp”. Ensure that the folder is empty.
 10. From the *Ultra* software, browse to “Surface Calibrations” and then to “Programs”. Open the appropriate check program for the standard being used.
 11. Run the program by clicking the green arrow “play” button. Follow the directions of the program.
 12. During the measurement procedure, monitor the profiles as they are measured, the calculated values, and also the exported files. The exported files will be temporarily saved to the “Export Temp” directory, visible in Windows Explorer. You will also need to close some of the profile windows from the Ultra software if too many are open at one time.
 13. After the measurements are completed, remove the specimen from the stage.

14. In Windows Explorer, move the exported files from the “Export Temp” directory to the one that was created under **Surface Calibrations\Checks\ .. **
15. Verify that the exported files were moved to the correct location.

5. Measure Customer Specimen
 1. Place specimen on stage.
 2. Align stylus tip with top left corner of roughness patch.
 3. Ensure that the Y stage is in a good location to reach the measured area of the specimen. If not, you may need to shift the specimen on the stage in the Y direction.
 4. Contact surface and verify again that the tip is at the top most corner.
 5. In the Ultra software, click **View -> Folders**. Browse to the Surface Calibrations directory, then to “Roughness”. If there is not already a folder created with the calibration folder number, do this now: In the Roughness directory, create a folder with the calibration folder number and company name. e.g.: **123456-06 ABC Inc.** Under this folder, create a folder for the roughness patch and serial number you are working on and name it such. eg: **3 um SN 12345**. In the case where the decimal point is required (eg: **0.35**), use an underscore instead (eg: **0_35**).
 6. Select this folder as the active folder. **It is important to make sure the data that is taken will be stored in this folder.**
 7. Open Windows Explorer and browse to the “Surface Calibrations” directory. The full path is: C:\Work\Data\Surface Calibrations. Browse to “Roughness”. If there is not already a folder created with the calibration folder number, do this now: In the Roughness directory, create a folder with the calibration folder number and company name. eg: **123456-06 ABC Inc.** Under this folder, create a folder for the roughness patch and serial number you are working on, and name it such. eg: **3 um SN 12345**. This is where the exported data will eventually be stored.
 8. Still within Windows Explorer, browse back to “Surface Calibrations”, and then to “Export Temp”. Ensure that the folder is empty.
 9. From the *Ultra* software, browse to “Surface Calibrations” and then to “Programs”. Open the appropriate roughness program for the size roughness standard being measured.
 10. Run the program by clicking the green arrow “play” button. Follow the directions of the program.
 11. During the measurement procedure, monitor the profiles as they are measured, the calculated values, and also the exported files. The exported files will be temporarily saved to the “Export Temp” directory, visible in Windows Explorer. You will also need to close some of the profile windows from the *Ultra* software if too many are open at one time.
 12. If any profiles or calculated values are bad, make a note of it. These position(s) may need to be manually re-measured later.
 13. After the measurements are completed, remove the specimen from the stage.
 14. In Windows Explorer, move the exported files from the “Export Temp” directory to the one that was created under **Surface Calibrations\Roughness\ .. **
 15. Verify that the exported files were moved to the correct location.
6. Re-Check Roughness measurement using NIST Roughness Standard

1. The SRM standard that was used for the Check procedure will now be used for re-checking the roughness calibration of the instrument.
 2. Place specimen on stage.
 3. Align stylus tip with top left corner of roughness patch.
 4. Ensure that the Y stage is in a good location to reach the measured area of the specimen. If not, you may need to shift the specimen on the stage in the Y direction.
 5. Contact surface and verify again that the tip is at top most corner.
 6. In the *Ultra* software, click **View -> Folders**. Browse to the Surface Calibrations directory, then to “Re-Checks”, and then to the type of specimen being used (e.g.: SRM 2073_1104). Create a new folder in this directory and name it to today’s date.
 7. Select this folder as the active folder. **It is important to make sure the data that is taken will be stored in this folder.**
 8. Open Windows Explorer and browse to the “Surface Calibrations” directory. The full path is: C:\Work\Data\Surface Calibrations. Browse to “Re-Checks”, and then to the type of specimen being used (eg: SRM 2073_1104). Create a new folder in this directory and name it to today’s date. This is where the exported data will eventually be stored.
 9. Still within Windows Explorer, browse back to “Surface Calibrations”, and then to “Export Temp”. Ensure that the folder is empty.
 10. From the Ultra software, browse to “Surface Calibrations” and then to “Programs”. Open the appropriate re-check program for the standard being used.
 11. Run the program by clicking the green arrow “play” button. Follow the directions of the program.
 12. During the measurement procedure, monitor the profiles as they are measured, the calculated values, and also the exported files. The exported files will be temporarily saved to the “Export Temp” directory, visible in Windows Explorer. You will also need to close some of the profile windows from the Ultra software if too many are open at one time.
 13. After the measurements are completed, remove the specimen from the stage.
 14. In Windows Explorer, move the exported files from the “Export Temp” directory to the one that was created under **Surface Calibrations\Re-Checks\ .. **
 15. Verify that the exported files were moved to the correct location.
7. Post measurement data collecting
1. It is now necessary to collect the needed data and analysis for construction of the Calibration Report.
 2. The profiles and calculated values for the Check and Re-Check measurements need to be printed. The Ra values from the Check and Re-Check measurements should be compared to each other. The average of the Re-Check values is used in the control chart for that SRM. The control chart is located on the mxnet file server:
\mel.nist.gov\mel\mxproj\surfmet\Surface Calibrations\Control Chart
 3. The data from the customer’s roughness calibration now needs to be recorded and printed. Open the Appendix B Roughness Template Excel file, and enter the needed information into the yellow cells. Header information will be entered first, such as date, specimen ID, check standard, etc. Then, open the roughness profiles one by one from the *Ultra* software, and record the Ra values in the appropriate locations on the

- Appendix B Roughness sheets. Alternatively, the “SPC” files can be opened from Windows Explorer, and the Ra values can be read from there and typed into the Appendix B Roughness file.
4. When complete, save the Appendix B Roughness file to the directory where the relevant data is stored. Make sure to name the file appropriately. Eg: **Appendix B – 3um SN 12345 ABC Inc.xls**
 5. Print the Appendix B Roughness file. Also save the Appendix B Roughness file to a memory stick, transfer to a network PC, and copy to the appropriate folder on the mxnet file server: **\mel.nist.gov\mel\mxproj\surfmet\Surface Calibrations\roughness**
 6. From the roughness Ra results, determine which position/trace resulted in the highest value, and which one resulted in the lowest value. Once those are determined, print out the corresponding profiles of those measurements. These will be included in the Appendix B data.

8. **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 the *Ultra* software and any other programs that are running and log off of the computer.