U. S. Department of Commerce
Malcolm Baldrige
Secretary
National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate

Standard Reference Material 2073

Sinusoidal Roughness Specimen

Serial No. _____

This Standard Reference Material (SRM) is intended primarily for use as a standard for the calibration of stylus instruments that are used to measure surface roughness. The SRM is a steel block of nominal Knoop hardness 500 which has been nickel coated by the electroless nickel process. A sinusoidal roughness profile was machined onto the top surface of the specimen in a facing operation by a single-point, diamond tool on a numerically controlled lathe.

The roughness average, Ra, and surface wavelength, D, were measured by means of a stylus instrument interfaced to a minicomputer and a laser interferometer. Ra is the average absolute deviation of the surface peaks and valleys about the mean line and is defined in the ANSI Standard B46.1 entitled Surface Texture. D is the average period of the sinusoidal surface profile and is calculated as the average distance between successive positive-going crossings of the mean line by the surface profile.

The stylus instrument was first calibrated using an interferometrically measured step. Then the parameters Ra and D were calculated from roughness profiles of the SRM's.

The surface roughness profiles were determined using the procedures in the American National Standard B46.1 with a 0.76 mm cutoff length, and a sampling rate of 1 point/1.6 μm over the traversing length of 6.3 mm. The stylus had a tip radius of 7.5 $\pm$ 1.0 μm as measured by the radius scale method [1]. Ra values were calculated as described in Appendix C of B46.1.

The certified Ra and D values for this specimen are:

Roughness Average (Ra), μm	Surface Wavelength (D), μm

The certified values represent average values of 16 profile traces taken in pairs at each of eight distributed positions on the specimen as shown in the Figure. The certification is valid within the area defined by the extremes of these profile traces. Because of the curvature in the surface markings, the value for D, outside the limits of the measured area is expected to increase.

The stylus force was approximately 4×10^{-4}N. This force should cause negligible damage to the hard metal surface; however, faint stylus traces may be visible on the surface. Repeated use with stylus instruments can slowly degrade roughness specimens; however, the specimen is expected to maintain its calibration value for at least five years provided that measurements are taken on clear, undamaged areas.

The uncertainties for Ra and D are sums of instrument calibration uncertainties and random uncertainties. Sources of calibration uncertainty for Ra include: (1) the uncertainty of the height of the calibrating step, (2) the surface finish of the calibrating step, (3) variations in the measured values caused by sampling and digitizing processes, (4) software computations and nonlinearities in the transducer and interface hardware, and (5) uncertainty in the stylus radius. The calibration uncertainty for Ra is 0.064 μm and the random uncertainty (3 standard deviations) is 0.019 μm.

Sources of calibration uncertainty for D include: (1) uncertainties in the interferometric measurements of displacement caused by uncertainties in the laboratory environment, possible cosine errors in the specimen alignment, and a possible Abbe offset error, and (2) uncertainties in a backup measurement of D using a calibrated microscope stage. The calibration uncertainty for D is 0.34 μm and the random uncertainty (3 standard deviations) is 0.02 μm. A systematic uncertainty of 0.12 μm was added to account for the variability of D with position on the specimen.

The technical direction and physical measurements leading to certification were provided by F.E. Scire, C.H. Giauque, E.C. Teague, and T.V. Vorburger of the Mechanical Production Metrology Division. The specimens were machined by Pneumo Precision, Inc. of Keene, N.H.

Guidance on statistical analysis was provided by M.C. Croarkin of the NBS Statistical Engineering Division.

The technical and support aspects involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by L.J. Kieffer.

Reference:

[1] Vorburger, T.V., Teague, E.C., Scire, F.E., and Rosberry, F.W., Wear 57, 39-49 (1979).

Gaithersburg, MD 20899
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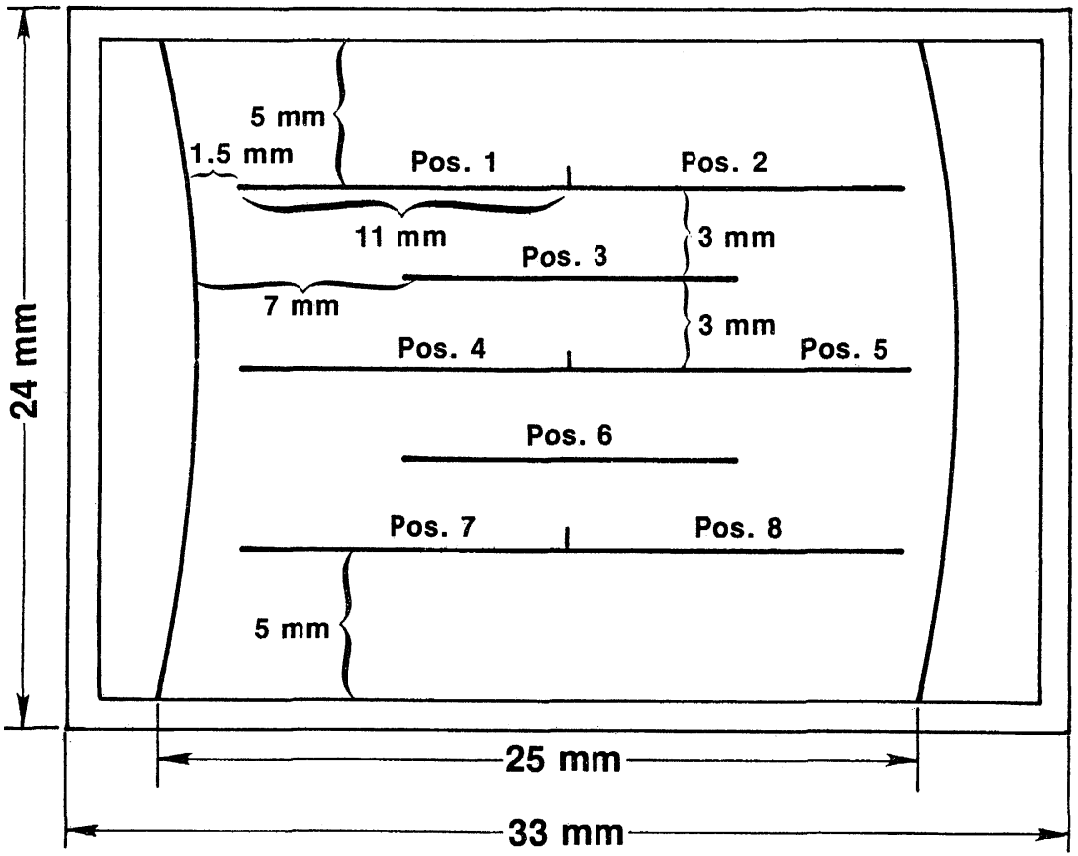
Stanley D. Rasberry, Chief
Office of Standard Reference Materials

Measurement Positions



Total Trace Length ≈ 11.0 mm
Data Reading ≈ 6.3 mm of 11.0 mm Trace Length