U. S. Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate

Standard Reference Material 475

Optical Microscope Linewidth Measurement Standard

This Standard Reference Material (SRM) is intended for calibrating optical microscopes used to measure linewidths from 0.5 to 12.0 μm and is specifically designed for the measurement of both opaque and clear lines on integrated circuit (IC) photomasks in transmitted illumination.

This SRM is certified for linewidths (both clear and opaque) and line spacings (both center-to-center and edge-to-edge) for one of eight basic patterns. These certified values are given in the attached tables. (The last digit of the serial number ____________ identifies which basic pattern is certified.) Each certified value is an average of nine measurements.

All of the certified linewidth values have an uncertainty (systematic and random errors) of ± 0.05 μm. The dominant contribution to this uncertainty is the estimated maximum linewidth error resulting from the finite material edge slope, further details are given on the following page. In addition, this uncertainty includes a small contribution from the measurement precision which is ____________ on rows A, B, & F (95% confidence limits), and for the edge locations in row G the precision is ____________. The line-spacing uncertainty (precision only) for row E is ____________.

The method for using SRM 475 to calibrate optical linewidth measurement systems is described in the attached documents. These procedures have successfully been used in an interlaboratory study with photomasks nearly idential to SRM 475. This study showed that the SRM can be used to calibrate optical linewidth measurement systems and, in most cases, leads to an improvement in the accuracy of the measurements.

SRM 475 is made from an anti-reflective chromium photoplate by conventional photolithographic techniques. The substrate is a borosilicate glass plate nominally 6.35 x 6.35 x 0.15 cm (2.5 x 2.5 x 0.060 in). The nominal thickness of the two-part anti-reflective chromium layer is 150 nm.

The technical measurements and characterization of this Standard Reference Material in the Electron Devices Division were performed by M. J. Dodge, W. R. Smallwood and C. Vezzetti. J. M. Jerke has assisted in the preparation of the recommended procedures for its use. Technical measurement coordination and overall direction of the technical activities were performed by D. Nyyssonen, also of the Electron Devices 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 R. K. Kirby.

Washington, D.C. 20234
April 21, 1981

George A. Uriano, Chief
Office of Standard Reference Materials

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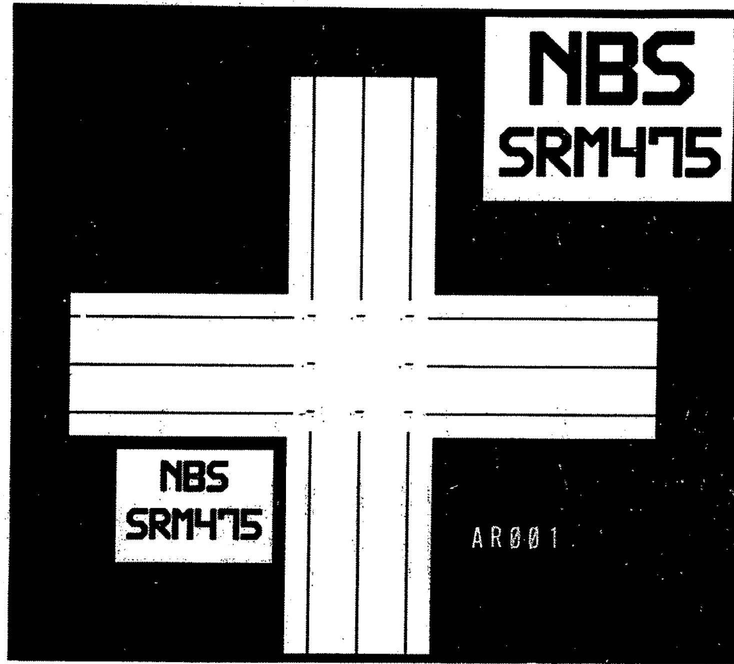

Fig. 1. A view of the overall pattern on SRM 475. The horizontal and vertical lines help to locate the eight basic measurement patterns located in the center.

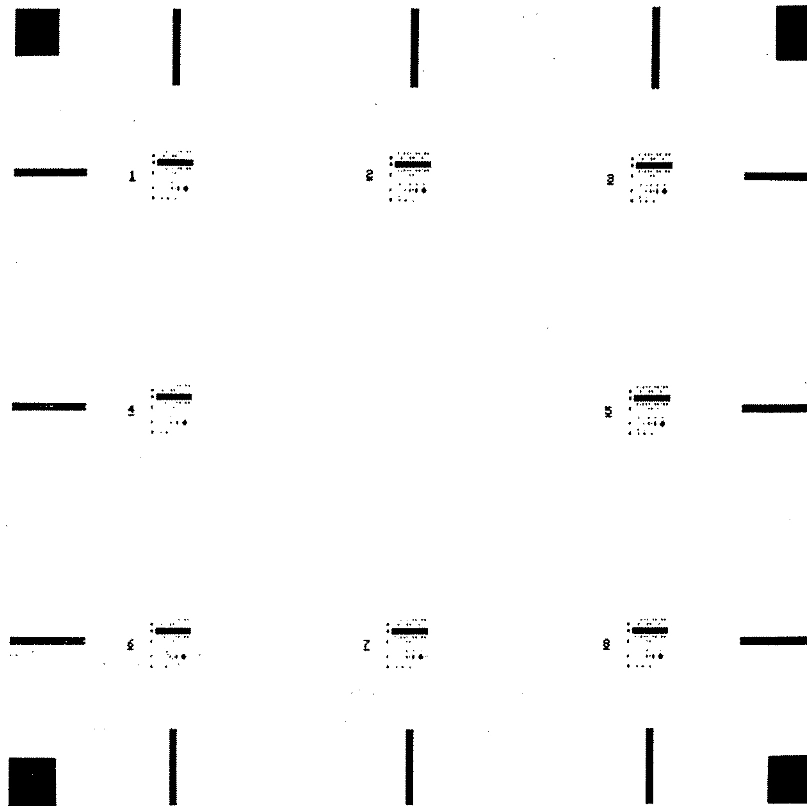

Fig. 2. A view of the center of SRM 475. The basic measurement pattern is repeated eight times about the center, and each basic pattern is numbered.

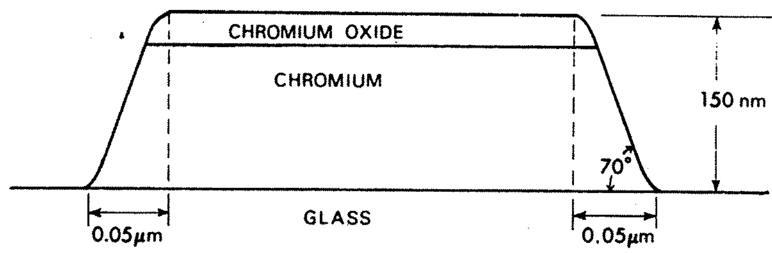

FIG. 4. Schematic of the profile for an opaque line on SRM 475.