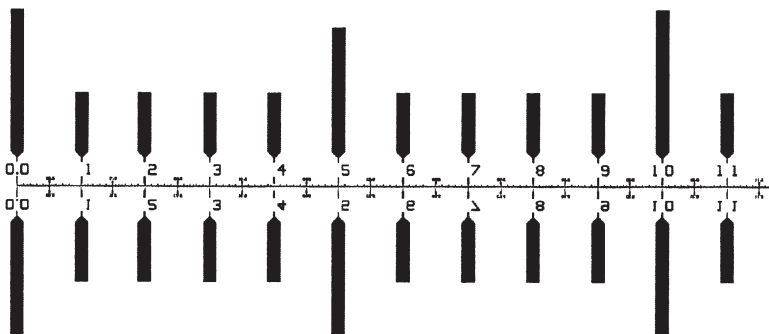
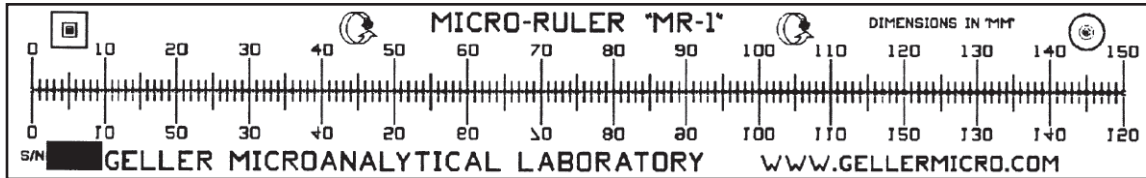
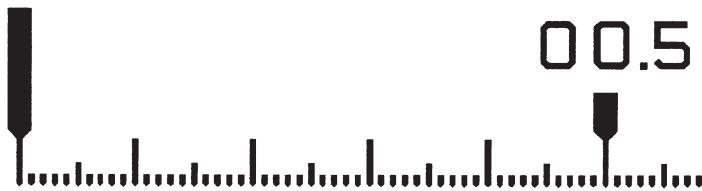


Micro-Ruler MR-1

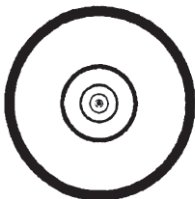
A NPL (NIST counterpart in the U.K.) Traceable
Certified Reference Material.
A Traceable "Micro-Ruler"



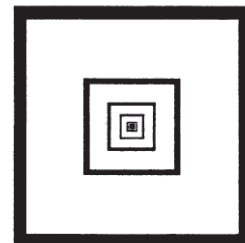
Markings are all on one side. Mirror image markings are provided so right reading numbers are always seen.



The minimum increment is 0.01mm.



The circles (diameter) and square boxes (side length) are 0.02, 0.05, 0.10, 0.50, 1.00, 2.00 and 5.00mm.



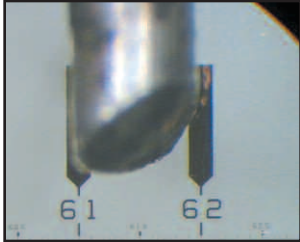
150mm OVERALL LENGTH
150mm uncertainty: $\pm 0.0025\text{mm}$, 0-10mm: $\pm 0.0005\text{mm}$)
0.01mm INCREMENTS, SQUARES & CIRCLES UP TO 5mm

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DOES THE WORLD NEED A TRACEABLE RULER?

According to ISO, traceable measurements shall be made when products require the dimensions to be known to a specified uncertainty. These measurements shall be made with a traceable ruler or micrometer. For magnification to be traceable the image and object size must be measured with calibration standards that have traceable dimensions.



This is a steel wire placed on the MR-1. The MR-1 is used with the scale facing up. The wire is about 1mm.

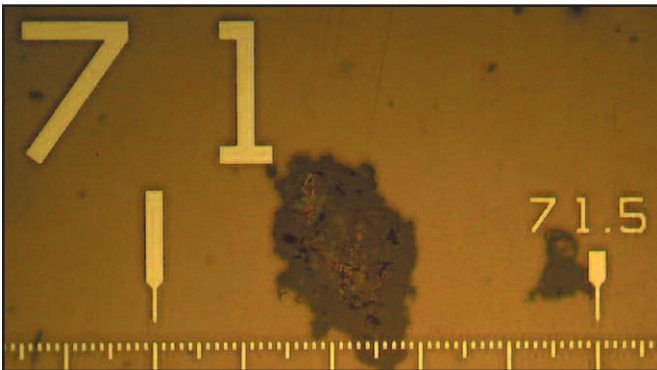


100µm aperture... the scale is down this time, placed on top of an aperture and photographed. The aperture diameter is 100µm.

INTRODUCTION

Traceable rulers are required under ISO, QS-9000 and ISO-17025 quality programs; for this reason the Micro-Ruler MR-1 was introduced, a metric dimensional calibration product.

One significant use of the MR-1 is to measure magnified images to determine absolute magnification. The MR-1 is offered only as a certified reference material (a traceable standard). Recertification is recommended in 5 year intervals.



Again, the scale is down, placed on top of the small particles for measurement. Each scale division is 0.01mm. The particle dimensions can be measured against the scale.

PATTERN DESIGN

The MR-1 is fabricated by using highly accurate semiconductor fabrication equipment. The pattern is anti-reflective chromium (30nm of CrO₂ over 70nm of Cr) over soda-lime glass. The overall size is ≈25mm x 180mm x 3mm thick. The linear expansion coefficient is 9×10^{-6} PPM/°C. Over its full 150mm length, the ruler will predictably change dimensions by $1.35\mu\text{m}/^\circ\text{C}$.

The MR-1 is labeled in mm. Its overall scale extends over 150mm with 0.01mm increments. The ruler is designed to be viewed from either side as the markings are both right reading and mirror images. This allows the ruler marking to be placed in direct contact with the sample, avoiding parallax errors. Independent of the ruler orientation, the scale can be read correctly. There is a common scale with the finest (0.01mm) markings to read.

We measure and certify pitch (the distance between repeating parallel lines using center-to-center or edge-to-edge spacing. This is the only type of measurement that can be used to relate measurements from different microscopy techniques (see "Submicrometer Linewidth Metrology in Optical Microscopy", Nyssonen & Larrabee, Journal of the Research of the National Bureau of Standards, Vol. 92, No. 3, 1987). Linewidth measurements (the measurement of a single line of space width) can only be related if the same type of illumination is used as for the calibrating instrument, since edge effects lead to uncertainty in the edge locations. Using pitch measurements, errors from edge-to-edge locations cancel out as long as like positions are measured.

Square boxes and circles are used for measuring magnification simultaneously in the X and Y directions. This gives a measure of image skew, barreling, pincushion and other non-linearities, which have various origins.

WHAT IS THE MEASUREMENT UNCERTAINTY?

The MR-1 ruler uncertainty is $\pm 0.5\mu\text{m}$ over the 0 - 10mm distance and $\pm 2.5\mu\text{m}$ over the entire 150mm length, as measured by the National Physical Laboratory (the NIST counterpart in the United Kingdom). Our in-house measurements will slightly degrade the uncertainties listed above.

WHAT IS INCLUDED IN THE CERTIFICATION REPORT?

The Micro-Ruler is currently under Geller's ISO-17025 scope. The report issued follows the ISO-17025 guidelines for certification and traceability. Included is the unique serial number engraved on the standard, certification data, recertification due date (5 year suggested interval), operator, instrumentation used, and actual pattern measurements along with a measure of total uncertainty. This report has satisfied 100% of our customer audits.

ORDERING INFORMATION

6085 Micro-Ruler, MR-1, NPL Traceable, each

